U.S. Fish & Wildlife Service

Mark Twain

National Wildlife Refuge Complex

Comprehensive Conservation Plan and Environmental Assessment

Cover Photograph: Jim Rathert

Comprehensive Conservation Plans provide long-term guidance for management decisions; set forth goals, objectives and strategies needed to accomplish refuge purposes; and, identify the Fish and Wildlife Service's best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

Mark Twain

National Wildlife Refuge Complex

Comprehensive Conservation Plan Approval

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Mark Twain

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Chapter 1: Introduction and Background

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Vision Statement

For thousands of years, the Mississippi River (River) corridor has served as an important migration route for millions of ducks, geese, shorebirds, waterbirds, songbirds, hawks, eagles and gulls. This network of wetlands, forests, and grasslands has also provided habitat for a variety of fish and resident wildlife species. The Upper Mississippi River (UMR) floodplain has been greatly altered for agriculture, urbanization, navigation and flood control. The quantity and quality of wildlife habitat on the River has declined. We believe that partnerships will play a key role in achieving the long-term ecological integrity of the UMR.

Cooperative working relationships between federal and state agencies, industry, and the public are crucial to achieving a balance between commercial navigation, recreation, River habitat for wildlife and safe municipal water. Mark Twain National Wildlife Refuge Complex (Complex) lands will contribute to larger public policy goals regarding floodplain management. Research and monitoring data must be current, readily available, and applicable to land management decision-making needs. In the future, the Complex management program on 500 miles of the UMR will be an exemplary model for partnerships and science-based wildlife management.

The River will provide a mosaic of habitats to sustain healthy populations of native wildlife. Managed lands, such as those within the Complex, have become critical for the ecological sustainability of the UMR. A balanced program of habitat protection, enhancement, and restoration will consider overall habitat needs on the pool, reach, and watershed levels. The Complex will provide high-quality habitat along the UMR for migratory birds, other wildlife species, and fish. Management programs will be effectively monitored for success and adapted and modified as new scientific information becomes available.

While wildlife management remains the primary purpose of the Refuge Complex, compatible public use and enjoyment of those resources is also important. The Complex will provide an array of environmental and wildlife education programs and wildlife-dependent recreational activities. Habitat management programs and public use facilities will attract thousands of visitors annually. The partnership with the Army Corps of Engineers involving the Riverlands Project Area provides an opportunity for conducting a quality off-refuge wildlife education and interpretation program within a large metropolitan area. Local communities will appreciate the role of the Service in managing quality wildlife habitat and contributing to improved floodplain factors such as flood water storage and helping to provide for clean, safe water in the River corridor.

Manager's Note on the CCP

The following plan, along with appendices, is a large document because it covers five National Wildlife Refuges (Port Louisa NWR, Great River NWR, Clarence Canon NWR, Two Rivers NWR, and Middle Mississippi River NWR) and nearly 500 miles of Mississippi River corridor. The plan was written in a fashion that was intended to give the citizen reader enough common language information to understand the Fish and Wildlife Service role on the River. However, the primary purpose of the CCP is to be a guide for current and future refuge managers.

We would like to direct the reader's attention to several specific points or highlights within the overall plan:

- The planning process was undertaken at a landscape scale, including the 500-year floodplain through nearly 500 miles of the Upper Mississippi River and a portion of the lower Illinois River. The level of detail outlined for areas within the existing Refuge boundary is much greater than for strategies outside the boundary in the River corridor area. See section “Area of Ecological Concern” in this chapter for more information on the planning area.
- Due to expansion of the Refuge in the late 1990s and overuse of the name “Mark Twain,” the Refuge was reorganized into several separate refuges within a Complex. See the section in this chapter called “Organizational Change in Stations Within Mark Twain Complex.” This plan includes all five resulting refuges.
- As a landscape-scale plan, albeit a long and relatively narrow corridor, goals were developed for habitats to meet wildlife needs, but no wildlife goals themselves are present. Wildlife populations are dependent on too many factors outside the Refuge planning area to be “controlled” enough for good objectives and strategies.
- Some of the desired future conditions outlined for the end of the planning period reflect program adjustments that occurred since the Flood of 1993. As the first comprehensive conservation plan since the “flood era,” several rehabilitative actions have never been put into an overall planning context. Actions such as the spillway construction at Clarence Cannon NWR underwent National Environmental Policy Act (NEPA) evaluation, but the effects of the overall Refuge Complex program had not been evaluated as a whole to address floodplain functions, connectivity or flood-friendly facilities. The Environmental Assessment associated with this plan focuses on the implication of these broad factors and future outcomes.

- The plan includes a new 27,659-acre boundary expansion proposal. For the 10 years prior to this effort there were various evaluations conducted on resource needs along the Mark Twain reach of the River. This document pulls together the purpose and need for land protection and rehabilitation in the historic floodplain to address deteriorating habitat conditions and is consistent with other federal policies and management goals for the River. The boundary addition represents a strategy to meet identified needs. See Chapter 5 for more information on the proposed boundary expansion.

This plan has been prepared by the refuge staff at the field level. The process involved a considerable amount of coordination with the public and with the States of Illinois, Iowa and Missouri, the Corps of Engineers and the U.S. Geological Survey. It is our intent to constantly gain more and better information which will help us refine the strategies contained herein, and to fuel adaptive management adjustments.

Refuge System Mission

The mission of the National Wildlife Refuge System is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans[1].

National Wildlife Refuge System Goals

Fulfill our statutory duty to achieve refuge purpose(s) and further the System mission.

- Fulfill our statutory duty to achieve Refuge purposes and further the System mission.
- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate the migratory bird, interjurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife and plants.
- Conserve and restore, where appropriate, representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- Foster an understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

1. National Wildlife Refuge System Improvement Act of 1997, Section 4(2)

Mark Twain Refuge Complex Goals[2]

Wetlands and Aquatic Habitat:	Restore, enhance, and manage refuge wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.
Forest Habitat:	Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.
Other Terrestrial Habitats:	Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl, and neotropical migrants.
Sedimentation and Water Quality:	Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.
Floodplain Management:	Enhance floodplain functions and where practicable mimic historical water level fluctuations in the River corridor.
Public Use and Education:	Provide wildlife-dependent recreation and education opportunities where appropriate, and improve the quality and safety of the visitor experience.
Monitoring:	Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the River corridor, to evaluate the effectiveness of refuge management programs and to provide information for adaptive management strategies.

2. Details provided in Chapter 4, "Refuge Goals, Objectives and Strategies."

Mark Twain NWR Complex

Area of Ecological Concern[3]

The lands and waters of the Mark Twain Refuge Complex (Complex) contain valuable and important habitat areas along the lower half of the Upper Mississippi River System (UMRS). The UMRS includes the Upper Mississippi River and navigable tributaries, including the Illinois River but excluding the Missouri River. While the entire river corridor is important, particularly to the health and recruitment of aquatic species, habitat values change along each river mile. Locations where habitat diversity, quantity and quality are currently the highest are considered core areas for long-term attention. However, due to some of the problems identified in this plan, such as sedimentation, the entire UMRS riverine habitat condition has been in decline. As an integral part of the system, the Complex needs an organized approach to consider how it fits and contributes to these larger river values, as well as identifying the best opportunities for reversing habitat declines outside current refuge boundaries.

This planning activity on the Mississippi River started as a watershed perspective effort, however, the resulting “planning area” would have included a good portion of the continent. While it is helpful to consider all the cause/effect actions within the entire watershed, such as farming practices and development that accelerates runoff, this macro scale view is clearly beyond the management capability of the Refuge staff. A more manageable approach was to outline the 500-year floodplain between the Quad Cities (Illinois/Iowa border) and the confluence of the Ohio River (River Mile, or RM, 493 to RM 0). This area covers about 1.6 million acres.

The floodplain area was further modified, as appropriate, to accommodate the practical limits of Refuge Complex habitat concerns. For instance, highly developed areas such as towns are obviously not the most suitable locations for riverine habitat restoration and were excluded from further consideration. A revised map to reflect such changes was created and defined an Area of Ecological Concern (AEC) for refuge planning purposes. The AEC totals nearly 1,400,000 acres and extends from RM 493 at Lock and Dam 15 to RM 0 on the Illinois side. In Illinois where the Shawnee National Forest area borders the River, only aquatic and River border habitats have been evaluated for potential restoration in this plan. The remaining 500-year floodplain between Grand Tower and the Thebes area falls within a Forest Service study area for the Shawnee National Forest. The major adjustment on the Iowa/Missouri side of the River was located at the last 30 miles on the Missouri side where the floodplain extends a long distance inland from the

3. An ‘Area of Ecological Concern’ can be defined as: “An essentially complete ecosystem (or set of interrelated ecosystems) of which one part cannot be discussed without considering the remainder.” [Malheur, National Wildlife Refuge Master Plan and Environmental Assessment, 1985, p.7] This definition was later used to develop the “planning area” for the 1994 Lower Colorado River Refuge Complex Comprehensive Conservation Plan.

River. The AEC relates to the practical limits of the Complex's evaluation of floodplain areas for possible restoration activities, including potential land acquisition. However all land types and uses are being monitored by other programs within the 500-year floodplain to the Ohio River to track present River status and trends compared to past resource values. The Habitat Needs Assessment (HNA), and the Long Term Resource Monitoring Program (LTRMP) are Corps of Engineers funded efforts to monitor the environmental conditions of the UMRS. Each of these efforts address the historic 500-year floodplain of the River.[4]

Need for Action/Planning Perspectives

This Comprehensive Conservation Plan (CCP) is intended to outline how the Complex will fulfill its legal purposes and contribute to the National Wildlife Refuge System's wildlife, habitat and public use goals. The plan articulates management goals for the next 15 years and specifies the objectives and strategies for each unit of the Complex that will help achieve those goals. While the planned future condition is 15 years out, or 2016, the Complex anticipates plan updates every three to five years due to the volume of information available through the LTRMP monitoring program. Monitoring data will be used to implement adaptive management strategies, which will be documented in future plan revisions. Development of this CCP has been guided by legislative mandates contained in the National Wildlife Refuge System Improvement Act of 1997. These mandates include:

- Wildlife has first priority in the management and uses of refuges.
- Wildlife-dependent recreation activities including hunting, fishing, wildlife observation, wildlife photography, environmental (wildlife and habitat) education and interpretation are priority public uses of the Refuge System. These uses will be facilitated when they do not interfere with the Refuge's ability to fulfill its purposes or the mission of the Refuge System.
- Other uses of the refuges will only be allowed when they are determined to be appropriate and compatible with the refuge purposes and the mission of the Refuge System.

Due to the scope and scale of the planning area and the variable nature of River conditions that affect the use patterns of the migratory species using the Mississippi River flyway, a decision was made to concentrate future management actions on habitat conditions rather than wildlife abundance. Since the Refuge cannot control many of the factors relating to wildlife populations, there are no specific wildlife goals included in this CCP. This approach was reinforced by the U.S. Geological Survey, (Schroeder et al., 1998) in addressing the manner in which habitat management strategies should be selected on refuges:

> “The presence of high quality habitat is a necessary prerequisite for, but does not guarantee, an abundant wildlife population. Inadequate habitat, however, will cause wildlife to be absent or less abundant. Because wildlife populations are affected by factors other than habitat, a logical goal of habitat management is to focus on the habitat conditions required to provide the greatest potential for the species or resources of concern. To the extent that limiting factors other than

4. See Monitoring Goal Section for further information on these programs.

habitat can also be successfully managed, the greater the likelihood that the species or resource will actually reach the limits imposed by the habitat."

This CCP replaces the Mark Twain National Wildlife Refuge Master Plan, which was completed in 1979. In that plan, habitat was not presented directly in goals or objectives but was included as the means of getting to the detailed wildlife objectives. Implementation of the plan was measured by resulting wildlife population levels in terms of "use days." However, animal populations on-refuge may be influenced by weather, disease or other off-refuge habitat conditions. If populations do change, it is impossible to prove a causal link to specific refuge management actions, which also precludes practicing adaptive management based on those results. By pursuing habitat goal based planning, the Complex can focus on manipulating habitat components and creating a direct link between those actions and responses on the ground. Due to the variable habitat conditions inherent in the UMR floodplain, these refuges will also need to employ adaptive management strategies to adjust to droughts, floods, invasive species and other major influences. It should be noted that these conditions are so dynamic and unpredictable that habitat strategies, particularly those for various wetland types, have been developed which reflect "target" conditions for at least 3 out of every 5 years. The plan is designed to make the best of the variable conditions the River gives each year.

Although the CCP is habitat based, Complex lands and waters are managed for wildlife. Decisions had to be made first about which wildlife species, guilds or groups to consider in determining which habitats to promote. To help focus this decision process and to ensure that a broad array of wildlife needs were considered (wildlife and habitat diversity) on the appropriate landscape scale, a "Species Priority List" was generated for the Mark Twain National Wildlife Refuge Complex. These species were selected by "funneling down" the Fish and Wildlife Service Resource Priorities List for Region 3, which was developed in 1998. This list was first narrowed to all those priority species found within the UMR ecosystem, then to those found within the planning area, or AEC. The resulting list was further modified by considering Refuge purposes, the species, historic range, habitat types found within the AEC and whether there were major voids or duplications. These species are essentially "indicators" with associations to AEC habitats upon which the Refuge Complex can relate the effect of CCP habitat goals, objectives and strategies on wildlife. The Refuges within the Complex are not managing exclusively "for" these species. This planning process studiously avoided any single-species management directions. Species on the Priority List can be considered representatives of guilds or other groupings of species that are dependent on a particular type of habitat. For that reason they provide an identifiable link between a wildlife species and its associated habitat managed by the Complex. Establishing these associations during the planning process will help in future monitoring activities and adaptive management decisions. Most of the identified fish and wildlife concerns are reflected in the habitat goal section of this plan. However, the floodplain management and water quality goals also relate directly to desired outcomes for wildlife, and fisheries in particular.

The Complex Species Priority List contains one mammal, 15 birds, two fish and one mussel guild, including the following species:

<u>*Mammals*</u>
Indiana bat *(Myotis sodalis)*

<u>*Birds*</u>
American Bittern *(Botaurus lentiginosus)*
Canada Goose *(Branta canadensis)*
Wood Duck *(Aix sponsa)*

Mallard *(Anas platyrhynchos)*
Blue-winged Teal *(Anas discors)*
Canvasback (Aythya valisneria)
Lesser Scaup *(Aythya affinis)*
Bald Eagle *(Haliaeetus leucocephalus)*
Red-shouldered Hawk *(Buteo lineatus)*
Least Tern - interior population *(Sterna antillarum athalassos)*
Cerulean Warbler *(Dendroica cerulea)*
Grasshopper Sparrow *(Ammodramus savannarum)*
Henslow's Sparrow *(Ammodramus henslowii)*
Short-billed Dowitcher *(Limnodromus griseus)*
Yellow-billed Cuckoo *(Coccyzus americanus)*

Fish
Pallid Sturgeon *(Scaphirynchus albus)*
Paddlefish *(Polydon spathula)*

Mussels
Sheepnose *(Plethobasus cyphyus)*
Salamander Mussel *(Simpsonaias ambigua)*
Round Pigtoe *(Pleurobema coccineum)*
Rock Pocketbook *(Arcidens confragosus)*
Pistolgrip *(Tritigonia verrucosa)*
Monkeyface *(Quadrula metanevra)*
Higgins' Eye *(Lampsilis higginsi)*
Fat Pocketbook *(Potamilus capax)*
Black Sandshell *(Ligumia recta)*

During plan implementation the Complex will continue to track the status of all Regional Resource Priority species within the AEC and, to the degree practicable, all species utilizing the River corridor. Appendix B contains a list of species found in the AEC, including their habitat preferences and any State or Federal listing information. The Complex will modify these lists and plan strategies as needed through an adaptive management process.

Organizational Change in Stations within Mark Twain Complex

Mark Twain National Wildlife Refuge was established in 1958 from lands originally purchased by the COE for construction of the Mississippi River 9-foot navigation channel project. The headquarters was located in Quincy, Illinois, with district offices in Annada, Missouri; Brussels, Illinois; and Wapello, Iowa. These three District field offices were originally one-person sub-stations organized to conduct the habitat and survey work locally due to the distance of these units from Quincy. For years, the Quincy Headquarters was run as the “command and control” center, making habitat and budget management decisions for the whole Refuge. Over the years additional Refuge lands were acquired. Part-time administrative staff were added to the Districts and each station started to manage its own budget. During this time, Maintenance and Assistant Manager positions were added to meet the growing responsibilities. Eventually, administrative positions were made full-time and the Districts operated as separate refuge field offices for most day-to-day issues. Today, the role of the headquarters is no longer one of directing the habitat management decisions at each unit. It is now focused on Service involvement and responsibilities on fish and wildlife issues within the entire lower half of the UMR. Within this charge, the highest priority is facilitating management of the core habitats in the National Wildlife Refuge System, including the nearly 50,000 acres of General Plan land out-granted to the states of Illinois, Iowa and Missouri through Cooperative Agreements. Districts still coordinate management efforts with the headquarters to ensure a consistent Service approach in addressing River resources, policy implementation and continuity with interagency partners.

From the Great Flood of 1993 through this plan process a large amount of Refuge headquarters time was devoted to land acquisition issues and the subsequent management direction of new units. Areas on the open River section between St. Louis and the mouth of the Ohio River, referred to as the "Middle Miss," were added as unstaffed divisions of the Refuge in 1996-97. The distance from Quincy to these purchased areas compounded the logistical difficulties that existed in a large, sprawling, single refuge. Since considerable interest remains for Refuge expansion along the River, particularly among the three border state conservation departments, floodplain farmers and non-governmental organizations, the work load was destined to grow in that distant part of the Refuge.

In addition to the logistical difficulties resulting from the distance of Refuge units, another organizational problem was identified in the planning process. There has been a considerable issue involving Refuge name recognition in the planning area. Samuel Clemens, pen name Mark Twain, brought national recognition to the Mississippi River with his entertaining and colorful stories. The Refuge was named with an intention to capture the existing public recognition of Mark Twain and the association with the Mississippi River. However, it has become apparent that there is also public confusion about the Refuge due to its namesake. "Mark Twain" is now overused in the area. Other facilities include: the Corps of Engineers' large and popular Mark Twain Lake, the Mark Twain National Forest, caves, banks, buildings, a bridge, a casino and numerous other landmarks utilizing the name. This has understandably resulted in confusion about what and where the Refuge is, particularly since its units are scattered over such a large area. The Refuge staff has found that local citizens, politicians and partner agencies get confused about the identity and organizational structure of the Refuge.

To address these issues, a solution was proposed and implemented, and is documented in this CCP. The Service converted each of the three Mark Twain Refuge Districts into separate refuges with separate names. An additional refuge was established on the Middle Mississippi River. The restructuring is intended to assist the public in identifying the local refuge places they relate to and enjoy. The Service will maintain overall program continuity, with a watershed and ecosystem perspective, through a Refuge Complex Office located at Quincy.

The changes listed in Table 1 were approved by the Director of the U.S. Fish and Wildlife Service on May 31, 2000. Another proposal was made regarding the Clarence Cannon NWR[5], which was approved to pursue. Clarence Cannon NWR has been managed as a unit of the Annada District of Mark Twain and it was suggested that the name of the Congressman be retained with the unit, as the Clarence Cannon Division of the Great River NWR, rather than as a separate refuge. However this change could not be approved solely by the Director and will require the approval of the Migratory Bird

5. In 1963, the Migratory Bird Conservation Commission approved the purchase of lands for the Annada Division. The Commission added lands to the Division on June 24, 1964. at that same meeting it was suggested that the Annada Division be named in honor of Congressman Clarence Cannon, which was approved at the August 10, 1964, MBCC meeting.

Conservation Commission. This approval will be requested from the Commission following the completion of this planning effort. All other approved changes, as noted in Table 1, have been incorporated into this document.

Table 1: Changes in Organizational Structure, Mark Twain NWR Complex

Past Organizational Structure	Current Organizational Structure
Mark Twain NWR Headquarters	Mark Twain NWR Complex Headquarters
Wapello District	Port Louisa NWR
Annada District/Clarence Cannon NWR	Great River NWR/Clarence Cannon NWR
Brussels District	Two Rivers NWR
New divisions south of St. Louis, Missouri	Middle Mississippi NWR

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The Complex also includes the Iowa River Corridor Project (IRCP), which includes nearly 10,000 acres of Service fee title lands located along the Iowa River between Amana and Tama in Iowa. This project was born out of the Great Flood of 1993 when the corridor area was covered with floodwater for 5 months. Prior to this event the Iowa River Valley had experienced at least one flood in 28 of the previous 30 years. This chronic problem, along with associated public and private expenditures to deal with it, brought together a partnership of Federal, state, local and private interests to explore alternatives. This partnership has resulted in the Department of Agriculture Natural Resources Conservation Service (NRCS) purchasing over 13,000 acres of Emergency Wetland Reserve Program easements to reduce agriculture losses in the floodplain, along with the Service picking up the residual fee title value for much of that area. Service involvement was key to success since most landowners were not willing to pay for general maintenance, restoration upkeep and property taxes for land that would provide little income. The Iowa Department of Natural Resources (DNR) already had a presence on the corridor and an expressed interest in its role there. This resulted in the development of a cooperative agreement between the Service and the state for shared management responsibilities for the project, with the primary day-to-day management role given to the Iowa DNR. The IRCP has been placed administratively under the Port Louisa NWR, but it is outside the AEC and is not included in this planning effort. Future planning efforts on the corridor will be a collaborative effort with the Iowa DNR and NRCS.

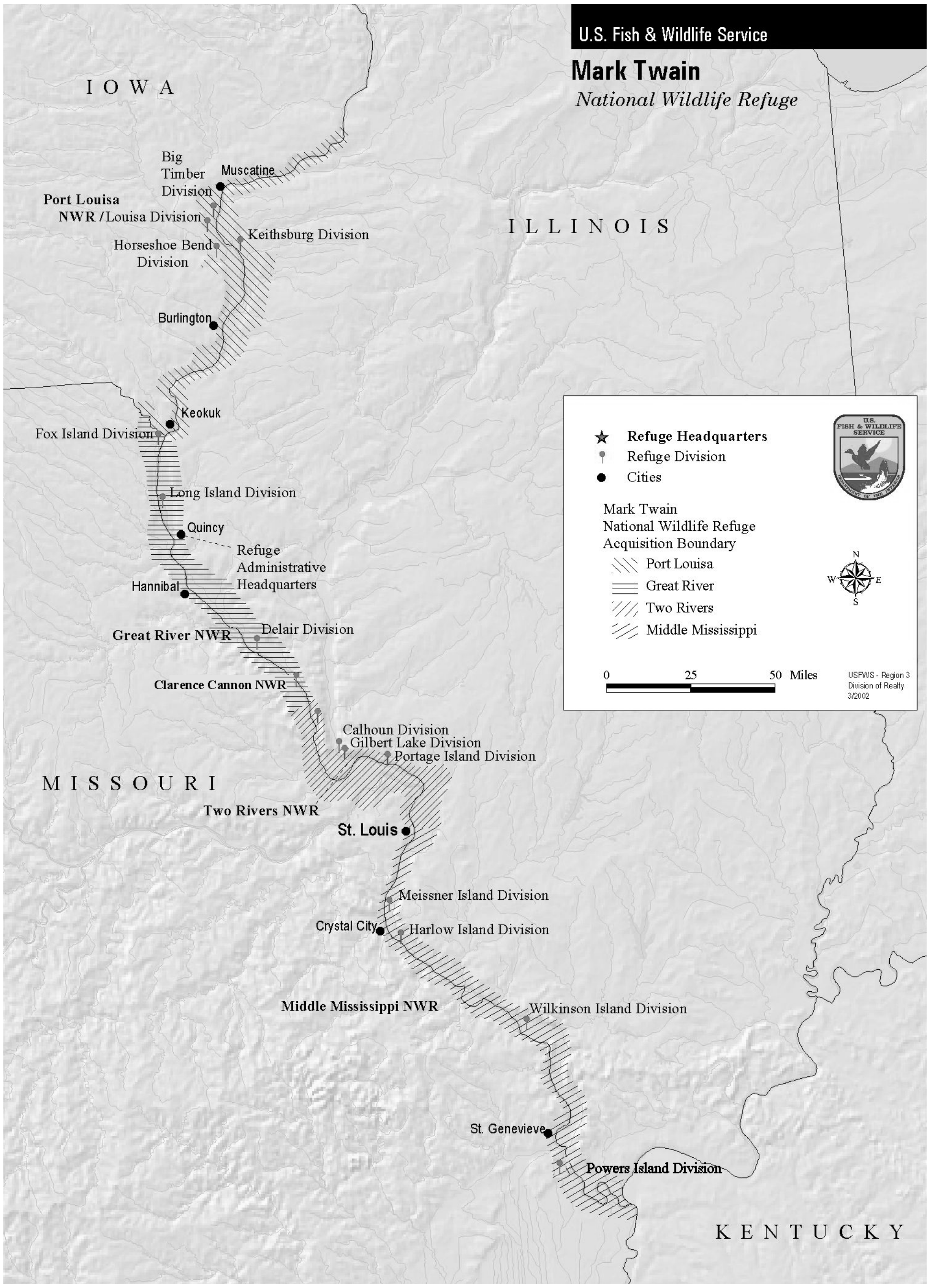
The 270-acre Apple Creek Division is a former Farmers Home Administration property that was transferred to the Service and is also outside the AEC. This unit has been managed in the same manner as conservation easements (See Refuge Management Considerations-Management of Lands Associated with Agriculture Department section). Any further plans for the area will be included in tiered documents such as a Habitat Management Plan for Two Rivers NWR.

Legal, Policy and Administrative Guidelines

Legal Mandates (including FWCA, Refuge Improvement Act)

See Appendix H, Guiding Laws and Orders

Figure 1: Organization of Refuges Within Mark Twain NWR Complex



Relationship to Other Plans

The Mark Twain Complex staff work closely with the U.S. Army Corps of Engineers, other Federal and State agencies and other Service programs in developing or consulting on a variety of plans and initiatives. The following paragraphs describe some of the plans pertaining to the Refuge Complex.

Migratory Bird Conservation Initiatives

Several ongoing migratory bird conservation initiatives are relevant to this planning effort. The North American Waterfowl Management Plan (NAWMP) is a partnership effort to restore waterfowl populations to historic levels; it was developed in 1986, with objectives and strategies evolving through NAWMP Updates (the latest produced in 1998). Refuges found within NAWMP Joint Ventures should strive to achieve waterfowl objectives outlined in the pertinent Joint Venture Implementation Plan. The Mark Twain NWR Complex lies within the Upper Mississippi River and Great Lakes Region Joint Venture area.[6]

Several nongame bird initiatives are in the planning stage, with implementation beginning in the near future. Partners In Flight (PIF) is developing Bird Conservation Plans, primarily for landbirds, in numerous physiographic areas; these plans include priority species lists, associated habitats, and management strategies. The same elements will be by-products of ongoing planning efforts for shorebirds (U.S. Shorebird Conservation Plan) and colonial waterbirds (North American Colonial Waterbird Conservation Plan). The Mark Twain NWR Complex lies primarily within PIF Physiographic Areas 31, and the Prairie Peninsula, 32, the Dissected Till Plains. Small portions of PIF Areas 19, the Ozark - Ouachita Plateau, and 14, Interior Low Plateaus, also abut our AEC.[7] The American Bird Conservancy has included Mark Twain refuges and surrounding river reach in it's Important Bird Areas program.

The U.S. Shorebird Conservation Plan (USSCP) and the North American Colonial Waterbird Conservation Plan (NACWP) have identified priority species and conservation strategies, mostly focused around habitat, that will address the needs of those groups of birds. The Mark Twain NWR Complex lies primarily within Shorebird Planning Regions 22 (Eastern Tallgrass Prairie) and also 24 (Central Hardwoods).[8]

The North American Bird Conservation Initiative (NABCI) is a continental endeavor to improve all habitats for all birds through a united effort of individual programs and agencies. The previously mentioned initiatives (PIF, NAWMP, USSCP, and NACWP) have joined together to work more efficiently and effectively to achieve their mission. Migratory bird initiatives will operate under common Bird Conservation Regions, major ecologically based geographic units covering the entire continent. In the U.S., the vision is to restore, protect and enhance populations and habitats of North American birds. This is to be accomplished through coordinated efforts at international, regional, state and local levels, and supported by sound science and effective management.[9]

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6. More information on NAWMP is found at: http://www.fws.gov/r9nawwo/nawmphp.html
7. Species priorities for these areas can be found at: hppt://www.cbobirds.org/pif/physios/index.html
8. The U.S. Shorebird Conservation Plan website is at: http://www.manomet.org/USSCP.htm.org. the website for the North American Colonial Waterbird Conservation Plan is: http://www.nacwcp.org
9. The NABCI website is www.crossdraw.com/cec/about_frame.htm

Upper Mississippi River/Tallgrass Prairie Ecosystem Team

The Complex lies within the Service's Upper Mississippi River/Tallgrass Prairie (UMR/TGP) Ecosystem. Members of the ecosystem team are comprised of representatives from each of the Service's offices including Ecological Services, Fisheries, Federal Aid, Private Lands, Law Enforcement and Refuges. The vision for the UMR/TGP Ecosystem team is to perpetuate the ecological integrity of the UMR/TGP Ecosystem through the protection, restoration, and enhancement of the Ecosystem's function, structure, and species composition by full implementation of the Service's mandates.

An Action Plan was developed by team members defining six ecotypes as the focus areas for this ecosystem: prairie wetland and associated habitats; oak savanna and forest lands; the Driftless Area; streams, riparian woodland corridors, and associated habitats; and the mainstem Mississippi River corridor. Five goals were developed in the plan, with associated objectives and strategies.

Upper Mississippi River Conservation Committee

"A River That Works and A Working River – A Strategy for the Natural Resources of the Upper Mississippi River System," was prepared by the Upper Mississippi River Conservation Committee (UMRCC). Led by the five Upper Mississippi River System states, this process consolidated the input of state, federal and non-governmental organizations for a conceptual plan of action. It includes a description of the significance of the River's natural resources; describes a set of objectives to maintain those resources; describes the physical River processes that support those resource values; and, outlines an overall strategy using nine tools and associated measures to restore natural river processes. The document also recommends implementation and leadership roles for agencies, organizations and individuals, including the national wildlife refuges managed by the Service on the River. The five main issues addressed are:

- Levee construction and the subsequent loss of over 50 percent of the historic floodplain.
- Construction and operation of the locks and dams have converted most of the free-flowing River into a series of pools, or reservoirs.
- The River has been channelized and maintained for navigation.
- Changes in land use and land practices have degraded water quality and increased sediment and nutrient problems in the River and the Gulf of Mexico.
- By connecting Lake Michigan to the Illinois River, we crated a pathway for non-native species in both directions.
- The nine objective areas identified are:
- Improve water quality for all uses.
- Reduction in erosion and sedimentation impacts.
- Return of natural floodplain to allow channel meanders and habitat diversity.
- Provide for seasonal flood pulse effect and periodic low flows to improve nutrient base, plant growth and succession.
- Enable connectivity of backwaters to main channel.
- Provide for opening of side channels, create islands, shoal and sandbar habitat.
- Manage channel maintenance and disposal to support ecosystem objectives.
- Sever the pathway for exotics into and spread within the Upper Mississippi River System.
- Provide native fish passages at dams.

This effort was prepared during the same period as the first half of the Complex's comprehensive conservation planning process, and was published in 2000. Since its release, the document has been used by a number of agencies and organizations to plan their partnership role on the River. The Mark Twain Complex draft comprehensive conservation plan is consistent with the interagency concept plan and contributes to most of the referenced objectives.

Army Corps of Engineers St. Louis District Master Plan

The St. Louis District, U.S. Army COE of Engineers, recently completed a Rivers Project Master Plan for the management of the natural, cultural and recreation resources on federal lands and waters associated with Mississippi River Navigation Pools 24, 25, and 26 (including the lower 80 miles of the Illinois River), Pool 27, the Kaskaskia River Navigation Project and applicable portions of the Mississippi River from St. Louis to the Ohio River confluence. The primary objective of the Master Plan is to publish a clear, practical, and balanced plan that will guide future COE land use decisions and public use development actions on the St. Louis District's portion of the UMRS. The overall goal of the document is to provide a guide for effective management of the federal lands, natural and constructed resources, while preserving habitats, accommodating public recreational demands and insuring continued river navigation.

Several issues relevant to the management of the Mark Twain Complex and partner states managing COE owned General Plan lands are included in the Master Plan, including several boundary adjustments between the State of Illinois and the Two Rivers NWR. This document has incorporated those changes in the CCP as part of the desired future condition mapping.

Army Corps of Engineers – Rock Island District Land Use Allocation Plan

The Land Use Allocation Plan (LUAP) established the land resource management policies, objectives and uses for federal lands under the jurisdiction of the Rock Island District within the Upper Mississippi River Navigation System. The Rock Island District encompasses Pools 11-22. Management guidelines are in accordance with Federal regulations and programs concerning natural resource practices, and are directed toward optimum use of such resources in the overall interests of the general public and the nation. Objectives considered in plan development included navigation, recreation, fish and wildlife, forestry, cultural, environmental, and floodplain management. The LUAP is part of the project's comprehensive Recreation-Resource Master Plan documentation. A significant feature of the LUAP is the Shoreline Management Plan, which establishes the Rock Island District's administrative policy concerning private, exclusive use of recreational structures such as boat docks permitted on project-owned lands and waters.

Public involvement during the comprehensive conservation planning process raised the issue of barge fleeting on government owned lands. Currently there are no fleeting sites attached to the Refuge Complex or at General Plan lands within the St. Louis District. However, there are several locations in Rock Island District where "casual mooring" of barges has occurred at the same locations for many consecutive years and have essentially become permanent uses.

As part of this planning process, the Complex and the COE began discussions regarding the problem of tree, riverbank and near shore habitat damage as a result of these activities. The Service will continue working with the COE and the navigation industry to devise a better method for barge storage than that which now occurs on public lands. Complex adaptive management strategies to address this issue, and public concerns about it, will be developed in collaboration with the COE. One forum in which this topic will be addressed in the newly established annual coordination meeting between all the General Plan land managing agencies, which is now mandated by the revised Cooperative Agreement for General Plan lands. In general, the Service supports the move of fleeted barges to off-shore site that are located through a consideration of navigation system needs, proximity to loading terminals, environmental resources and public recreation.

Army Corps of Engineers Operational Management Plans (OMP)

The COE "Environmental Stewardship Operations and Maintenance Policies" guidance (ER-1130-2-540, 15 November, 1995) establishes policy for administration and management of natural resource activities at COE civil works water resource projects. "Policy and Planning: Planning Guidance", (ER-1105-2-100, 28 December, 1990) describes the types of Army civil works planning programs and studies, the various purposes served by the water resource projects and principle guidance for the formulation and evaluation of water resource plans. As mentioned previously, the St. Louis District has an updated Master Plan, however the Rock Island District does not currently have a contemporary Master Plan for project lands. Operational Management Plans (OMP) detail objectives and strategies to implement programs within the Environmental Stewardship, Recreation and Flood Damage Reduction areas conceptually addressed in Master Plans. Rock Island District staff have continued to update OMPs to provide effective guidance to daily operations. The long-term goal of the District, included in its OMP, 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. Forest management objectives on refuge lands are directed whenever possible to improve timber quality for wildlife habitat. The St. Louis District will be developing several OMPs, as step-down plans from the Master Plan during the next several years. In an effort to maintain consistency between agencies in the these documents, Refuge Complex staff have consulted with COE Natural Resource Management staff in the development of goals, objectives and strategies for this CCP on the management of GP lands regarding forestry, recreation and other stewardship issues.

Other Plans / Studies Relevant to This Document

Upper Mississippi River Summit

In 1998, an Upper Mississippi River Summit sponsored by the COE was held that attracted a variety of Federal, State and many non-governmental organizations, to discuss their visions of the Upper Mississippi River. The objective of this Summit meeting was to seek commitment to develop a multi-interest strategy for managing the River. The group's vision is to seek long-term compatibility of the economic use and ecological integrity of the Upper Mississippi River. The group committed to several key issues including:

- Identifying and prioritizing issue and geographic areas in which cooperative action is most likely;
- Seeking ways to remove obstacles to cooperative action within existing programs and authorities;
- Seeking funds and/or new authorities, as appropriate for the following:
  a) Continue enhanced environmental pool management in navigation pools.
  b) Operations and maintenance activities that enable increased environmental benefits while maintaining a safe and dependable navigation system;
  c) An evaluation of the current and future physical structure of the River floodplain under current management practices and the development of

models to achieve a greater understanding of the economic and ecological interrelationships of management alternatives;

d) Restore 60,000 acres of floodplain habitat by making the UMR floodplain a high priority for federal conservation easements. In addition, coordinate federal, state, local and non-profit programs to acquire fee title from willing sellers for conservation purposes, and work with landowners to protect and restore private lands within the floodplain by increasing funding for conservation programs like Partners for Fish and Wildlife and the Wildlife Habitat Incentives Program;

e) Support the U.S. Fish and Wildlife Service, as part of the revision of refuge Comprehensive Conservation Plans in evaluating expanded refuge boundaries to acquire land from willing sellers in the UMR floodplain;

f) Improved operation and maintenance for the Mark Twain National Wildlife Refuge Complex and the Upper Mississippi River National Wildlife and Fish Refuge.

Report of the Interagency Floodplain Management Review Committee to the Administration Floodplain Management Task Force (The "Galloway Report")

The Interagency Floodplain Management Review Committee proposed a blueprint for "a better way to manage the nation's floodplains." This comprehensive review contained many recommendations, several of which were relevant to this plan, including:

- To provide integrated, hydrologic, hydraulic, and ecosystem management of the Upper Mississippi River basin............(5) Charge the Department of the Interior with conducting an ecosystems needs analysis of the UMR basin. This action has been partially completed through the first Habitat Needs Assessment (HNA) (see below):

  During the 1993 flood, environmental easement and land acquisition programs became tools in assisting recovery and in removing people from long-term flood vulnerability. In addition to meeting the needs of disaster relief victims, these programs can be effective in achieving the nation's environmental goals. Environmental enhancement and mitigation programs essential to ecosystem management are often part of federal development projects. In the past, though, such programs have been delayed, underfunded, or not funded at all. Had they been implemented before the 1993 flood, these programs would have restored natural lands and provided a measure of flood protection through reduced runoff and increased floodwater storage.

- Action 7.1: The administration should establish a lead agency for coordinating acquisition of title and easements to lands acquired for environmental purposes. The report goes on to say, "Because the mission of the FWS within the DOI, the Committee suggests that the DOI coordinate federal acquisitions of environmental lands.

- Recommendation 10.2: The USACE should consider land acquisition as an alternative during planning and design of habitat rehabilitation and enhancement projects under the Environmental Management Program (EMP)

The Floodplain Management Assessment of the Upper Mississippi and Lower Missouri Rivers and their tributaries (FPMA)

The Great Midwest Flood of 1993 generated Congressional authorization and appropriations for the Corps of Engineers to conduct a comprehensive, system-wide study to assess flood control and floodplain management along these river corridors.

Probably the most notable work on this subject by others is the report commonly referred to as the "Galloway Report", described above. The FPMA attempted to complement the findings and recommendations contained in that report for which the Corps has authorities and expertise. The FPMA focuses on a comparison of impacts and costs of implementing a wide array of alternative policies, programs, and structural and nonstructural measures by assuming they had been in place during the flood. It explores three scenarios of change in flood insurance, State and local floodplain regulation, flood hazard mitigation and disaster assistance, wetland restoration, and agricultural support policies. The structural alternatives ranged from levees high enough to contain the 1993 flood event to totally removing the levee systems, with several intermediate alternatives. The Fish and Wildlife Service and other State and Federal partners participated in this process.

Among many conclusions the report recommends a reduction of agriculture in the most flood prone areas, expanding the flood storage capacity in some areas, and restoring wetlands as an "alternate" land use in increasing floodplain health and function.

Upper Mississippi River System Habitat Needs Assessment – 2000

The primary objectives of this initial Habitat Needs Assessment (HNA) are the evaluation of existing habitat conditions throughout the UMRS, forecasting future conditions, and quantifying ecological sustaining and socially desired future habitat conditions. The HNA addresses the system-wide, river reach, and pool levels of spatial scale and includes the bluff to bluff extent of the floodplain.

The HNA used 18 land use/land cover classes to represent habitat types along the corridor. Each individual type was quantified and predictions were developed, based on river geomorphic processes, about the amount of change for each type. Consultations were held with river resource managers and the public to help define a desired future condition. These sessions were based on information provided on historic conditions, existing conditions, the available forecast of future conditions as provided by models, and information about the geomorphic processes influencing river conditions. A loss of diversity is a major concern. Bathymetry is becoming more homogenized as deep holes become filled in while islands are eroding away. For the Mark Twain reach of the river the HNA summary needs are:

Lower Impounded Reach Needs (Pools 14-26)

- Reduce main channel habitat by 1,800 acres
- Create or restore: 9,000 acres of secondary channel habitat; 10,500 acres of contiguous backwater habitat; 5,000 acres of isolated backwater habitat; and 3,000 acres of island habitat.

Open River Reach Needs (Middle Mississippi River)

- Create or restore 25,000 acres of backwater and secondary channel habitat, of which 7,000 acres should be isolated backwaters
- Increase the amount of prairie, marsh and forest by about 100,000 acres
- Restore geomorphic processes that create and maintain sand bars and shoals

Special Land Use Designations

Wilderness Review

Lands within the existing and proposed boundaries of each unit of the Mark Twain National Wildlife Refuge Complex were evaluated for wilderness suitability as part of this planning process. No lands were found suitable for designation as wilderness as defined in the Wilderness Act of 1964. The Refuge Complex AEC does not contain 5,000 contiguous, roadless acres nor does the Complex have any units of sufficient size to make their preservation practicable as wilderness. The lands of the refuge have been substantially affected by humans, particularly through agriculture and the navigation system.

Other Special Land Designations

As a part of the planning process, other land designations potentially appropriate to the National Wildlife Refuge System were evaluated. Public Use Natural Areas, Research Natural Areas, Wild and Scenic Rivers and RAMSAR (Convention on Wetlands, signed in Ramsar, Iran in 1971) designations have been considered and none are proposed at this time. Due to the same factors influencing wilderness considerations mentioned previously, as well as the scattered nature of the divisions within each refuge, it is thought that refuge management under the guidance of the 1997 Refuge Improvement Act is sufficient for meeting the goals and objectives of the project. The American Bird Conservancy has designated Mark Twain Complex refuges as Important Bird Areas (IBAs).

Cooperative Agreement with COE for General Plan (GP) Lands

The Cooperative Agreement addresses Service management of COE GP lands. It defines the privileges granted to the Service for refuge overlay areas, as well as some of the authorities reserved by the COE. At the start of this CCP planning process the existing agreement, which covered all lands owned by the COE within the Mark Twain Complex, the Upper Mississippi River National Wildlife and Fish Refuge and state managed areas, was signed into place in 1963. (See Section on History and Establishment of Mark Twain NWR). Certain provisions of the agreement had long been recognized by both Service and COE personnel as deficient. However, the fact that the agreement area covered two refuges, three COE Districts, two COE Divisions and three states always seemed to stall any attempts to revise the document. In late 1997 the COE implemented a reorganization that put all three of the UMR Districts under the Mississippi Valley Division in Vicksburg, Mississippi. This streamlined the COE involvement and provided an opportunity to address the document's problems at the same time the refuge was beginning this CCP process. A revised agreement was finalized in the summer of 2001. Highlights of the revision include:

- Added an introduction on the Corp's overall role and the existence of other interagency involvement.
- Deleted several elements on commercial development and reserved private rights.
- Clarified boundary management and trespass issues.
- Removed the restriction on converting farm lands to other habitat uses.
- Changed the extensive annual reporting requirement.
- Added element to clarify COE "harvest and selling of merchantable timber."
- Added a dispute resolution process.

The 2001 revised Cooperative Agreement between the COE and Service relating to GP lands and refuge management is attached as Appendix E.

Other Interagency Coordination

Spill Response

Response to oil or hazardous substance spills is a coordinated effort between local, state, and federal authorities. Spills on the UMR have the potential to affect people and natural resources far downstream of the original incident, so quick coordination and response by all parties is essential to minimize the damage from hazardous substance spills.

In response to this need, the Upper Mississippi Spill Response Plan and Resource Manual was developed in a cooperative effort of the five states bordering the upper River, the U.S. EPA, the U.S. Coast Guard, USFWS, and the Upper Mississippi River Basin Association (UMRBA). The manual addresses some of the unique circumstances that may arise in coordinating spill response on the Mississippi River and includes emergency telephone numbers for all agencies that may be involved in initial spill response efforts.

When a spill occurs, state authorities are responsible for assuring that an investigation is initiated to determine the severity of the spill. It is also the responsibility of the state to notify other potentially-affected states and the appropriate federal response and natural resource agencies. The level of response necessary is determined by considering such factors as size and location of the spill, type of material spilled, damage potential, cost of clean-up versus effectiveness expected, and media/political interest.

When a federal response is deemed necessary, the Coast Guard and EPA share the responsibility as predesignated federal on-scene coordinators (FOSC) for the UMR. Per EPA/Coast Guard memorandums of understanding, the Coast Guard serves as FOSC for all incidents involving commercial vessels or marine transportation related facilities. In all other federal responses, the EPA serves as the FOSC.

The Service's primary role in responding to spills is to provide technical assistance to the coordinating agency, incident commander, or on-scene coordinator to minimize adverse effects to fish, wildlife, and other trust resources. A field response coordinator has been designated for each Service facility to provide initial on-site response when necessary. For Mark Twain NWR Complex, the coordinator is the Wildlife Biologist in the Quincy office.

Refuge staff may be asked to provide their expertise and assistance to spill response personnel. This may include, but is not limited to, advising as to resources at risk from the spill, advising on River conditions and possible access points, hazing waterfowl and other wildlife from areas known or likely to be impacted, and coordinating oiled wildlife collection and rehabilitation efforts. Only properly trained Service personnel can participate in spill response and clean up activities. The Region 3 Oil Spill Response Plan identifies minimum training requirements for all participating personnel.

In addition, each refuge may need to have its own Spill Prevention, Control and Countermeasures (SPCC) Plan on file. According to the Federal Register for all agencies, 40 CFR 112, a plan is required for any facility where all three of the following conditions are met:

- The facility is non-transportation related.

- The above-ground storage capacity of any single container is in excess of 660 gallons, or the aggregate above-ground storage capacity is greater than 1,320 gallons, or the total underground storage capacity is greater than 42,000 gallons.
- Due to its location, oil spilled at the facility could reasonably be expected to reach waters of the United States.

Spill Prevention and Control, Control and Countermeasures Plans are designed primarily to prevent any discharge of oil and oil products from the refuge, but also to address control and clean-up measures in case of an accidental spill. More specific information on plan development can be found in 40 CFR 112 and the Service document "Guidance for SPCC Plans" prepared by the Service Pollution Control Office in Denver.

Channel Maintenance and Dredge Disposal

Maintenance of the 9-foot navigation channel on the UMR requires maintenance of channel training structures and dredging in areas of sand deposition by keeping scouring flows directed to the main channel. Wing dams and closing dams were constructed with the intent of reducing the need for dredging. Also, banks along the channel have been protected with revetment where necessary to maintain channel position. Continuous adjustments and repairs to these control structures are necessary to maintain their hydraulic effectiveness. Each of these actions has an effect on riverine habitat for fish and wildlife. For this reason the Refuge Complex is working with the Ecological Services Offices in Rock Island and Marion, the COE, and the States to address this program throughout the AEC.

Erosion accounts for a major portion of the coarse material sedimentation problems and subsequent dredging requirements, but even optimum control of upland erosion would not eliminate dredging needs. Other factors also influence the amount of material dredged in a given location such as: channel width and depth, water flow and current patterns. Due to the influence of these hydraulic factors, certain portions of the River are more prone to deposition than others. Specific dredging locations and quantities vary annually due to continually changing flows, but many areas in the AEC have a number of chronic dredging sites. All material dredged from the River must have a disposal site on land and/or water. Where and how dredged material is placed can influence the potential for impacts on water quality, fish and wildlife habitat, side channel conditions, flood levels, cultural resources, and recreation. Dredged material historically has been placed in close proximity to the dredging site along the shoreline, on inland sites, or in open water since placement near the dredge site is generally the least expensive alternative.

In 1974, the Great River Environmental Action Team (GREAT) was authorized by Congress to "investigate and study" a realistic River resource management plan that would provide for multiple-use management of the UMR. The GREAT studies (GREAT I in St. Paul District, GREAT II in Rock Island District, and GREAT III in St. Louis District) identified potential placement locations along the UMR that would minimize adverse environmental impacts. Within the Rock Island District, several coordinating groups were formed following the GREAT II recommendations. The River Resources Coordinating Team (RRCT) provides a mechanism for all federal and state agencies with management or regulatory responsibilities in the Rock Island District area to coordinate their programs and activities. Three coordinating groups report to the RRCT. The Fish and Wildlife Interagency Committee (FWIC) provides coordination regarding dredging impacts on fish and wildlife, dredged material disposal, River and backwater modifications, habitat restoration projects, and River management studies and investigations. The FWIC is composed of fish and wildlife biologists from the Missouri, Illinois, Iowa, Wisconsin, Minnesota, FWS, and COE. The inter-agency On-Site Inspection

Team (OSIT) was developed to more effectively deal with site-specific dredged material problems. The OSIT reviews each proposed site in the field and makes recommendations pertaining to the placement of dredged material, so as to minimize any impacts on backwaters, wetlands, and other sensitive habitats. The Committee to Assess Regulatory Structures (CARS) recommends repair and modification of channel training structures with the objective of reducing dredging needs.

The St. Louis District developed the Great River Resource Management Study (GRRM) under GREAT III. Its recommendations included: continuing existing dredging coordination activities; initiating a program to modify, design, and evaluate channel training structures to benefit aquatic resources on the Middle Mississippi; and conducting additional studies on fish/wildlife habitat and sediment transport. Currently, interagency coordination in the St. Louis District includes an annual channel inspection boat trip to discuss channel maintenance and habitat restoration issues. The District and its partners have recently established a more formal River Resources Advisory Team (RRAT) as a forum for interagency coordination and for long-term continuity.

Each station on the Mark Twain Complex has been involved with these groups as appropriate. The Complex Office assumes the lead to represent refuge interests, and occasionally Service interests, in these forums throughout the AEC.

U.S. Department of Agriculture

U.S. Fish and Wildlife Service employees provide biological technical assistance to U.S. Department of Agriculture (USDA) agencies for implementation of key conservation programs of the Farm Bill. The Service's assistance helps USDA meet the technical challenges presented by these programs while maximizing benefits to fish and wildlife resources. The Service also assists in on-the-ground habitat restoration actions associated with several of these programs, including the Wetlands Reserve Program (WRP) and Conservation Reserve Program (CRP), administered by the Natural Resources Conservation Service (NRCS), and Farm Service Agency's (FSA) Farm Credit Programs.[10]

Natural Resources Conservation Service

Under the Wetlands Reserve Program, conservation easements are acquired that restore and protect degraded agricultural wetlands. Service employees provide technical assistance to USDA and private landowners on site selection, restoration planning and compatible uses for easements. Four divisions of the Mark Twain Refuge were acquired through a WRP provision, namely the Emergency Wetland Reserve Program. The Conservation Reserve Program (CRP) provides substantial benefits to fish and wildlife resources by temporarily retiring up to 40 million acres of environmentally sensitive cropland nationwide. Refuge employees provide technical assistance in order to maximize the wildlife values of enrolled lands. The Service may also provide direct assistance to landowners to further enhance wildlife benefits beyond those achievable by CRP on its own.

The Service assists USDA and landowners in implementing the wetland conservation provision of the Farm Bill known as Swampbuster. This provision makes eligibility for receiving USDA program benefits conditional on wetlands stewardship. The Service provides technical assistance to USDA on wetland identification, assessment of wetland

10. Additional information on easements and FSA properties managed by the Mark Twain NWR staff is found in the CCP Refuge Management Consideration section, under "Refuge Lands Associated with Farm Services Agency."

functions relative to minimal effects and mitigation exemptions, and wetland restoration planning. Prior to the 1996 Farm Bill, USDA was required to consult with the Service by statute; however, under the 1996 amendments, this consultation is discretionary on the part of USDA.

Farm Service Agency (FSA)

The Service provides technical assistance to the FSA's Farm Credit Programs in the implementation of three of FSA conservation programs. Two of these elements are related to disposal of property obtained through loan failure. Service employees review inventory properties and make recommendations on:
1) the establishment of permanent conservation easements for the protection and restoration of wetlands and the conservation of other important natural resources; and, 2) the fee title transfer of inventory properties to State or Federal agencies for conservation purposes. A third area in which the Service occasionally provides technical assistance involves private property owned by FSA borrowers. The Service can assist in evaluating natural resource values of property and make recommendations for conservation contracts where FSA borrowers voluntarily set aside land for conservation purposes in exchange for partial debt cancellation.

Chapter 2: Public Involvement and Identification of Refuge Planning Issues

USFWS

On October 1, 1997, the Service issued a Notice of Intent to prepare a number of Comprehensive Management Plans (CMP), along with associated environmental documents, in the Federal Register, Vol. 62, No. 190. This Notice of Intent included the preparation of a Comprehensive Management Plan (CMP)[11] for the Mark Twain National Wildlife Refuge Complex.

Following internal scoping and other preparations, the Refuge Complex hosted six open houses (August 25-27, November 17-18, and December 15, 1998) to inform the public of the planning process. These open houses were held at Wapello, Iowa, Keithsburg, Illinois, Alexandria and Annada, Missouri, Ursa and Brussels, Illinois, respectively. Refuge staff provided maps, National Wildlife Refuge System information and were available to answer questions from visitors. Interested citizens attending each open house were asked to express their thoughts, ideas and concerns regarding refuge programs and operations. Most of the interactions were verbal conversations with staff but visitors were also encouraged to fill in comment sheets that could be turned in at the open house or mailed in later. In either case, issues raised in these sessions were recorded and are on file at Complex headquarters. News releases were issued to local communities prior to each open house. News and/or television media covered four of the events.

The following spring, Refuge staff participated in additional public involvement by joining in six of the 12 Habitat Needs Assessment public meetings held in April and May 1999 (those held within the AEC). The National Audubon Society and Upper Mississippi River Conservation Committee (UMRCC) gathered public input on current and future priorities for the River system. Staff interacted with members of the public, non-governmental organizations (NGOs) and personnel from other Federal and State agencies as an integrated part of our CCP public involvement process.

11.The name of this process was subsequently changed to Comprehensive Conservation Plan (CCP) by the National Wildlife Refuge System Improvement Act signed into law on Oct. 9, 1997.

Mailing lists were compiled of interested individuals, adjacent property owners, non-governmental organizations, State and Federal agencies, and political interests from each open house and public meeting. Comprehensive conservation planning updates were mailed periodically to these parties. The updates were intended to inform those who had expressed an interest in the status of the planning process and to invite additional comment. The mailing list continues to grow and at last count was approximately 700 contacts, including the media.

Because the Complex overlays thousands of acres of COE General Plan (GP) lands within the floodplain, the COE was asked to participate in the CCP process as a cooperating agency in accordance with NEPA guidelines. Coordination efforts have been established with the Rock Island and St. Louis Districts, as well as the Mississippi Valley Division (MVD) in Vicksburg, Mississippi. A joint CCP briefing for both Districts' field operations staff was held in Quincy on March 28, 2000. The Directors of the Illinois Department of Natural Resources and the Iowa Department of Natural Resources and the Director of the Missouri Department of Conservation designated points of contact at their State Office level for providing state input on the CCP process and, in particular, to coordinate comments from their various organizational levels and programs into a single state position. Briefings for these points of contact and other staff were held in Iowa on December 9, 1999, in Missouri on December 10, 1999, and in Illinois on January 24, 2000. Additional briefings were conducted at the St. Louis and Rock Island Corps Districts and at state headquarters of the Illinois DNR, Missouri DNR and Iowa DNR in July 2001. Input and ideas reflected in this plan have been gained through interactions with State field level biologists both before and during the formal CCP process.

Open House, Mark Twain NWR Complex

In June 1999, Complex staff met at the Upper Midwest Environmental Sciences Center (UMESC) with research biologists from three locations of the U.S. Geological Survey (USGS) Biological Resources Division. The 2-day workshop focused on the development of habitat management objectives for the Complex. The Service developed a Memorandum of Agreement with UMESC for assistance with interpreting existing data and for utilizing the expertise at UMESC to help provide the best available scientific information for consideration in the development of the plan.

A draft CCP was released for public review in August 2003. The draft plan was posted on the Service's web site, and paper copies were mailed to individuals who had requested one. A summary of the draft plan was sent to everyone on the project mailing list. People were invited to submit comments either in writing or by talking to Refuge staff. A summary of the comments received and how we responded in included in Appendix N.

During the comment period, a series of open house events was conducted to give people interested in the Refuge Complex an opportunity to meet with staff and discuss the draft CCP. Meetings were held in Annada, Missouri, on August 20, 2003; Quincy, Illinois on August 21, 2003; Wapello, Iowa, on August 26; Keithsburg, Illinois, on August 27; Chester, Illinois, on September 4, 2003; and in Brussels, Illlinois, on September 8, 2003.

Issues

The following, in no particular order, is a summation of major issues discussed at open houses and inter-agency meetings. Refuge program goals, objectives and strategies listed later in this document address each of these issues.

- Water level management
- Fishery resources
- Forest management
- Recreational opportunities
- Wildlife disturbance by recreational visitors
- Waterfowl habitat management
- Environmental Management Program
- Siltation and water quality
- Habitat for non-game migratory birds
- Facilities repair and upkeep
- Contaminant-free, abundant wildlife
- Hunting/fishing/trapping opportunities
- Land acquisition
- Interagency partnership and coordination
- Balance between the competing uses and user of the River, and,
- Restoration of backwaters, side channels, and associated wetlands.

Chapter 3: Refuge and Resources Description

History and Establishment of Mark Twain NWR[12]

Port Louisa NWRP

Mark Twain Refuge, and consequently the individual refuges within it as a Complex, shares much of its history with the Upper Mississippi River National Wildlife and Fish Refuge, the U.S. Army Corps of Engineers, and the five states of the UMRS. The Refuge was officially established in 1958, but the Department of the Interior had been involved on the Upper Mississippi River for many years regarding navigation, protection of wildlife, and public recreation. At all times in the nation's history, including the present, the dominant objective of the Federal government in the Mississippi River was the use of the River for navigation. Even though wildlife and habitat concerns were expressed early in the 20th century, these "environmental" objectives have remained secondary to the economic benefits associated with the navigation system. The current day Refuge is obliged to plan and operate within the context of this history, along with the physical and legal constraints attendant with managing a subordinate River objective. This section of the CCP is more extensive than that for most refuges, however the history of the Mark Twain NWR Complex has many twists and turns that continue to have a bearing on the daily operations of each refuge within the Complex.

12. Most of the material for this section came from files at the Refuge Complex Office and an unpublished document prepared by Michael Fiarchild, May 1982, titled "The Legal and Administrative History of the Upper Mississippi River Wildlife and Fish Refuge." The research and resulting report completed by Mr. Fairchild fulfilled a contract service to the FWS during the Upper Mississippi River NWFR Master Plan process, which was completed in 1987.

Pre-Refuge History

As early as 1882, unpatented islands in the Mississippi River below Cairo, Illinois were withdrawn by the Secretary of the Interior at the request of the Secretary of War to serve the interests of navigation. The COE had been authorized to maintain channels of varying depths since the 1880s. The COE believed that by withdrawing islands from disposal by the Federal government, the islands would be used by all navigating on the River, or could be removed as necessary to maintain a navigable channel. In 1891, a similar request was made for the removal of islands in the Mississippi above Cairo. The islands were temporarily withdrawn by the Secretary of the Interior on April 10, 1891. Withdrawal protected the islands from private ownership and maintained them in a relatively undisturbed state. These islands were among the first lands to be included in the Upper Mississippi River Wildlife and Fish Refuge. On June 7, 1924, Congress passed legislation creating the Refuge. Shortly thereafter, the Secretary of War notified the Secretary of the Interior that the islands were no longer needed by the War Department and, on April 25, 1925, the 1891 withdrawal order was revoked. Authority over the islands, no longer withdrawn, and other vacant public lands was transferred to the Department of Agriculture for inclusion in the Refuge as a result of Executive Order 4519 of October 2, 1925.

As early as 1900, conservationists were trying to maintain and restore wildlife of the River and urged the Bureau of Fisheries of the Department of Commerce and Labor to begin fish rescue operations along the UMR. This effort was expanded to include the propagation of freshwater mussels in 1908, when Congress provided funding for the establishment of a biological station in the "Mississippi Valley." The UMR and its floodplain flats had been a particularly fertile habitat for numerous freshwater fish, mussels, fur-bearing animals and migratory birds. These same lands and waters were considered wastelands for agriculture, homesteading and industrial development. The dominant uses of the area were sport and commercial fishing, mussel harvesting for the pearl and button industry, hunting and furbearer trapping. But by the 1920s, the UMR was being threatened by over-hunting, pollution and drainage of the surrounding wetlands.

Within a few years of the Upper Mississippi River National Wildlife and Fish Refuge's creation, the Corps of Engineers became highly involved in the process of developing a 9-foot channel in the Mississippi River upstream from the confluence of the Missouri River. After construction and when operational, the 9-Foot Channel Project greatly increased commercial traffic and drastically altered the type of habitat in the River and Refuge. Most of the Upper Mississippi River National Wildlife and Fish Refuge lands were submerged by the navigation pools created by the locks and dams. The project changed nearly everything about the existing Refuge, and it created new opportunities south of the Refuge from Rock Island to the Missouri River where the Mark Twain Complex is now located.

Corps of Engineers Activity on the UMR

Army Corps of Engineers flood control and navigation improvement activities on the Upper Mississippi River had begun long before the Upper Mississippi River Refuge was established. In 1871, funds were appropriated by Congress for the COE to improve navigation on the Mississippi River above the confluence with the Ohio River. Most of the initial COE activity on the channel involved keeping the River clear of snags. On occasion, the COE was also authorized to conduct dredging operations. By 1878, the COE had begun work on maintaining a 4-foot channel to Minneapolis. In 1910, Congress authorized the COE to pursue a 6-foot channel project above the confluence of the Missouri River. The demand for greater shipping use of the River created the demand for a deeper channel through to the Minneapolis grain elevators. Congress approved the 9-Foot Project and between 1930 and 1940 26 locks and dams were constructed from Alton, Illinois to Minneapolis, Minnesota.

Both the Bureau of Biological Survey (BBS), which later became the FWS, and the COE recognized the damage to wildlife that was resulting from the first locks and dams installed at Hastings, Minnesota, and Keokuk, Iowa. The pools that formed behind the dams slowed flowage and decreased the oxygen level in the water. Silt on the riverbed killed some aquatic animals, such as mussels and food sources for fish. In addition, because the locks and dams were unequipped to facilitate fish movement, a dozen species of migratory fish were affected. Consequently, both commercial fishing and mussel harvesting were dramatically decreased[13]. On the other hand, both agencies also recognized that new aquatic habitats were created and that in spite of the above problems, it would be many years until those values would be overtaken by those problems. One solution considered by the BBS and COE to address the conflicting Congressional directives was for the COE to purchase the lands to be flooded in fee and transfer those lands unnecessary for managing the navigation project to the Bureau. The BBS urged the COE to manage the pools in a manner that would stabilize the water level rather than managing mid-winter drawdowns in support of downstream navigation. (While “abnormal” water level spiking is still a concern, the Service is now working with the COE to accomplish early summer seasonal drawdowns - see Pool Level Management.)

Moist-soil unit, Mark Twain NWR Complex

Negotiations for early interagency agreements were necessitated by conflicts between Refuge and COE objectives resulting from different project purposes. Refuge staff wanted to reduce or eliminate secondary interests, such as agricultural leaseholds, cabin sites, or timber rights, which parties had on COE land. The COE, on the other hand, wished to have all the land it purchased readily available to serve the COEs' primary navigation purpose (as well as all support activities) and secondary purposes (economic uses and recreational), while avoiding the direct policing and maintenance of so much land. The Refuge viewed the land as wildlife habitat that needed protection from various uses, while the COE at that time viewed the land excess to its primary purpose as an investment from which an economic return could be derived.

In 1931, the Secretary of Agriculture initiated negotiations with the Secretary of War to develop a working agreement between the two agencies, and an informal agreement was achieved. The first formal documentation of an agreement between the BBS and the COE is provided by three executive orders issued by President Roosevelt between September 1935 and October 1936. The executive orders were issued at the request of the Secretary of War and the Secretary of Agriculture. These executive orders differed only as to which lands were reserved to the Refuge. The orders reserved COE lands.... “for the use of the Department of Agriculture as a breeding place for migratory birds, other wild birds, game animals, fur-bearing animals, fish and other aquatic animal life and for the conservation of wild flowers and aquatic plants, to be administered as a part of the Upper Mississippi River

13. Henderson, 1931

Wild Life and Fish Refuge." The executive orders noted that the lands "are primarily under the jurisdiction of the War Department" and conditioned the reservations with the right of the COE to pursue its activities without interference. A 1940 executive order (No. 8331) reserved additional COE lands for Refuge use.

The 1945 Cooperative Agreement

By the 1940s, both the FWS and the COE recognized that a more structured arrangement between the agencies was necessary to facilitate the administration of COE owned lands within the Refuge. Coordination of the land transfers were facilitated by Executive Order Number 9146 (later addressed by E.O. 9337) that vested the authority to withdraw or reserve public lands in the Secretary of Interior, provided that concurrence for the withdrawal or reservation was obtained from the head of the agency or department having primary jurisdiction.

To help clarify their relationship to these federally owned lands, the COE and [FWS] began to plan for cooperative use in late 1941 by classifying the lands and preparing a written agreement. In 1942, the Secretary of the Interior suggested to the Secretary of War that all COE lands not used for navigation should be transferred to the Department of Interior for administration as part of the Upper Mississippi River National Wildlife and Fish Refuge. Interior Secretary Ickes pointed out that there had been an agreement to that effect since the early 1930s. Shortly thereafter, additional COE lands were reserved by the Interior Department as part of the Refuge. Negotiations were held from 1941 through 1945 between the FWS and the COE, without the participation of the states, which were successfully concluded with the signing of the first cooperative agreement on May 15, 1945.
The 1945 agreement categorized lands within the Upper Mississippi River National Wildlife and Fish Refuge, as well as new Refuge areas through the pooled project south of the Quad Cities[14], into red, brown, blue and uncolored areas. Red and brown areas were to be administered by the FWS. Hunting was prohibited on COE lands adjacent to "Brown lands" but not on lands adjacent to "Red lands." "Blue lands" were administered by the FWS for hunting and trapping only. "Uncolored lands" were those that would be maintained and administered by the COE for project operations. The COE retained the right to administer timbering programs on all lands it had originally purchased. All lands originally purchased by the COE, whether transferred or not, were to remain under COE primary jurisdiction even if management of the lands had been transferred.

Not long after completion of negotiations for the first cooperative agreement, the FWS requested further control by the Refuge because the leasing authority retained by the COE continued to interfere with administration of the Refuge. Another concern was whether the COE could transfer lands directly to the states for administration, or whether the transfer had to be made through the FWS.

The 1954 Cooperative Agreement and General Plan

The first conference between the COE, FWS, and the states to negotiate general plans was held in St. Louis, Missouri, in 1950. The COE still resisted land transfers through any devices other than revocable permits. Related issues were direct land transfers to the

14. The reach of the river that included pools 15 through 26 was beyond the original Upper Miss Refuge project area. These additional FWS interests, as they developed with the COE and states, were managed out of the Upper Mississippi NWFR office in Winona until the creation of the Mark Twain NWR as a separate refuge in 1958. The first Service employee in the new area was assigned to the Alton Pool (26) in the autumn of 1943.

states and the relative authority of the 1946 Fish and Wildlife Coordination Act Amendments and the 1946 Flood Control Act. Although these last two issues were related because the COE insisted that the 1946 Flood Control Act called for direct transfer of land (except those necessary for the purposes of the Migratory Bird Treaty Act) to the states for water use projects, the issues were negotiated and resolved separately.

By late 1951 the Department of the Interior and Department of the Army reached an agreement to dispose of wildlife lands in accordance with the 1946 Coordination Act Amendments. Direct land transfers were resolved simply for Illinois, Missouri and Wisconsin because these states were satisfied with the system already in effect whereby land was first transferred through the FWS. Iowa was at first interested in direct transfers particularly to allow Iowa to develop the Lake Odessa area for hunting. After the FWS clarified to Iowa that the State would obtain control of the same lands under cooperative agreement with the FWS as it would from direct leases from the COE, Iowa dropped its interest for direct transfers. Minnesota also requested direct COE-to-State transfers for the land within the Pool 3 area. Minnesota later withdrew its request to facilitate a five state/FWS unity on negotiating with the COE over the general plans. As a result, by mid-1952, direct land transfers were no longer a topic of dispute. At the time the COE insisted on 25-year revocable permits for use by the Refuge. The FWS wanted transfer of complete jurisdiction over all lands, unencumbered by any COE leases or reservations. In late 1952, a compromise was reached which allowed for the transfer of land without time limitations and revocation only upon mutual consent by the COE and FWS or in the event of national emergency.

The General Plans all had been executed by the states and forwarded with the COE/FWS Cooperative Agreement to Washington, D.C. by April 1953. In October 1953, the Secretary of the Army approved the General Plans for all five states the General Plans had been completely executed and were signing by the Service and the COE by January 21, 1954. Additional step-down cooperative agreements were established between the states and the Service for state managed areas. The final action taken to place all transferred lands under the authority of the 1954 Cooperative Agreement was the revocation of all executive orders and public land orders that previously transferred COE lands to the Refuge. This was accomplished on February 19, 1954, by the publishing of Public Land Order 936. Henceforth, Service authority over COE land within the Refuge depended exclusively on the cooperative agreement.

The 1954 Cooperative Agreement and the 1953 General Plans provided a unified system of administration over COE lands. Only three major categories of land were to exist: “Green lands” were Upper Miss. Act land as part of the original Refuge; “Blue lands” were non-transferred COE land; and “Red lands” were those transferred by cooperative agreement. Some project lands were transferred from the Service to the states (Illinois, Iowa and Missouri) for administration.

Although the new agreements appeared to clarify the rights and responsibilities of the parties involved, the shortcomings of the cooperative agreement soon became apparent. The Refuge staff had believed that the FWS had exclusive jurisdiction over transferred lands, referred to as “Red lands.” The cooperative agreement, however, made Nine-Foot Channel Project lands “available . . . for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon, in connection with the national migratory bird management program . .“subject to numerous conditions and reservations. The Department of Army reserved “all rights . . . not . . . specifically granted . ...." and specifically reserved the right to change water surface elevations, to dredge and dispose of spoil, to dispose lands for commercial and industrial sites, and to issue leases for accommodating public uses of the land. And, given the Federal objective, no refuge use could interfere with navigation. The cooperative agreement did not specify any of the rights or uses which the Service could exercise over “Red lands.” The failure to enumerate which rights the Service obtained over lands transferred through the cooperative agreement made it practically impossible to determine just which rights the Service obtained. Calls for further negotiations on this subject began shortly after the documents were signed.

The 1961 General Plans and 1963 Cooperative Agreement

With the passage of the 1958 Coordination Act Amendments, all parties agreed that the general plans and cooperative agreement needed to be renegotiated. Among other issues addressed was the transfer of land from the COE directly to the states, then made possible by the act amendments. The 1958 amendments clarified the relationship between the Fish and Wildlife Coordination Act and other statutory authorities over federal activities regarding waterways. It directed that the consultation and modifications requirements contained within Section 2 applied retroactively to projects not yet 60 percent complete. Section 2(b) was added, requiring government agencies to give “full consideration” to the report supplied by the Secretary of the Interior regarding modifications of water projects for the protection of wildlife. Consequently, the Coordination Act clearly applied to future COE activities on the Upper Mississippi, and the COE was required to act on recommendations of the Secretary of the Interior to the extent necessary to comply with the full consideration requirement. Merely consulting with the Secretary of the Interior was insufficient.

Another of the 1958 Coordination Act Amendments added section 3(e) which settled the dispute over the relationship between the Coordination Act and the 1946 Flood Control Act. Section 3(e) stated that “Federal lands acquired or withdrawn for Federal water resource purposes and made available to the states or to the Secretary of the Interior for wildlife management purposes, shall be made available for such purposes in accordance with this Act, notwithstanding other provisions of law.” The effect of Section 3(e) was to prohibit the COE from unilaterally issuing cottage siting or other public use leases or licenses on land turned over to the Refuge for wildlife management. In addition, the amendments clearly authorized direct transfers of land for administration by the states where such transfers would be in the public interest. The Service decided to allow the states to determine if direct transfers would be incorporated into the general plans. Direct transfers were of no concern to the Wisconsin Conservation Department because it did not administer any COE land for wildlife purposes. Iowa, Illinois and Missouri were opposed to any alterations in the 1954 transfer arrangements. Only Minnesota was interested in direct transfers for limited acreage in Pool 3, and that general plan was modified to allow for direct administration with the COE in that pool.[15]

Prompted by the 1958 amendments to the Fish and Wildlife Coordination Act, the FWS and COE developed a new system for coordinating public use of COE land with other Refuge activities. Section 10 was added to the cooperative agreement whereby the COE retained the authority to develop public use facilities and issue leases in coordination with the Refuge's programs. In line with Section 10, a zoning plan was to be developed “whereby specific areas for public use, recreational [sic], cabin sites, etc.” would be designated. The COE agreed to stop issuing cottage site leases and to phase out existing leases and agricultural leases. In their stead, the COE planned to convert some cottage sites into

15. As a part of this planning process, the Service asked Illinois, Missouri and Iowa to review the status of General Plan lands managed by their departments to determine whether they now are in favor of a direct transfer from the COE. Each of the states have reaffirmed the status quo arrangement.

public access, camping, picnicking or boat launching areas. Section 6 was added to require the consent of both the Department of Interior and the Department of the Army before any rights of way for roads, telephone lines, power lines or other uses over either COE or FWS lands. Thus, involvement of both Departments was required for the approval of public uses and grants of rights of way. In addition, the 1963 Cooperative Agreement provided authority to the Service "to prevent and eliminate any trespass or unauthorized use" of property made available through the cooperative agreement.

One of the objectives of the 1958 negotiations was to provide for a system whereby minor changes in the land categories covering transferred lands could be made without requiring the signatures of the Secretaries of the Army and Interior. A provision was made in the general plans which allowed that "minor adjustments may be made in the boundaries . . . by mutual agreement" between the District Engineer, Regional Director, Service, and the appropriate state official.

Mark Twain Refuge Established

USFWS

In the late 1940s several GP land units managed by the Service south of the Quad Cities were designated separate national wildlife refuges administered by the Upper Mississippi River National Wildlife and Fish Refuge through publication in the Federal Register. These Refuges were located at Batchtown, Calhoun, Louisa, Keithsburg and Flannigan Island[16]. Due to the great distances involved in dealing with issues south of the Quad Cities from Winona, Minnesota, a proposal was made in June 1957 to "divorce the management of the Corps of Engineers land which have been made available to the [Service] south of Rock Island from the administration of the Upper Mississippi River Wildlife and Fish Refuge." In a memo to the Director dated October 31, 1957, the Regional Director stated, "it would be logical to designate these lands as a single refuge unit and suggest the Mark Twain National Wildlife Refuge as an appropriate refuge designation. This is a very logical name for the refuge, since it encompasses those portions of the Mississippi River which were made famous by the writings of Mark Twain." The memo also stated that the refuge should "establish a new headquarters office for this area somewhere in the vicinity of Quincy, Illinois."

A news release dated August 1, 1958, stated that "Secretary of the Interior, Fred A. Seaton signed a document giving official Refuge status to certain lands along the Mississippi River between Rock Island and Alton, Illinois. The new Refuge, comprising some 20,000 acres in Illinois, Iowa and Missouri will be known as the Mark Twain National Wildlife Refuge." The release also stated that portions of the Refuge would be designated for public hunting, while other important waterfowl concentration points would continue to be maintained as sanctuaries for migratory birds and other wildlife. On August 28, 1958, the Director published a Notice of Proposed Rule Making in the Federal Register to permit the hunting of game birds and mammals on certain lands of the Refuge. At the time of establishment

16. The process to transfer additional COE lands at Flannigan Island to the Service was begun in 1957. Following the addition, this unit was referred to as Gardner Refuge, and later Gardner Division of the Mark Twain NWR. Since this name never resonated with the public, as a result of this planning process the Division is no"w referred to as the Long Island Division, as it is known locally.

the Refuge contained the following lands, by county: Iowa (10,328) - Muscatine, 1200; Louisa, 6064; Des Moines, 3,064; Illinois (9,909) – Mercer, 1,466; Adams, 1,426; Calhoun, 6,409; Jersey, 608; Missouri (232) – St. Charles, 232; for a total of 20,469 acres. At the time an additional 2,500 acres on Long Island in Adams County, Illinois was in the process of being transferred from the COE to the Service. In 1958, the State managed GP land areas totaled 43,643 acres. Of that total 3,134 acres were in Iowa, 28,141 acres were in Illinois and 12,368 acres were located in Missouri.

During the 1940s and 50s, the exact legal status of state managed GP lands within the system of lands managed as National Wildlife Refuges in the Bureau of Sport Fish and Wildlife was uncertain. After the establishment of Mark Twain Refuge in 1958, and the subsequent legislation relating to the National Wildlife Refuge System, the status of state managed GP lands were further confused.

General Plan (GP) Lands and the National Wildlife Refuge System

In 1966, Congress passed the National Wildlife Refuge System Administration Act (NWRSAA), for the express purpose of "consolidating the authorities relating to the various categories of areas that are administered by the Secretary of the Interior for the conservation of fish and wildlife." The Act also provided the Secretary of Interior with the authority to acquire land or interests in land in exchange for existing acquired land. The NWRSAA did not explicitly include lands acquired through cooperative agreement, or address whether the provisions of cooperative agreements remained valid after the passage of the NWRSAA. Hence, prior to 1976, it was not clear that land acquired under cooperative agreement were within the National Wildlife Refuge System.

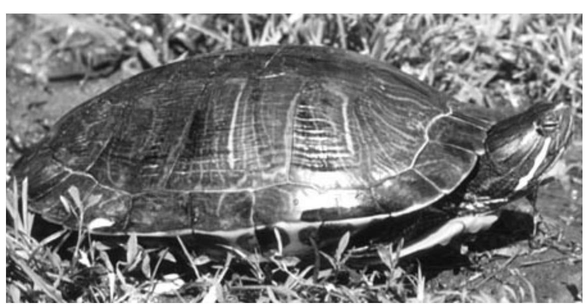
In 1976, the NWRSAA was amended by what became known as the Game Range Amendments. The amendments provided that suitable lands acquired through cooperative agreement were part of the National Wildlife Refuge System, but could be disposed of in accordance with the terms of the cooperative agreement. Questions were still raised regarding the effect of the NWRSAA, as amended, on the Upper Mississippi River cooperative agreement lands. The Game Range Amendments appeared to include only those cooperative agreement lands which were acquired before January 1, 1975, if sufficient managerial authority was transferred to the Secretary of Interior. In addition, the amendments appeared to allow only those provisions of the cooperative agreement to remain in effect that related to disposal of lands. The Acting Associate Solicitor for Conservation and Wildlife addressed these questions in a memorandum of August 8, 1980. He concluded that the Secretary of the Interior had the authority to enter into cooperative agreements for lands that would be included within the National Refuge System, whether or not entered into before or after January 1, 1975. The wildlife lands would be part of the System on the terms contained in the cooperative agreements without regard to the managerial authority reserved to the cooperating agency. He concluded that it was unreasonable to believe that Congress intended to rewrite management arrangements for lands under cooperative agreement to give the Secretary of the Interior total managerial authority. Thus, lands that are managed by the Fish and Wildlife Service under cooperative agreement, whether entered into before or after January l, 1975, are part of the National Wildlife Refuge System under the terms for management and disposal as contained in the agreement. Thus, GP lands managed as part of the Mark Twain Complex are subject to all the laws and policy of the National Wildlife Refuge System, including compatibility, to the extent of the authority granted to the Fish and Wildlife Service in the cooperative agreement.

On October 9, 1997, the President signed Public Law 105-57, "The National Wildlife Refuge System Improvement Act" (RIA), which amended the NWRSAA. The RIA spoke to elements of "Coordination Areas" within the National Wildlife Refuge System (NWRS). According to the RIA, "the term 'Coordination Area' means a wildlife management area that is made available to a State....by cooperative agreement between the United States Fish and Wildlife Service and a state agency having control over wildlife resources pursuant to Section 4 of the Fish and Wildlife Coordination Act (16 U.S.C. 664)...." The term 'Refuge' is defined as a designated area of land or water, or an interest in land or water within the system, but does not include Coordination Areas. The House Report on the Refuge Improvement Act gives a good understanding of the intended relationship of these particular state managed areas and the issue of compatibility. It states that while these areas are considered a part of the Refuge System, they are specifically excluded from the definition of the term 'Refuge' so as not to require every state management decision to be approved by the Service. Thus, Coordination Areas are a part of the NWRS, but are not a part of any particular Refuge and are not subject to refuge compatibility standards. Each area is subject to the provisions of the Cooperative Agreement between the state and the Service, and as a part of the NWRS it is intended that each will contribute to the mission of the Refuge System. The mission of the System is to administer a national network of lands and waters for the conservation, management and, where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.

The Mark Twain Refuge Complex is deeply entwined with the COE on the lands and waters of the Mississippi River. The Cooperative Agreement, included in Appendix D, was revised during the CCP planning effort and details those topics in which the COE has retained authorities that affect Refuge operations, procedures and compatibility. This agreement covers all GP lands managed as part of the Mark Twain Complex, the Upper Mississippi River National Wildlife and Fish Refuge and those lands passed on to the states of Missouri, Illinois and Iowa through step-down agreements with the Service. These state agreements now need to be revised to reflect the provisions in the new Cooperative Agreement with the COE for all lands and to ensure that the agreements are framed to contribute to the Mission of the NWRS. In a letter to the Chicago COE Division on February 4, 1977, the Regional Director designated the Mark Twain Refuge Manager as the point of contact for state managed GP agreement issues. As such, the Complex Manager will initiate the agreement revision process with each of the states.

Description of Existing Units within Mark Twain NWR Complex

The Mark Twain National Wildlife Refuge Complex is currently comprised of approximately 44,300 acres and stretches from Muscatine, Iowa, to Gorham, Illinois, covering approximately 342 river miles. This Complex consists of a Complex Office located in Quincy, Illinois, and five Refuges: Port Louisa NWR; Great River NWR; Clarence Cannon NWR; Two Rivers NWR and Middle Mississippi



USFWS

River NWR. Each individual Refuge is composed of separately named divisions scattered along the River corridor. Clarence Cannon NWR is managed as a unit of Great River NWR. The Iowa River Corridor Project (IRCP), which is managed primarily by the Iowa Department of Natural Resources through a cooperative agreement, is administratively a part of the Port Louisa NWR. Much of the Complex (approximately 17,000 acres, with some adjustments approved in St. Louis District Master Plan) is General Plan lands owned fee title by the COE, but managed by the Fish and Wildlife Service under the 1963 cooperative agreement. The units managed by Refuge staff vary in habitat from bottomland hardwoods to moist soil impoundments to grasslands and croplands. All Refuge divisions experienced dramatic habitat changes from several flood events in the 1990s. Also, four new divisions were purchased following the Great Flood of 1993. These were lands made available on the market due to flood impacts on private farm operations in the floodplain. In addition to the divisions listed in the following paragraphs, the refuges also administer several fee title land units acquired from Farm Services Administration.[17]

Port Louisa NWR

The Port Louisa NWR is based 6.5 miles east of Wapello, Iowa, and is the northernmost of the Refuges. Refuge staff manage four divisions: Louisa, Big Timber, Keithsburg and Horseshoe Bend, totaling approximately 8,373 acres. Louisa, Big Timber, and Horseshoe Bend are located in Louisa County, Iowa, while the Keithsburg Division is in Mercer County, Illinois. Louisa, Big Timber and Keithsburg are located within the floodplain of the Mississippi River and are primarily General Plan (GP) lands. Horseshoe Bend Division lies within the Iowa River floodplain and was purchased fee title by the Service following the Flood of 1993.

Big Timber Division

The 1,758-acre Big Timber Division is located 2 miles south of Muscatine, Iowa, in Pool 17, along the right descending bank. The Division is comprised of a 1,252-acre contiguous backwater area as well as Turkey, Turkey Towhead, Otter, and Ramsey islands, which total 506 acres. Turkey, Turkey Towhead and Otter islands lie just above Lock and Dam 17 (RM 437-439), while the backwater portion of Big Timber stretches from RM 443-447. Ramsey Island is located at RM 443, just above the mouth of Big Timber's confluence with the main channel of the Complex connected to the Mississippi River. Big Timber Division is entirely General Plan lands. The bulk of Big Timber Division is a contiguous backwater of the River, consisting of sloughs surrounded by bottomland hardwoods. It is not protected by a levee and is completely open to the River's fluctuations. The area generates good Wood Duck production, as well as good numbers of neotropical birds and some Hooded Merganser.

Early in Big Timber's history as a refuge, several small fields were farmed near the north end, but the last 26-acre field was abandoned in 1984 and planted with bottomland hardwood seedlings. Prolonged flooding during 1993 and subsequent floods have caused many mature trees to die and become wind-thrown, leaving large openings in the canopy. Bur cucumber, an early successional invasive vine, is now the predominant ground cover in these large openings, but silver maple and green ash seedlings are beginning to regenerate. The unit's backwaters contain very little aquatic vegetation due to sedimentation and the lack of a soil consolidation and drying cycle.

17. See section on "Refuge Management of Lands Associated with Agriculture Department (USDA)" at the end of this chapter.

Big Timber is open to waterfowl hunting. However, fishing is the Division's primary recreational attraction. Bank fishing is available at the parking lot/ramp site. The fisheries resource has slowly declined as sedimentation has accumulated in the backwaters. Deepwater habitat was created in the early 1990s when the Environmental Management Program (EMP) completed a dredging project through Round Pond continuing to the tip of Big Denny. However, since project completion, a great deal of sedimentation has occurred within the dredge cuts. This is due primarily to extensive flooding, particularly the 1993 flood. This project also included mast tree plantings on dredge spoil sites.

Access to the four islands of the Division is only by boat. The islands have been subjected to extended flooding during the past 10 years, which has significantly impacted the forest resources. Siltation in Swift Chute (between Turkey and Otter Islands) has decreased navigability, reduced submerged vegetative growth, and reduced habitat diversity in the remnant sloughs located within the island interiors.

Louisa Division

The 2,609-acre Louisa Division stretches from RM 438 to RM 441, right descending bank (Iowa). It is protected from average to moderate flooding by a COE levee stretching to Lock and Dam 17, approximately 1 mile south of the Division border. The levee is integral to maintaining the 9-foot navigation channel due to its proximity to the dam. However, seep water from the navigation pool makes some units in the Division difficult to manage. The Port Louisa Refuge headquarters area includes 48 acres of wooded bluff, a 4-acre prairie restoration and the office building site situated on the bluff overlooking the Mississippi River floodplain. Only this upland administrative acreage is owned fee title by the Service; the remaining acreage is General Plan lands.

Traditional waterfowl management has been the primary objective on this Division since its conversion from an agricultural levee district in the 1940s to a national wildlife refuge. Some cropping still occurs on the slightly higher elevations, but 800 acres are dedicated to promoting growth of moist soil plants for use by waterfowl. Other habitat types include a permanent 45-acre body of water (Prairie Pocket), and bottomland forest. Existing hardwoods in the floodplain were devastated by prolonged flooding in 1993 and a high percentage have died, although the 18-acre pecan grove continues to survive. A small 25-acre sand prairie was established on the highest ridge of Louisa Division in 1985. Even though this site was inundated by 1993 flood waters, some warm season grasses and forbs survived and prescribed burning on the unit has helped invigorate the stand.

Louisa Division is bordered to the south by Lake Odessa State Wildlife Area, which is managed by the Iowa Department of Natural Resources. Primary management on this area is for migratory waterfowl and fisheries. Lake Odessa and the Louisa Division share recently constructed water control structures at the north end (inlet from the River) of the Louisa Division, and south end of Lake Odessa (outlet). Water travels via gravity-flow through the inlet structure and is diverted into Louisa Division or sent on to Lake Odessa. The Refuge and Lake Odessa Unit coordinate water delivery to satisfy both management objectives. Often times both entities need flow at the same time.

Up to 330 acres are currently cropped on the Louisa Division. Corn, soybeans, buckwheat and winter wheat have traditionally been planted. Following the Flood of 1993, vehicle access to the Division was lost due to a large levee break. No mechanical manipulations occurred to deter natural succession, and the area quickly began converting to silver maple, cottonwood and willow saplings. In the last few years farming and burning have been used to reduce tree invasion in the moist soil units.

Louisa Division functions as a migratory bird sanctuary each fall and is closed to public entry. No hunting of any kind is permitted on the Division, however the adjacent Lake Odessa receives heavy hunting pressure. A concrete double boat ramp allows access directly to the River from the northern boundary of the Louisa Division. An accessible fishing pier allows fishermen to cast their lines into the diversion ditch leading to Lake Odessa.

Horseshoe Bend Division

Horseshoe Bend Division is located in the Iowa River floodplain, Louisa County, Iowa, approximately 4 miles upstream from its confluence with the Mississippi River. The 2,606-acre tract was purchased fee title by the Service in response to the Flood of 1993. Previously known as Levee District 8, privately owned agricultural fields were protected from the Iowa River by a levee built in the 1920s. Since its completion, the levee had been breached by floodwaters on an average of every 4 years. In 1993, floodwaters broke the levee at three sites, depositing large amounts of sand and debris across the floodplain and scouring many deep holes. Damage totaled $2.7 million. The landowners decided farming was no longer economically feasible, as their levee district taxes increased each time the levees breached. Due to the severe midwestern floods, the U.S. Department of Agriculture offered a program to affected landowners entitled the Emergency Wetland Reserve Program (EWRP). Eleven of the 13 landowners within Levee District 8 participated in the EWRP. The Service then offered each landowner with an EWRP easement the residual value to sell the land. Ten of the 11 landowners took the “buyout.” The easements prohibit agriculture, but do permit the planting of food plots for wildlife.

Acquisition of Horseshoe Bend has reconnected the floodplain to the River by maintaining three breeches in the levee. During annual high water periods, floodwaters enter and exit the Division. The result is a mosaic of grassland, wet meadow, seasonal and semi-permanently flooded wetland, and forest. The wetland complex provides floodwater storage, and fish spawning and feeding habitat. The unit receives considerable migratory bird use including shorebirds, waterfowl, wading birds and grassland birds. There has been one active Bald Eagle nest on the Division the past several years

Since the property was transferred to the Service in 1995, many changes have been made to Horseshoe Bend's landscape. Approximately 400 acres of wetlands have been restored, 250 acres of former crop lands have been seeded with warm season native grasses and forbs, and 50 acres of mast-producing bottomland tree species have been planted. The unit contains the largest block of grassland/wet meadow habitat located in the AEC. Burning is the primary management tool used.

Horseshoe Bend Division is open to wildlife-dependent public use except during the fall, when it serves as a migratory bird sanctuary. Access to the Division is limited, however a public parking area exists on the west side off of F Avenue.

Keithsburg Division

USFWS

The 1,400-acre Keithsburg Division is located between RM 428-431, left descending bank (Illinois). The entire Division lies within Pool 18, immediately north of Keithsburg, Illinois. An 8-acre boat ramp site is owned fee title by the Service; the remaining acreage of the Division is General Plan lands. The Division is a mosaic of wetland and bottomland forest habitat complex including sloughs surrounded by bottomland timber stands. The forested stands suffered from the Flood of 1993 and subsequent wind storms, and many snags now exist. Dead and dying trees are used by woodpeckers, Wood Ducks, Hooded Mergansers and Prothonotary Warblers. Bald Eagles also use the area during migration, and several nesting attempts have occurred. A 2-acre remnant sand prairie borders the east side of the public parking lot.

Keithsburg Division averages 0.75 mile in width and has a 3-mile-long levee separating it from the Mississippi River. The north end of the Division is bounded by a levee, but a spillway allows water from the Edwards and Mississippi Rivers to flow into the Division during flood events. Its eastern boundary is a sand escarpment that rises quickly from the floodplain. The southern containment boundary of the Division is the former Minneapolis and St. Louis Railroad right-of-way. This right-of-way, which acted as a levee separating Pope Creek from the Division, was breached during the Flood of 1993. In 1999, a spillway to provide River connectivity during periods of high water was constructed in cooperation with the landowner and the City of Keithsburg.

The Keithsburg Division was previously an agricultural levee district in private ownership. The expense of trying to drain the area for farming became too much and the area was purchased in 1942 by the COE for the navigation project. In 1945, the area was transferred to the Service for management. Attempts to farm small fields continued, but were finally abandoned in 1984. The Division was established for protection of migratory waterfowl and has been managed accordingly since its establishment. Two 36-inch screwgates permit water levels to be lowered by gravity during summer months, allowing moist soil plants to grow in preparation for fall use by migratory waterfowl. A permanent pump station situated on the River levee was once used to facilitate lowering and raising water levels. However, this pump was damaged by the Flood of 1993 and is currently non-functional.

A recent contaminant investigation has indicated significant delivery of nitrogen and ammonia from neighboring watersheds into the northern portion of the Division, and it is an unresolved management concern. In 2000, CRP buffer strips were placed along private land drain ditches entering the Division to reduce sedimentation.

This Division serves as a sanctuary for migratory waterfowl during fall migration and is closed to public entry. Fishing is the primary public use on this Division, offering a diverse resource to bank, boat and ice fishermen. However, when the area is drawn down through the summer to promote moist soil vegetation, oxygen levels may become dangerously low for fish.

Great River NWR

The Great River NWR headquarters is located near the small town of Annada, Missouri, but is only 40 miles north of the sprawling St. Louis, Missouri, suburbs. Great River NWR staff manage three divisions for a total acreage of 10,146 acres and the Clarence Cannon NWR (3,750 acres). The Refuge also has management responsibility for two small fee title tracts acquired from Farmers Home Administration.

Fox Island Division

(formerly Gregory Landing Division)
The northernmost division is Fox Island, between the very small towns of Gregory Landing and Alexandria, Missouri, about 5 miles south of Keokuk, Iowa. It comprises approximately 2,109 fee title acres in Clark County, Missouri, adjacent to Pool 20, RM 354-358, right descending bank. The Division was formerly known as Gregory Landing, but was recently renamed in accordance with local custom. The Fox River, which runs through southeastern Iowa and northeastern Missouri, bisects the Division and empties into the Mississippi River at the southern tip of the Division. A portion of the western boundary touches the Missouri Department of Conservation's Rose Pond Conservation Area. The original 1,037 acres of Fox Island were purchased in 1989 with additional purchases taking place in 1996 and 1997, in response to the record flood in 1993. Flooding events affect Fox Island both from the Mississippi and Fox Rivers.

A large percentage of the more recently acquired acreage had been in agricultural production. Oaks and pecans were planted on 160 acres in 1994, with an additional 80 acres planted in 1998. Wetland restoration within the Division is difficult due to the porosity of the soils, but three remnant sloughs have been partially restored by blocking agricultural drains with water control structures. Approximately 130 wetland acres have been enhanced by these efforts. Development of fixed pumping facilities is under consideration, but may be restricted by soil types and limited road access to the Division.

Other habitat available to wildlife includes marsh areas, one lake, slough channels and forested wetlands. Ninety acres of former cropland within the Mississippi/Fox Drainage District levee may be suitable for restoration of grasses. Approximately 675 acres are still planted annually with corn or soybeans by two cooperative farmers in order to keep the land clear for planned reforestation.

Fox Island is open to antlerless deer hunting during the Missouri state January extended season. It is closed to waterfowl hunting, but open to turkey and other upland game, except that it is closed October 16 to December 31. No public use facilities exist at this time and minimal “flood friendly” structures are proposed for development. Because only 90 of the 2,109 acres are protected by a levee, reliable access to this floodplain Division is limited by the River's fluctuations. A railroad track that traverses the Division contains an adjacent lane for railroad maintenance within their right of way, but is not open to the public.

Long Island Division

Formerly known as Gardner Division, Long Island Division is located 6 miles north of Quincy, Illinois, in Pool 21, RM 333-340, left descending bank. The Division was formerly known as Gardner, but was recently renamed in accordance with local custom. This 6,300-acre non-leveed Division is comprised of a complex of islands and floodplain. Major islands include Barnes, Shandrew, Flannigan, Long and LaGrange. Wildlife habitat consists of about 4,670 acres of bottomland hardwoods, with lakes, sloughs and ponds making up an additional 600 acres. While extensive tree mortality occurred due the Flood of 1993, the unit is still the largest contiguous forest of its type south of Rock Island, Illinois. The size and diversity of trees makes the area unique along this portion of the UMR. In recent years a cooperative program with the COE has restored several hundred acres of farmland to hardwood habitat on Long Island. Less than 160 acres of crop lands remain on the Division at this time. The agricultural fields in the Bear Creek unit (124 acres) were restored to floodplain forest following the 1993 Flood.

Sedimentation in chutes and channels has greatly reduced depths and limited boat travel. Much of the sedimentation is due to training and closing structures needed for navigation. Quality of fishing has greatly declined due to sedimentation. The entire Division is open to hunting and fishing, in accordance with state regulations. The State of Illinois manages the waterfowl blinds through its 2-year permit allocation cycle. The Corps of Engineers manages the Bear Creek Recreation Area adjacent to the Division. This recreation area, which provides camping and boat access to the River, is used extensively by fishermen and hunters. In cooperation with the Corps of Engineers, a permit program is administered by the refuge for winter storage next to a Division island of private docks historically present along a portion of Canton Chute. An evaluation of this program was recently conducted, including its possible impacts to wildlife or habitat resources. When docks are moored properly, there is no evidence of negative impacts to the shoreline. Annual inspections will be conducted to ensure that trees or other resources remain unharmed. New permits for these docks will require that the most environmentally friendly material be used for flotation, which will have an off-site positive impact on the river. In addition, the Service will begin charging a fee for these permits to cover program implementation.

Delair Division

The 1,737-acre Delair Division extends from RM 277.5-282 along Pool 24 in Pike County, Illinois. The closest town is Louisiana, Missouri, 2 miles northwest of the Refuge. This Division was purchased fee title in 1965 and 1976 with funds from the sale of migratory waterfowl stamps. The Division lies completely within the 52-mile-long Sny Agricultural Levee District, and is separated from the River by the main line Sny Levee. The sandy soil structure and low elevation permits constant seepage of water into the Division from the River.

When originally acquired, the area was almost entirely cropland. Much of the Division has been restored to marshes, lakes, forest and grasslands. Semi-permanent and permanent water bodies make up 485 acres of Delair, providing feeding and resting areas for migratory birds and waterfowl. Water level management, mowing and discing are used to create diverse vegetation within moist soil units. Farming on this Division is used as a tool to provide supplemental food for waterfowl. Three hundred acres are being cropped currently by one cooperative farmer. Some loss of bottomland timber has occurred due to saturation of soils from flooding. However, the south Sny Levee was one of very few levees between Rock Island and St. Louis that was not breached during the 1993 flood event. Therefore, timber within Delair was not as extensively damaged as other divisions.

The Division is substantially protected from flooding by the Mississippi River by the main line Sny levee along the western refuge boundary. Additionally, all runoff and seep water from the Refuge are drained into the Sny ditch along the eastern boundary. These benefits provided by facilities of the Drainage District allow current management of refuge wetlands and other habitats. The federal government is not legally obligated to pay drainage assessments on lands that it owns. However, based on the benefits described above, under a 1967 cooperative agreement the FWS agreed to pay the Sny Drainage District a fee equal to the annual drainage assessment for refuge lands. Although this agreement expired in 1977, the FWS has continued to voluntarily make this annual payment. In recent years this amount has been approximately $11,400.

Delair Division is closed to public entry at all times, as stipulated in the purchase agreements. However, school groups often use the area for environmental education purposes. In 1993, it became necessary to control the expanding deer population and a muzzleloader deer hunt was initiated to assist with habitat management efforts. Either-sex permits and optional antlerless-only permits are issued to maintain burgeoning populations. Although no waterfowl hunting opportunities exist on the division, intense duck hunting pressure surrounds the Refuge, including Illinois Department of Natural Resources lease blinds on the Mississippi River.

Bald Eagles produced young in a nest along the southern boundary in 1998. A new nest was built within the Division in 1998 next to Upper Swan Lake and produced young in 1999, 2000 and 2001.

Clarence Cannon NWR

The Clarence Cannon NWR was established in 1964 through the purchase of migratory waterfowl stamp sales. It lies in Pike County, Missouri, between RM 261-264 in Pool 25. The headquarters for Great River NWR is located on Clarence Cannon. The area was formerly part of an agricultural levee district, and all but a few hundred acres are protected by a levee. This 3,750-acre unit was established to provide a feeding and resting area for migratory birds. The area is bounded on the east by the Mississippi River levee, on the south by the Bryants Creek levee and on the west by a levee that protects adjacent private crop ground and the small town of Annada, approximately 1 mile away.

Twelve moist soil units (2,000 acres) are disced, burned, mowed and cropped on a rotational basis to maintain a diversity of plants which, when flooded in the fall, provide excellent forage for migratory shorebirds, marsh birds and waterfowl. Peak waterfowl numbers may reach 100,000 in November and December. Over 400 acres on Clarence Cannon NWR are cropped by cooperative farmers annually. Corn, soybeans, winter wheat and clover are rotated through the crop fields and moist soil units to maintain diversity. Mast trees were severely impacted by the prolonged 1993 flooding. Over 80 percent of the pin oaks and hickories died, but some natural regeneration is occurring. Approximately 450 acres of bottomland forest remain. The flood also killed established warm season grasses.

Following the 1993 flood, an 800-foot spillway was built into the Mississippi River levee on the southeast side of the Refuge. This construction allows floodwaters to enter the Refuge more frequently at 4.5 feet below the levee top. Because of the spillway cut and spring high water events, timing for water management drawdowns has been altered. Monitoring of this frequent flooding is necessary to determine sedimentation rates within the Refuge. The spillway has provided increased connectivity to the River and temporary floodwater storage, which may help reduce downstream flooding on private lands.

Refuge visitors come to observe migratory birds, including Bald Eagles, waterfowl, shorebirds and neotropical migrants. Nesting marsh birds include the King Rail and Sedge Wren, both priority species of concern. One pair of Bald Eagles has nested the past several years. No hunting is allowed on Clarence Cannon NWR except for a special managed deer hunt in cooperation with the Missouri Department of Conservation to control the deer population. Portions of the Refuge are seasonally closed to public entry based on peak waterfowl migrations. Fishing is permitted by boat only in Bryant's Creek, along the southern Refuge boundary.

Two Rivers NWR

Two Rivers NWR is headquartered near the small town of Brussels, Illinois, in Calhoun County, only 20 air miles from St. Louis, Missouri. The Refuge includes five divisions; four are located in the AEC but the fifth, Apple Creek Division, is outside the planning area and was acquired fee title from the Agriculture Department.

Batchtown Division

The Batchtown Division is within the Mississippi River floodplain of Calhoun County, Illinois, between RM 246 and RM 251.5 in Pool 25. The Division includes about 2,300 acres of forests, backwater sloughs, agricultural lands, lakes, ponds and moist soil units. A large portion of the Division, known as Prairie Pond, is separated from the River by a low elevation dike, making limited water level management possible on 400 to 550 acres during non-flood periods. A 52-acre moist soil unit is located next to Prairie Pond and also uses the low dike for water level management. More than half of the Division is open to River flood pulses and consists of a network of islands, side channels and backwaters.

The Division is adjacent to the Batchtown State Fish and Waterfowl Management Area on the south and the Red's Landing State Fish and Waterfowl Management Area on the north. Both are managed by the Illinois Department of Natural Resources. As part of the COE St. Louis District Master Plan, the Division was extended north to include a part of the expired Gilead private use lease area. The Refuge also transferred the lands south of Turner Hollow Road, including primary road maintenance and the Mississippi River boat access site, to the Illinois Department Natural Resources to create better interagency management use lines. Although the state assumes habitat management for this area, it was agreed that it would remain waterfowl sanctuary and that existing waterfowl blinds along the old boundary would not be moved any further north toward the Refuge.

Post 1993 flood improvements to Batchtown include three spillways in the dike/service road paralleling the River. The spillways were built 1.5 feet below road elevation to reduce future flood damage and increase River connectivity. Fish and waterfowl use of the Division has declined due to a decrease in habitat quality caused largely by sedimentation. There are approximately 1,600 acres of bottomland forest on the Division. Many mature trees have died due to extended flood events. Several former agricultural units were planted with mast-producing seedlings, however many of these did not survive subsequent high water. Construction of an EMP project began in 2000 and features habitat improvements on both the Refuge and state-managed areas. The Batchtown project includes dredge cuts for improved fish habitat, new water control structures for enhanced drawdowns, sediment traps and pumps.

Fishing is popular on Batchtown in spring and summer. The Division has one boat ramp at Prairie Pond, and another accessing the Mississippi River backwaters at Gilead. Service lands at Batchtown are managed as migratory bird sanctuary in the fall while the adjacent state-managed areas receive heavy pressure from waterfowl hunters. Some of the Division on the south end was open to hunting prior to the COE Master Plan land exchange of the Refuge General Plan lands with the Illinois Department of Natural Resources. Following the adjustment, the entire Division was closed to waterfowl hunting.

Calhoun Division

The Calhoun Division is located just north of the confluence of the Mississippi and Illinois rivers in Calhoun County, Illinois, and stretches along the Illinois River from approximately RM 5 to 10. The 4,820-acre Division is comprised of the 2,300-acre Swan

Lake, moist soil units, agricultural land, bottomland forests, grasslands, lakes, ponds, backwater sloughs, and Refuge headquarters.

An Environmental Management Program project on Swan Lake was nearly completed in 2000. The project included a low-elevation dike to separate the lake from the River (except during high flows), cross dikes to separate the lake into three management units (the lower two Refuge units and the state-managed upper unit), pumps and water control structures. An upland hillside sediment control component was added to the project in conjunction with the Natural Resources Conservation Service. By regaining water level management capabilities on Swan Lake, an occasional draw down will mimic historic conditions by consolidating the flocculent bottom and permitting conditions in which wetland vegetation can germinate. Lower Swan Lake will normally be open to the River for fish passage. Due to the results of the initial drawdown attempt in the summer of 2000, an additional pump is being planned for the south unit as a project performance follow-up.

During the St. Louis COE Master Plan process, the Division boundary was extended north to the cross dike between Refuge-managed Middle Swan Lake and state-managed Upper Swan Lake. The change established a more logical boundary between the two areas and added approximately 152 acres to the Division.

Prescribed fire is used to manage warm season grass on several higher elevation sites. Seven moist soil units totaling approximately 240 acres are managed for migratory birds. Silt deposition is a problem across the Division following floods. Approximately 550 acres of cropland are currently farmed by cooperative agreements on the Calhoun Division. Corn, soybeans and winter wheat are planted rotationally through the units. Approximately 25 acres of crop lands were removed from agricultural rotations and planted with bottomland hardwood tree species in 1994 and 1995.

Bald Eagles regularly use the area during winter. Visitors also enjoy the thousands of Snow Geese and other waterfowl that come to browse on the winter wheat and roost on Swan Lake. Bank fishing and small boat fishing is available. With the exception of the headquarters/visitors contact station, Calhoun Division is closed each fall to provide sanctuary for migratory birds.

Gilbert Lake Division

Gilbert Lake is adjacent to Pere Marquette State Park in Jersey County, Illinois, at Illinois RM 3.8 to 8. Gilbert Lake totals approximately 735 acres, consisting of a 250-acre lake bordered by forest, grassland and small agricultural fields. The area includes a 128-acre tract of land owned by the State of Illinois and managed by the Refuge under a cooperative agreement.

There has been a considerable amount of rehabilitation done on Gilbert Lake following the floods of 1993 and 1995. Improvements included upgrading and repairing the dike/service road that parallels the Illinois River, dredging silt from Gilbert Lake, and removing deposits from drainage ditches and silt basins. Two large spillways were built into the service road to reduce flood damage and permit regular river connectivity. However, due to an inoperable pump station, water level management for the past 15 years has consisted only of de-watering the lake by gravity through a stoplog structure. As on other River divisions, extended and recurring flood events have killed forest resources. The southern portions of the Complex, including Gilbert Lake, have suffered the greatest impacts.

The Duncan Farm Site has been identified as an important archeological resource at Gilbert Lake due to the Native American mound that is located on this area. A Federally-listed threatened plant species, Boltonia decurrens, or decurrent false aster, is also found on this Division.[18] At Gilbert Lake, this plant showed a marked increase in population following the extended flood events of 1993 and 1995, as documented by the Southern Illinois University - Edwardsville.

Public use on Gilbert Lake consists primarily of bank fishing and bird watching. Gilbert Lake is closed annually during the fall as sanctuary for migratory birds, except for the overlook road adjacent to the highway. Bald Eagles use the area routinely during the winter and there are excellent viewing opportunities from Illinois State Highway 100. An active eagle's nest has been located on the Division in recent years. The Alton Convention and Visitors Bureau and Pere Marquette State Park conduct tours around the area for eagle viewing.

Portage Islands Division

Portage Islands Division's 230 acres are comprised of one large and three small islands in Pool 26 of the Mississippi River, RM 213-214. These forested islands lie just northeast of Portage des Sioux, Missouri. Backwater and ephemeral wetlands on the big island are used by waterfowl, wading birds, and other migrants. The three islands experience public use of the beaches by boaters during summer months. Illegal camping and campfires destroy vegetation on the islands each year. A great deal of bank erosion and island loss has occurred over the years. Hunting is not permitted.

Middle Mississippi River NWR

The Middle Mississippi River NWR planning area begins below Lock and Dam 26 at St. Louis, and continues to the confluence of the Ohio River near Cairo, Illinois. There are no locks and dams in this reach, but the River has been confined to its main channel by rock training structures while large agricultural levees restrict lateral floodplain connection. The lands comprising the Middle Mississippi River NWR were purchased in response to the 1993 Flood, after the failure of various private levees. Currently, the acreage managed totals approximately 3,835 acres. Each existing Division is named an “Island,” although the term is now misleading. At one time these areas were actual islands, but River structures intended to keep water flowing to the center of the navigation channel early last century caused sedimentation, accreting the island to the mainland and eliminating flowing side channels.

Meissner Island Division

The 78-acre Meissner Island Division is located in Monroe County, Illinois, between RM 153.5 and 155.5, left descending bank. It is less than 20 river miles from St. Louis' southern suburbs. The Service purchased the residual value on these lands, which were enrolled in a perpetual Emergency Wetland Reserve Program (EWRP) easement from the Department of Agriculture. Due to its small size and limited access, little active management can be done on Division lands. The former cropland acreage is naturally regenerating with silver maple, willow and cottonwood. Noxious weed control is an ongoing problem on the retired agricultural fields in the area and is being treated on a spot-by-spot basis. Because of a lack of formal access no public use is currently permitted at this parcel, which may change with additional expansion at the Division.

18. See Current ‘Status of the Area of Ecological Concern Resources, Endangered Species’.

Harlow Island Division

Harlow Island Division is located in Jefferson County, Missouri, between RM 140.5-144, right descending bank. The closest town is Crystal City, Missouri, 6 miles north.

The Service purchased this 1,225-acre tract in 1996. Nearly 800 acres had been cropland protected by a private levee that was breached during the 1993 flood. Following the fee title acquisition, the levee breaks were not repaired, which allows the Mississippi River into the floodplain during high water events. The cropland has been allowed to naturally revegetate and is now comprised of young silver maple, cottonwood and willow saplings. The remaining acreage is primarily bottomland forest with a small remnant side channel.

Harlow Island is closed to all migratory bird hunting. Archery deer and upland game hunting is permitted in accordance with state regulations. Access to the unit is limited since private land (Kimmswick Isle of Capri Casino, which is included in the Complex expanded boundary area) must be crossed to get to the north part of the unit. The southern part of the unit can be accessed from the adjacent Missouri Department of Conservation boat ramp site.

Wilkinson Island Division

The southernmost part of the Mark Twain NWR Complex is currently the 2,532-acre Wilkinson Island Division. This area is about 37 miles north of Cape Girardeau, Missouri, and lies between RM 88.5-93 in Jackson County, Illinois. Wilkinson Island was protected by a levee that was breached during the 1993 flood and has not been repaired. The landowners placed 1,900 acres of the island in EWRP easements; the Service paid residual value on this acreage and paid full appraised value for the remaining acres. There is one private landowner (780 acres) who is now surrounded by Refuge lands and the River. This landowner has an access easement across the Refuge to his land.

Natural revegetation has resulted in a thick stand of silver maple, willow and cottonwood saplings. A few residual side channels and wetlands remain throughout the area, but opportunities for restoration are limited by the desire to not negatively affect the adjacent private lands.

Hunting and fishing are allowed in accordance with state regulations. The Missouri/Illinois State line runs through the Division, but is not delineated on the ground. No parking lots, kiosks or informational panels are currently available for visitors.

Service Fee Title Properties Acquired From USDA

Three fee title tracts acquired by the Service through the Farm Service Agency (FSA)[19] are managed by the Complex refuges. The Apple Creek Division was acquired in 1992 and was initially referred to as a Wildlife Management Area (WMA). The Division is located outside the AEC, approximately 5 miles northwest of Carrollton in Greene County, Illinois. Apple Creek includes 269 acres of bottomland forest, shallow wetlands, and retired agricultural fields at the confluence of Coates Creek and Apple Creek. Roughly 105 acres are currently wetland, including the 30-acre Horseshoe Lake, 70 acres of seasonally flooded wetlands, and 5 acres in Apple Creek and Coates Creek. Another 160 acres are upland forest and retired agricultural fields reverting to forest. The Division is open to all the

19. This agency was previously named ‘Farmers Home Administration. Lands were acquired under the authority of the Food Security Act of 1985.

priority wildlife dependent public uses, except that the size of Apple Creek makes fishing opportunity quite limited.

Because Apple Creek is outside the AEC for this planning process it is not included in the same level of detail as areas within the 500-year floodplain. However, the unit contains high quality habitat that has the potential to be expanded and enhanced through acquisition and active wetland management. The unit contributes to the CCP water quality goal for the Complex by providing passive water treatment of an upland tributary (Apple Creek) that flows into the AEC. Several parcels of land adjacent to the Apple Creek property are also prone to frequent flooding and if acquired would add to the wetland habitat total in the area, as well as increasing the desirable effects on water quality. More specific management plans for the Apple Creek Division and other parcels in this section will be outlined in subsequent Habitat Management Plans.

In 1993, Great River NWR acquired a 43-acre tract in Lewis County, Missouri, within the Mark Twain AEC. It lies just north of the town of Canton, Missouri, and adjacent to Lock and Dam 20. Although partially protected by a levee, the area is subject to backwater flooding from the Mississippi River almost every spring. Farming was abandoned on the area in the early 1990s and the area is reverting to an early successional forest with silver maple and green ash.

The second fee title tract managed by Great River NWR is 80 acres in size and is located in Clark County, Missouri. It was also acquired in 1993. About half of the property was formerly cropland located along Hickory Creek. The cropland has been abandoned and is being allowed to naturally regenerate to bottomland forest. This has removed non-productive, highly erodible cropland from production and created a riparian buffer zone along the creek. The remaining half is established forest. The tract is not within the Mark Twain AEC.

Area of Ecological Concern Setting

USFWS

Climate

The Mark Twain Refuge Complex AEC lies within the heart of the Midwest. The climate for this section of the country varies from cold in the winter to hot and humid during summer months, and includes some variation from north to south. Table 2 shows the variation in average seasonal temperatures and precipitation in the north part of the complex (Louisa County, Iowa) to south (Jackson County, Illinois). Temperatures have been recorded within these counties as low as -25 degrees Fahrenheit (Calhoun and Louisa counties) and as high as 116 degrees Fahrenheit (Pike County).

Up to 70 percent (Louisa County) of the annual precipitation falls between April and September of any given year. Thunderstorms occur about 50 times per year throughout this corridor of counties. Severe thunderstorms, sometimes accompanied by hail, are usually localized. At least 1 inch of snowfall is present an average of 36 days per year in Louisa County and 6 days per year in Jackson County. The sun shines in the summer an average of 65 percent of the time in Louisa County and 75 percent of the time in Jackson

Table 2: Average Temperatures, Precipitation, Snowfall and Humidity in a Few AEC Counties, From North to South

Location	Average Winter Temperature (F)	Average Summer Temperature (F)	Average Precipitation	Average Snowfall (Inches)
Louisa, Iowa	25	73	37	37
Clark, Missouri	27	74	38	28
Pike, Missouri	30	75	37	18
Calhoun, Illinois	31	75	35	21
Jackson, Illinois	36	77	43	12

County. Winters can be a bit dreary with only 40-50 percent sunshine throughout the corridor. The highest average wind speeds occur during the spring at around 11-12 m.p.h.

Information in this section was compiled from soil survey books from each county. Their source of data is the National Climatic Center, Asheville, North Carolina.

Geomorphology of the Upper Mississippi River[20]

The headwaters of the Mississippi River is at Lake Itasca, in Minnesota, at 440 meters above mean sea level. At Bemidji, the River flows through lakes Irving and Bemidji and then through Stump, Big Wolf, Andrusia, Cass, Winnibigoshish, and Pokegama lakes. The outlets of lakes Winnibigoshish and Pokegama were dammed in 1891 and 1884 as part of a U.S. Army Corps of Engineers navigation and flood-control system that included four other dammed reservoir lakes on Mississippi River tributaries. The headwaters' dams are now used mainly for flood control, recreation, conservation, and related uses. None of the 11 dams between Lake Itasca and St. Anthony Falls (in Minneapolis, Minnesota) have navigation locks.

The Upper Mississippi River flows 1,462 kilometers from St. Anthony Falls to the mouth of the Ohio River at Cairo, Illinois. The major period of valley scouring began about 15,000 years ago when the Wisconsin Glacier began to melt, increasing river flow. About 12,700 years ago, the retreating Wisconsin Glacier blocked the northward drainage routes of its meltwaters toward Hudson Bay, forming glacial Lake Agassiz. This huge lake spilled over its southern rim for about 2,700 years, forming the glacial River Warren and carving the large valley now occupied by the Minnesota River. The River Warren was much larger than the present Minnesota River but carried little sediment. The glacial St. Croix River provided additional sediment-free overflow from Lake Duluth (glacial Lake Superior). The combined flow of the two rivers greatly increased the erosive capacity of the Upper Mississippi River, enabling the River to remove sediments from its bed and to deepen its channel by as much as 90 meters. The Upper Mississippi River must have been spectacular at that time-a massive, torrential river in a gorge that was eventually scoured more than 250 meters deep. As the Wisconsin Glacier retreated into Canada about 9,200 years ago, inflows of meltwater to the Upper Mississippi River ceased. The Upper Mississippi River valley then began filling with glacial outwash, mainly sand and gravel, a process that is still under way.

20. Information in this section is largely taken from Theiling et al., Habitat Needs Assessment Technical Report, 2000; and Ecological Status and Trends of the Upper Mississippi River System, USGS, 1998.

Just upstream from St. Louis, Missouri, the Missouri River joins the Upper Mississippi River from the west. Most tributaries to the Missouri River flow through highly erodible soils, which means that the Missouri River has always been the principal supplier of sediment to the Mississippi. Construction of a series of large dams in the Missouri River basin in the 1950s and 1960s created deep, cold-water reservoirs that trap sediment, reducing the Missouri River's total contribution of sediment to the Mississippi by about 70 percent.

About 160 kilometers downstream from St. Louis, the Mississippi River flows through Thebes Gap, which resembles the stem of an inverted funnel. Where it exits the gap, the constricted river widens as it enters an ancient sediment-filled lobe of the Gulf of Mexico called the Mississippi Embayment. The Mississippi River valley expands to a width of about 50 miles where it meets the mouth of the Ohio River. Floodplain geomorphology provides the template upon which plant communities and habitats develop. The geomorphology and topographic features of the River are diverse along its length, and also laterally from the channel to the bluffs. The longitudinal profile of the Upper Mississippi River can be divided into at least 10 major geomorphic reaches. The limits of the reaches are defined as:

- Geomorphic Reach 1:Pools 1-3
- Geomorphic Reach 2:Pool 4 (Lake Pepin)
- Geomorphic Reach 3:Pools 5-9
- Geomorphic Reach 4:Pools 10 -13
- Geomorphic Reach 5:Pools 14 -17 (Refuge Complex reach starts in Pool 16)
- Geomorphic Reach 6:Pools 18 - 19
- Geomorphic Reach 7:Pools 20 - 22
- Geomorphic Reach 8:Pools 24 - 26
- Geomorphic Reach 9:Below Pool 26 to Thebes Gap
- Geomorphic Reach 10:Thebes Gap to Ohio River confluence (End of Complex river reach)
- Geomorphic Reach IR2: Illinois River (Alton and Peoria Pools) is also in the Complex AEC.

Soil types and the geomorphic setting are critical considerations when addressing river corridor restoration activities. Having the right habitat planned for the right place is dependent on an understanding of these factors before project features are constructed or modified. The Mark Twain Refuge Complex AEC begins within Reach No. 5, and extends through Reach No. 10. Geomorphic Reach 5 includes the highly constricted Fulton-Rock Island gorge in Pools 14 and 15, and the wide valley expansion in Pools 16 and 17. The portion of the reach through the gorge is a steep, constrained channel with few islands and little floodplain terrestrial area. The River flattens in Pool 16 and large islands were formed when sediment was deposited in a main stem delta downstream of the steep gorge. Island formation in Pool 17 is similar to Pool 16, but the valley widens significantly in the ancient Iowa River valley. The plan form (as seen from above) changes resulting from impoundment are not as apparent in Geomorphic Reach 5 compared to upstream reaches. Agriculture is an important component of the floodplain landscape; levees protect 12 percent and 74 percent of the Pools 16 and 17 floodplain, respectively.

Geomorphic Reach 6 consists of Pools 18 and 19. Pool 18 and upper 19 are similar to Reach 5, with many large islands and secondary channels. Impoundment effects are not pronounced in lower Pool 18. Lower Pool 19 was a steep rapids through a geologically young rock gorge from Fort Madison to Keokuk, Iowa, prior to impoundment, but the hydroelectric dam constructed in 1913 inundated the gorge. Lock and Dam 19 creates a 38-foot head that impounds about one-half of the 46-mile-long reach. Much of the impounded area has filled with sediment and aquatic plants now grow in areas that were 30 feet deep when the dam was constructed. The dam is the major impediment to fish migration throughout the basin. The broad floodplain upstream from the gorge has largely been converted to agriculture. Slightly more than 30 percent of Reach 6 is leveed.

Geomorphic Reach 7, including Pools 20, 21, and 22, is a surprisingly steep reach due to sediment from the Des Moines River entering the Mississippi below Lock and Dam 19. The reach shows evidence of old meander belts through the post-glacial alluvial soils. Large island complexes and long interconnected secondary channels characterize much of the reach, but relatively simple channel reaches are evident too. Lower pool impoundment effects are not pronounced in plan form. Agriculture is the dominant floodplain landscape element. The floodplain in the reach is about 70 percent leveed.

Geomorphic Reach 8 includes Pools 24, 25, and 26. The slope of the riverbed decreases through the reach to the hump of the Illinois River and Missouri River alluvial fans. The Missouri River contributes most to this feature due to the lower flow and higher suspended sediment component of the Illinois River. Upper reaches of the pools have numerous large islands and mostly simple single thread secondary channels. Lower pool reaches generally have smaller and fewer islands. Impoundment effects are noticeable immediately upstream from Locks and Dams 25 and 26. Agriculture is the dominant floodplain landscape element. About 70 percent of Pools 24 and 25 is leveed. Only about 23 percent of the Pool 26 floodplain is leveed on the available GIS coverages, but levees visible on topographic maps do not appear on the GIS maps. The coverage needs to be verified and updated.

Geomorphic Reach 9 includes the Mississippi south of Pool 26 to Thebes Gap at RM 48. The floodplain is about 7 miles wide and the River has meandered through it many times. The head of the reach is very steep due to the influence of the Missouri River alluvial fan. Prior to improvements for navigation the reach had many islands and ephemeral sand bars, but channelization and dredging have greatly simplified the river channel. Side channels provide most of the off-channel aquatic area and many are being lost to sedimentation and river training efforts. Closing structures and wing dams divert moderate and low flow currents away from, and often isolate, side channels, so only sediment-laden flood flows influence the secondary channels. Scour holes below closing structures may be 50-100 feet deep and experience episodic periods of poor water quality when isolated from the River. Eight secondary channels were lost between 1880 and 1960, another two were lost between 1960 and 1989. This process has slowed somewhat since huge quantities of sediment delivered from the Missouri have been diminished with the construction of the Gavins Point Dam on the Missouri River in 1955. River bed degradation (i.e., scour) has significantly deepened the highly regulated channel. The floodplain is over 70 percent leveed, with agriculture dominating the landscape.

The river channel in Geomorphic Reach 10 (Thebes Gap to the Ohio River) is very similar to Reach 9, but the floodplain widens greatly below the rock gorge at the upstream end. The floodplain widens to about 10 miles and the River has two large bends. The bed slope continues to be steep due to scour through the gorge. The same impacts from navigation displayed in Reach 9 are operating in Reach 10.

The lower Illinois River reach, including Peoria, La Grange, and Alton pools, is a remnant of the ancient Mississippi River that once flowed across northwestern Illinois. Glacial flows down the ancient valley created a floodplain that is exceptionally large for the current river discharge. The floodplain has been filling with fine loess sediment for millennia and the current channel slope is very low. The three navigation pools in this reach are about twice as long as the longest Mississippi River pools. The modern river channel is relatively simple, with few islands and side channels, but many backwaters of differing degrees of connectivity fringe the channel. Prior to navigation and agricultural development, Illinois River backwaters were very numerous and diverse in shape, size, and depth. Currently, water level regulation maintains fewer, larger lakes with uniform shallow depths and silty substrates. Agriculture dominates the floodplain, which is about 50 percent leveed in the La Grange Pool and about 70 percent leveed in the Alton Pool.

Lateral Variation of Geomorphology

Lateral variation in UMR floodplain morphology is very diverse, but some generalities can be described based on geomorphic and navigational features of the river system (Wilcox 1993).

The main navigation channel in most of the UMRS is 300 feet wide in straight reaches and 500 feet wide in bends. The prescribed depth of at least 9 feet is maintained by navigation dams, channel training structures, and dredging. The main navigation channel is a high current velocity environment with shifting sand substrates.

Tailwaters are the areas directly downstream of the navigation dams. They have deep scour holes, high velocity, and turbulent flow. This is a hydraulically severe environment with boulder, cobble, gravel, and shifting sand substrates.

Channel borders are the areas between the navigation channel and the river banks. Channel borders are narrow in upstream portions of the pools, where banklines are steep and the main channel is narrow. Channel borders are widest in the lower reaches of the pools where water is impounded by the dams and many former floodplains are inundated. Substrates vary with current velocity but include sand, mixed sand, silt and/or clay, or fine silts and clays. Submersed aquatic plants, submerged logs, rip rap, and wing dams, where present, provide habitat for many aquatic animals.

Secondary channels are large channels that carry less flow than the main channel. Some may be obstructed at their upstream ends by closing dams that may lead to rapid filling with sediment. Secondary channel habitats can be quite variable depending on their connectivity with the main channel, age, size, and substrate. Large, highly connected secondary channels provide habitats similar to the main channel. Smaller less connected secondary channels provide lower current velocity, finer sediments, and may have more log jams and aquatic plants.

Tertiary channels are small channels (less than 30 meters wide) splitting off secondary channels in braided river reaches. Tertiary channel habitat can be quite variable depending on its connectivity with other aquatic areas and tree cover. High current velocity tertiary channels are likely to have sand and gravel substrates and few plants. Low current velocity tertiary channels may be quite “backwater-like,” with silt/clay substrates. Herbaceous plants may be present if light filters through riparian forests.

Tributary channels are channels of tributary streams and rivers. Tributary channel habitats differ with size of the stream or river. Larger streams and rivers may be important for certain migratory fishes, while small bluff line tributaries provide little habitat for river species. Tributary deltas are sometimes highly dissected with abandoned channels, scour holes, and natural levee ridges created by the meandering of high gradient tributary channels across erodible floodplain. The diverse physical structure of tributary deltas promotes high biological diversity. Tributary channels provide fish shelter from harsh conditions in the main channel. Many tributaries have been degraded by fine sediment and sand eroded from the watersheds. Tributary channels in leveed areas are highly controlled and channelized.

Contiguous backwater floodplain lakes are hydraulically connected to the River at low flow. Isolated backwater floodplain lakes are floodplain water bodies that do not connect with the River at low flow. However, they are frequently inundated during higher river levels permitting exchanges of sediment, nutrients, plants, and animals. All provide similar low current velocity habitat. Backwater lakes provide habitat to a wide variety of plants and animals adapted to low flow conditions. Most submersed and emergent aquatic plants are adapted to the shallow, relatively clear water of UMRS backwaters. Many fish and wetland bird species live and feed on and among aquatic plants. Lower pools and the Lower Illinois River have far fewer backwaters than upper pools and fine sediments are frequently resuspended by waves, thus creating constant high turbidity that prevents aquatic plant growth.

Islands are especially numerous in pools 1 through 13 and in mid-pool reaches of other pools. Islands and sand bars were once numerous in the Open River reach, but channel training and dredging has destroyed most islands since improvements for commercial navigation were initiated. Many islands in contiguous backwater impounded areas have been eroded by waves. Islands are typically sand based and capped with fine silts and clays deposited during floods. Islands are typically wooded. Islands create habitat diversity for aquatic species allowing submersed aquatic plants to grow in their “flow shadow.” Islands also provide flow refugia for fish, and reduced predator problems for nesting birds.

Contiguous floodplain areas include all non-island terrestrial habitats subject to flooding. Small differences in contiguous floodplain physiography are poorly defined due to a lack of high resolution topographic data to delineate important features of floodplain terrestrial areas. Much of the contiguous floodplain is inundated each year, but the distribution of floodwaters is impossible to predict given current terrestrial elevation data. Wet floodplain forests dominate the lowest elevation contiguous floodplain areas (i.e., most frequently flooded), and mesic bottomland forests occur in the higher elevation or better-drained areas. Terraces are likely to support savanna and grassland habitats, but most have been converted to agriculture.

Isolated floodplain areas are protected from moderate flooding by constructed levees. Most of the land area protected by levees has been converted to agriculture, but urban areas and small towns are also protected. Much of the land in leveed areas has been leveled to facilitate farming, thus filling small wetlands and backwaters. Tributaries and former channels are highly channelized and water levels are often controlled with pumping stations. Native plant communities composed of oak groves, savannas, and grasslands are largely absent since the conversion of hundreds of thousands of acres to agricultural use. Large communities of prairie birds, reptiles, and large herbivores have been either extirpated or suffer from lack of habitat.

Many aquatic areas have been modified with features known to affect habitat quality. Wing dams are rock structures usually constructed perpendicular to the river to constrict flow in the main channel. Wing dams create unique hydraulic eddies and scour holes in their downstream shadow that are often used by fish. Wing dams can also have negative impacts where the area between wing dams becomes filled with sediment and converts to terrestrial floodplain area. Rip rapped shorelines are covered with large grade limestone to prevent bankline erosion and river meandering. The banks are cleared of vegetation, graded to a stable slope, and covered with rock. The rock substrate provides stable habitat for macroinvertebrates that frequently colonize the rock in very high densities. Fish of many types live in or in proximity to the rock structure.

Socioeconomics

Two economic studies help characterize the importance of refuges to local community economies and, more specifically, the economics of the Mississippi River corridor counties. The first is the Service-produced “Banking on Nature: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation” in 1997. This report is the first of a multi-phase study investigating the impact of national wildlife refuges on their local economies. The report discusses income and employment effects that recreational visitors to refuges have on the economies of local regions. In addition to the economic effects of refuge hunting and fishing programs in local communities, it measures the economic impact of “eco-tourism,” the relatively recent phenomenon of large numbers of people traveling substantial distances to take part in non-consumptive uses of the natural environment. Eco-tourism is one way to derive economic benefits from the conservation of wildlife and habitat. The study found that:

- Recreational visits to national wildlife refuges generate substantial economic activity. In Fiscal Year 1995, people visited refuges more than 27.7 million times for recreation and environmental education. Their spending generated $401.1 million of sales in regional economies. As this spending flowed through the economy, more than 10,000 people were employed and $162.9 million in employment income was generated.
- Non-consumptive use of wildlife at refuges generated far more economic activity than hunting and fishing. Although non-consumptive wildlife users usually stay for shorter periods of time and spend less, their numbers at many refuges far exceed those of hunters and anglers and more than compensate for lower spending per person (Laughland 1997). This is a relevant fact to the conditions throughout the Mark Twain complex. Since much of the Complex is managed as sanctuary that is surrounded by areas open to hunting, wildlife observation can be accommodated at most Complex locations during the fall.

The second study the Upper Mississippi River Conservation Committee directed was the “Economic Profile of the Upper Mississippi River Region” report. This study provides a snapshot of current regional economic activity dependent on the Upper Mississippi River.

The profile by Black, et al., encompasses economic activity in all 60 counties in five states bordering the Mississippi River, including 26 that are north of the AEC. Specific data to the Mark Twain corridor counties cannot be extrapolated from the totals, but generalities can be implied. The Refuge Complex does not include any of the 17 Minnesota or Wisconsin counties included in the report, but does consist of 14 (of 18) Illinois counties, 5 (of 10) Iowa counties, and 14 Missouri counties. The report uses available databases and literature to characterize 10 key economic sectors listed below.

Commercial Navigation – The waterway transportation industry ships 125 million tons of commodities on the UMR every year. These commodities consist primarily of farm products (55 million tons), coal (24 million tons), and non-metallic minerals (21 million tons). Commercial navigation generates about $1 billion in revenues per year and employs approximately 6,300 people.

Harvest of Natural Resources – The primary commercial harvest activities are fishing, musseling, and trapping. Depending on the harvest year, revenues vary from about $4 million to $9 million and employment varies from 1,200 to 4,000 people. While commercial fishing and trapping have remained stable in recent years, musseling has declined dramatically.

Water Supply – About 7.2 billion gallons of water are withdrawn from the UMR each day for use by the energy, agriculture, mining, manufacturing, and water supply vectors. Most of this water (6.4 billion gallons per day) is used as cooling water in the energy production process and returned to the River. Twenty-two cities obtain drinking water from the UMR as well. Public water supply systems employ about 1,000 people and generate about $130 million in annual revenues.

Recreation – People enjoy more than 11 million recreational visits to sites along the UMR each year, with most people engaging in fishing, boating, hiking or sightseeing. This recreation generates more than $200 million in revenue for local businesses. The economic importance is even greater when other recreation in the region that depends on the UMR's ecology is taken into account. For example, about 40 percent of all waterfowl in North America rely on the Mississippi Flyway; waterfowl hunting and viewing generate over $1 billion in revenue in the UMR's five-state region.

Tourism and Cultural/Historical Resources – Tourists come to the UMR corridor to visit the more than 1,700 cultural landmarks and sites, and to enjoy River festivals, riverboat tours, and riverboat gaming. Leisure travelers to the corridor spend about $6.6 billion per year, which supports about 140,000 jobs, mostly in the hotel, restaurant, and retail industries.

Mineral Resources – The primary mining activities in the corridor are crushed stone, coal, sand and gravel, cement, and lime production. These mining operations generate over $1.2 billion in revenues per year and employ over 6,500 people, mostly in Missouri and Illinois.

Agriculture – The corridor's 52,600 farms generate more than $5 billion in revenue per year and employ 94,000 people (including part-time and seasonal workers). Corridor farms primarily produce corn, soybeans, cattle, hogs, and dairy products. These products are used as inputs to food processing industries, which produce commodities such as corn oil, fructose, soybean oil, processed milk, and meat products.

Energy Production – The corridor's 49 power plants generate about 7,500 megawatts of electricity per year, about 20 percent of the total power generated in the UMR five-state region. The energy sector depends on the River for cooling water, transportation of coal, and as a direct fuel source for hydroelectric generation. Power plants and distribution facilities in the corridor employ more than 13,000 people and generate $4.7 billion in annual revenues.

Manufacturing – The corridor's manufacturing sector is composed of numerous diverse industries, of which the largest are food processing, machinery, transportation equipment, and chemicals. Manufacturing generates $126 billion in annual revenue and employs over 600,000 people.

Natural Resource Services – The River provides many services that may not be directly reflected in the commercial economy.

> *Wastewater Treatment:* Approximately 280 facilities use the UMR as a “sink” for discharging wastewater. Dischargers include manufacturers and municipal sewage treatment plants.
>
> *Wetland Services:* Over 40,000 acres of wetlands in the corridor provide benefits associated with flood control, protection of water quality, water supply, and habitat for wildlife.

Wildlife Species and Habitat: Environmental quality and the health of habitat and species have an intrinsic value, irrespective of human use. This value is reflected in the many past and ongoing efforts to restore and preserve UMR habitat.

Considered together, the 10 economic sectors in the five-state area account for about $145 billion in revenue to businesses in the corridor. Approximately 870,000 jobs are associated with this economic activity. The revenue generated by the 10 sectors represents about 40 percent of the total output of the corridor, and 18 percent of the economic activity in the five-state region.

Another study, conducted by Carlson et al. (1995), measured recreational usage originating from developed sites along the Upper Mississippi River and the Illinois River. This study produced basin-wide estimates of the total number of recreation visitors, the activities they engaged in, the amount of money they spent on recreation and the patterns evident in their spending. The researchers estimated that more than 12 million daily visits by recreationists took place during the study year. Boating was the most popular activity, with more than half of all visitors participating in this activity (6.9 million boaters).

Current Status of Area of Ecological Concern Resources

Fish and Wildlife

Several factors have contributed to the recent general declines in the River's fish, wildlife and habitat including sedimentation, toxic substances, nitrogen loading, commercial and recreational navigation, loss of plant and invertebrate food sources, invasions of exotic species and human disturbances. The continued accumulation of sediment in the navigation pools on the UMR will eventually destroy or degrade much of the aquatic habitat in the pools. Sedimentation is considered the biggest problem confronting the resources of concern for the Mark Twain Refuge Complex.

USFW

There are also some favorable biological trends on the Mississippi River. The abundance of Bald Eagles along the river corridor has increased, paralleling the national trend. Mink populations have begun to recover, probably due to the declines in PCB contamination of riverine fishes that followed the ban on production of PCBs. According to state furbearer biologists, other furbearer populations, such as otters, have increased and are stable at present.

Birds

The Upper Mississippi River is a major bird migration corridor within North America. Millions of migratory birds use the Mississippi River corridor each year during fall and spring migration. The River's north-to-south orientation and nearly contiguous habitat make it critical to the life cycle of many migratory birds. Diving ducks, swans, pelicans, and cormorants use the River's large open water pools, and dabbling ducks, geese, herons, egrets, bitterns, and rails use the shallower backwater wetlands. Bottomland forests support resident and neotropical migrant songbirds, Bald Eagles, Red-shouldered Hawks, Mallards, Wood Ducks, Hooded Mergansers, and nesting colonies of herons and egrets. In 1986, Congress declared the Upper Mississippi River to be a nationally significant ecosystem.

Waterfowl

The Upper Mississippi River Valley is the primary fall migration corridor for 10 species, and is a secondary migration corridor of considerable importance for eight other species of waterfowl in North America. In addition, 13 other waterfowl species can be found regularly in smaller numbers during migration in the Upper Mississippi River (Reid et al., 1989).

The numbers of migrating waterfowl on the River fluctuate widely from year to year because of variations in waterfowl production on the breeding grounds, food resources, and weather. The Illinois Natural History Survey (INHS) has conducted aerial waterfowl counts along portions of the Mississippi and Illinois River corridors during fall migration since 1948. The purpose of these inventories is not to acquire exact waterfowl counts, but to estimate the number of each species in order to provide an index of change within and among years and to document the distribution of the species throughout the monitored region (Havera 1999). The following tables depict the percentage of ducks and Canada geese found on Refuge Complex lands, compared to the total counts in the Mark Twain Complex river reach in the fall of 1998 and 1999. These counts include lower Pool 16 through Pool 26 and the Illinois River confluence. Fall precipitation in 1998 was heavy, which may have provided more waterfowl habitat than normal. Fall precipitation levels in 1999 were average. Table 3 describes the waterfowl species for which the UMR is critical habitat; Table 4 depicts the INHS aerial duck counts for the Mark Twain Complex river reach; and Table 5 shows the INHS Canada goose counts for the Mark Twain Complex river reach.

Table 3: Waterfowl Species for Which the Upper Mississippi River Valley is Critical Migration Corridor

Primary	Secondary
Tundra Swan *Cygnus columbianus*	American Wigeon *Anas americana*
Lesser Snow Goose *Chen caerulescens*	Gadwall *Anas strepera*
Canada Goose *Branta canadensis*	Green-winged Teal *Anas crecca*
Wood Duck *Aix sponsa*	Black Duck *Anas rubripes*
Mallard *Anas platyrhynchos*	Northern pintail *Anas acuta*
Blue-winged Teal *Anas discors*	Northern Shoveler *Anas clypeata*
Canvasback *Aythya valisineria*	Redhead *Aythya americana*
Ring-necked Duck *Aythya collaris*	Ruddy Duck *Oxyura jamaicensis*

Table 3: Waterfowl Species for Which the Upper Mississippi River Valley is Critical Migration Corridor (Continued)

Primary	Secondary
Lesser Scaup *Aythya affinis*	
Hooded Merganser *Lophodytes cucullatus*	

❄ Primary importance is assigned to species for which the UMRV is the single or one of two major corridors in North America. Secondary is assigned to species for which the UMRV is a major corridor, but not the most important migration pathway in North America. Table from Reid et al. 1989.

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Table 4: INHS Aerial Canada Goose Counts, Mark Twain NWR Complex*

Fall Migration Month	Canada Geese on Refuge Complex	Total Canada Geese Counted	Percent of Geese Using Refuge Lands
1998 (Wet Fall)			
October	8,390	9,550	88%
November	24,430	25,955	94%
December	26,985	30,550	88%
1999 (Average Fall Precipitation)			
October	12,105	13,710	88%
November	27,930	31,100	90%
December	25,500	27,620	92%
2000 (Dry Fall)			
October	2,525	2,885	88%
November	25,365	29,455	86%
December*	N/A	N/A	N/A

❄ Surveys discontinued after first week due to freeze-up.

Table 5: INHS Aerial Canada Goose Count, Mark Twain NWR Complex River Reach*

Fall Migration Month	Canada Geese on Refuge Complex	Total Canada Geese Counted	Percent of Geese Using Refuge Lands
1998 (Wet Fall)			
October	8,390	9,550	88%
November	24,430	25,955	94%
December	26,985	30,550	88%
1999 (Average Fall Precipitation)			
October	12,105	13,710	88%
November	25,365	29,455	86%
December	N/A	N/A	N/A

Table 5: INHS Aerial Canada Goose Count, Mark Twain NWR Complex River Reach* (Continued)

Fall Migration Month	Canada Geese on Refuge Complex	Total Canada Geese Counted	Percent of Geese Using Refuge Lands
2000 (Dry Fall)			
October	2,525	2,885	88%
November	25,365	29,455	86%
December*	N/A	N/A	N/A

* Surveys discontinued after first week due to freeze-up.

The major wave of duck migration in Illinois typically occurs during the 2-week period of 10-23 November, while the largest wave during spring migration usually occurs during 14-27 March. Peaks of Canada goose migration occur 8-31 December and 15-28 February. Because species vary in their chronology of migration, peak numbers of various species occur at different times. For example, peak numbers of Blue-winged Teal usually occur in mid-September, Northern Pintails in late October, and Mallards in late November (Havera 1999). Mallards, Wood Ducks, Canada Geese and Pintails are some of the earliest migrants heading north in the spring, often passing through central Illinois in late February and early March. Blue-winged Teal and Ruddy Ducks tend to travel north a little later, passing through the northern Mark Twain reaches in early April (Reid et al., 1989). The abundance of migrating waterfowl in the spring is more variable than in the fall. Generally high river levels, flooded fields due to spring rains, and the lack of hunting pressure all encourage spring dispersal of birds into additional areas that are unavailable during the fall (Havera 1999).

The number of ducks that stop in the Refuge reach of the River each year depends on many factors including the number heading north in the spring, the condition of wetlands on the breeding grounds, local fall weather conditions, and local food resources. The Mallard is consistently the most abundant duck migrating through the AEC in the fall. North American breeding population estimates vary widely, but showed a generally declining trend through the early 1990s, rebounding after 1993 to levels not recorded since 1980. Mallard numbers within the AEC have shown similar trends. The lowest number inventoried (45,600) occurred in 1993 when the flood virtually eliminated food resources for waterfowl from large areas of the floodplain, but numbers have rebounded since then. Migration numbers for Pintail and Blue-winged Teal have also shown an up and down pattern. Gadwalls reached record numbers in the INHS survey area in the early 1990s, and Northern Shovelers reached their highest levels in the late 1980s and mid-1990s.

The most numerous diving ducks using the Mississippi River within the AEC are Canvasback, Lesser Scaup, Redhead, and Ring-necked Duck. Pool 19 is a critical migration area for migrating diving ducks in the Midwest due to its large bodies of open water. On Poolÿ19, fall waterfowl censuses between 1948-84 by F. Bellrose and R. Crompton (INHS data) revealed an average annual peak of 345,000 diving ducks. The composition was 71 percent Lesser Scaup, 18 percent Canvasback, 10 percent Ring-necked, and 1 percent Redhead.

Peak counts of diving ducks on Pool 19 have shown significant declines in recent years. For example, the number of Lesser Scaup declined since a peak of 685,500 in 1969. In 1993, only 2,150 Lesser Scaup were observed from Keokuk to Rock Island, the lowest count since aerial surveys began in 1948. The second lowest number of 16,150 was recorded in 1996. The Lesser Scaup is declining range-wide for reasons that are not clearly understood. It is listed in the FWS Regional Conservation Priorities List as a "species of management concern." Canvasbacks also have been declining in this stretch of the River since 1978, when they reached a peak of 188,150. In 1993, only 8,425 Canvasbacks were observed. (Havera 1999)

USFWS

Many of the changes in the distribution of migrating diving ducks in the Midwest over the last several decades are attributable to habitat alterations caused by changes in land and water use. Drainage and levee districts drained almost half of the existing bottomland lakes between 1909 and 1922. Increasing flood heights and the deposition of sediments diminished habitat values on the remaining lakes and floodplain. The drought of the late 1980s drastically reduced the number of fingernail clams and aquatic vegetation in Pool 19. Both are important food sources for diving ducks. These resources have recovered only to a small fraction of their early 1980s level.

The most abundant species of nesting duck in the planning area is the Wood Duck. U. S. Fish and Wildlife Service breeding bird survey trends indicate that Wood Ducks have increased an average of 2 percent annually in Illinois from 1966 to 1989, with similar trends throughout the AEC. Wood Ducks and Hooded Mergansers both nest in tree cavities in the floodplain forests of the river corridor. Mallards, Blue-winged Teal, and Canada Geese also nest within the AEC.

Missouri and Illinois are at the northern end of the Mallard wintering grounds and the Mallards are the most common duck seen within the AEC during the Midwinter Waterfowl Inventory. Other species such as Wood Duck, Pintail, and Gadwall may also been seen. The number of ducks in this area in the winter is dependent upon the severity of the weather, abundance of food, and annual variations in the continental populations.

Canada Geese migrating within the AEC consist primarily of the Mississippi Valley Population (MVP), which has increased from an apparent all-time low of 22,000 birds in 1946 to a fall flight estimate of about 1.5 million in the early 1990s. The growth of the MVP is similar to increases in other populations of Canada Geese in North America and is due to better harvest management, remote and less-degraded breeding grounds, and the adaptability of the species. The MVP nests on Hudson and James Bay in Canada and winters in southern Illinois and western Kentucky. Intermingled with the MVP is a large and growing number of Giant Canada Geese of the Mississippi Flyway Resident Population. The Giant Canada Goose population was once thought to be extinct but has now grown to the point of being a nuisance species in many urban areas. Giant Canada Geese are seen year round in the AEC and the species both nests and winters on refuge lands.

The AEC lies east of the main Lesser Snow Goose migration route along the Missouri River. The number of Snow Geese using the UMRS is not only variable from season to season, but during the season as well (see Table 6). Peak numbers often occur the last week of November or the first week of December. Although the data are scattered, it does not

Table 6: Peak Snow Goose Numbers Using the UMRS*

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Average
Peak	6,175	7,300	6,500	16,000	7,900	4,800	9,500	19,220	12,400	7,600	9,740

* Data from the Illinois Natural History Survey, Waterfowl Aerial Inventory reports. These Snow Goose counts include the area from lower Pool 16 through Pool 26 and the Illinois River.

appear that concentrations are growing to a level of concern or that they negatively impact refuge food resources. The Complex will continue to monitor Snow Goose numbers and their effect on the UMR corridor in order to develop adaptive management strategies if necessary.

Shorebirds and Marsh Birds

USFWS

Of the 27 North American shorebird species for which data are available, 16 species have experienced significant population declines in the past two decades. Semipalmated Sandpipers, Short-billed Dowitchers, and Whimbrels, for example, show declines of 30 to 50 percent; numbers of Sanderlings are down 80 percent. Only recently has the importance of interior U.S. habitats to shorebirds become widely understood. Most shorebirds using the interior region (including the AEC) are long-distance migrants that require suitable wetlands where they can stop periodically to replenish their fat reserves. Unlike coastal areas where habitat and food resources are fairly predictable and abundant, resource availability in inland areas is highly dependent on precipitation and hydrology patterns and varies in time and space. Due partly to this unpredictability of habitat, shorebirds migrating through the interior tend to be scattered over larger areas in small numbers at numerous sites, rather than concentrated at a few major staging areas as is common along the Atlantic and Pacific coasts.

The AEC is included in the Upper Mississippi Valley/Great Lakes (UMVGL) Regional Shorebird Conservation Plan, developed in 2000 as a component of the North American Bird Conservation Initiative. The purpose of the plan is to conserve shorebirds in the region through a combination of habitat protection, restoration, and monitoring; population monitoring; research; and education/outreach. Species of concern were selected for the region by considering global abundance and distribution, population trends, and relative importance of the UMVGL region to the species. Species of high regional concern in the plan include Short-billed Dowitcher, Greater Yellowlegs, and Wilson's Phalarope.

As with waterfowl, the timing of peak migration varies between species and regions. Composition of species in stopover areas can also differ between spring and fall since some species, such as White-rumped Sandpiper, migrate through the Midwest in the spring and through the Atlantic coast in the fall. Generally, shorebirds begin spring migration through the southern reaches of the AEC by late February, with Killdeer and Common Snipe leading the way northward. Lesser and Greater Yellowlegs also are early migrants, being observed by early-mid March. Spring migration continues into May with Semipalmated Sandpipers, Least Sandpipers and Solitary Sandpipers. The return trip to wintering grounds begins by early-mid July and continues through August and into September.

Common Snipe, Pectoral Sandpipers, Dunlins and Western Sandpipers have been observed as late as November and December at Mingo NWR, about 60 air miles southwest of Wilkinson Island Division (Reid et al., 1983).

The Upper Mississippi River is an important nesting and feeding area for Great Blue Herons and Great Egrets because the extensive bottomland forests and diverse aquatic areas provide suitable nesting and foraging habitat. The number of nesting colonies for both species in the AEC declined during the 1970s. Possible causes for the declines include poor water quality, loss of nesting trees and foraging areas, and contaminants. However, the INHS has found an increase in heron and egret rookeries on the River in Illinois since surveys began in 1983. Herons increased from 2,111 nests in 21 colonies in 1987 to 5,045 nests in 20 colonies in 1991. Active egret nests also increased from 351 nests in 14 colonies in 1987 to 1,099 nests in 18 colonies in 1991. Both occur mostly in tall living cottonwood and sycamore trees on River islands. Managed wetlands on Clarence Cannon NWR have recorded up to 900 individuals of both species after summer drawdowns that concentrated prey items.

Killdeer, Woodcock, Snipe, Moorhen, Coot, Sora and King Rails, Least and American Bitterns, Snowy and Cattle Egrets, Green Herons, and Yellow-crowned Night Herons also have been reported nesting on Complex lands. Clarence Cannon NWR is one of the few sites in Missouri where the state-endangered King Rail is known to nest. In 1999, eight different King Rail broods were seen on the Refuge.

Songbirds

Habitat-specific data on the occurrence, relative abundance, and breeding success of songbird species are not yet available for most areas along the Mississippi River. The Breeding Bird Survey is the only long-term data set for assessing population trends of migratory songbirds as well as certain other migratory birds and residents. Estimating breeding trends specific to the River is difficult because many survey routes exclude the Mississippi River floodplain. There is also little site-specific data concerning songbird use of the river corridor during migration.

However, some trends have been detected from Breeding Bird Survey data obtained within Physiographic Stratum 17. This stratum lies along the UMR, primarily north of the AEC, but also includes large areas removed from the River. Within this stratum, 35 of the 119 species showed significant Breeding Bird Survey trends during 1966-94. Sixty percent of these significant trends were positive, indicating increasing populations, and 40 percent were negative, indicating decreasing populations. These data were similar to continental trends. Songbirds showing increasing trends in the UMR stratum included Rose-Breasted Grosbeak, Cedar Waxwing, Yellow-throated Vireo, Blue-winged Warbler, and American Redstart. Species with decreasing trends included Bobolink, Western Meadowlark, Grasshopper Sparrow, Bell's Vireo, and Marsh Wren.

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Although no comprehensive songbird monitoring program has been implemented on the Complex yet, several small-scale surveys have been done in recent years. Most point counts were run only a few years and protocols varied somewhat from study to study, but all of the surveys indicate use of a wide variety of Complex habitats by songbirds. Some baseline point count data was collected at Horseshoe Bend (Port Louisa NWR) in 1995, in forest and grassland areas. Spring migration was well-advanced by the time the survey was initiated, so some species already may have passed through. And this was before large-scale habitat improvements were completed at the Division. Nonetheless, more than 120 bird species were noted, including seven flycatcher species, 15 species of sparrows, and 18 species of warblers.

In 1992, a breeding bird survey was conducted in the mature forest habitat of Long Island Division (Great River NWR). Five routes were run four times each during June. A total of 76 bird species were recorded during the study. Not surprisingly, most were associated with forest habitats. Similar surveys were conducted in 1994 and 1995 using slightly different methodology. Many hard mast trees had died and understory was reduced due to the 1993 flood. A total of 55 and 60 species, respectively, were identified including Cerulean and Prothonotary Warblers, Acadian and Great Crested Flycatchers, and Yellow-billed Cuckoo. These five species were ranked by the Midwest Working Group of Partners in Flight as neotropical migratory bird species of high management concern (based on Thompson et al. 1993).

In June 1997, point counts were conducted on Harlow Island and Wilkinson Island (Middle Mississippi River NWR). Fields had been left idle for several years and many areas were already showing signs of converting to early successional forest. There were also some mature forest stands within the survey areas. Each point was surveyed only once, but 35 and 44 species were noted respectively, including Red-eyed, White-eyed, and Warbling Vireo; Yellow-breasted Chat; Yellow-billed Cuckoo; and Prothonotary and Kentucky Warblers.

Point count surveys were initiated at Big Timber in 1992 and expanded to include Keithsburg in 1993 (Port Louisa NWR), with data collected from both divisions through 1995. A total of 132 bird species were observed at Big Timber, including 60 neotropical migrant species. Keithsburg Division surveys yielded 134 species, with up to 53 neotropical migrants observed, including 22 warbler species and six vireo species.

Two Cerulean Warblers were detected on Delair (Great River NWR) in 1993 as part of the Cerulean Warbler Atlas Project developed by Cornell Lab of Ornithology. The project is designed to determine the status, habitat, and area requirements of the cerulean warbler. The Delair point counts were repeated in 1999. Thirty-one species were heard or seen during the survey, but no Cerulean Warblers were detected.

Raptors

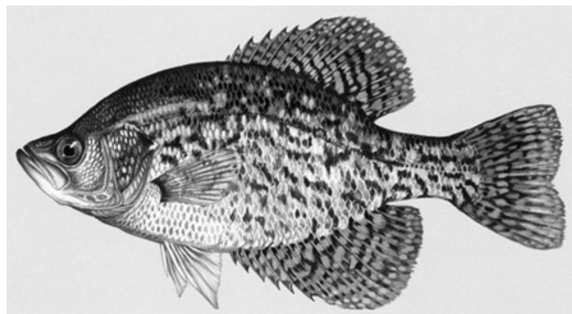
Red-shouldered Hawks are listed as endangered in Iowa and Illinois, rare in Missouri, threatened in Wisconsin, and of special concern in Minnesota. These populations are estimated to be down 90 percent from their pre-settlement historic numbers. The breakup of contiguous forest into small blocks has created habitat more suitable to the aggressive Great Horned Owl and the Red-tailed Hawk, the Red-shouldered Hawk's closest competitor.

Red-shouldered Hawks require relatively large tracts (300 acres or more) of mature floodplain or riparian forests as nesting habitat. Forest structure is important since Red-shouldered Hawks usually select tracts with a well-developed canopy and an open sub-canopy for their nesting sites. Floodplain forests on the edge of the River valley, adjacent to upland or valley slope forests have the highest rate of occupancy. This combination of upland and lowland forest habitat provides a diversity of prey and hunting opportunities, especially during high water.

Red-shouldered Hawk ecology has been studied along the Upper Mississippi River since 1983 by Jon Stravers (National Audubon Society). Survey sites vary from year to year but have been primarily north of the AEC in the McGregor/Dubuque/Bellevue area and in Milan Bottoms, just south of the Quad Cities. Thirty-two breeding territories were confirmed in 1992, and 37 territories were confirmed in 1993. Six sites are currently active between the Quad Cities and Keokuk. Most sites have had a good rate of re-occupation, but a few have been lost, mostly due to large-scale timber harvest on private land. Reproductive success varies somewhat between years, but has been steady over the long-term (Jon Stravers, pers. communication). Nesting sites that have been occupied year after year usually have had little or no disturbance or logging in the last 40 years or more.

Fish

There are at least 156 species of fish present in the mainstem Mississippi River. About 50 species are common or abundant in certain pools or reaches. Gizzard shad, common carp, and emerald shiner are the three most common species found River-wide. Although the UMR still hosts most of the species that were present historically, the relative abundance and distribution of some species has changed dramatically in the last 100 years. Some of these changes are attributable to events such as the introduction of the common carp, flood protection projects, and construction of the Keokuk, Iowa, hydroelectric dam in 1913 and subsequent locks and dams in the 1930s.



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Navigation dams create conditions favorable to many centrarchid species such as bluegill, bass, and crappie, but at the expense of species preferring rapids and swift water conditions such as sturgeon, paddlefish, and blue sucker. The dams also restrict the movement of fish between pools. Rock dikes, constructed to direct water into the navigation channel, create localized fish benefits, but sacrifice habitat diversity system-wide.

In the Upper Mississippi River, the catch of sport fishes has been dominated by bluegills and crappies. Other sport fishes, in approximate order of importance, include white bass, freshwater drum, sauger, channel catfish, yellow perch, walleye, and largemouth bass. The commercial harvest is dominated by four groups: common carp, buffalos, catfishes, and freshwater drum. The abundance of several species in the catch has changed greatly within the last century. The common carp has increased the most and has ranked first among species in the commercial catch for decades. The grass carp first appeared in Pool 25 in 1975 and has since expanded upstream to Pool 5A. A decline in the harvest of buffalo fishes coincided with the increase of common carp. Invasions of these exotic species (e.g. common, grass, bighead, and black carp) constitute a major threat to native fish species.

Long Term Resource Monitoring Program (LTRMP) data suggest that main channel populations of species such as sauger, walleye, channel catfish, and freshwater drum are steady or increasing. Channel catfish in particular have shown significant increases in abundance since the 1970s. Backwater species such as bluegill have shown wide annual fluctuations in abundance, likely due to variable factors such as water level fluctuation and abundance of aquatic vegetation.

The paddlefish was formerly abundant over much of the Mississippi Valley but has undergone a drastic decline since 1900 due to over harvest and destruction of habitat. Under natural conditions, large free-flowing rivers of the Mississippi Valley provided ideal habitat, with their oxbows and backwaters for feeding and extensive gravel bars for spawning. But channelization, levees, and drainage of bottomland lakes have eliminated much of the feeding habitat (Pflieger 1997). Swan Lake (Two Rivers NWR) has been identified as providing spring feeding habitat for paddlefish. Since 1995, more than 250 paddlefish have been tagged and released in the lake as part of a Mississippi Interstate Cooperative Resource Association (MICRA) study to assess the status of paddlefish stocks.

The shovelnose sturgeon inhabits the bottom of open channels of large rivers, often in areas of swift current and sand or gravel bottom. The shovelnose is the most abundant sturgeon in the Mississippi and Missouri rivers but has declined greatly since 1900. In recent years, the catch of sturgeon in Missouri has averaged only about 9,000 pounds annually, compared to more than 150,000 pounds reported in 1899. In common with many big-river fishes, the shovelnose sturgeon can migrate long distances. One fish tagged in the Mississippi near the mouth of the Ohio River in 1978 was caught 7 years later in the Wabash River in Indiana (Pflieger 1997).

The lake sturgeon primarily inhabits areas with firm, silt-free bottoms of sand, gravel, and rock. Before 1900, lake sturgeon was a common fish in the AEC. Missouri fisherman harvested 50,000 pounds from the Mississippi and Missouri Rivers in 1894. By 1908, the lake sturgeon was rarely taken. In 1984, the Missouri Department of Conservation began releasing hatchery-reared fish into several places including the Missouri River and Mississippi River Pool 24. Small lake sturgeon from these stockings have been reported by fishermen from several localities along the rivers.

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Thirty-four UMR fish species exhibit seasonal movements to spawning areas, over-wintering locations, or other habitats. The effects of Mississippi River dams on fish movement were first raised in the early 1900s when the Keokuk hydroelectric dam (which now forms Pool 19) was constructed. Keokuk Dam presents an almost insurmountable obstacle to fish passage. Carlander (1954) described the changes in the fishery after dam construction:

> "There was evidence that the dam was a barrier to extensive upstream migration of paddlefish, American eel, skipjack [herring], Ohio shad, buffalo, shortnose gar, freshwater drum, carp, shovelnose sturgeon, and three species of catfishes...The only fish likely to have their spawning interfered with were the skipjack, Ohio shad, and the blue sucker...this interference was of great importance in the case of the skipjack, because it is the host for the larval form of the important ebony shell mussel, so valuable in the button industry (Coker, 1930). In the 1930's and 1940s there apparently were fewer paddlefish, no skipjacks, probably fewer blue catfish and fewer American eels above Keokuk Dam than prior to 1910...The blue sucker was at one time a fairly important commercial species in swift parts of the river...By 1926 it had virtually disappeared...However there were other factors which changed after the dam was built and these may also have influenced the decline of these species." (Nelson et al.)

The degree to which UMR navigation dams impede fish movement has been unknown for decades. An analysis of 126 fish movement studies indicates that the dams are undoubtedly impeding movement of both native and exotic species between navigation pools. What is yet to be determined is how significant this impediment is to fish populations. Lateral floodplain connectivity is also important for movement of fishes to fulfill life history requirements; but in many reaches, levees isolate one half or more of the floodplain from the mainstem river (see Floodplain Management Goal discussion).

In the Middle Mississippi River (the unimpounded UMR below St. Louis), wing dikes and revetments have closed off side channels at lower flows and resulted in a narrower, deeper, and swifter river. Upstream reservoirs on the Missouri River have reduced the high natural turbidity and sediment load in the Middle Mississippi River. Populations of at least five fish species (pallid sturgeon, sturgeon chub, sicklefin chub, flathead chub, and western silvery minnow) adapted for life in turbid plains rivers have fallen in numbers to the point that long-term species survival is in doubt (Pflieger 1997). All five species are listed in the USFWS Region 3 list of Resource Conservation Priorities. The pallid sturgeon is a federally-listed endangered species (See Endangered Species section). The sturgeon chub and sicklefin chub were candidates for listing, but a status review completed in 2001 indicates that populations are more abundant and better distributed than previously believed.

The sturgeon chub is confined to open channels where it lives in a strong current over a bottom of sand and fine gravel. Its historic range includes the Yellowstone River, the Missouri River, and the Mississippi River south of the Missouri River confluence. It is now estimated that the species occupies about 55 percent of its historic range, including a viable population in the Middle Mississippi River.

The sicklefin chub, like the sturgeon chub, is adapted for life in large, turbid rivers with strong current and a bottom of sand or fine gravel. Its historic range includes the Lower Yellowstone River, the Missouri River, and the Mississippi River south of the Missouri River confluence. Today the species is estimated to occupy about 54 percent of its historic range. Data collected by the Missouri Department of Conservation since 1997 indicate that a viable population of sicklefin chub is present in the Middle Mississippi River.

The flathead chub is found in turbid waters with swift current and a bottom composed of sand and fine gravel. The flathead chub was the most abundant small fish collected in the Middle Mississippi River in the 1940s. By the middle 1960s, it had begun a precipitous decline and by the 1980s it comprised less than 0.1 percent of small fishes from the Middle Mississippi. The decline coincided with the construction of six large reservoirs on the upper Missouri River that altered the natural flow regime and decreased the water turbidity.

The western silvery minnow is generally found in backwaters and pools of large streams. It was formerly common behind wing dikes and revetments but has undergone a drastic decline in recent decades. The historic distribution of the plains minnow was similar to the western silvery minnow and, like that species, has undergone a dramatic decline in recent decades. Although they both occur at the same localities, the plains minnow prefers sandy bottoms with some current while the western silvery minnow is more common in protected areas with little current and a silt bottom.

Freshwater Mussels

Mussels serve as good indicators of ecosystem health because they are relatively long-lived and depend on good water quality and habitat. Eggs are fertilized by sperm released into the water by the males. The females expel their embryos into the water for attachment to an intermediate fish host. After further development, the young mussels drop off the fish and, if they land in suitable habitat, can become adults. Freshwater mussels are typically found buried in the substrate in beds containing several different species with similar habitat requirements Most of these species require flowing water and coarse gravelly substrates, although some survive well in silty lake-like conditions in backwaters.

Mussel populations in the UMR are declining in both abundance and diversity. In the main stem of the UMR, 51 species of freshwater mussels have been recorded historically, but only 44 species have been documented in surveys conducted within the past 35 years. Many of the absent species were considered infrequent inhabitants of the UMRS mainstem by biologists in the early 20th century, but were more commonly found in the tributaries of the UMRS. Upstream from lock and dam 19, mussel composition changed after 1913 in part because some fishes that are obligatory hosts for mussels could not migrate past the dam. Navigation dams built in the 1930s also affected mussels by changing the character of the River. For instance, the three-ridge mussel is now the most abundant species in the UMRS. The ebony shell (formerly comprising 80 percent of the mussel fauna) and elephant's ear almost disappeared because populations of their primary fish host (skipjack herring) declined sharply. Populations of other species such as the washboard, mapleleaf, flat floater, and lilliput mussels have increased in pooled portions of the River.

Some mussel species in the UMR are declining due to sedimentation, the introduction of zebra mussels, and poor water quality. Heavy commercial harvesting formerly for the pearl button industry, and more recently to supply raw shells for the cultured pearl industry in Japan, have also been detrimental to mussel populations. Between 1982 and 1986, massive die-offs of mussels occurred in the UMR, but the exact cause was never identified. Little is known about the biology and population dynamics of mussels or to what degree commercial exploitation or other human-induced factors have affected these animals.

Three species historically present in the AEC are currently federally listed as endangered: (Higgins eye pearlymussel, fat pocketbook, and winged mapleleaf. The five UMRS border states list many other mussel species as threatened or endangered (see Appendix B). Interagency management recommendations concerning the protection of mussel populations include establishing reaches of the UMR as mussel sanctuaries, developing population models to guide and assist the management of mussels, and monitoring zebra mussel densities and impacts in the Mississippi River.

Macroinvertebrates

Macroinvertebrates are creatures smaller than freshwater mussels, but large enough to be captured by screens used to filter samples. Macroinvertebrates (such as mayflies, midges, worms, and fingernail clams) are integral to the River's food chain and are important water quality indicators. They digest organic material and recycle nutrients. They feed on aquatic vegetation, algae and detritus, converting energy in lower levels of the food chain into a form more usable by vertebrate river fauna. Macroinvertebrates provide an important food source for waterfowl, other waterbirds, and fish.

Fingernail clams are important to the diet of migratory diving ducks, including Lesser Scaup, Canvasback, Ring-necked Duck, and Common Goldeneye, as well as fish. During the 1980s, clam densities were found to have dramatically declined in samples collected in many UMR pools. Densities in Pool 19 averaged 30,000 per square meter in 1985 and decreased to zero in 1990. The observed declines of fingernail clams, as well as their slow rate of recolonization, were seemingly caused by the uninhabitability of bottom sediments - perhaps due to the presence of one or more toxic substances (Wiener et al., 1998).

Since 1992, benthic (bottom-dwelling) invertebrates, such as fingernail clams and burrowing mayflies, have been sampled in Pools 4, 8, 13, and 26, and in an open-river reach near Cape Girardeau, Missouri. Fingernail clam densities were 0-2,500 per square meter. Mayfly densities were 0-237 per square meter. Most samples contained no mayflies or fingernail clams, and low densities were common. Densities of both organisms were consistently highest in Pool 13 and lowest in Pool 26 and the open reach of river. Densities of both mayflies and clams also varied among habitat types; areas classified as contiguous backwater, impounded, and tributary delta lake had much higher mean densities than main channel border and side-channel habitats. This pattern was anticipated, as the instability and sandy content of channel substrates make them a less-suitable habitat for most macroinvertebrate species than the muddier substrates of non-channel areas.

Studies of macroinvertebrate communities other than bottom dwellers are limited. Areas containing wetland plants typically support more predaceous species (e.g. dragonfly nymphs, beetles, etc.) than do open water sediment areas. The macroinvertebrate community found above the river bottom consists of animals that are free-swimming (e.g. water boatmen, beetles), those that float in the water column (e.g. zooplankton), or live on the water surface (e.g. whirligig beetles, water striders). This community also is generally more abundant in aquatic plant beds and flooded terrestrial vegetation. They provide important waterfowl food and also are important for fish populations, especially the zooplankton eaten by larval fish (Lubinski and Theiling 1999). Rock-dwelling communities (e.g. caddis flies) in the UMRS now are confined mostly to wing dams, revetted banks, and other channel training structures made of rock. In the unmodified river they would have been found on woody debris, on boulders in rapids, and on cobble sediments of the riverbed.

Reptiles and Amphibians

Amphibian population declines and malformations are occurring worldwide and many studies are under way to determine extent, causes, and solutions. In response to these concerns, Port Louisa NWR, Two Rivers NWR and Great River NWR (along with 36 other refuges) participated in a region-wide monitoring effort in the summer of 1997. On Port Louisa NWR, 54 leopard frogs were captured with no observed malformations. On Two Rivers NWR, 20 malformed leopard frogs were observed out of 217 captured (9.2 percent), while Great River NWR had 13 malformations out of 217 leopard frogs (5.9 percent). Some of these malformations may have been due to predation, or injury during capture. The study was repeated at Two Rivers NWR and Great River NWR in 2000, with 5 out of 147 frogs (3.4 percent) having malformations at Two Rivers, and 1 out of 135 (0.7 percent) having malformations at Great River. Malformations consisted primarily of missing limbs or parts of limbs, although one club foot and several missing eyes were also noted. The study will continue for at least one more year.

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Amphibian call count surveys have been conducted on Big Timber and Keithsburg Divisions of Port Louisa NWR since 1993. Ten species have been heard including the gray treefrog, western chorus frog, Copes treefrog, Fowler's toad, and Woodhouse's toad (a species normally found in western Iowa). Similar surveys have been done on Clarence Cannon (Great River NWR) since 1995 in cooperation with Missouri DNR. Noteworthy was the presence of a green treefrog in 1996, a species not previously recorded on the Refuge.

There is concern about declining female turtle populations (primarily red-eared slider) in the Calhoun Division area. Male turtles rarely leave the water while females must do so to lay their eggs. According to Dr. John Tucker (Illinois Natural History Survey, LTRMP), the majority of turtles taken under Illinois fishing licenses are by hand and are, therefore, female. A Special Use Permit has been issued to him to collect gravid females and release the hatchlings back onto the Refuge.

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The copperbelly watersnake (*Nerodia erythrogaster neglecta*) was recently confirmed in Louisa County, Iowa, on Port Louisa NWR and adjacent state-managed land. 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 copperbelly is a federally-listed threatened species in Michigan, Indiana, and Ohio. It was not listed in Illinois and Kentucky because of protections provided by a Conservation Agreement with the mining industry. At the time the Conservation Agreement was established, the Iowa population had not been discovered. Because most of this local population is thought to reside on public land, a Conservation Agreement may provide sufficient protection, making official listing unnecessary. The Refuge will continue to work with the Ecological Services office on the monitoring and management of this species.

The Eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*) is a candidate for listing under the federal Endangered Species Act and is listed as endangered, threatened, or species of concern in all states where it is currently found. Massasaugas show a strong affinity for wetlands, but also utilize upland habitats during part of the year. It appears that structural characteristics of a site are more important than vegetation type. Suitable habitat includes three components: 1) open, sunny areas intermixed with shaded areas for thermoregulation, 2) presence of the water table near the surface for hibernation, and 3) variable elevations between adjoining lowland and upland areas. The range of the massasauga includes western New York and southern Ontario to southern Iowa and northeastern Missouri, but within this range, the number of populations has steadily declined. Today, the eastern massasauga is generally found only in small, isolated remnant populations due to habitat loss and indiscriminate killing. There are no known populations remaining within the AEC.

Endangered Species

Indiana Bat

The Indiana bat *(Myotis sodalis)* is an endangered species that has been found in 27 states throughout much of the eastern United States. The total known population in 1997 was estimated at 353,000, which represents a decline of about 60 percent since population surveys began in the 1960s.

Indiana bats winter in caves or mines that satisfy their highly specific needs for cold (but not freezing) temperatures during hibernation. Stable low temperatures allow the bats to maintain a low rate of metabolism and conserve fat reserves through the winter. The fact that Indiana bats form large aggregations in only a small percentage of known caves suggests that very few caves meet their requirements.

During the summer, Indiana bats roost in trees and forage for insects in or near floodplain and upland forests, including the Area of Ecological Concern. The Service recommends that no tree clearing occur between April 1 and September 30 within the preferred summer range of the Indiana bat, unless mist-netting indicates that the species is not present in the area. The Indiana bat prefers standing dead trees with loose bark and enough space to roost between the bark and the trunk. Therefore, to be suitable summer habitat, a forest needs to provide a continual supply of dead trees. Indiana bat roost trees typically are located within 500 meters of a stream or river. Indiana bats feed exclusively on flying insects. Mating occurs in the fall at the hibernation caves. Females usually produce only one offspring per year in June. Limited observations indicate that birth and development occur in small, widely scattered maternity colonies consisting of 25 or so females and their young.

The short-term objective of the Indiana Bat Revised Recovery Plan (Draft 1999) is to halt and reverse the continued decline of the Indiana bat. The long-term objective is the eventual de-listing of the species. To date, conservation efforts have concentrated on protection of winter habitat along with some life history research. A number of hibernation caves have been protected, but these measures have not produced the desired result of recovery for this species.

Not all of the causes of Indiana bat population declines have been determined. Although several known factors have caused declines in the past (vandalism, gates on cave entrances, natural hazards such as flooding and freezing), they do not appear to account for the current decline. Potential, but unproven, causes include changes in the microclimate of specific caves, chemical contamination, and land use practices (such as forest fragmentation, fire suppression, loss of plant community diversity).

Until we better understand the factors that are contributing to the decline of the Indiana bat, we cannot accurately assess whether the loss of summer habitat is limiting to the species. Increased knowledge of the species' ecology during the summer and migration seasons is needed in order to effectively conserve and restore Indiana bat populations.

Pallid Sturgeon

The pallid sturgeon *(Scaphirynchus albus)* is primarily a bottom-dwelling species, preferring turbid water with a strong current and firm substrate, along sand bars, and behind wing dikes with deeply scoured trenches. Its range includes the Missouri River, the middle and lower portions of the Mississippi River, and some portions of their major tributaries. Although the pallid sturgeon has a large range, catch records are extremely rare. Little is known of the basic biology, life history, and habitat utilization of this species. In addition, the pallid sturgeon hybridizes with the more common shovelnose sturgeon, making identification difficult.

The pallid sturgeon has a unique prehistoric-like appearance with a flattened snout, long slender tail and rows of bony plates instead of scales. The mouth is positioned under the snout for sucking small fish and invertebrates from the river bottom. Pallid sturgeon can weigh up to 80 pounds and reach lengths of 6 feet.

Modification of habitat has been a major factor in the decline of the species. Human alteration of the River has blocked fish movement, destroyed or altered spawning areas, reduced turbidity, and changed the natural hydrograph. Overfishing, pollution, and hybridization also have probably contributed to the population decline. The pallid sturgeon was federally listed as endangered in September 1990.

Pallid sturgeon are being spawned and reared successfully at several fish hatcheries for restocking in suitable habitat. In addition, spawning of pallid sturgeon in the wild had never been documented until July 1998 when a young-of-the-year pallid sturgeon measuring 79 mm was collected in an experimental trawl near Cape Girardeau, Missouri.

The recovery objective ("Pallid Sturgeon Recovery Plan," Dryer and Sandvol, 1993) is to delist the species through protection and habitat restoration activities by 2040. Achievement of this objective will require a better understanding of the basic biological characteristics and habitat needs of the species. Research projects are currently under way throughout its range. For instance, biologists at Southern Illinois University (SIU) in Carbondale, Illinois are studying habitat use and movements of pallid sturgeon in the Middle Mississippi River. In this effort wild fish caught by researchers and commercial anglers are surgically implanted with sonic transmitters and re-released into the River. Ten hatchery-reared pallid sturgeon also were implanted with transmitters and released in 1997. A total of 157 relocations of the study fish were made between November 1995 and September 1998. Average home range was 21.2 miles and the study fish appeared to move generally upstream during the late summer and fall, and slowly downstream during the winter. Study fish were found most often in the main channel, the main channel border, and between wing dams.

A USFWS Biological Opinion released in May 2000 determined that the continued existence of the pallid sturgeon would be jeopardized by continued operation and maintenance of the 9-foot navigation project. The Opinion states that the navigation project will continue to disrupt and alter dynamic natural river processes (e.g. channel meandering, erosion, deposition) leaving little opportunity for the establishment of important aquatic habitats. "Reasonable and prudent" alternatives recommended to the COE in the Biological Opinion include:

- Conduct a Middle Mississippi River pallid sturgeon habitat study.
- Facilitate development of a pallid sturgeon conservation and restoration plan.
- Implement a long-term Middle Mississippi River aquatic habitat restoration program.

Higgins' Eye Pearlymussel

The Higgins' eye pearlymussel *(Lampsilis higginsi)* was historically found in the Upper Mississippi River as far north as the southern half of Minnesota and Wisconsin, ranging south to Iowa, Missouri and Illinois. Currently the only known population in the AEC is within the Rock River, near Rock Island, Illinois. The Higgins' eye prefers sand or gravel substrates in fast currents of larger rivers. This mussel was never abundant, and where it has been found only comprised a small percentage of the mussel population. The site near Rock Island is one of 10 sites within its range determined to be essential to the survival of the species.

A USFWS Biological Opinion (May 2000) determined that the continued existence of the Higgins' eye pearly mussel would be jeopardized by continued operation and maintenance of the 9-foot navigation project. The barges using the navigation channel facilitate upstream transport of zebra mussels. Zebra mussels attach to native mussels in such large numbers that infested mussels cannot breathe, feed, burrow, or move. A "reasonable and prudent" alternative recommended by FWS is for the COE to (1) develop a Higgins' Eye Pearlymussel Relocation Action Plan and (2) to conduct a reconnaissance study on the feasibility of zebra mussel control in the UMR.

Fat Pocketbook Mussel

The fat pocketbook mussel *(Potamilus capax)* was Federally listed as endangered in 1976. Its historic range included Iowa, Illinois, Arkansas, Kentucky, Missouri, Mississippi, and

Ohio. This mussel prefers large rivers in slow-flowing water with a mud, sand or fine gravel substrate. Its fish host species is unknown. The fat pocketbook is now thought to be extirpated from its entire range, including the AEC.

Winged Mapleleaf Mussel

The winged mapleleaf *(Quadrula fragosa)* was historically found in 11 midwestern states including the AEC, but siltation, pollution, and dams have destroyed its habitat. Today *Quadrula fragosa* is probably extirpated from its historic range except for one remnant population in the St. Croix River between Minnesota and Wisconsin. The winged mapleleaf was Federally listed as endangered in June 1991. Recovery criteria include maintaining the St. Croix population and re-establishing four additional populations within its historic range.

Bald Eagle

Historically, there may have been as many as 100,000 nesting Bald Eagles *(Haliaeetus leucocephalus)* in the conterminous United States when the bird was adopted as our national symbol in 1782. But, by the early 1900s, Bald Eagle numbers were declining nationwide because of habitat loss and illegal shooting. The Bald and Golden Eagle Protection Act passed in 1940 prohibited killing or selling Bald Eagles and their parts. However, the populations continued to decline due to the pesticide DDT. By 1963, only 417 nesting pairs were found in the lower 48 states. In 1967, the Bald Eagle was listed as endangered under the Endangered Species Preservation Act. Following the passage of the Endangered Species Act in 1973, the bird was listed as endangered or threatened throughout the lower 48 states. Numbers have steadily increased since DDT was banned in the U.S. in 1972. In 1995, the FWS announced that Bald Eagles in the lower 48 states had recovered to the point that those populations previously considered endangered had been down-listed to threatened status. Populations continued to increase. Today, there are more than 5,700 nesting Bald Eagle pairs. At this writing the FWS has proposed to completely remove it from the endangered species list. If de-listed, the species will still be protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Bald Eagles are regularly seen using refuges within the Mark Twain NWR Complex during migration for resting, feeding, and, more recently, nesting. Mature trees are a key component for eagle habitat along the River corridor, for both roosting and nesting. During fall migration eagles take advantage of large trees near dependable fishing spots. In the winter, particularly when ice has formed on most of the River, the tailwater areas just below each dam provide prime fishing locations for eagles. Those dams, which also include perching trees along the downstream side, are great places for the public to view large numbers of eagles from relatively close locations. Winter eagle watching is a popular "Watchable Wildlife" opportunity along the AEC.

Numbers of breeding Bald Eagles along the Upper Mississippi River have increased from two to five pairs in the 1970s to 43-44 pairs in 1993 and 1994. Productivity per nest varied little between 1986 and 1993, with 0.95 to 1.5 young per nest. There are presently 19 known active eagle nests within the Mark Twain Complex AEC (Pools 15-26 and open river). There are also five active eagle nests located in the Alton Pool on the Illinois River. Eagles nest on several refuge divisions, but the most consistent area has been Clarence Cannon NWR where approximately 20 young have been produced in the last 10 years. The Upper Mississippi River is a major migration route and wintering area for Bald Eagles. More than 150 roosting and feeding areas for Bald Eagles have been reported within the Mark Twain Complex AEC.

Interior Least Tern

The interior population of the Least Tern *(Sterna antllarum athalassos)* currently nests in the Mississippi and Rio Grande River basins from Montana south to Texas, and from eastern New Mexico and Colorado to Indiana and Louisiana. Loss of sandbar habitat due to dams, river channelization, and water level changes has caused a decline in interior Least Tern populations. Undisturbed sandbars are critical for successful nesting. Predation, flooding and recreational activities on sandbars can cause nest disturbance and abandonment. The interior Least Tern was Federally listed as endangered in May 1985.

Currently, within the AEC, the interior Least Tern nests only in the Middle Mississippi, south of RM 80. Seemingly suitable sandbar habitat north of RM 80 may be unused due to high spring water levels that inundate the sandbars. The population has been increasing on the Middle Miss, but it appears that local productivity is not great enough to support these increases. It may merit investigation whether some of these birds are coastal subspecies migrating inland (Kirsch 1999). Interior Least Tern management techniques include the creation of new nesting habitat through the use of dredged material and/or channel training structure modifications, removal of vegetation from existing sandbars, modification of water level management, and restrictions of public use on nesting beaches.

Decurrent False Aster

The decurrent false aster *(Boltonia decurrens)* is a Federally listed threatened species that historically ranged along a 248-mile stretch of the Illinois River and Mississippi River floodplains between LaSalle, Illinois, and St. Louis, Missouri. Its natural habitat included wet prairies, shallow marshes, and the shores of rivers, creeks, and lakes.

Although Boltonia population levels vary somewhat from year to year, the overall number of naturally occurring populations continues to decline (Smith et al., 1998). The draining of marshes, lakes, and wet prairies for conversion to cropland characterizes the habitat destruction and modification believed to be the main reasons for the decline of Boltonia. The construction of dams, locks, and levees along the River has altered the natural hydrologic cycle, often causing either a lack of flooding or prolonged inundation. Although the seeds of Boltonia are apparently adapted for water dispersal, the levee systems provide a barrier to dispersal except during major floods when the levees are overtopped (Smith and Keevin, 1998). In addition, intensive agriculture has increased soil erosion and resulted in heavy siltation in flooded areas. A study conducted by Smith and Keevin (1998) indicated that seeds covered with as little as 0.5 centimeters of sediment did not germinate.

Boltonia can be distinguished from other asters by its decurrent leaves and absence of rhizomes. The wing-like appendages of the leaves give the stem of Boltonia a slightly ruffled look. The flower heads have a yellow disk surrounded by white to pale violet rays. The species can reach more than 2 meters in height. Boltonia flowers between August and November. The seeds usually germinate in the fall and then overwinter as vegetative rosettes. Populations also can be maintained by the vegetative production of basal rosettes. In fact, few seedlings are found in established populations; most regeneration occurs vegetatively which can give Boltonia populations a clumped appearance.

Boltonia is extremely tolerant of long periods of inundation and the flood-related deaths of less tolerant species may be important in maintaining its presence in the floodplain. Although Boltonia can establish and grow quickly immediately following a flood disturbance, it will be replaced within 3 to 5 years by faster-growing species unless another disturbance occurs. Shade created by competing species prevents seed germination, slows plant growth, and reduces seed production.

Before the flood of 1993, Boltonia populations had been declining for several years. In 1993, only four of the existing populations produced any flowering plants. However, in 1994, two new populations were discovered and existing populations increased dramatically in size. Currently, there are approximately 20 disjunct populations that range from Bureau County, Illinois, to St. Clair County, Illinois, and west to St. Charles County, Missouri (Smith, pers. comm.).

One known population is located on the Gilbert Lake Division of Two Rivers NWR. Although the Gilbert Lake population was virtually eliminated by the 1993 flood, it rebounded with the establishment of thousands of new seedlings in 1994 (Smith et al., 1998) and a current population of approximately 250 individuals. The Refuge currently controls encroaching willow by mowing and discing as needed. A step-down management plan will be developed in consultation with the Rock Island Ecological Services office.

Habitat[21]

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The Mississippi River, together with its floodplain, provides important habitat for fish and wildlife and includes the largest continuous system of wetlands in North America. The River corridor contains a diverse array of wetland, open-water, and terrestrial habitats, but human activities have greatly altered this river ecosystem for commercial navigation and other development. Much of the watershed is intensively cultivated and many tributaries deliver substantial amounts of sediment, nutrients, and pesticides.

Throughout the River corridor two of the most historically prevalent, and now highly impacted, habitat types are forest and aquatic vegetation. The impacts of water level fluctuation, sedimentation, and development have been particularly severe south of the Quad Cities.

Wetland

Emergent and submersed aquatic plants were present but not abundant in the Upper Mississippi River before the construction of locks and dams in the 1930s flooded thousands of hectares of marsh, bottomland forest, and agricultural areas. The creation of navigation pools abruptly altered the hydrology of the River, and the diversity, abundance, and distribution of aquatic plant species changed markedly in the decades after impoundment. Water levels were least altered in the upper end of the navigation pools, and these areas remained in the mostly natural condition of deep sloughs and forested islands. In the middle of the pools, shallow flooding of terrestrial areas encouraged the development of marshes. The downstream reaches of the newly created pools were usually too deep for marshes but often supportive of aquatic plants (Havera 1999).

However, new growth of aquatic and wetland plants in the impoundments soon showed signs of deterioration. Water circulation in many backwaters was limited and sedimentation

21. Much of the material in this section is edited directly from the 1998 USGS Report on the Status and Trends of the Nation's Biological Resources, specifically the 'Regional Trends of Biological Resources – Mississippi River' chapter. This section was prepared at the Upper Midwest Environmental Sciences Center, see reference section for complete citation of contributors.

increased, resulting in decreased diversity and abundance of aquatic vegetation. The broad floodplain of the AEC encouraged the establishment of drainage and levee districts for agriculture and the extensive loss of wetlands. Some of this former wetland habitat has been restored in Refuge divisions within the Mark Twain NWR Complex including Louisa, Keithsburg, Clarence Cannon, Delair, and Batchtown. Wetland and aquatic vegetation is almost non-existent in the open river reach.

Most of the wetland vegetation monitoring on the UMR has focused on submersed aquatic species. The abundance of many submersed plants, including wild celery, declined markedly in much of the Upper Mississippi River during the drought of the late 1980s. More than 1,200 acres of submersed vegetation disappeared in the lower half of Poolÿ19, where plant beds had generally been expanding since the 1960s. In early September 1990, the only submersed vegetation found in the lower half of Pool 19 were small patches of Eurasian watermilfoil.

Most species of submersed plants also decreased in frequency of occurrence during the 1993 flood at monitoring sites in Pools 4, 8, 13, and 26. The decreases were greatest in Pools 13 and 26. In 1994, submersed aquatic plants had recovered to pre-flood frequencies in Pools 8 and 13, but not in Pool 26, where the duration and magnitude of the flood were greatest. Sedimentation, water turbidity, and grazing fish (particularly common carp) may be inhibiting the re-establishment of submersed aquatic plants in some parts of the River.

Relatively little wetland habitat still exists within the AEC compared to the years immediately following lock and dam construction, except within federal or state-managed areas and private duck-hunting clubs. Even less acreage is managed as “sanctuary” for migratory birds. In the non-hunted sanctuary areas, birds can rest and feed with minimal disturbance during that segment of their fall migration. When disturbance causes unnecessary flights, feeding is disrupted and extra energy is expended. To meet these increased energy demands waterfowl must increase foraging time, and if food resources become limited, birds may need to depart the area with less than optimal body weight. Excessive disturbance or hunting pressure also tends to reduce hunting opportunity by stimulating the birds to move through these mid-migration areas sooner than normal weather conditions would otherwise dictate. At the present time, most of the available sanctuary is located within the boundaries of the Mark Twain Complex. A few state areas provide temporary sanctuary to waterfowl by ending shooting hours early, while some private lands are hunted by only a few people, which results in light pressure. The Complex will be evaluating this factor in greater depth in conjunction with the completed Habitat Needs Assessment and will consider sanctuary needs in future public use management designations for the expanded boundary areas included in this plan.

Forest

Floodplain forests in the Upper Mississippi River valley are now confined to a riparian zone a few kilometers wide at most. Agricultural and urban development have been leading causes of the loss of floodplain forests along the Upper Mississippi River. By 1929, farmland and urban areas covered 22 percent of the floodplain, and forest had declined to 29 percent. In 1989, forests covered 14 percent of the overall floodplain and the amount was: 18.9 percent between Minneapolis, Minnesota, and Bellevue, Iowa; 13.5 percent between Bellevue and Alton, Illinois; and 7.3 percent downstream from Alton. In many reaches, especially downstream from Bettendorf, Iowa, most of the forest is on islands. The loss of forests in the Upper Mississippi River valley, although considerable, has been less than that in many other large North American floodplain rivers, such as the Missouri, Illinois, Ohio, and the Lower Mississippi. This is attributed to the acquisition of land for navigation pools and national wildlife and fish refuges, which placed more than 497ÿsquare miles of the Upper Mississippi River valley into public trust.

Flooding, erosion, and sedimentation are powerful natural processes that shape floodplain landscapes and affect succession and species composition of forests. However, these hydrologic and geomorphic processes have been constrained by navigation and flood-protection structures in the Upper Mississippi River for several decades. These, and other factors, have resulted in an altered forest composition throughout the Refuge Area of Ecological Concern. Individual forest stands on the UMR floodplain can be dominated by any or a few of several species, including (but not limited to) black willow, eastern cottonwood, sycamore, boxelder, silver maple, river birch, green ash, American elm, hackberry, pin oak, bur oak, and swamp white oak. Silver maple is now the predominant species in all reaches. American elm declined markedly during the 1900s because of Dutch elm disease. Eastern cottonwood, green ash, and oaks have all become less abundant relative to silver maple. For example, forests at the confluence of the Mississippi and Illinois rivers, now dominated by silver maple, were co-dominated by hackberry, elm, pecan, willows, and eastern cottonwood during early European settlement. Floodplain forests along a 50-mile unimpounded reach of the Upper Mississippi starting 13 miles upstream from the mouth of the Ohio River were dominated by eastern cottonwood and sycamore during early settlement but are now dominated by silver maple and willow. The amount of forest in pioneering and transitional successional stages has decreased greatly, and much of the present forest in the UMR floodplain is overly mature.

Extreme flooding during a single growing season can severely disturb forests. This is illustrated by the effects of the Flood of 1993, a year when unusually heavy, persistent rainfall caused extreme flooding that lasted from early spring through much of the growing season along much of the Upper Mississippi River. The Flood of 1993 caused substantial tree mortality in the forests, particularly in lower reaches of the UMR, where the flood persisted the longest. Mortality was positively correlated with flood amplitude and duration, and negatively correlated with tree size. Overall tree mortality in 1994 ranged from 1 percent to 4 percent in Pools 4, 8, and 13 and from 18 percent to 37 percent in Pools 17, 22, 26, and the open river. For saplings, overall mortality rates were higher, ranging from 2 to 9 percent in Pools 4, 8, and 13 and from 48 to 80 percent in Pools 17, 22, 26, and the open river reach between St. Louis and Cairo, Illinois.

The mortality of trees and saplings varied greatly among species. The least flood-tolerant trees were hackberry, Kentucky coffeetree, sugarberry, river birch, and white mulberry. Pin oak, silver maple, American elm, and slippery elm were moderately tolerant, and sycamore, hawthorn, green ash, black willow, swamp white oak, slippery elm, and eastern cottonwood were more tolerant. The effects of the 1993 flood on forests along the UMR are expected to persist for decades.

Grassland

At the time of European settlement, prairie grasses dominated more than 50 percent of Illinois and the state was once nicknamed the “Prairie State.” Nearly all of Iowa and about 40 percent of Missouri were once covered with tallgrass prairies. Now, as a result of the intense agriculture now present throughout the Midwest, less than one-tenth of 1 percent of the original tallgrass prairie exists in these states. According to the Habitat Needs Assessment, the extent of grassland fragmentation and conversion are the most extreme changes in many parts of the UMRS. Grassland patch connectivity has been highly reduced agriculture and development. Historic surveys indicated that grasslands and oak savanna once dominated floodplain plant communities throughout the AEC. The following examples demonstrate how grassland habitats have been reduced: Pool 17 – 56 percent pre-settlement to 7 percent contemporary; Pool 22 – 35 percent to 4 percent, Pool 24 – 47 percent to 3 percent and Pools 25/26 – 47 to 6 percent.

Many of the divisions in the Complex contain managed grasslands. The Horseshoe Bend Division has about 250 acres of restored native prairie on the highest elevations and over 2,000 acres managed as grassland and wet meadow containing some non-native species. The Horseshoe Bend Division contains the largest grassland tract on the Complex. Following the Flood of 1993, small patches of native prairie cordgrass began to reappear on several divisions including Louisa, Horseshoe Bend and Clarence Cannon NWR.

Soils

Alluvial soil associations predominate within the Mark Twain Complex management divisions. Alluvium is water-transported sediment that has been deposited along rivers and streams and on stream terraces. The main sources of alluvium are loess, glacial till, and sediment deposited by the Mississippi River when overflowing its main channel. The coarser or larger particles generally are deposited closer to the stream channel or in and along the path of the main current of the overflowing stream. The finer particles are deposited in the areas farther away, where the floodwater has little or no current.

The texture of alluvium varies widely because of differences in the material from which it was derived and the manner in which it was deposited. Alluvium soil textures found within refuge divisions range from silty, silt loams and silty clay loams (dominant associations) to loam, fine sandy loam, loamy sand, and silty clay. The soils on the river bottoms generally are underlain by sandy alluvium at varying depths.

Many of the floodplain soil associations are defined as hydric, or hydric with inclusions (of other soil types), by Natural Resources Conservation Service (NRCS). Hydric soil is defined as a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (no oxygen) conditions. The NRCS has mapped soils in each county and delineated each type that is hydric. Soil surveys are available through the NRCS county offices.

Mississippi River floodplain soils tend to be nearly level in nature and vary from poorly drained to well-drained. Some topographic relief is found within a few divisions, such as Louisa and Horseshoe Bend, where some loess soil may be found in the bluffs. Loess soil is wind-deposited material that consists largely of silt particles and smaller amounts of clay and sand.

Most of the soil associations mapped by NRCS have noted that they are "well-suited" or "suited" to trees, wetland habitat, or crop ground. A listing of the soils associations on the Complex can be found in Appendix J.

Water Quality

Development, agriculture, navigation, and flood control measures have all negatively impacted UMR water quality. Sedimentation is the number one management concern on the UMRS since it degrades wetlands throughout the system, diminishes diversity of water depths, and over time can convert wetlands to terrestrial habitat. Suspended sediments also increase turbidity, resulting in a reduction of light penetration that may limit or eliminate aquatic plant growth and reduce primary production by phytoplankton. Nutrients, heavy metals and pesticides also degrade the quality of wetland habitats throughout the River.

Sedimentation


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The main source of sediment filling UMRS backwaters is soil eroded from upland agricultural areas within the basin (Gaugush 1994). Average soil loss in the basin is presently about 4.4 tons/acre/year. In 1993 soil loss approached 20 tons/acre in Iowa (Lubinski and Theiling 1999). Moving downriver, the concentration of suspended materials increases and the UMR becomes more turbid as tributary streams enter the River.

Pool 19 was formed in 1913 by construction of the Keokuk, Iowa, lock and dam for hydroelectric power generation. Over 33 feet of sediment have been deposited in the lower part of the pool since the dam was completed. Pool 19 had lost about 55 percent of its original capacity by 1980. It is estimated that 80 percent of its capacity will be lost by 2050. Swan Lake on the Illinois River (Two Rivers NWR) had an approximate capacity of 4,800 acre-feet in 1902. By 1975, the capacity was reduced to about 2,800 acre-feet. While each pool has different geomorphology, the trend is the same for all pooled areas of the River.

The impacts of sediment depend, in part, on the size of the particles. Mississippi River sediment generally consists of smaller particles of sand, silt, and clay. Sand is the largest particle size and settles out of the water column the fastest, often within the main channel itself. This main channel sedimentation increases the need for dredging of the navigation channel to maintain the minimum 9-foot depth for barge traffic. In addition to the expense of dredging, environmentally suitable disposal sites are becoming increasingly difficult to find (see dredging section). Sand also tends to accumulate behind wing dams, in backwater entrances, and at the lower end of islands.

Silt remains suspended longer than larger particles and settles out in areas of lower flow, generally further down in backwaters or in quiet areas above dams. Clay, the smallest sediment particle, usually settles out in more remote backwater areas some distance from the flow of the main channel. Wind, bottom-feeding fish, and boat traffic easily stir it up. The resulting turbidity decreases light penetration, which can have severe impacts on aquatic plant growth. Fine sediments consolidate very slowly, resulting in a mucky river bottom not suitable for aquatic plant growth. All sediment types can smother mussels and other aquatic invertebrates during unusually high load events.

Developments for commercial navigation have proven costly to the River's capacity to transport sediments in most river reaches. By impeding its natural flow, the River's sediment transport efficiency was reduced and deposition rates increased dramatically in the impounded pools. Aquatic vegetation has declined as sediments from the uplands have accumulated in backwater areas. Navigation dams, channel training structures, levees, and channel maintenance dredging have altered river hydraulic characteristics, sediment transport processes, and the pattern of sediment deposition within the UMRS floodplain (Gaugush 1994). For the past 60 years the system has experienced high sedimentation rates but for many of those years retained good habitat. We have now begun a stage that will be marked by slower sedimentation rates, but with poorer habitat quality due to the years of accumulation without management actions to counteract this effect. Once the system reaches a sediment transport equilibrium, overall sedimentation rates may return to nearly the same levels as before European settlement (Lubinski 1992). Stabilized water levels established by dam operations also eliminated the River's annual flooding and drying pulses, which compact sediments that helped maintain highly productive floodplain habitat.

The loss of depth, area, and water clarity in the backwaters has led to an overall decline in aquatic vegetation as well (Lubinski and Theiling 1999).

Both commercial and recreational boat traffic have been found to resuspend bottom sediments and to erode river shorelines. Negative effects of this erosion and resuspension include reduction of light penetration and loss of aquatic vegetation, disturbance of benthic organisms, loss of fish spawning and nursery habitat, and loss of terrestrial vegetation due to undercutting of roots.

Bhowmik (1992) conducted research on the Mississippi River and the Illinois River to determine the physical impacts of navigation, including the resuspension and lateral movement of sediment. The increase in sediment concentration was found to be higher in shallow and narrow channels (Illinois River) than in deep and wide channels (Mississippi River). Concentrations of suspended sediment increase within the wave wash zone (close to the shore) (Bhowmik 1991). Resuspension and lateral movement of sediment can have negative impacts on sensitive biological habitats, especially those bordering the navigation channels.

The impacts of recreational boating were studied in 1994 on Pool 4, near Red Wing, Minnesota (Johnson 1994). This study concluded that recreational boat-generated waves may be a more pervasive influence on shoreline erosion than commercial tows. The highest impacts were near the land/water interface and were directly responsible for elevated turbidity levels in this zone during peak boating times. Additional observations have shown an increase in shoreline erosion due to boating traffic, and sediment inflow to backwater areas might increase with increased vessel traffic (Gaugush 1994).

Isolating wetlands from the River improves the ability to control water levels and reduces the sedimentation rate. However, this isolation also can prevent inflow of nutrients, cut off important fisheries habitat, and increase flood heights downstream. To balance the need for floodplain connectivity with the need for high quality, reliable fish and wildlife habitat, spillways were constructed in the levees at Keithsburg and Clarence Cannon following the flood of 1993. The spillways allow more frequent connectivity to the River but also, presumably, a somewhat higher rate of sedimentation. The USGS has developed a plan to monitor the effects of the spillway on sedimentation and habitat at both units. Short-term and long-term changes can be monitored using the protocol.

Nutrients

Between 1945 and 1985, the application of commercial fertilizers increased 20-fold in the United States. From 1985 to 1988 the UMR accounted for 31 percent of total nitrogen delivered to the Gulf of Mexico, despite being only 15 percent of the Mississippi River Basin land area (Lubinski and Theiling 1999). Average nitrogen concentration in the River's mainstem has doubled since 1950, with commercial fertilizers being the largest source.

High levels of nitrogen input to the River begin a chain reaction. Nitrogen causes phytoplankton and algae blooms to occur sometimes so thick that growth of aquatic plants is inhibited. Decaying algae and phytoplankton consume oxygen from the water, sometimes resulting in critically low dissolved oxygen (DO) levels in parts of the UMR. A minimum of 5 parts per million (ppm) DO is necessary to maintain a healthy aquatic system. Lower DO levels often result in fish kills and also adversely affect pollution-sensitive organisms such as mayfly nymphs.

The “dead zone” in the Gulf of Mexico is an area of approximately 7,000 square miles of water (varying annually) with oxygen levels below 2 ppm. The zone lies between the

Mississippi delta and the upper Texas coast and is caused by increased nutrients, such as nitrogen and phosphorus, from the Mississippi River. Changes in the distribution of fish and shrimp due to Gulf hypoxia pose a potential threat to the Gulf of Mexico's $4 billion a year seafood economy.

Other Contaminants

Other contaminants in the Mississippi River include heavy metals (such as mercury, lead, cadmium), pesticides (herbicides, insecticides, fungicides), and polychlorinated biphenyls (PCBs, an industrial chemical). Many toxic chemicals do not dissolve readily in water and adhere to small sediment particles. They may be transported downstream or settle out in backwaters and side channels. Toxic chemical discharges have decreased since the 1970s, but material discharged prior to federal regulations may still be contained in sediments (Lubinski and Theiling 1999).

Some metals (e.g. copper, zinc) are essential to living organisms but can be toxic at high concentrations, whereas others (e.g. cadmium, lead, mercury) are nonessential and toxic at relatively low concentrations. Aquatic organisms can be exposed to contaminants through contact with sediment, the water column, or the river bottom. Use of bottom sediment as spawning substrate by fish, for example, may expose sensitive young to toxic substances in the sediment. Bottom sediments in many areas of the Upper Mississippi are contaminated with cadmium, copper, chromium, lead, mercury, zinc and PCBs. Because sediment toxicity can persist for years or decades, ecological recovery or restoration efforts within the River and its backwaters may be hampered (Lubinski and Theiling 1999).

Most pesticides used in the UMR basin are herbicides used for weed control. The river basin upstream of the Missouri River contributes 40-50 percent of pesticides found in the Mississippi River, even though it represents only 22 percent of the flow from the entire basin. These chemicals enter tributary streams in both contaminated surface runoff and groundwater. The Minnesota River and the Des Moines River, for example, are the primary contributors of the herbicides alachlor, cyanizine, and metolachlor to the entire Mississippi River mainstem. Concentrations of the three major herbicides (atrazine, cyanazine, and simazine) in the Upper Mississippi River are greatest near the confluences of the Iowa, (Pool 18), Des Moines, (Pool 20), Illinois (Pool 26) and Missouri rivers (Lubinski and Theiling 1999).

Polychlorinated biphenyls (PCBs) are a class of stable industrial chemicals. Contaminants such as PCBs and methylmercury readily accumulate in aquatic organisms and can bio-magnify to high concentrations in animals near the top of the food chain. Contamination of the riverine food web with PCBs is the probable cause of the dramatic decline in mink populations on the UMR during the early 1960s. The partial recovery of mink populations that began in the late 1970s coincided with a period of declining PCB levels in fish. In 1989-91, PCB concentrations in carcasses of mink from the Upper Mississippi River in Minnesota average 0.26 ppm wet weight, exceeding concentrations in mink from all other areas of Minnesota except Lake Superior (Lubinski and Theiling 1999). Unfortunately, this indicates that PCBs are continuing to enter the food chain within the River's biological cycle. Concentrations of PCB are greatest in pools with human communities, such as the Quad Cities area, where a known point source of PCBs has contaminated Pool 15 (Lubinski and Theiling 1999).

Contaminant levels were measured in eggs collected from Black-crowned Night Herons and Little Blue Herons near East St. Louis in 1988. Herons and egrets consume aquatic invertebrates, amphibians and reptiles associated with potentially contaminated sediments. Both species showed elevated levels of the organochlorine compounds PCB and

DDE (Young 1989). The rookery is near RM 174, a highly industrialized area with at least 20 hazardous waste sites within a 5-mile radius. Little Blue Herons, Cattle Egrets, Black-crowned Night Herons, Great Egrets and Snowy Egrets populated this colony. All except the Cattle Egret are recognized threatened or endangered species in Illinois. Selected reaches of the Upper Mississippi River within the AEC have formal fish consumption advisories due to high levels of organochlorine chemicals.

In 1989, staff from the Rock Island Ecological Services Office conducted contaminant studies along the Illinois and the Mississippi rivers to determine if pollutants were present in aquatic sediments. Refuge sites tested included Big Timber, Louisa, Keithsburg, Fox Island, Long Island, Delair, Batchtown, and Clarence Cannon NWR. No organic pollution from chemicals such as DDT, chlordane, or PCB was detected in refuge divisions. Heavy metal concentrations were between normal and slightly elevated. However, poor water quality conditions as indicated by low dissolved oxygen concentrations and elevated ammonia concentrations were found at Keithsburg. These findings prompted a more in-depth study to characterize water quality in the Division.

Keithsburg Division

The Keithsburg Division of Port Louisa NWR is bordered by the Edwards River to the north, Pope Creek to the south, and the Mississippi River to the west. Surface water from these streams and rivers flows into the backwater only during flood stages. Four un-named tributary ditches flow intermittently into the Refuge along the northeast edge. Subsurface water and tile effluent regularly flow into these ditches. Ground water intermittently discharges from springs in the sandy bluff along the east side of the Division.

Contaminant studies have found that water quality problems at Keithsburg limit production of desirable food for waterfowl. Many Refuge wetlands now function to treat pollution versus the functions of providing wildlife habitat and food resources. This shift in wetland functions appears to be the result of nutrient enrichment. High levels of nitrogen and phosphorus cause blooms of nuisance aquatic plants such as blue-green algae, duckweeds, and coontail, which covered a large extent of the Division at certain times of the year. These nuisance plants do not produce seeds preferred by waterfowl and do not provide substrate for invertebrate production.

The invertebrate community was poorly represented in the sloughs and was dominated by high numbers of a few pollution-tolerant species. Poor oxygen conditions, lack of plant stems, and chemical stress are the probable causes of limited invertebrate production. It is estimated that over half of the Division does not achieve its potential for annual production of desirable aquatic invertebrates.

Agricultural herbicide concentrations did not reach levels that are lethal to aquatic plants, but did reach harmful levels. The nuisance plant species apparently were not affected by the herbicide exposure, but the concern is that repeated exposure may cause the loss of sensitive species from the plant community, thereby reducing biodiversity. Wetlands that are more isolated from runoff sources contained balanced plant communities and produced a more diverse invertebrate community (Coffey 1998).

Cultural Resources – Archeology and History


USFWS

As a part of this planning process the Service contracted for an archaeological and cultural values overview study of the Refuge. The resulting report, "An Archaeological and Historical Records Study for the Mark Twain National Wildlife Refuge in Illinois, Iowa and Missouri," by Midwest Archaeological Consulting, (Rusch, McKay, Karstens) was submitted to the Service and accepted on January 7, 2000. The authors divided the study by refuge divisions to facilitate understanding and use of the report. It also included an area within a 2-mile radius outside of each division boundary. Due to the size of the study area and the rich cultural history of the Mississippi River Valley, the contract report, maps, tables, appendices, etc., total more than 600 pages. Information was provided on nearly 750 previously recorded cultural resources that are located within the Refuge Complex and the contextual study area surrounding each refuge division. Each of the sites and associated information within one-quarter mile of the Refuge boundary have been entered into the refuge GIS system so that the information is readily available for management purposes.

The following summary is based on the overview study and other information as interpreted by the Regional Historic Preservation Officer (RHPO). With approximately 0.5 percent of the Refuge Complex having been investigated through detailed archeological survey, the current inventory of 176 known or reported cultural resources sites is thought to be a fraction of the potential sites on the Complex. Although erosion occurs at some sites, the overall trend in the river bottom is to aggrade. Deeply buried sites can be expected and are likely to be in relatively undisturbed condition. Sites and isolated resources from the Archaic, Woodland, Mississippian, and historical periods are known to exist, and many more sites likely exist. Some divisions are close to the Mississippian cultural center at Cahokia, and known Mississippian sites occupy landforms of the kind found on some divisions. In the historic period, river transportation is the single theme that connects all the divisions. In the earliest historic period, people transported materials down-river on flatboats and keel boats, and returned on keel boats or on trails paralleling the River. Landing sites, often with warehouses or stores or residences, exist throughout the length of the River. Other sites, probably not likely to be identified, would be associated with firewood stockpiling to feed the wood-burning river boats, which reportedly burned up to 10 cords of firewood a day. Land on some divisions is high enough that farming was practical. Other divisions supported camps, cabins, and resorts for hunters. Old roads, including some of historic importance in Missouri, are on or adjacent to refuge lands. Other than recent administrative and maintenance buildings, no standing structures remain on the Complex. Objectives of the overview study include identifying Indian tribes and other organizations and public groups that might have an interest in cultural resources and historic preservation on the refuge. The study identified 120 organizations and 19 Indian tribes. It also posed significant research questions to guide future archeological and other cultural resources investigation on refuge lands.

Most of the resources identified in the above described study are protected under provisions of the Archaeological Resources Protection Act of 1979 (ARPA). There have been recent developments in another important Act related to the manner historic preservation management responsibilities are conducted on the Refuge Complex and that warrant a mention in this plan. On June 17, 1999, the Advisory Council on Historic Preservation revised the rules and procedures (36 CFR 800) under Section 106 of the National Historic Preservation Act. The goal of the process is to seek ways to avoid, minimize or mitigate any adverse effects on historic properties. The Section 106 process covers any federally funded, licensed, or permitted undertaking. An undertaking is a project or activity that has the potential to cause effects on historic properties regardless of whether or not the activity ultimately results in any effect.

The responsibility of the Refuge Manager is to identify undertakings that could affect cultural or historic resources and coordinate subsequent review process with local officials. The actual determinations relating to historic and cultural resources are to be made by the RHPO for undertakings on Service fee title lands. The COE retains authority and responsibility under these acts of Congress for COE-owned General Plan (GP) lands managed as a part of the Refuge Complex, and for state-managed GP lands. Determinations relating to GP lands are the responsibility of the COE Rock Island or St. Louis Districts, as appropriate. State Historic Preservation Officers (SHPO) serve in an advisory capacity to the federal agencies and must be consulted, but the Service and COE are responsible for final decision making on federal lands.

Chapter 4: Management Direction

Refuge Management Considerations

Wetland Management[22]

Jim Rathert

Management techniques on moist soil units (MSUs) and other wetland types are variable and include relatively passive methods, as well as active applications. The goal is to produce mudflat conditions that promote the germination of wetland plants for use by migratory birds. De-watering the units - a drawdown - in the spring is the initial step in the plant regeneration process. Gravity flow of water or pumping is used to drawdown the units. Once dry, mechanical manipulations such as discing, mowing, burning or cropping can be used to reset the successional process. Some units may require no management at all until re-flooding in late summer and early fall to provide migratory birds with access to seeds and tubers for their southbound journey. Experience and experiments have shown that a variety of techniques used in rotation provide a healthy diversity of plant species.

Drawdowns in our latitude ideally begin in April or early May. Water control structures that allow the passage of water are typically placed at the lowest elevation within each impoundment to allow a complete de-watering and drying out of the unit. Although gravity flow of water is far less expensive than pumping, unpredictable water levels in the

22. The habitat values and balance of habitat types are addressed in the Goals/Objectives/Strategies (Habitat) Section of this plan. This section addresses some of the implications of utilizing this tool at the Mark Twain NWR Complex.

Mississippi River necessitate the use of pumps on some areas. Pumps may increase the rate at which water is removed, but they are even more important in August, September and October, when river levels are typically low and not conducive to gravity flow for re-flooding the units.

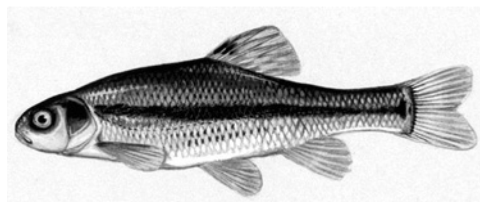
The drawdown process stimulates the growth of naturally occurring plants. Gradual drawdowns, lasting 2 weeks or more, provide slowly receding water lines. This allows a variation in plant germination timing and offers migrating shorebirds an opportunity to feed on invertebrates in open mudflats. Drawdown timing also affects which plant species will grow. For instance, "early drawdowns tend to stimulate germination of smartweeds on early successional sites. However, smartweeds are less likely to respond to early drawdowns by the third year after a soil disturbance such as discing or continuous flooding. Mid-season drawdowns result in millets, and late-season drawdowns result in sprangletop, beggartick, panic grass and crabgrass" (Fredrickson and Taylor 1982). Annual plants, which live through only one season, are high seed producers, but frequent disturbance of each unit is required for the highest yield of these species. Perennials, which have indefinite lifespans, become more common when units have had no disturbance for a number of years and may become dense stands, shading out more desirable food-producing species. However, some perennials can be beneficial in limited amounts. Rice cutgrass and marsh smartweed, for instance, can provide excellent habitats for invertebrates, which in turn are fed upon by waterfowl, rails and herons.

Mechanical manipulations can be used to set back encroachment of woody vegetation and to influence which species of wetland plants will germinate. Optimum seed production is obtained by early season discing. Deep discing followed by shallow flooding promotes germination of annuals over perennials. Tuber production can also be promoted with discing. If possible, shallow discing early in the season enhances the decomposition process and provides invertebrate foods for migratory birds. Rotation of row crops into moist soil units is another technique used on the Complex to provide diversity and control succession. Because farming methods can loosen and roll the soil, it can be used to control undesirable stands of rank vegetation and woody plants. Control of woody vegetation is a constant management concern within most moist soil impoundments of the Complex. Following flooding or management disturbances that result in late season bare ground, several refuges have aerially seeded Japanese millet to produce a quick cover and, that same year, provide an otherwise absent food source on the unit for waterfowl. This method gives way to good early successional annuals the following year, if water can be managed appropriately.

Burning will remove plant litter and expose the soil for new plant growth. Mowing, followed by burning and/or flooding, can be used to eliminate rank stands of low-value vegetation. Both burning and mowing help break down organic matter, which then decomposes and provides invertebrate habitat and nutrients for new plant growth. Slow drawdown and refilling of wetlands will make invertebrates available to shorebirds during migration.

A potential problem during drawdowns and re-flooding for migratory bird use is the possibility of an avian botulism outbreak. In recent years the nearby Illinois River Refuge Complex experienced outbreaks of this disease due to incomplete water management control. Avian botulism is caused by the ingestion of toxin produced by the bacterium, *Clostridium botulinum*. Fluctuating water levels contribute to outbreaks when terrestrial and aquatic invertebrates die as areas are flooded and subsequently become dry when the water recedes. The presence of vertebrate carcasses and high ambient temperatures are conducive to the buildup of fly populations involved in the bird-maggot cycle for avian botulism transmission. Intentional re-flooding of refuge areas that have been dry for a longtime will not be done during the summer months. Similarly, sharp drawdowns of water will be avoided to the extent possible since they could result in fish-kills and die-offs of aquatic invertebrates whose carcasses could then become a center for the growth of C. botulinum. Fortunately, units of the Mark Twain Refuge Complex have not experienced a history of this problem.

Divisions within the Mark Twain Refuge Complex contain over 21 miles of ditches that deliver water to individual impoundments or wetland complexes. Seven permanent pump stations permit the lowering of water levels within units; four of these stations also allow the pumping of water into the units for re-flooding in the fall. More than 100 water control structures (stoplog structures and flap gates) are used to manipulate water levels for optimal moist soil plant growth on more than 7,000 acres of wetlands.



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Even with varying levels of water management control on eight divisions (Louisa, Horseshoe Bend, Keithsburg, Fox Island, Delair, Calhoun, Batchtown, Gilbert Lake) and Clarence Cannon NWR, the River's fluctuations and precipitation dictate the amount of drawdown and re-flooding each year. Gravity flow of water from the River into impoundments can limit the amount of irrigation and re-flooding permitted in the fall if river levels are low. Refuge impoundments cannot always be flooded to the capacity desired during fall migration. Conversely, early spring drawdowns generally are impossible due to seasonal high water. Under these conditions, drawdowns can not begin until June or even July.

Fredrickson and Taylor (1982) noted that fast drawdowns late in the season may produce less desirable vegetation than those early in the season. Several years may go by before weather and soil conditions are dry enough to allow the mechanical manipulation of MSUs. These disturbances set back undesirable vegetation such as invasions by silver maple, willow, green ash and cottonwood seedlings. Because these tree seedlings are so prolific, several techniques, including chemical applications, may be used to regain control of open areas for moist soil plant production.

Operation and maintenance of pumps and water control structures can cost the refuge a great deal of time and money. Significant structural losses and damages have occurred due to flooding and we must be cognizant of the need to construct “flood-friendly” forms within the floodplain. Therefore, each location is evaluated for its suitability before facilities are added to gain control over water level management. Within the current Refuge Complex boundary, all areas with suitable topography and drainage for operating water control structures economically are already being managed for moist soils or other wetlands. A few areas have been identified for possible moist soils expansion and improvements that would require a more substantial capital outlay, such as the creation of perched wetlands on fine sediment disposal areas.

Forest Management[23]

Open water and forest are the largest habitat cover types along the river corridor, both historically and presently[24]. Forest management can be confusing because the Service shares management responsibility for this habitat type in the UMR with the COE on the GP lands which are managed by the Service and states for conservation. The COE's involvement could be at conflict with the Service if the COE managed its forest interest for economic purposes. However, an interagency relationship has been developed on this topic that can be characterized as a mutually beneficial partnership. Refuge goals to maintain a healthy river system have been helped by COE involvement in the forest management facet of the corridor. The following is a summary of the COE forest program interests on refuge GP lands and the resulting interagency program.

Logging caused significant changes in the habitat of the UMR floodplain during the 1800s and continued into the 1930s. Timber harvest was necessary to supply fuel for steam boats and railroads, firewood for heating and cooking, and lumber to construct the towns along the river. Most of the cut over land was converted to farmland. Much of the lowland timber that was still present along the river prior to the construction of the locks and dams was cut and burned on site. In spite of this depression era "waste," the Department of Defense developed an interest in standing timber as a valuable natural resource during the Second World War. This interest was incorporated into the Cooperative Agreement with the Service for the management of GP lands.[25] In each of these agreements the COE has retained rights for "harvesting and selling of merchantable timber" on state and federally managed GP lands.

On September 6, 1960, Congress addressed the issue of forest management on COE projects nationwide. Public Law 86-717 spoke to the COE's overall stewardship responsibility for forest resources on project lands. The Act states that "..reservoir areas of projects for flood control, navigation... shall be developed and maintained so as to encourage, promote, and assure fully adequate and dependable future resources of readily available timber, through sustained yield programs, reforestation, and acceptable conservation practices, and to increase the value of such areas for conservation, recreation, and other beneficial uses: Provided, that such development and management shall be accomplished to the extent practicable and compatible with other uses of the project." For the GP lands along the UMR, the 9-foot Navigation Project and the National Wildlife Refuge System are both "other" designated uses in this context. Regarding vegetative cover, including forest, the COE is to pursue "... the establishment and maintenance of other conservation measures... to yield the maximum benefit and otherwise improve such areas. Programs and policies developed pursuant to the preceding sentence shall be coordinated with the Secretary of [Interior], and with appropriate State conservation agencies."

During the past 20 years it has become evident in the Mark Twain river reach that the COE is committed to restoring and maintaining a sound and diverse forest resource in support of Refuge Complex goals for wildlife management. Any economic value resulting from managed harvest has remained a secondary outcome realized from an active conservation-

23. Habitat values and the balance of other habitat types are addressed in the Goals/Objectives/Strategies (Habitat) section of this plan. This section addresses a possible jurisdictional implication on the Refuge Complex forest.
24. While there is still a high percentage of riverine forest cover in the "between the levees" portion of the AEC, two-thirds of the historic floodplain making up the AEC is now in agricultural production.
25. See History and Establishment of the Mark Twain NWR in Chapter 3 for more information on GP lands.

oriented program. Regularly scheduled coordination meetings between the COE, Service and states have been effective in assuring that the program is compatible with Refuge Complex wildlife goals and objectives. During this period the Rock Island District (and the St. Paul District north of the AEC) has conducted a more formal and active forestry management program than has the St. Louis District. Although the St. Louis District program is not as well developed, its staff have been equally cooperative with the Service and states regarding case-by-case forest management concerns. The Mark Twain Refuge Complex has advocated a more active forest program in the St. Louis District by means of coordinating the comprehensive conservation planning effort, our active participation in the development of the St. Louis District Master Plan, and in efforts to revise the Cooperative Agreement for management of all GP lands.

The Rock Island District has set forth goals and objectives for forestry operations and maintenance in its 5-year plan. The District's long-term 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." District foresters plan to increase and maintain healthy and productive stands of bottomland and forest timber in varying stages of growth from seedling to mature forest through various acceptable silvicultural techniques. By doing this, the COE will help support a diversity of productive fish and wildlife habitat for both game and non-game species, and any affected endangered species. Rock Island foresters have used timber stand improvement (TSI), planting and small timber sales to manipulate forest resources for fish and wildlife habitat. They have maintained an active database of all federal- and state-listed threatened and endangered species (including candidate or sensitive species) and their habitats on project land in order to protect specific habitats. Information is also kept on active nesting colonies, eagle nests and roosting areas, and Indiana bat brooding and roost areas. Through participation in development of Environmental Management Program projects, and with other project authorities, Rock Island District foresters have played an active role in efforts to regenerate mast-producing trees on higher elevation sites in the floodplain.

During the CCP process, many conversations and meetings between the Service, states, USGS scientists and COE resource management personnel occurred to coordinate ideas on the best means to enhance floodplain forests. The Habitat Needs Assessment (HNA) process spawned an interagency forest management model team effort that was just starting near the end of this CCP process.

Refuge goals, objectives and strategies for forest resources are found in the Forest Habitat Goal section of this Plan. Additional efforts are needed between refuge managers, state biologists and COE forestry professionals to develop a forest management step-down plan for GP and Service fee title lands. From the Service's perspective, the desired partnership outcome for COE-owned lands within the National Wildlife Refuge System includes: 1) consistent programs are conducted on each COE District of the UMR; 2) programs are well coordinated with partners; 3) programs support partner agencies' habitat management goals; 4) programs fit with Service fee title land management in a seamless manner; and 5) programs provide data complementary to and consistent with the Long Term Resource Monitoring Program (LTRMP).

Cropland Management[26]

Beginning in the 1970s, the Service decreased emphasis on agriculture on National Wildlife Refuges and increased emphasis on wetlands and moist soil units to enhance species diversity and to provide a healthy diversity of diet for waterfowl. However, cropland management remains an important tool for managing refuges and in providing high-energy food for waterfowl and other wildlife. In addition, it provides managers a means to effectively set back succession in moist soil units. Agriculture also can be used to maintain fields in an open condition in preparation for other habitat types, such as, grasslands, moist soil units or bottomland hardwood plantings. The costs of a crop program are primarily administrative if cooperative arrangements are made with local farmers. This tool can only be used if it is economically beneficial to the farm partner. Crops include winter wheat, corn, soybeans, buckwheat and sorghum. Soybeans are used as the farmers' share and are rotated with other crops to fix nitrogen in the soil and reduce cutworm infestations.

Cooperative cropland management requires staff time in pre-planning, farmer selection and subsequent coordination. Once these tasks are completed, the farmer must then deal with the difficulties of farming in the floodplain environment, which can include unpredictable river flood pulses. With the assistance of a reliable and conscientious cooperative farmer the Refuge Complex can secure supplemental food sources for migratory birds and resident wildlife without utilizing refuge labor, equipment and supplies. By rotating cooperative farmers through different units of the refuge, the program can provide successional setback in other habitats at no direct costs to the refuge. At current staff and funding levels, most of these actions would not be possible without the assistance of the cooperative farmers.

Traditional cropping techniques and rotations require the application of herbicides and fertilizers. Any herbicide applied on refuge lands must be pre-approved by the Regional Office. Herbicides and fertilizers can be detrimental to the aquatic environment and their use is limited and strictly monitored when they are utilized on refuge grounds.

Thirteen of the 15 Mark Twain Refuge Complex divisions and Clarence Cannon NWR serve as a migratory sanctuary for waterfowl during hunting season. Eight divisions presently contain cropland as a habitat type to provide a supplemental food source for migratory birds. In 1999, cropping totaled approximately 2,622 acres, ranging from 64 acres at Gilbert Lake to 675 acres at the Fox Island Division. This represents a significant decrease from more than 6,100 acres cropped on refuge lands when the last Master Plan was done in the 1970s. This decrease took place at the same time that thousands of acres were added to the overall Refuge. Most of the land taken out of crop production has been converted to wetland, grassland, or hard mast trees; or else been allowed to naturally regenerate to wet floodplain forest. Further cropland reductions are proposed in the strategies for the desired future condition.

Port Louisa NWR has worked cooperatively with local farmers to plant from 130 to 330 acres of crops on the Louisa Division, depending on moisture conditions, to provide supplemental food for waterfowl. Changes to the program are proposed through wetland development projects in the habitat section of this plan that would result in an average of 80 acres per year being farmed.

26. The habitat values and balance of habitat types are addressed in the Goals/Objectives/Strategies (Habitat) section of this plan. This section addresses some of the implications of utilizing this tool at the Refuge Complex.

Great River NWR administers cooperative farming agreements for crop production ranging from 1,300 to 1,725 acres annually on four divisions. Under implementation of this plan, farming will be substantially reduced to an annual range of 550-850 acres. On Clarence Cannon Refuge, the farming program is used primarily as a tool for maintaining high quality seasonal wetlands. Crops are rotated through the moist soil units on average every 4 years to disturb vegetation and soils, to control pest plants, and to promote the growth of desirable vegetation. Outside of the moist soil units, crops are also planted in a limited area as a supplemental food source for migrating waterfowl. On Delair Division, farming is used primarily to provide a supplemental food source for migrating waterfowl. Farming is rotated through some fields with subsequent years of fallow condition. Winter wheat is generally a portion of the Refuge share on both of these Refuges and is used extensively by geese. On Long Island, the remaining 120 acres of agriculture are scheduled for reforestation beginning in 2001. On Fox Island, the remaining 675 acres of cropland is on lands acquired during the past 10 years that are planned for re-forestation either through planting or natural regeneration. This transition will be phased in over several years due to the size of the acreage. In the interim, the remaining cropland will be farmed to keep it in an open condition.

Two Rivers NWR administers cooperative farming agreements to provide supplemental food for migratory waterfowl. Corn, wheat and soybeans have been planted annually on a maximum of 800 acres. Current plans call for an average of 450, unless further reduced by force account management with additional staff and funding. The cooperators are also required to aerially seed winter wheat into harvested soybean fields as green browse for geese.

Middle Mississippi River NWR Divisions are subject to WRP easement and are not cropped. There are no plans to implement a farming program on the Refuge in the future.

One problem confronting the Refuge Complex in recent years is how to manipulate crops to make supplemental grain available to waterfowl. Although the divisions containing crops are not hunted, each is in some proximity to public or private waterfowl hunting areas. Even manipulation of crops via normal agricultural practices can be a problem if the activity draws birds to the area, creating hunting opportunity. But the “zones of influence,” or distance by which birds are influenced, can only be determined site-by-site considering many variables. There is no standard distance, as the influence of bait (such as grain on the ground) depends on factors such as topography, proximity to other crops or water bodies used for feeding or resting, and the usual waterfowl flight patterns for the area. The law prohibits hunting if bait is present that could lure or attract birds “to, on, or over areas where hunters are attempting to take them.” (50 CFR 20.11). Complex refuges do not conduct practices that would be likely to place hunters in a position of hunting by the influence of bait.

Complex Refuges have in the past knocked down crops during the season in the core refuge areas away from hunted areas. During the mid-1990s, the baiting issue went through some controversy and changes. Since then the Complex refuges have taken a more conservative approach to crop manipulations until waterfowl seasons are closed to ensure that no bird flight patterns are being influenced by grain on the ground during an open season. This practice makes the high-energy food available to birds late in their stay, and when returning in late winter. However, late Snow Goose seasons (as per state conservation order) have lasted through mid-March during the past several seasons in an effort to reduce their over-population. Most waterfowl have already migrated north of the Complex by the end of the snow goose season when the crops could be made more readily available. It is not known how long this situation may last, but some cropland reductions are proposed for the Complex, especially along border areas where baiting is a concern. This represents a plan topic to be monitored closely and evaluated for future adaptive management strategies.

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Prescribed Fire Management

General Land Office surveys have helped researchers to reconstruct a picture of the habitat present in the Mississippi River Valley prior to European settlement. Prairie cordgrass, a fire-dependent grass species, appears to have been the predominant species in much of the UMR floodplain. For instance, a prairie community dominated the floodplain in pools 25 and 26 (Clarksville, Missouri, to Alton, Illinois) prior to settlement. "Timberlands were restricted to islands, the margins of the river and its tributaries, and valley slopes. Tree density and composition estimates indicate that oak savanna and oak woodland communities also were important features of the floodplain and adjacent uplands whereas closed-canopy forests of cottonwood, hackberry, box elder, elm, ash, and silver maple prevailed on the islands. This apparent "mosaic" of habitats contradicts the long-held perception that forests alone once dominated the bottomlands of the Mississippi River Valley. It is now apparent that fire as well as floods helped shape and maintain the diversity of pre-settlement habitats." (Lubinski and Theiling 1999).

It would be impossible to reconstruct the UMR floodplain prairies as they once existed along with the hydrological changes caused by the locks and dams. However, refuge managers still use prescribed fire to enhance native prairie restorations and existing prairie cordgrass remnants in the floodplain. Fire is also used as a tool in moist soil units and wet meadows to alter vegetation composition and patterns, and to set back woody and undesirable herbaceous vegetation in various other habitat types. In addition, prescribed fires have been used for oak regeneration in forest habitats. Although mowing can be used in some instances, the optimal management technique for tallgrass prairie is fire.

To meet prescribed fire goals and objectives as described in individual burn plans, each unit is planned on a 4-6 year rotation. Burns are done in early to mid-spring or in late summer to mid-fall. The timing and occurrence of burns are not always ideal, but are dictated by seasonal weather and flood conditions. Currently there are nine refuge staff trained to assist with prescribed fires; three of these individuals are certified burn bosses. By 2001, official burn plans had been prepared for approximately 6,355 acres on eight divisions. Potentially, over 9,500 acres of existing refuge land could be burned for habitat management purposes.

Table 7 shows the prescribed burn units within Mark Twain NWR Complex refuges.

With increased requirements for explicit burn plans, updated station fire plans, and higher levels of accreditation needed by refuge staff in order to execute prescribed burns, the cost effectiveness of this practice has decreased. Each burn boss spends large amounts of time preparing extensive plans for annual prescribed burning on refuge divisions. Plans must then be submitted to a Fire Management Officer (FMO) for approval. In order to

Table 7: Prescribed Burn Units, Mark Twain NWR Complex

Refuge Complex Prescribed Burn Unit	Acres
Port Louisa NWR	
Big Timber	506
Horseshoe Bend	2,357
Keithsburg	67
Louisa	1,047
Total	3,972
Great River/Clarence Cannon NWR	
Clarence Cannon NWR	3,680
Delair	1,648
Fox Island	170
Two Rivers NWR	
Calhoun	190
Gilbert Lake	83
Total	273
Refuge Complex Totals	9,573

effectively implement this management tool, additional staff and funding are needed. GIS maps have been prepared showing all burn units and fire management areas in the Complex. No burning is being proposed at Middle Mississippi River NWR at this time. Any future fire management proposed at that refuge will first be evaluated and documented in a station fire plan.

Invasive Species Management

The Service has made prevention and control of invasive plant and animal species a top priority. Exotic, invasive or alien species cause vast ecological and economic damage and range across almost every ecosystem of the country. Invading species are usually very successful when introduced to a new environment because they have no natural enemies that keep the population in check. Non-native mammals, birds, insects, mollusks, fish and plants have been accidentally or intentionally introduced to our country since the 1800s. Many species, such as the European Starling, Ring-necked Pheasant, and common carp, have been here for so long that we forget they are not native to the United States. Other species have been here a shorter period of time but are no less detrimental to native fauna and flora, including zebra mussels, purple loosestrife, gypsy moths, and Asian bighead carp. More than 135 non-native species have been introduced to the Mississippi River Basin during the past 100 years.

The Federal Noxious Weed Act (Act) of 1974 provides for the control, eradication, and regulation of interstate movement of those weeds that interfere with the growth of useful plants, clog waterways, interfere with navigation, cause disease, have other adverse effects on humans and the environment, or are detrimental to agriculture, commerce, or public health of the United States. A 1990 amendment to this Act, the National Undesirable Plant

Management Act, mandates a national comprehensive plant management program to control and contain undesirable plant species on Federal lands in order to alleviate damage to the environment.

Implementation of Integrated Pest Management (IPM) techniques have been Service policy since at least 1990 (30 AM 12.1). Integrated Pest Management is the thoughtful selection and use of multiple strategies and tactics to suppress target pest populations to tolerable levels within a given habitat or ecosystem. It is an ongoing process of addressing pest-related damages in ways that tend to preserve biological stability, reduce risks of catastrophic losses, and are less intrusive upon the environment than more conventional, purely chemical approaches. A critical component of IPM is the establishment of an acceptable threshold of pest numbers and/or level of damage. It is Service policy that all reasonable steps should be taken to minimize or, when feasible, eliminate dependence on chemical pest control agents.

Biological control can involve the use of natural predators, parasites, and pathogens. Any management practice that encourages natural populations of those organisms is a viable IPM component. Attractants, pheromones, and trap crops can also be used for biological control. Physical control methods include removal of small populations of plants by pulling them, removing them from the area and burning them. Mechanical control methods include such practices as burning, mowing, discing, managing water levels or rotating crops. Chemical control becomes necessary when other methods are impractical or not sufficiently effective in achieving identified pest population thresholds.

Very few weeds have biological control agents. Two exceptions are the Galerucella beetle species available for control of purple loosestrife, and three types of weevils for the control of musk and Canada thistle. These insects will be used where applicable. In fact, thistle weevils were released on the Gilbert Lake Division in 1996 and 1997 and have been somewhat successful in reducing the thistle population in the immediate area. While biological control methods are the most environmentally friendly, they can be labor intensive.

Missouri, Iowa and Illinois each have noxious weed laws that require land managers to control specific weeds including marijuana (*Cannabis sativa*), musk thistle (*Carduus nutans L.*), Canada thistle (*Cirsium arvense*), Johnson grass (*Sorghum halepense*), field bindweed (*Convolvulus arvensis*) and purple loosestrife (*Lythrum salicaria*). Many units of the Mark Twain NWR Complex have noxious and exotic weeds that are controlled biologically, mechanically, or chemically. Chemical use has been greatly reduced on the Mark Twain Complex but is still needed in some instances to control invasives. When necessary, FWS-approved chemicals will continue to be employed to control large outbreaks of noxious weeds. Abandoned agricultural land is particularly susceptible to invasion by these weeds and can quickly be overcome by annual species. Chemicals should be considered after first attempting to eradicate the problem by other means. Preferred methods of control include burning, mowing or discing.

Plants

Reed canarygrass (*Phalaris arundinacea L.*) is distributed throughout the United States. Botanists believe a native variety of reed canarygrass existed prior to major European settlement, but it seems likely that the native variety has mixed with more aggressive cultivars from Europe. This plant can reach 6 feet in height, and out-compete more beneficial wetland plants within the floodplain, quickly developing into a monoculture with very little proven wildlife benefit. The Flood of 1993 provided an avenue for wide disbursement of reed canarygrass seeds. As a result, the grass has invaded some fields, forests and wetlands within the Upper Mississippi River floodplain.

Reed canarygrass is very difficult to eradicate, once established. Where invasions are just beginning, tillage in combination with water management works well. These techniques must be implemented immediately after an invasion is recognized, or when a disturbance such as a flood creates conditions conducive to reed canary grass germination. Many sites invaded by this plant are too wet to be immediately attacked, allowing the grass to proliferate before attempting control. Prescribed fire, chemical and mechanical treatments have all been used in an attempt to control reed canarygrass, with varying degrees of success. Greatest success appears to involve a regimen of herbicide treatment, discing, and deep flooding.

Both Port Louisa NWR and Great River NWR have experienced problems with reed canarygrass. Mowing and burning on Horseshoe Bend Division have promoted healthy prairie cordgrass stands that seem to be out-competing the canarygrass. Mowing to address this problem has also been done at Louisa Division, and spraying has shown some effectiveness at Clarence Cannon NWR and Delair Division. To date, there has not been a significant reed canarygrass problem at Two Rivers NWR.

Eurasian watermilfoil (*Myriophyllum spicatum L.*) is considered one of the most widely distributed of all nonindigenous aquatic plants, with confirmed specimens in 45 states and three Canadian provinces. Spread by boats and waterbirds, it became established in the mid-western states between the 1950s and 1980s. Watermilfoil is tolerant of low water temperatures and can quickly grow to the water surface, creating dense mats that overtop and shade surrounding vegetation. Canopy formation and light reduction result in the decline of native plant abundance and diversity. This plant has less value as a good food source for waterfowl than the native plants it replaces. And although fish may initially experience a favorable edge effect, Eurasian watermilfoil's overabundant growth quickly negates any short-term benefits it may provide fish.

Current methods of Eurasian watermilfoil eradication include mechanical, chemical and biological control. Biological control offers a distinct advantage over both mechanical and chemical treatments by reducing cost, providing long-term effectiveness, and contributing little or no negative impacts on other aspects of aquatic systems. Several aquatic insects have been associated with declines of Eurasian watermilfoil. Current efforts are focused on the native milfoil weevil, *Euhrychiopsis lecontei*, which has been associated with natural declines of Eurasian watermilfoil and has shown potential in controlled experiments.[27]

Purple loosestrife, *Lythrum salicaria L.*, is a native of Europe and Asia. It aggressively reproduces, choking out domestic grasses, sedges, and other flowering plants that provide a higher quality source of nutrition for wildlife. It was introduced to the northeastern U.S. and Canada in the 1800s for ornamental and medicinal uses. It currently occurs in every state except Florida and is still widely sold as an ornamental, except in states such as Minnesota, Wisconsin and Illinois where regulations now prohibit its sale, purchase and distribution. Purple loosestrife adapts readily to natural and disturbed sites, allowing dense, homogenous stands to form. It is capable of invading many wetland types, including freshwater meadows, tidal and non-tidal marshes, river and stream banks, pond edges, reservoirs, and ditches. Blooming from June to September, a mature plant may have as

27. www.fw.umn.edu/research/milfoil/milfoilbc.html

many as 30 flowering stems capable of producing 2 to 3 million minute seeds per year. It also reproduces vegetatively through underground stems at a rate of about 1 foot per year.[28]

Small infestations of young plants may be pulled by hand. Older plants develop woody stems, making them difficult to pull, and small populations may be spot treated with glyphosate-type herbicides. Biological control of this invasive species has also been successful in the United States. The USDA has approved three insect species from Europe for use as control agents on purple loosestrife. These plant-eating insects include a root-mining weevil (*Hylobius transversovittatus*), and two leaf-feeding beetles (*Galerucella calmariensi*) and *Galerucella pusilla*). Root mining weevil larvae feed on vascular tissue in the root and often completely destroy mature plants. Galerucella adults and larvae feed on shoots, leaves and flowers. When beetle densities are high (greater than 200 per plant), entire plants are either destroyed or weakened sufficiently to prevent seed production. As few as 10 larvae can kill terminal buds and prevent seed production. Galerucella beetles have been released on several midwestern national wildlife refuges. Although purple loosestrife populations are not high enough on the Refuge Complex at this time to warrant biological control, this aggressive invader requires active monitoring. Small, isolated patches of this plant were found growing on several divisions following the Flood of 1993.

Garlic mustard, *Alliaria petiolata*, was first collected in 1868 on Long Island, New York. It has since spread to 30 eastern/midwestern states and three Canadian provinces. This biennial herb from the *Brassicacea* (mustard) family invades forested communities and edge habitats where it rapidly spreads and displaces native herbaceous species. The plant has no known enemies and, once established, is very difficult to control. Annual monitoring and rapid removal of plants are the most effective measures in preventing the establishment of garlic mustard. Hand-pulling small communities is very effective, while chemical control with glyphosate may be necessary for larger infestations. Burning can provide control if fire burns completely through the affected area. Illinois and Indiana have issued “garlic mustard alert” fact sheets. Illinois and Missouri have developed vegetation management guidelines for Alliaria. This invasive terrestrial plant has been found in small patches on the Louisa Division, and may be on several other Mark Twain Refuge Complex divisions.

The invasive biotype of the common reed *Phragmites australis* is regarded as an unwanted invader in many parts of the East and Upper Midwest. The plant spreads by rhizomes and is capable of forming large monoculture stands from just a few seeds. mowing, burning, discing and pesticide application have all been used in attempts to control it. In the Chicago area, *Phragmites* has out-competed cattail in many urban wetlands, and many islands and shorelines on the upper half of the Illinois River are loaded with the species. Isolated patches of *Phragmites* have been found on the Upper Mississippi River north of the Area of Ecological Concern, but for unknown reasons it does not appear to be spreading within the UMR floodplain at this time.

Exotic Mussels

Zebra mussels (*Dreissena polymorpha*) were introduced to the Great Lakes from European oceanic ships as they exchanged ballast water. They entered the UMRS through the Illinois waterway from Lake Michigan and attached to the hulls of boats. They were first documented in the Illinois River in 1991 when a commercial sheller brought a single specimen attached to a native mussel to biologists at the Illinois Natural History Survey. Since then, the prolific zebra mussel has been transported throughout the inland waterway

28. www.nsp.gov/plants/alien/fact/lysal.htm

system on the hulls of barges and by river currents that carry their larval stage. Zebra mussels do not have a fish host; they develop as planktonic organisms drifting in the current. They have a very high reproductive rate and can produce several broods per summer season (Lubinski and Theiling 1999).

Monitoring efforts conducted on the Illinois River from 1992-1995 by the Illinois Natural History Survey showed maximum densities approaching 83,612 mussels per square meter. This population was found at one site in Pool 26, near the Two Rivers NWR in 1993. That particular population crashed and was mostly gone by 1994, but zebra mussels have moved rapidly upstream since then. By 1997, densities of more than 25,000 per square meter were reported in Pools 9 and 10 of the UMR. Apparently, population densities in pooled reaches of the Mississippi continue to increase and the native mussel fauna are being colonized at a high rate (Lubinski and Theiling 1999).

Zebra mussels attach to hard surfaces, such as rocks or native unionid mussels, with byssal threads that secrete a strong glue-like substance. Zebra mussels attached to native mussels compete for food, make movement difficult, and can force shells open. Dense beds of zebra mussels can completely cover and kill native mussels, causing a reduction in overall numbers and species diversity. At one zebra mussel location in Pool 26, 18 species of native mussels with three co-dominant species were found at a density of 15.5 mussels per square yard in 1993. One year later, the site contained only 10 native species, density was reduced to 5.5 mussels per square yard, and the fauna was dominated by a single species. In 1995, only four native species were collected, density was 1.7 mussels per square yard, and threeridge mussels (*Amblema plicata*) constituted nearly all specimens (Lubinski and Theiling 1999).

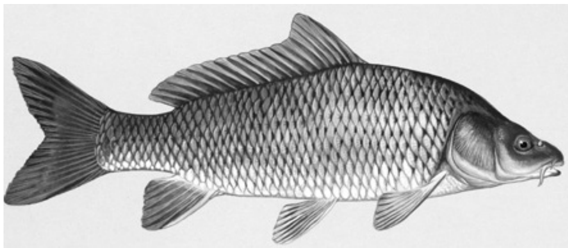
In Europe, a number of fish species are known to feed on zebra mussels, including the common carp (*Cyprinus carpio*), bream (*Abramis brama*), and pumpkinseed (*Lepomis gibbosus*). In North America, freshwater drum (*Aplodinotus grunniens*) prey on the exotic mussels. A 1996 study by Tucker et al. also found that “Americanized” common carp are feeding on zebra mussels. Carp collected at Mississippi River Mile 217 contained between 1 and 407 zebra mussel beaks in 83.9 percent of the fish examined. While this may sound like a potential biological control method, managers would prefer not to enhance carp reproduction in order to reduce zebra mussel populations.

In experiments conducted in Pool 26 by the Illinois Natural History Survey, high zebra mussel mortality was noted following aerial exposure for 24 hours during warm summer conditions. In contrast, native unionid mussel survival was generally unaffected under the same conditions. The experiments suggest that pool level drawdowns in mid-summer could cause a profound reduction in zebra mussel distribution (Tucker et al. 1997).

Exotic Fish

The common carp was introduced into the U.S. from its historic European range during the late 1800s. Several other exotic carp species including the grass carp (*Ctenopharyngodon idella*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Hypophthalmichthys nobilis*) have recently made a widespread assault on the UMR. These species have been used since the 1970s for aquaculture and pond applications. Another exotic carp species, the black carp (*Mylopharyngodon piceus*), feeds on shellfish and has been approved by the Mississippi Department of Agriculture and Commerce for control of snails on the state's catfish farms. When the black carp eventually finds its way to the Mississippi, the basin's already suffering mussel and shellfish populations could be devastated.

Fisheries biologists believe the Asian carp species (silver, bighead, grass and black) may be more threatening than the common carp because they compete more directly with native fish and shellfish for food and habitat. The bighead carp, currently reported in 22 states, feeds on zooplankton, which places it in direct competition for food with native paddlefish, bigmouth buffalo, and gizzard shad. Grass carp and silver carp are fast approaching the bighead's numbers and also have the ability to capitalize on degraded habitat not preferred by native species.



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In October 1999, during a fish kill investigation on the Wilkinson Island Division, a Service fisheries biologist discovered that 97 percent of 219 dead fish were comprised of exotic carp species. Silver, bighead, grass, and common carp accounted for nearly all the dead fish present in the seasonally flooded borrow ditch that had dried up. Additional observations show that the bighead carp is firmly established in the open river segments of the Mississippi River; three year-classes were documented in 1999 by LTRM researchers from the Cape Girardeau, Missouri, field station. Concerns over continued expansion of bighead carp populations have prompted Iowa, Kansas, Missouri and South Dakota to begin developing a multi-state study of the species (River Crossings 1999).

The invasive round goby has spread from the Great Lakes to the upper Illinois River and continued downstream movements of the species may soon present an additional threat to native fish communities (especially darters) of the UMR.

Other Invasive Species

Many other foreign aquatic and terrestrial species are on their way to the Midwest and/or Mississippi River, and monitoring efforts must be continued to determine their progress. The Great Lakes has become the dumping ground for alien species' introduction through ballast water exchange. Several aquatic species are currently in the Great Lakes and will eventually enter the Cal-Sag and Chicago Sanitary and Ship Canals leading from Lake Michigan to the Illinois River. These exotics include two small fish – the round goby (*Neogobius melanostomus*), which has already been found in the Illinois River near Romeoville, moving towards the UMR; and the Eurasian ruffe, (*Gymnocephalus cernuus*), which currently is found in Lake Huron.

Daphnia lumholtzi (a zooplankton native to Africa, Asia and Australia) was imported in the early 1990s with African fish for the aquarium trade or to stock reservoirs. It is now well established in the Illinois River. And a tiny crustacean, the water flea *Cercopagis pengoi*, has been dumped into the Great Lakes from its Russian origin. The effects of these invasive organisms on native zooplankton and crustaceans is unknown. However, studies of reservoirs in Kentucky and Illinois indicate that *Daphnia lumholtzi* may be replacing native Daphnia and other zooplankton species (Stoeckel and Charlebois 1999).

Kudzu, (*Pueraria montana* (Lour.) Merr.), is a terrestrial plant creeping in a northerly direction from its footholds in Mississippi, Alabama and Georgia. It currently covers an estimated 7 million acres in the southeastern U.S., and is already known to exist in southern Illinois. A native of Asia, kudzu can grow up to 50 feet in one growing season.

The gypsy moth, (*Limantria dispar*), is expected to arrive in western Illinois, and eastern Missouri and Iowa, within the next 5-10 years. Gypsy moths are known to feed on the foliage of hundreds of species of plants in North America, but its most common hosts are oaks and aspen.

Commercial Fishing

The targeted species of commercial fishermen on the Mississippi River are generally common carp, bigmouth and smallmouth buffalo, channel and flathead catfishes, and freshwater drum. The common carp, an introduced non-indigenous species, was first reported in the Mississippi River in 1883. Although total commercial harvest by weight has not changed that much in a century (6,200 metric tons in 1894 to 5,200 tons in 1987), the percentage of individual species within the catch has changed dramatically. In 1894, common carp averaged only 3 percent of the total harvest, but increased to 47 percent between 1953 and 1977. The decline in the harvest of buffalo fishes occurred with increased carp harvest. The decline in buffalo fishes may have resulted from competition with common carp and from destruction of their spawning habitat. (Wiener et al. 1998). Buffalo fishes made up 43 percent of the 1894 catch, but were down to an average of 22 percent of the 1953-1977 harvest. Grass carp is another non-indigenous species that has expanded upstream from the Lower Mississippi River. This species is now spawning successfully as far north as Illinois River tributaries and has also become a commercial harvest target.

Commercial fishing has been permitted within a few refuge divisions by issuance of Special Use Permits to help control carp and other “rough” fish that compete with native fish for habitat. In addition, these fish stir up bottom sediments, increase turbidity, and forage in beds of submersed plants. Grazing fish such as carp may inhibit re-establishment and growth of submersed aquatic vegetation. (Wiener et al. 1998). Populations of rough fish are reduced within refuge waters to improve water quality for growth of aquatic vegetation and to enhance habitat for native fish. (See Water Quality Goals and Objectives section).

Currently, commercial fishing is permitted at Big Timber Division and Swan Lake in the Calhoun Division. Occasionally, when the Mississippi River and Keithsburg Division become contiguous during periods of high water, commercial fishing within the Division has been permitted. During 1999, eight Special Use Permits were issued for fishing within the Big Timber Division and five for the Keithsburg Division. Four permittees were also issued Special Use Permits to commercial fish within Swan Lake. Native paddlefish use Swan Lake for spring feeding, but because their numbers have dramatically declined since 1900, commercial fishermen are not allowed to harvest them in Swan Lake. The fishermen have been requested to call the Illinois Department of Natural Resources fisheries biologists for on-site gathering of data when paddlefish are present. Concern about legal and illegal harvest of paddlefish for the lucrative caviar trade has resulted in Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) listings and proposals to ban harvest in some states.

In addition to the above areas, commercial fishing is being proposed within the waters of the Bear Creek Unit of the Long Island Division in this plan. Other areas, such as newly acquired lands, may be included if habitat conditions warrant these control measures. Permits require harvest reports and a fee to cover the costs involved with issuing the permits. Commercial fishermen may be contacted to salvage rough fish from impoundments when drawdowns occur. Some refuge waters are open to both commercial and recreational fishing opportunities. Potential conflicts between these two user groups will be addressed through commercial fishing special use permits and compatibility determinations written on a site-by-site basis.

Trapping

Trapping of furbearers is utilized occasionally as a management tool by Complex refuges to address infrastructure damage caused by muskrat and beaver. Muskrats construct houses from aquatic vegetation when constant water levels and adequate vegetation are available. However, when water levels remain too high or low, or when populations become too high, muskrats often resort to burrowing into roads and dikes. Their tunnels generate cave-ins, weaken roads and water management systems, increase maintenance costs and can create a safety hazard to visitors and staff. Beavers create quiet pooled waters by blocking the flow with sticks and mud. When culverts are blocked, effective water level management of refuge impoundments becomes difficult, if not impossible. Blocked ditches and culverts may also affect refuge neighbors by backing water onto private property. Such restriction of drainage is unwanted by landowners and can be a violation of state law.

Trapping is done by refuge staff when feasible or by issuing special use permits to local trappers. Since these services may be needed during a period of the year when muskrat or beaver have no commercial value, it is possible the refuge would need to arrange a contractual service to assist with reducing this type of problem. During the past 5 years trapping has been used one to three times at four divisions. The scope and scale of trapping within the Refuge Complex is so limited that no specific plan for this intermittent management activity will be prepared. The entirety of the program is defined here and management action is based on a site evaluation of conditions at the time damage is occurring. If it is decided that non-staff special use permit trapping will be utilized to address an occasional infrastructure problem, a site-specific evaluation will be documented. A compatibility determination for trapping on the Refuge Complex was published for public review as part of the Draft CCP in August 2003. The final compatibility determination can be reviewed at headquarters for each Refuge.

Environmental Management Program (EMP)

The Upper Mississippi River System-Environmental Management Program (UMRS-EMP) originated due to controversies over the proposed construction of twin 1,200-foot locks to replace Lock and Dam 26. Conflicts arose between further development of the navigation system and maintenance of the environmental values of the Upper Mississippi River System.

In 1978, Public Law 95-502 authorized the Lock and Dam 26 Replacement Project, but also directed the Upper Mississippi River Basin Commission to prepare a Comprehensive Master Plan for the management of the Upper Mississippi River System. The Master Plan was completed on January 1, 1982 and recommended, among other things, development of an Environmental Management Program (EMP). The environmental recommendations contained in the plan were tied to past, present, and future deterioration of fish and wildlife habitat of the river system, and were not to be considered as “mitigation” for any past or future lock construction. According to the Master Plan, the environmental recommendations were to be implemented by the U.S. Fish and Wildlife Service as the lead agency. However, Congress authorized the EMP for implementation by the U.S. Army Corps of Engineers under P.L. 99-662, the Water Resources Development Act of 1986. The Water Resources Development Act of 1990, P.L. 101-640 extended the authorization period for EMP an additional 5 years, through fiscal year 2002. In 1999, the Water Resources Development Act extended the EMP for an indefinite period and increased the annual authorization to over $33 million.

The purpose of the EMP is to ensure the coordinated development and enhancement of the Upper Mississippi River System, recognizing its several purposes while supporting "environmentally sustainable development." The primary elements of the EMP include: Habitat Rehabilitation and Enhancement Projects (HREP), Long Term Resource Monitoring (LTRM)[29]; and, new in 1999, the Habitat Needs Assessment (HNA). (See Monitoring Goal Section.)

The HREP program is making it possible for the Refuge Complex to convert 2,300 acres of open water with highly degraded habitat at Swan Lake to wetland and aquatic vegetation of value for big river fish and wildlife species. The costs of the project would prohibit the Service from achieving these goals without the partnership of the Congressionally funded program administered by the COE. Another project was constructed at the Big Timber Division to enhance the backwater habitat values. Projects are also being constructed, or near construction, at Batchtown, Long Island and Louisa divisions. The EMP will provide a mechanism to accomplish some of the habitat strategies outlined in this plan. While the construction cost of these projects is borne by the COE, interagency planning and subsequent operations and maintenance costs can be significant at the Complex Refuges. In order to sustain the Service share of this river restoration program, additional funding will be required.

Navigation Pool Water Level Management

About 260 miles of the AEC is impounded by the lock and dam system built in the 1930s by the Army Corps of Engineers. These dams were authorized by Congress and constructed in order to maintain a 9-foot navigation channel for commercial barge traffic. Waters backed up by the dams are known as "pools." The area just upriver of a dam is known as the headwater, and the area immediately down river is called the tailwater.

Water level elevations at the navigation system dams are regulated as a function of discharge, with specific operating plans for each dam. The COE strives to maintain a target water level at a specific location in a pool (control point) within a specific range of discharges (control range). At very low discharges, dam gates remain in the water impeding flow and backing up water to maintain the 9-foot navigation channel. As discharge increases above relatively low values, gates are raised, allowing more water passage in order to maintain the proper water level at the control point and avoid flooding adjacent property. As discharge increases toward the high end of the range of control, the water level in the tailwater increases until it is near the elevation of the dam's headwater. At discharges where a 9-foot channel would occur without the dams, the gates are raised above the water surface and "open river" conditions are said to exist.

The current operating procedures at each dam were established during the development of the navigation system, mostly to minimize land acquisition costs to the federal government. However, under the broad authority of the Secretary of the Army, operations may be tuned to produce benefits for environmental and social goals such as flood control, water quality, fisheries habitat, recreation, or other goals as long as navigation is not compromised. In recent years, the COE has been working with the Service and UMRS states to develop modified operation plans that would improve fish and wildlife habitat by partially re-creating historic low summer water levels in the navigation pools.

29. See the Monitoring section for more information on the LTRM, including its relationship and utility to the Mark Twain Refuge Complex.

Water level fluctuations play a major role in ecosystem processes in large floodplain rivers. Extreme floods can alter floodplain geomorphology and reset advanced stages of vegetative succession. More often, moderate floods maintain riparian vegetation in early successional stages and control the annual movement of carbon, nutrients, debris, and fish between the floodplain and the river channel. Lubinski's 1991 paper on UMRS water level regulation for fish and wildlife quotes the Junk et al. hypothesis that 'the principal driving force responsible for the existence, productivity and interactions of the major biota in river-floodplain systems is the flood pulse', and defines the area of the floodplain that is alternately wet and dry because of floods as the 'aquatic/terrestrial transition zone' (ATTZ).[30]

To achieve the objective of creating a continuous channel nine feet deep, the navigation dams were constructed to raise water elevations. The higher water resulted in more backwater and side channel aquatic habitat, but constant maintenance of higher water levels greatly reduced the ATTZ. Backwaters and side channels acted as sediment traps, greatly decreasing habitat diversity. The loss of historic low water periods that consolidated bottom sediments has resulted in flocculent sediments subject to resuspension by wind and waves. Increased turbidity has contributed to a decline in aquatic plant communities throughout the UMRS.

Since 1994, natural resource managers have worked with COE water control managers on experiments with water level drawdowns in Pools 24, 25 and 26, termed Environmental Pool Management (EPM). A pool drawdown of 0.5-2.0 feet for at least 30 days yields successful results for these pools. Pool drawdowns can occur between May and August, with the May-June period being the most desirable for vegetative growth, seed production and the predicted flows to accomplish the technique. After the initial drawdown, the goal is to allow the pool to rise at a rate not greater than 0.2-foot per day so that plants are not inundated too rapidly. Floods and droughts can affect the ability to achieve and maintain drawdowns without compromising flood control or navigation. In such years, drawdowns may not be possible. Discharge data compiled by the St. Louis COE District shows that a 0.5-foot drawdown could have occurred during 92 percent of the years since impoundment. Table 8 shows the predicted reliability of pool level management in the St. Louis District.

Table 8: Predicted Reliability of Pool Level Management in St. Louis District

Drawdown (feet)	Number of Years (59 total)	Percent Reliability
0.5	54	92%
1.0	51	86%
1.5	41	70%
2.0	36	61%
2.5	25	42%

EPM represents a large scale habitat management practice that mimics historic wet/dry cycles that produced the same type of responses. These drawdowns dry and consolidate flocculent sediments found in the lower end of the affected pool and permit aquatic plants to germinate, thus creating a wider diversity of habitat. The only other opportunity to accomplish such benefits, albeit on a smaller scale, is by isolating selected areas with low

30. Lubinski 1991

berms and installing infrastructure to permit drawdown and re-filling. Although the weather must cooperate to a greater degree for EPM than for impoundment management, its potential to impact larger areas throughout the upper river makes it an attractive management alternative.

Several studies have been initiated to monitor fish and wildlife use of vegetated areas produced by EPM. Timing of the drawdowns should be optimized to allow maximum growth of aquatic vegetation, but consider the possibility of stranding fish populations in backwaters. Bathymetric data is lacking for nearly all the impounded pools. Collection of this data would be invaluable in the EPM process because it would allow an estimate of the number of acres to be exposed during a drawdown. The 1994 drawdown exposed over 2,000 acres of floodplain backwaters in Pools 24, 25 and 26, producing a lush growth of wetland vegetation.

The restoration of wetland vegetation via EPM could benefit the entire Mississippi River ecosystem by reducing excess nitrogen and phosphorus input, and potentially contributing to the reduction of Gulf hypoxia. As upland run-off passes through vegetated wetlands, plants absorb these nutrients during growth periods, reducing output to the system. Also, as soils are allowed to dry, nitrogen is released from the soil into the atmosphere. A significant portion of the nutrients entering the Gulf come from the UMR north of the Missouri River, so expansion of EPM to the entire UMR lock and dam system has the potential to measurably reduce the amount of nitrogen entering the Gulf of Mexico. (See Water Quality section for more details.)

Many factors must be considered within each pool before any type of drawdown can be performed. These factors include maintenance of the 9-foot navigation channel, potential dredging program impacts, recreational impacts (e.g. marinas), and water intake supplies to cities. Careful consideration of the effects of drawdowns on all user groups must be weighed site-by-site, but the Refuge Complex is supportive of the concept and will encourage the practice with the Corps of Engineers wherever it is deemed feasible.

Management of Lands Associated with Agriculture Department (USDA)[31]

Conservation Easements

In the mid-1980s, Farmer's Home Administration (now Farm Service Agency, or FSA), foreclosed on many farm loans due to delinquent payments. One of the provisions in the 1985 Farm Bill requires FSA to protect wetland and floodplain resources on the default property prior to resale to the public. The Service assists the FSA in identifying wetlands and important floodplain resources on these properties. Once identified, the FSA assigns a perpetual conservation easement on the property and transfers management responsibility to the Service as part of the National Wildlife Refuge System.

Each refuge in the Complex is responsible for reviewing foreclosed properties in an assigned number of counties. Port Louisa NWR has been responsible for reviewing properties in 11 southeastern Iowa counties and 11 Illinois counties, stretching to the Indiana border. The Refuge has management responsibilities for permanent FSA conservation easements on seven properties in four Iowa counties, and five properties in

31. In addition to the active land management efforts described in this section, the Complex is involved with other technical service and coordination efforts with the USDA. See section, “Legal, Policy and Administrative Guidelines – Other Interagency Coordination – U.S. Department of Agriculture.”

four Illinois counties, totaling 759 acres. Another property located in Davis County, Iowa, was transferred to the County Soil and Water Conservation District for environmental education purposes.

Great River NWR has management responsibilities for 17 eastern Missouri counties. Seventeen permanent FSA conservation easements have been obtained, totaling 778 acres in eight different counties. Two other properties were acquired in fee title in Clark County (80 acres) and Lewis County (43 acres).

Two Rivers NWR manages 19 FSA conservation easements totaling 257 acres. Farm Service Agency inventory property review is limited to Pike, Calhoun, Greene and Jersey counties in Illinois. Also, a 269-acre easement referred to as the Apple Creek Division was transferred in fee title to the Service from FSA in Greene County.

The Quincy Complex Office has FSA property review responsibility for five west-central Illinois counties and oversees one 173.9-acre conservation easement in Schuyler County, Illinois.

Each station administers this program through the Partners for Fish and Wildlife Program. Management and enforcement of easements is a problem with current refuge staffing levels. Sub-dividing of easements due to land sales is increasing the number of landowners and impacts. Existing conservation easements are up to 2.5 hours drive from each office, making inspections and management difficult to achieve. Good working relationships and coordination efforts between refuge staff, other federal agencies, and local law enforcement personnel is critical to maintain the integrity of this program.

Private Land Assistance Through the Partners for Fish and Wildlife Program

The Partners for Fish and Wildlife (PFW) program focuses on restoring and enhancing wetland and grassland habitats that provide wildlife, fisheries, water quality and recreation benefits. The Refuge Complex staff provide technical and cost-share assistance to private landowners for wetland and upland restorations in 48 counties in Iowa, Missouri and Illinois.

Port Louisa NWR covers 11 southeastern Iowa and three west-central Illinois counties. Great River NWR has local coordinator responsibilities for 17 eastern and northeastern Missouri counties. Two Rivers NWR is accountable for private lands activities in 12 west-central Illinois Counties. The Quincy office is responsible for five west-central Illinois counties regarding private lands issues. The entire area covered by the Complex is within the UMR drainage basin and projects generally target the most erodible soil areas. Eighteen of the counties actually lie within the 500-year floodplain planning area.

Partners for Fish and Wildlife funding is used for cost-sharing wetland restorations, including water control structures and pipe, or upland restoration such as re-establishment of prairies. Landowners must agree to maintain the area for a period of 10 years or more. Within assigned areas, refuge staff also provide technical assistance to the state Departments of Natural Resources, FSA, NRCS, private conservation organizations, and private individuals on wetland issues, habitat conservation and enhancement, and regulatory requirements.

Goals, Objectives and Strategies Discussion

Habitat Goals

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Land and water resources within the UMR floodplain have been heavily altered for agriculture, development, navigation, and flood control. Due to these changes, wildlife habitat diversity has been reduced. According to the 1989 LTRMP land cover maps for the river corridor within the AEC, more than 53 percent is in agricultural production, while 17 percent offers a habitat consisting of floodplain forest. Only 2 percent of the coverage contained wetland vegetation while 4 percent was classified as grassland or wet meadow. Most of the fish and wildlife habitat remaining today is on public lands managed by the Service or States.

The Mark Twain Refuge Complex seeks to protect, enhance, and restore a natural diversity of habitat types sufficient to maintain healthy populations of native wildlife relying on the AEC. The Refuge Complex protects and enhances habitat where it still exists and restores it in appropriate places where it is lacking. Fish and wildlife habitats are intricate combinations of vegetation, soil, weather, water, invertebrates, etc. Service management control over some of the complex set of environmental conditions that make up "habitat" is minimal. Vegetation communities and species composition sometimes can be influenced using techniques such as water level control (flooding/drying), burning, discing, and planting. However, the river is often beyond management control. High water out-of-season can inundate or saturate soils, requiring adjustments to planned management actions. The strategies in this section are not intended to represent static conditions. The habitat within refuge units can oscillate between two or more cover types, often due to conditions outside management control.

As was mentioned earlier ("Need for Action/Planning Perspectives " on page 6), to help focus this decision process and to ensure that a broad array of wildlife needs were accounted on a landscape scale, a "Species Priority List" was generated for the Mark Twain Refuge Complex. These species were selected by developing a sub-set of the Regional Resource Priorities List. This list was first narrowed to all those priority species found within the UMR ecosystem, then to those found within the planning area, or AEC. The resulting list was further modified by considering Refuge purposes, the historic range, habitat types found within the AEC and whether there were major voids or duplications. These species are essentially "indicators" with associations across the spectrum of lower UMR habitats upon which the Refuge can relate the effect on wildlife of CCP habitat goals, objectives and strategies. The Complex refuges are not managing exclusively for these species. Species on the Complex priority list can be considered representatives of guilds, or other groupings, of species that are dependent on a particular type of Refuge habitat. For that reason they provide an identifiable link between a wildlife species and its associated habitat managed by the Complex.

Vegetation types used in this plan are based on the Habitat Needs Assessment (See Monitoring Section). The 155 vegetation cover types used in the existing LTRM database were organized into 18 data groupings for the HNA. For Mark Twain Complex planning and management purposes, this number has been further reduced into six major vegetation types (plus open water): wetland, forest, grassland, wet meadow, scrub-shrub, and agriculture. Future LTRM Land Use/Cover data will contain only 31 cover types, but both the old and new databases will yield the same result when combined to produce our six coverages.

Table 9 illustrates the number of species that have a very high association with the habitats managed by the Complex. The wildlife numbers on the table are up to twice as high for many habitats when including species with a high and/or moderate habitat association.

Plant composition is continually changing with trends in the environment, especially in the disturbance-prone habitats of floodplains. Nonetheless, vegetation patterns can be characterized by often-found groups of plants that together can explain prevailing environmental conditions. The floodplain of the Mississippi River has distinctive habitat zones because of differences in water flow, depth, and duration. The relative depth and duration of flow can be approximated by examining topographic and bathymetric data. Aquatic plant communities prevail at the lowest elevations. Communities dominated by submersed and floating aquatics indicate a place that is persistently flooded, year after year. Emergent stands will occur in areas of prolonged flooding, but at shallower depths. At higher elevations, where flooding is seasonal, terrestrial communities including floodplain forests, wet meadows, and grasslands predominate. Plant communities often are banded, following contours of flood frequency. (Galatowitsch, 1994)

As a result of changes planned and documented in the CCP, Refuge Complex habitats will be managed in a different proportion from the 1989 systemic coverage to the desired future condition in 2015. The following figures do not include lands within the proposed boundary or refuge lands outside the AEC at Apple Creek (Two Rivers) and the Iowa River Corridor Project (Port Louisa). Open water areas will be reduced from 5,200 acres to 2,900 acres. This is largely due to the conversion of Swan Lake (Two Rivers NWR) from a backwater and flocculent bottom and no aquatic vegetation to a harder bottom wetland that will support aquatics (primarily permanent and semi-permanent flooded emergents). The conversion will be the result of an Environmental Management Program (EMP) project that permits periodic drawdown. Within the Complex, all wetland types will increase by 4,500 acres to a total of over 9,000 acres. Forest habitats will increase by 4,630 to a total of 18,460. Grasslands increase from 725 to 1,900 acres. Agriculture decreases from 9,100 to 1,100 acres. Much of this agriculture conversion is due to areas acquired since 1989 being restored and converted to one of the above type habitats after purchase, along with a substantial shift in previous refuge management practices. However, farming continues to be an invaluable management tool for periodically setting back wetlands types, such as seasonally flooded emergent (moist soils). Scrub/shrub (875 acres), sand/mud (185 acres) and developed area (20 acres) cover types are changed very little due to the proposals.

It is difficult to accurately project the acreage figures for each type of planned habitat types for the areas within the expanded boundary proposal of the plan. These areas are private lands that have not been surveyed for wetland or other specific restoration project design. However, once purchase and restoration are completed, the flood prone areas

Table 9: Mark Twain NWR Complex Habitats and Prevalent Wildlife Associations

General Habitat Type for CCP Goals and Objectives	Cover Types for CCP Habitat Strategies	Habitat Needs Assessment (HNA)[1] Cover Type	Priority Species Ranked by HNA With a "High Probability of Occurrence' in Each Cover Type[2]	Total Number of Species with High Probability of Occurrence in AEC (Appendix B)			
				Birds	Mam.	Herps	Fish
Watershed / Aquatic	Open Water	Open Water (no vegetation)	Least Tern, paddlefish, pallid sturgeon, mussels.[3]	59	2	4	79
	Permanently Flooded Aquatics	Submersed Bed	Canvasback, Lesser Scaup	59	2	8	36
		Floating-leaved aquatic bed	Wood Duck	49	2	8	36
	Semi-permanently Flooded Emergents	Semi-permanently flooded emergent annual	Canada Goose, Wood Duck, Mallard, Teal	58	5	3	38
		Semi-permanently flooded emergent perennial	American Bittern, Canada Goose, Wood Duck, Mallard, Teal, Least Tern, Paddlefish	59	5	8	41
	Seasonally Flooded Emergents	Seasonally flooded Emergent Annual	Canada Goose, Wood Duck, Mallard, Teal, Canvasback	52	4	3	0
		Seasonally Flooded Emergent Perennial	American Bittern, Canada Goose, Wood Duck, Mallard, Teal, Least Tern	56	4	8	0
	Sand/Mud	Sand/Mud	Least Tern, Short-billed Dowitcher	41	0	0	0
Wet Meadow	Wet Meadow	Wet Meadow	Wood Duck, Mallard, Henslow's Sparrow	62	6	32	0
Scrub/Shrub	Scrub/Shrub	Scrub/Shrub	Wood Duck, Mallard, Teal	72	1	0	0
Grassland	Grassland	Grassland	Grasshopper Sparrow, Henslow's Sparrow	45	17	20	0

Table 9: Mark Twain NWR Complex Habitats and Prevalent Wildlife Associations (Continued)

General Habitat Type for CCP Goals and Objectives	Cover Types for CCP Habitat Strategies	Habitat Needs Assessment (HNA)[1] Cover Type	Priority Species Ranked by HNA With a "High Probability of Occurrence' in Each Cover Type[2]	Total Number of Species with High Probability of Occurrence in AEC (Appendix B)			
				Birds	Mam.	Herps	Fish
Forest	Wet Floodplain	Salix community	Red-shouldered Hawk, Yellow-billed Cuckoo	63	1	0	0
		Populus community	Red-shouldered Hawk, yellow-billed cuckoo	67	1	0	0
		Wet floodplain forest	Wood Duck, Bald Eagle, Red-shouldered Hawk, Cerulean Warbler, Indiana bat	91	21	24	0
	Mesic Bottomland	Mesic bottomland forest	Bald Eagle, Cerulean Warbler, Red-shouldered Hawk, Indiana bat	96	25	29	0
Agriculture	Agriculture	Agriculture[4]	Canada Goose	38	12	0	0

1. HNA species probability of occurrence for Agriculture included some passerine birds associated with pasture cover type.
2. These species were selected by developing a sub-set of the Regional Resource Priorities list.
3. Guild contains sheepnose, salamander mussel, round pigtoe, rock pocketbook, pistolgrip, monkeyface, Higgins' eye pearlymussel, fat pocketbook, black sandshell.
4. HNA species probability of occurrence for Agriculture included some passerine birds associated with pasture cover type.

identified in the Refuge Boundary Expansion section are estimated to yield approximately the same distribution of habitats current managed by the Complex in both the pool and open river portions of the river. For those locations above St. Louis habitat types are generally proportioned as; forest types 50 percent, wetland and aquatic types 30 percent, and other terrestrial types 20 percent. For newly acquired areas in the Middle Mississippi River forest types will likely be slightly higher while wetlands are projected to be slightly lower.

Goal 1 Discussion: Wetlands and Aquatic Habitat

Wetlands provide habitat for a wide variety of wildlife including ducks, shorebirds, marsh and wading birds, fish, reptiles and amphibians. On the Complex list of species of concern, nine birds, two fish, and the mussel guild have high probability of being found in at least one of the wetland vegetation types. In addition to fish and wildlife habitat, wetlands also serve water purification and flood storage functions. Because of wetland conversion to agriculture and changes in natural flood/drought patterns, the amount of wetland habitat providing natural wildlife foods has decreased significantly (see Floodplain Management). Wildlife managers have increasingly emphasized the importance of wetland restoration and management for healthy fish and wildlife populations.

Wildlife managers try to provide a variety of natural foods for migratory waterfowl and other wetland wildlife. Each food may accommodate nutritional requirements of different species at different times. Seeds, browse, tubers, invertebrates and crops are all important food items at various times. The higher the habitat quality and diversity of plant foods and invertebrates available to migratory birds, the greater the diversity of bird species that are attracted to the area.

Aquatic vegetation also plays an important role in structuring fish communities because many fish species use vegetation for feeding, refuge from predators, and spawning substrate. In the UMR, more than 80 species of fish use vegetated habitats during some stage of their life cycle (Janacek 1988). However, large expanses of highly dense submersed vegetation can result in problems with dissolved oxygen that are harmful to fish.

Wetland habitat strategies include purchase and restoration of former wetlands, and improvement of management capability and habitat quality on existing wetlands. Ability to manage existing wetlands varies from unit to unit within the Complex. Some areas are completely open to river pulses and have no independent water level control. Other units have varying elevation levels of protection by dikes and a variety of pumps, ditches, and water control structures to allow some water level management. Over 7,500 acres within the Complex can be manipulated to some degree in most years to achieve optimum growth of natural wetland vegetation for use by fish and wildlife. A combination of flooding, drying, mowing discing, burning, and agriculture are used to enhance wetland habitat on Louisa, Horseshoe Bend, Keithsburg, Delair, Clarence Cannon, Calhoun, Gilbert Lake, and Batchtown Divisions. Some potential for water level management also exists at Fox Island, given adequately low Mississippi River levels. Variation in flooding regimes and mechanical disturbance are used to encourage growth of the desired vegetation type in each wetland unit. Individual wetlands may contain a combination of vegetation communities at one time, or over a period of years. In addition, mud flats are typically exposed at the water's edge as wetlands recede. Refuge wetland units with good water control capabilities can be managed to provide mudflat habitat in the spring and fall to benefit migrating shorebirds. For Complex planning and management purposes, wetlands have been divided into four categories based on their HNA cover types - open water, permanently flooded aquatic vegetation, semi-permanently flooded vegetation, and seasonally flooded emergent vegetation.

Open Water

Open water areas contain no vegetation. Lack of vegetation may be due to many factors such as current, depth, water quality, etc. In backwaters and side channels that are devoid of vegetation due to sedimentation, turbidity, altered flood regimes, and other effects of navigation and flood control, the Complex seeks to increase wetland vegetation growth. Other open water areas are naturally free of vegetation and provide a variety of substrates for fish and wildlife. Deep open water with low current velocity provides fish overwintering habitat. “Big River” fish such as paddlefish and sturgeon use side channels and main channel borders for feeding. Gravel bars with water flow provide habitat for native mussels and some spawning fish. Other fishes are associated with gradually sloping sand bars, turtles nest on sand bars, and many shorebirds, gulls and terns use these exposed areas. The endangered Least Tern is a sandbar nester. Navigation structures such as wing dikes and partial closing structures can be designed to restore some open water habitat diversity such as slack water, plunge pools, and substrates for invertebrate colonization. The Service coordinates with COE and States throughout the entire AEC on issues related to open water habitats.

Permanently Flooded Aquatic Plants

Upper Mississippi River System submersed aquatic beds include about 30 species of plants, including pondweeds, waterweeds, and wild celery. Most are found at depths less than 1.5 meters in areas that rarely dry out. Submersed communities invest little in structural tissue, and so thrive when supported by the water column. Submersed aquatics will be found in a variety of semi-shallow, lake-like environments. Most species are rooted, but others (e.g. coontail) can float freely. A few fish species feed on plants, but most eat the macroinvertebrates found on the plants. Waterfowl feed on a variety of the plants, tubers, and the invertebrates they host, as do wading birds and shorebirds. Beaver and muskrats feed on stems and tubers. Of the priority species within the AEC, Canvasback and Lesser Scaup have a high probability of occurrence in this vegetation type.

Semi-permanently Flooded Vegetation

This category consists of two HNA classes: floating-leaved aquatics and semi-permanently flooded emergents. Floating-leaved aquatics are rooted in the substrate. Their leaves extend to the surface on a single stem where they spread flat. These species are restricted to low current velocity environments, usually less than 1 meter deep. They tend to form beds in deeper water than is optimal for emergent vegetation, but shallower than submersed aquatics. Floating-leaved plants support relatively few invertebrates compared to submersed beds, but the leaves provide feeding surfaces for insect-eating birds and many amphibians. The leaf mats provide shady refuge for fish and turtles. Waterfowl feed on the seeds; beavers and muskrats feed on the tubers.

The semi-permanently flooded emergent community is composed of a wide range of plants that grow in shallow water, e.g. bullrushes, cattails, arrowheads, and pickerelweed. The community can form dense thickets at the margins of stable shorelines, but most can tolerate periods of exposure. Emergent vegetation can withstand flooded conditions and exposed-but-saturated conditions because plants that grow there have an erect growth form with enough structural tissue to remain upright even when water recedes. Many species are prolific seed producers important to dabbling ducks and other seed-eating birds. Wading birds and shorebirds feed on small fishes and insects found in the vegetation. Amphibians, reptiles, and small mammals also use the seeds and macroinvertebrates associated with this group.

Of the priority species within the AEC, Wood Duck, Mallard, Blue-winged Teal, Least Tern, Canvasback, Canada Goose, American Bittern and paddlefish have a high probability of occurrence in this vegetation type.

Seasonally Flooded Emergents

This community occurs on mudflats associated with backwater lakes, sloughs, and impoundments. Normally, these sites are flooded throughout much of the year and are too wet for terrestrial plant establishment. However, during periods of low water levels in mid to late summer, these sites are colonized by wetland plants such as: wild millet, sedges, rice cutgrass and, in the northern reaches, wild rice. Seasonally flooded emergents provide food, cover, and nesting habitat for waterfowl, marsh birds, reptiles and amphibians, and small mammals. When inundated, fish spawn in the emergent grasses and feed on insects colonizing the detritus. Management for this class of vegetation is commonly referred to as "moist soil management."

Of the priority species within the AEC, American Bittern, Blue-winged Teal, Canada Goose, Canvasback, Least Tern, Mallard, and Wood Duck have a high probability of occurrence in this vegetation type.

Mudflats

When water is drawn down slowly during the appropriate times of the year, shorebirds are attracted to the available invertebrates. Some species may be attracted by shallow water, others by mudflats. Some forage at the edge of the receding water line. If the interface between mud and water remains constant, they can deplete the invertebrates available to them. A slow, continuous drawdown provides the birds with new habitat and invertebrates.[32] Many refuge units are managed to provide mudflats during shorebird migration periods as part of regular moist soil management techniques. The Complex refuges will include specific shorebird habitat strategies in their step-down habitat management plans.

The AEC provides important wetland and aquatic habitat for migrating birds along the Mississippi Flyway and for fish seeking spawning and overwintering areas. However, little data is available to determine an appropriate north-south spatial distribution of habitat in the river corridor. Until additional studies are completed, reviews of the literature and conversations with river biologists indicate that reasonable figures are: a minimum of 500 acres of wetland habitat every 60 miles for waterfowl, and overwintering and off-channel habitat every 5-7 miles for fish.

Goal 1. Wetlands and Aquatic Habitat:

Restore, enhance, and manage refuge wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.

Considerations: Vegetation types are based on the UMR Habitat Needs Assessment. In addition to the vegetation types, refuge divisions also provide unvegetated deepwater holes and channels (open water). The ability to control water levels and vegetation types varies between units and between years depending on flood regime, ground water table, elevations, soil type, and infrastructure. "Optimum Acres" indicates the preferred distribution of vegetation type in late summer/early fall during years of average flood regime and when the unit is not being managed for periodic setback of succession. More detailed wetland management background information is provided in Refuge Management Considerations Section.

Objective 1.A. Provide a 6-year average[33] of 2,200 acres seasonal, 1,800 acres semi-permanent, and 1,200 acres of permanently flooded wetland vegetation types in refuge wetland impoundments for waterfowl, shorebirds and other wetland-dependent wildlife species.

32. Eldridge, January 1992.
33. Average acreage figures represent 80 percent of total "optimum acres" for each habitat type on lands currently managed by the Mark Twain NWR Complex.

Strategies: Manage the following wetland impoundments to protect and enhance wetland vegetation:

Goal 1: Port Louisa NWR / Objective 1.A / Strategies 1.A

Strategy No.	Units	Total Wetland Acres	Vegetation Type of Optimum Acres				Additional Information
			SFE	SPF	P	OW	Additional Information: "✔" indicates that a unit can be managed to provide mudflat habitat for migrating shorebirds during drawdowns and refilling.
1.A.1	Keithsburg	408	4	108	80	216	✔Enhance water control through modification of existing spillways, and installation of water control structure. Dredge deep holes to improve fish habitat.
1.A.2	Louisa fields 4, 5, 12, 13, 14, 16, 17, 20, 21	524	147	343	25	10	✔Improve wetland habitat by scraping, filling ditches, standardizing water control structures, enhancing water delivery system to allow independent delivery. Periodically set back succession through mowing, discing, and/or burning.
1.A.3	Louis units 7 and 8	58	58	0	0	0	✔Improve water control by installing inlet structure from Goose Pond and outlet structure at Fox Pond, if feasible.
1.A.4	Louisa: Fox	53	0	10	0	43	✔
1.A.5	Louisa: Lake Odessa, Muscatine Slough, Goose Pond, Swarms Pond, Beebe Pond	468	64	131	6	267	Continue to coordinate water regime with IDNR.
1.A.6	Louisa: Prairie Pocket	45	0	0	0	45	Work with COE to obtain bathymetry data. Enhance fisheries habitat through dredging, if needed.
1.A.7	Horseshoe Bend, Rush Lake, Spitznogle Slough, Volunteer Marsh	183	74	73	0	36	✔ Open to river, with limited ability to control water levels when not flooded.
1.A.8	Horseshoe Bend, Mud Bottoms	133	0	133	0	0	Restored in 2000 by breaking tiles, installing ditch plugs and water control structures.

Goal 1: Great River NWR / Objective 1.A/ Strategies 1.A

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres				Additional Information
			SFE	SPF	P	OW	Additional Information: "✔" indicates that a unit can be managed to provide mudflat habitat for migrating shorebirds during drawdowns and refilling.
1.A.9	Delair: 4C, 7, 15A, Shoveler Marsh	87	87	0	0	0	✔ Convert fields 4C and 7 to wetlands if elevations are feasible. Supplemental pumping would be required. Enhance existing wetlands 15A and Shoveler Marsh through installation of wells.
1.A.10	Delair: Upper/ Lower, Swan Lake, Hanei/ Lower Hanei Marsh, Cattail Marsh, Lower Butcher	399	83	225	63	28	✔ These units do not dry out completely and usually cannot be mechanically manipulated. Install WCS and well to allow fall flooding of western portion of Cattail Marsh.
1.A.11	Delair: Lower Cattail Marsh	17	0	15	2	0	Restore water control by installing control structure in existing dike. Unit also provides 21 acres of scrub-shrub. (See Objective 3D).
1.A.12	Delair: Garner Slough	1	0	1	0	0	Potential to form partnership with adjacent landowner to enhance water control. Unit also provides 15 acres of scrub-shrub habitat. (See Objective 3D.)
1.A.13	Delair: South Marsh	27	0	27	0	0	Investigate methods to improve water level control.
1.A.14	Clarence Cannon 1,778 MSUs 1-8, 10-12, Goose Pasture, Big Pond, Rabbit Ears Pond, Supply Pond, Crane Pond	1,778	1,266	436	4	34	✔ Construct 25,000 gpm Mississippi River pump station to enhance management of all units in north half of Refuge. Install up to five wells to enhance shorebird management. Construct WCS to enhance management of Crane Pond.
1.A.15	Clarence Cannon 28, Rabourn Slough, Buttonbush pond, Display Pond, Heron Pond	28	0	8	9	11	These impoundments provide valuable wildlife habitat, but little water level control or habitat manipulation is possible. Investigate need for dredging in Rabourn Slough for deep water fisheries habitat. Renovate Display Pond shoreline by reshaping and stabilization.

Goal 1: Two Rivers NWR / Objective 1.A/ Strategies 1.A

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres				Additional Information
			SFE	SPF	P	OW	Additional Information: "✔" indicates that a unit can be managed to provide mudflat habitat for migrating shorebirds during drawdowns and refilling.
1.A.16	Calhoun: MSUs 1-7	285	285	0	0	0	✔ Scrape bottom of most of MSU-7 for more uniform water depths. Investigate alternativs to improve water supply to MSU 4.
1.A.17	Calhoun: MSU 8	29	29	0	0	0	✔ Convert existing crop ground to moist soil unit with dike, WCS, and portable pump.
1.A.18	Calhoun: Yorkinut, Duckpocket	27	27	0	0	0	Investigate alternatives for developing better water control.
1.A.19	Calhoun Swan Lake-Middle	1,058	347	404	269	38	✔ Do periodic (based on monitoring results) complete drawdowns for bottom solidification. Do annual partial drawdown to promote seasonally flooded vegetation around the perimeter.
1.A.20	Calhoun: Swan Lake - Lower	1,333	0	99	1,108	126	Do periodic (based on monitoring results) complete drawdowns for bottom solidification. Keep unit open to the river at other times for connectivity.
1.A.21	Calhoun: Schoolhouse	22	13	9	0	0	Continue management for bulrush marsh in center and seasonally flooded emergents around perimeter.
1.A.22	Gilbert Lake	237	21	210	1	5	Improve water level control by replacing pump system and dredging to improve drainage. Push back willows in upper end.
1.A.23	Gilbert Lake: S-Trap U-Trap	27	17	10	0	0	Develop water level control by rehabilitating dikes and WCSs and using a portable pump. Control willow encroachment and manage for moist soil conditions.
1.A.24	Batchtown: Prairie Pond	337	202	74	10	51	Improve drainage and fish habitat by dredging channel and deep holes. Push back willow encroachment along edges of waterways when dry enough.
1.A.25	Batchtown: MSU-1	55	55	0	0	0	✔ Install permanent pump. clean out ditches to improve drainage.

Goal 1: Two Rivers NWR / Objective 1.A/ Strategies 1.A (Continued)

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres				Additional Information
			SFE	SPF	P	OW	Additional Information: "✔" indicates that a unit can be managed to provide mudflat habitat for migrating shorebirds during drawdowns and refilling.
1.A. 26	Batchtown: MSU-2	17	17	0	0	0	✔ Convert from crop ground to wetland with low level dike, WCS, and portable pump. this MSU was a dredge disposal area constructed during Phase 1 of the Batchtown HREP in 2000.
1.A.27	Batchtown: Watson Pond	16	16	0	0	0	✔ Improve water level control by replacing stop log structure and adding portable pump sites. Push back and control wood encroachment.

Objective 1B: Protect, enhance, and maintain a 6-year average of 300 acres of isolated backwaters and ephemeral wetlands, providing seasonal and semi-permanently flooded wetland vegetation types in unleveed areas of the Refuge with little water level control for the benefit of migratory birds and other wetland -dependent species.

Strategies: Manage isolated wetlands to protect and enhance wetland vegetation as shown below:

Goal 1: Port Louisa NWR / Objective 1.B/ Strategies 1.B

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres			Additional Information Additional Information:
			SFE	SPF	OW	
1.B.1	Horseshoe Bend, Hall's Lake, Sunfish Lake, Diggins Slough, Iowa Pool	214	0	84	130	Evaluate fishery resources and methods of improving winter connectivity with the Iowa River.
1.B.2	Horseshoe Bend	24	0	15	9	
1.B.3	Big Timber: Isolated back-waters and ephemeral wetlands	27	8	15	4	Maintain and protect existing habitat.

Goal 1: Port Louisa NWR / Objective 1.B/ Strategies 1.B (Continued)

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres			Additional Information Additional Information:
			SFE	SPF	OW	
1.B.4	Fox Island: Coin Pond, Logsden Slough, Slim Slough, Nel-son Lake, Wil-low Lake	21	0	0	21	Determine feasibility of fall pumping on Coin, Logsden, and Slim by installing WCS and two wells.
1.B.5	Long Island	41	0	21	20	

Goal 1: Great River NWR / Objective 1.B/ Strategies 1.B

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres			Additional Information
			SFE	SPF	OW	
1.B.4	Fox Island: Coin Pond Logsden Slough Slim Slough Nelson Lake Willow Lake	21	0	0	21	Determine feasibility of fall pumping on Coin, Logsden, and Slim by installing WCS and two wells.
1.B.5	Long Island	41	0	21	20	

Goal 1: Two Rivers NWR / Objective 1.B / Strategies 1.B

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres			Additional Information
			SFE	SPF	OW	
1.B.6	Calhoun: Murphy Slough	27	0	27	0	Evaluate alternatives for improving backwater habitat.
1.B.7	Portage Islands	14	0	14	0	Evaluate alternatives for improving backwater habitat.

Goal 1: Middle Mississippi River NWR/ Objective 1.B/ Strategies 1.B

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres			Additional Information
			SFE	SPF	OW	
1.B.8	Wilkinson Island	125	40	60	25	
1.B.9	Harlow Island	100	80		20	

<u>Objective 1.C.</u> Protect, enhance, and maintain 3,000 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge for migratory birds and fish. Increase bathymetric diversity and wetland plant growth in these areas as feasible by 2015 where little or no local water level control exists.

Strategies: Protect and enhance contiguous aquatic habitat on refuge divisions as shown as follows:

Goal 1: Port Louisa NWR / Objective 1.C/ Strategies 1.C

Strategy Number	Units	Total Wetland Acres	Vegetation Type Average Acres			Additional Information
			OW	P	SPF	
1.C.1	Big Timber: Round Pond Little Denny Big Denny	81	18	52	11	Continue monitoring for desirability of future dredging.
1.C.2	Big Timber: Turkey Island Otter Island Main Island	100	36	28	36	Enhance permanent wetlands using potential techniques such as deepening, improving connectivity, and construction of partial closing structures. (Also will include 40 acres in SFE.)
1.C.3	Big Timber: other backwaters and side channels	213	92	115	6	Explore feasibility of environmental pool management to improve aquatic habitat on Big Timber.

Goal 1: Great River NWR / Objective 1.C/ Strategies 1.C

Strategy Number	Units	Total Wetland Acres	Vegetation Type Average Acres			Additional Information
			OW	P	SPF	
1.C.4	Long Island: Long Island Lake, Indian Graves Lake	146	138	0	8	Investigate need and potential benefits of dredging opening at mouth of lakes.

Goal 1: Great River NWR / Objective 1.C/ Strategies 1.C (Continued)

Strategy Number	Units	Total Wetland Acres	Vegetation Type Average Acres			Additional Information
			OW	P	SPF	
1.C.5	Long Island: O'Dell Chute	54	54	0	0	Dredge lower end of chute and construct closing structure to enhance deep water habitat. (Approved HREP project feature.)
1.C.6	Long Island: Canton Chute	1,250	1,250	0	0	In cooperation with partner agencies
1.C.7	Long Island: LaGrange Chute, Smoots Chute	617	604	0	13	Continue to maintain existing habitat.
1.C. 8	Fox Island: Fox River	23	23	0	0	Continue to maintain existing habitat.

Goal 1: Two Rivers NWR / Objective 1.C/ Strategies 1.C

Strategy Number	Units	Total Wetland Acres	Vegetation Type Average Acres			Additional Information
			OW	P	SPF	
1.C.9	Calhoun: 6-Mile Slough	23	23	0	0	Evaluate alternatives for improving backwater habitat at side channel; dredging and adding structures to maintain river connectivity and flow.
1.C.10	Batchtown: Church Gilead Other sloughs in the Maple Island Unit	431	389	8	34	Evaluate costs/benefits of dredging backwater areas that appear to be slowly filling in.
1.C.11	Portage Islands	10	10	0	0	Investigate need for dredging at lower end of backwater channel to improve connectivity.

Goal 1: Middle Mississippi River NWR / Objective 1.C/ Strategies 1.C

Strategy Number	Units	Total Wetland Acres	Vegetation Type Average Acres			Additional Information
			OW	P	SPF	
1.C.12	Harlow Island	12	11	1	0	Investigate feasibility of reconnecting remnant side channel with main channel by opening lower end and dredging to provide habitat for over-wintering fish.
1.C.13	Wilkinson Island	100	20	20	60	Develop active side channel at the upper end of Wilkinson Island. By connecting scour holes along a naturally occurring floodway, a 1.5-mile-long active side channel could be encouraged to form.

Goal 2 Discussion. Forest Habitat

Forest habitats within the floodplain are used by many wildlife species including migrating and nesting songbirds, waterfowl, raptors, herons, egrets, deer, small mammals, reptiles, and amphibians. Of the wildlife species on the Species of Concern List for the Complex, six have a high probability of utilizing at least one of the four forest types described in the HNA. These species are Bald Eagle, Red-shouldered Hawk, Cerulean Warbler, Wood Duck, Yellow-billed Cuckoo, and Indiana bat. Floodplain forests provide a different type of habitat than upland forests, as demonstrated by differences in presence/absence and abundance of different bird species. Floodplain forests support higher abundances of birds than upland habitats, in some cases nearly double the abundance (Knutson 1996, 1998). Species such as Brown Creeper, Yellow-billed Cuckoo, Yellow-bellied Sapsucker, and Great Crested Flycatcher show a clear preference for floodplain forests, and a few species, such as Red-shouldered Hawk and Prothonotary Warbler, are dependent on these forests (Fitzgerald and Pashley, 2000).

The amount of floodplain forest within the AEC has been significantly reduced from historic levels by clearing of land for agriculture and development. In addition, changes in flood frequency, duration, and depth resulting from impoundment and channelization have reduced the diversity within the remaining forests. Prior to European settlement, Upper Mississippi River floodplain forests were dominated by hackberry, elm, pecan, sycamore, willow, and cottonwood. Today, these forests are dominated by mature flood-tolerant silver maple. Less flood-tolerant hard mast species, such as oaks, have significantly declined. With sustained high water levels, little germination takes place, and seedlings are unable to survive the frequent floods. Absent restoration efforts, early successional stands of cottonwood and willow have declined due to the loss of large areas of mudflats and sandbars.

These changes could adversely affect species richness and relative abundance of some floodplain forest-nesting species. For example, species preferring the habitat structure provided by silver maples will likely increase on the UMR and those requiring the structure and/or mast provided by cottonwood, elm, and oak will likely decline. The

Complex seeks to restore and enhance the amount and diversity of floodplain forest within the AEC to meet the needs of forest-dependent wildlife. Three components of an improved floodplain forest component within the AEC are (1) reduced forest fragmentation (increased size of forest blocks), (2) increased diversity of habitat within those forest blocks, and (3) adequate spatial distribution of forest habitat throughout the length of the river corridor.

Fragmentation

Forest fragmentation occurs when large, contiguous forests are divided into smaller patches due to clearing of land for agriculture and development. During the past 150 years, much of the contiguous forest in the AEC has been lost, resulting in fragmentation of the remaining areas. Wildlife species richness increases as forest patches become more contiguous. Those species whose occurrence or reproductive success is reduced in small habitat patches are referred to as "area-sensitive." Many species of forest-dwelling birds, such as the Cerulean Warbler, are area-sensitive, but there is no simple answer regarding how big forest blocks need to be to support long-term self-sustaining populations. Sensitivity to forest fragmentation varies between species and between regions. The shape of the patch also affects the likelihood of finding area-sensitive species in a particular forest block. Round or square forest blocks provide less edge (and better quality habitat for forest interior birds) than narrow or irregular blocks. Research indicates that area-sensitive species generally tend to use forested areas that are at least 330 feet (100 meters) from an edge. The type of habitat in the surrounding landscape has an influence as well. The more forest that exists in the surrounding area, the more likely that a block will contain area-sensitive species. Isolation from other similar habitat significantly influences forest bird distribution and abundance in fragmented landscapes.

For example, Cornell Lab of Ornithology developed a table of minimum area requirements for Scarlet Tanagers, a moderately area-sensitive species. According to the study, if there is 40 percent forest in the surrounding landscape, block size in the Midwest must be at least 605 acres to provide high suitability for scarlet tanagers. If the surrounding area contains 70 percent forest, minimum block size drops to 66 acres. The Illinois Natural History Survey developed graphs giving estimates of the likelihood of encountering area-sensitive birds in forest patches of varying sizes in the Midwest. In an Illinois forest of 100 acres there is roughly a 70 percent likelihood of encountering a Wood Thrush or Red-eyed Vireo (moderately area-sensitive), and a 40 percent probability of encountering an Ovenbird (a highly sensitive forest species). The most imperiled area-sensitive species in the floodplain forest is the cerulean warbler, largely as a result of extensive loss of mature, deciduous forest habitat throughout its breeding range. Minimum area requirements for this species in the Middle Atlantic States have been estimated to be 1,750 acres, with maximum densities reached only when woodlands exceeded 7,500 acres (Fitzgerald and Pashley 2000).

Within the UMR, Knutson et al. 1996, found that wider riparian corridors can increase species richness. The fact that riparian forests are interspersed with marshes, sloughs, and lakes did not appear to have negative effects on species presence or abundance. On large rivers, Knutson recommended that floodplain forests be a minimum of 2,000 feet wide.

Establishing large forest tracts will not guarantee the presence of area-sensitive species and, conversely, these species are sometimes found on smaller tracts. But, in general, management activities that enlarge the amount of contiguous habitat are beneficial and actions that reduce tract size also reduce the likelihood that area-sensitive species will be found or persist there. Even when forest patches are large enough to attract area-sensitive species, mating success may be compromised until an even greater size threshold is reached. Some area-sensitive species will only establish breeding territories in the interior of large forest tracts, far from an edge. Others may attempt to nest in small forest blocks but are often unsuccessful due to high rates of nest predation (by jays, crows, raccoon, cats, etc.) and brood parasitism (notably by Brown-headed Cowbirds).

Studies of nesting success indicate that many forest bird populations are unable to produce enough young to balance adult attrition even in the largest forested tracts (up to 2,200 ha) in Illinois; it is only because of immigration from individuals outside the region that bird populations appear stable at some sites. Robinson et al. found high levels of parasitism in tracts as large as 3,300 acres in Illinois but substantial reductions in predation and parasitism in tracts in the size range of 25,000 to 62,500 acres. While little potential exists for restoring acreage of this size within the AEC, smaller tracts of forest may be able to support populations of less "cowbird-vulnerable" species of forest birds (Fitzgerald et al. 2000).

Diversity

A healthy floodplain forest that supports the full range of native wildlife species requires a diversity of forest structure that includes a variety of tree species, ages, canopy heights, and under story diversity. The HNA characterizes species diversity of Upper Mississippi River forest using four categories: willow, cottonwood, wet floodplain, and mesic bottomland communities.

Willow (*Salix*) and cottonwood (*Populus*) communities consist of pioneering trees, most often found nearest the banks of the river or slough. They are more flood-tolerant than most species, grow under full sunlight on bare soils, and are the first forest communities established after disturbance. Salix communities are most often associated with backwater lakes, sloughs, and side channels. Unless disturbed, willow stands will be replaced by wet floodplain forest species after 20-30 years. Willow thickets attract a variety of species including song birds, muskrats, beavers, and deer.

Populus communities are most often established on newly formed land at the downstream ends of islands and inside bends of meandering tributaries. Populus stands are likely to persist about 50 years before being overtaken by wet floodplain forests, but many individual trees typically survive much longer. They do not provide much wildlife food, but the leaf fall promotes secondary aquatic production and soil development. Communal nesting wading birds (e.g. Great Blue Herons and Great Egrets) and Red-shouldered Hawks often nest in the top-most branches of mature cottonwood stands and Bald Eagles use them for roosting and nesting.

As organic matter accumulates, conditions become favorable for other species to establish. Maple, ash, and sycamore soon colonize in cottonwood-willow communities. Trees and shrubs of these "wet floodplain" forests are shade tolerant and can establish under a canopy unlike those of cottonwood-willow communities. Consequently, in the absence of disturbance, these mixed forests may persist indefinitely. The community is flood tolerant up to a few weeks each year, but can be killed if inundated for long periods during the growing season. These wet floodplain forests occur at intermediate elevations on islands, riverbanks, floodplains, tributary deltas, and abandoned agricultural fields.

The wet floodplain forest is the most common type occurring along the AEC. River impoundment, increased flood frequency and duration, and increased sedimentation are thought to have benefited this forest type, although much has been lost due to clearing for agriculture and development. Remaining forests are mostly even-aged stands. Wet floodplain forest communities do not provide much wildlife food beyond deer grazing on saplings, but the leaf fall promotes secondary aquatic production and soil development.

Many neotropical migrant birds feed on insects and nest in the forest canopy, branches, bark, and snags. Indiana bats roost under the peeling bark of dead trees. Several groups of reptiles and amphibians are adapted to the moist woodland conditions of this forest type.

"Mesic bottomland" forests are commonly found on the floodplain of the Mississippi River at a slightly higher elevation than the wet floodplain communities. They are generally associated with natural ridges, and terraces. Although soils may be saturated for prolonged periods in the spring, extended periods of inundation are uncommon. A 1-foot or 2-foot difference in elevation can make a significant difference in the survival rate of mesic bottomland species. Common tree species include hard mast (nut) producers such as pin oak, bur oak, swamp white oak, northern pecan, and shellbark hickory. Mesic bottomland forests were once much more extensive along the Upper Mississippi River than their current limited status suggests. Natural regeneration has been poor due to river impoundment, the floods of 1973 and 1993, logging, conversion to agriculture, and elimination of associated prairies and fire disturbance. The remaining forests are mostly even aged stands. Mast producing species are a valuable food source for many wildlife species (e.g. waterfowl, deer, squirrels). Neotropical migrant birds feed on insects and nest in the forest canopy, branches, bark, and snags. Mesic bottomland forests also provide habitat for Indiana bats, small mammals, deer, reptiles, and amphibians.

Diversity of forest age also provides a variety of habitat types for wildlife and assures steady replacement of mature forest as trees become overmature and die. The COE forest management program in the Rock Island District has established a target for the ideal distribution of age classes. This standard calls for 20 percent sapling (0-4 inches dbh), 35 percent pole (4 inches to 12 inches), and 45 percent mature/overmature (greater than 12 inches). They are concerned that the present extensive stands of mature silver maple in the UMR are even-aged and a healthy distribution of younger trees is missing. As these forests mature, there is evidence that they may be replaced by shrub-scrub habitats with delayed regeneration of forests. To counteract this predicted outcome, the COE is harvesting small patches (less than 15 acres) from forest stands where trees are over mature. These canopy openings allow sun-loving species to regenerate, creating a diversity of canopy and under story heights. A few large trees are left in each cut area for use by wildlife and to provide a seed source. The COE has begun monitoring bird use of these cuts by conducting point counts annually at Pleasant Creek and Huron Island.

Greater diversity of tree species and age within the forest provides habitat for a greater diversity of wildlife species. For example, woodpeckers create nest holes for secondary cavity nesters including Prothonotary Warbler, Great Crested Flycatcher, Chimney Swift, Tree Swallow, and House Wren. These cavity nesters need an abundant supply of dead trees and snags. Cerulean Warblers nest in a variety of trees but seem to prefer large oaks, elms, and sycamores. Oaks have been reported to be an integral component of Cerulean Warbler breeding habitat. They also prefer forests with a high canopy, moderate to high vertical structural diversity, and moderate to dense ground cover. Red-shouldered Hawks also are forest interior breeders, preferring large blocks of mature riparian forest with a high closed canopy and low ground cover. Conversely, the Yellow-billed Cuckoo prefers open riparian woodlands with clearings and low dense scrubby vegetation. They are often found in early successional willow/cottonwood forests with dense stands of small trees. Indiana bats typically roost under the loose bark of larger dead trees.

Spatial Distribution

Floodplain forests within the AEC provide an important migratory pathway for neotropical forest-dwelling birds moving between breeding and wintering grounds. Migrating neotropical birds need stopover sites with adequate food to replenish fat reserves and protection from predators. As with breeding birds, plant species and structural diversity influence habitat suitability and can affect the rate at which migrants replenish their energy reserves. Because migrants feed both on fruit and insects, forest management techniques that foster adequate production of these should improve the tracts' suitability as stopover sites (Fitzgerald et al., 2000). Block size may be less critical for migrating birds than the spatial distribution of habitat along the migration corridor. Smaller tracts that do not support breeding populations may provide valuable stopover habitat for in-transient migrant birds needing to replenish fat supplies. Moore et al. 1992 suggests that a matrix of widely distributed habitats may be more effective than a small number of large habitat areas. Adequate spacing of migratory stopover habitat has not been well-defined and may not be a limiting factor within the AEC. As additional information becomes available through refined GIS data and HNA, the Complex will adapt its land acquisition and forest restoration strategies and priorities to meet those needs.

Refuge Complex Forest Management

A step-down management plan will be developed in partnership with Corps of Engineers foresters to achieve healthy floodplain forest diversity of adequate size and distribution. Management actions may include a selective harvest program in some areas to create early successional forest, diversity of canopy heights, and diversity of understory. Species diversity will be enhanced where feasible through planting of Root Production Method (RPMr) trees. This nursery method produces many lateral roots on seedlings instead of one long taproot through tree seedling root pruning. Trees that would normally take 20 years to produce acorns can begin producing in 3 or 4 years when planted with the RPM method. The expanded root system close to the surface also provides greater resistance to flood damage. RPM trees appear to have faster growth and greatly improved survival in the floodplain compared to plantings of acorns or bare-root seedlings. These plantings are being evaluated at several sites in the Upper Midwest. Hard mast trees will only be planted on higher elevation areas of the AEC. One or 2 feet of elevation can make a substantial difference in survival of hard mast trees in the floodplain. In some instances, elevation may be raised slightly using dredge material from side channel improvement projects or navigation channel maintenance. Forest fragmentation and spatial distribution will be addressed through a combination of land acquisition, conversion of former agricultural fields, and protection of existing forest tracts.

Goal 2. Forest Habitat:

Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.

Considerations: Important components of healthy floodplain forest include adequate block size to provide habitat for area-sensitive nesting neotropical migrants, adequate spatial distribution along the river corridor to provide stopover sites for feeding and resting birds during migration, and adequate diversity of forest structure within the blocks to provide for the habitat needs of a wide variety of forest-dwelling wildlife species. Factors influencing the definition of “adequate” are discussed in the narrative above and have been considered in development of these objectives and strategies.

Objective 2.A. Conserve and enhance floodplain forest block size and spatial distribution along the river corridor through management of existing 18,000 acres and restoration of an additional 800 acres by 2011 for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife.

Strategy 2.A.1. Maintain existing tracts of floodplain forest on the refuge. Some existing forest areas may require active management to maintain overall health. A step-down plan will be developed to determine management needs for each unit. (See strategy 2.B.1.)

Goal 2: Port Louisa NWR / Objective 2.A/ Strategies 2.A.1

Division	Acres of Existing Forest	Additional Information
Louisa	871	Louisa also contains 37 acres of upland forest on the bluff near Headquarters.
Keithsburg	672	
Big Timber	1,278	
Horseshoe Bend	580	

Goal 2: Great River NWR / Objective 2.A/ Strategies 2.A.1

Division	Acres of Existing Forest	Additional Information
Long Island	5,620	Rip rap portions of bankline to protect forest habitat from further loss. (Approved HREP project feature.)
Delair	512	
Fox Island	1,716	
Clarence Cannon	798	Large percentage of hard mast trees were killed by 1993 flood.

Goal 2: Two Rivers NWR / Objective 2.A/ Strategies 2.A.1

Division	Acres of Existing Forest	Additional Information
Batchtown	1,207	Extend off-bank revetment (rock wall) north to fully protect shoreline and prevent loss of forest.
Calhoun	1,275	
Gilbert Lake	295	
Portage Islands	110	Construct hard points or revetment to promote island growth, protect island heads, and prevent loss of mature forest.

Goal 2: Middle Mississippi River NWR / Objective 2.A/ Strategies 2.A.1

Division	Acres of Existing Forests	Additional Information
Wilkinson Island	2,238	
Harlow Island	1,190	

Strategy 2.A.2. Convert refuge units to floodplain forest. Many of these areas will be left idle for natural succession to floodplain forest to reduce forest fragmentation. Depending on elevation and flood frequency/duration, sites that might be suitable for future hard mast plantings are also included under strategy 2.B.3. All of these areas also will provide age/ structural diversity during the regeneration process.

Goal 2: Great River NWR / Objective 2.A/ Strategies 2.A.2

Division	Units	Acres	Additional Information
Fox Island	All	483	
Long Island	Field 7	94	Approved HREP project feature. (About 60 acres of this field will be planted with hard mast species.)
Clarence Cannon	F1, F2	64	

Goal 2: Two Rivers NWR / Objective 2.A/ Strategies 2.A.2

Division	Units	Acres	Additional Information
Batchtown	F1-F11	67	F1 and F5 are dredged material disposal sites used for the HREP in 2000. Oaks were planted in F2, F3, F6, F9, F10 and F11 in 1994-95. Some have survived, but no additional platings are planned for these areas. F5 will be planted to hard mast if elevations are suitable. Field will be converted to forest. Not suitable for wetland conversion due to small size (cost/benefit of O&M) and lack of access. Hard mast trees will be planted if elevations are suitable.
Calhoun	F3, F4, F6-11	170	Hard mast trees were planted in parts of F4, F8, F9, F10 and F11 in the middle 1990s with varying survival rates. F7 was planted to grass in the early 1990s and F3 and F6 are agricultural fields that will be converted to hard mast trees. (See 2.B.3)
Gilbert Lake	F1	10	Hard mast trees were planted in 1995 but did no survive. allow natural revegetation.
	F2	28	Field will be converted to forest, and will also include hard mast plantings.

Objective 2.B. Conserve and enhance structural (age and species) diversity on 2,500 acres of refuge floodplain forests by 2015 for the benefit of neotropical migrants, raptors, bats, and cavity nesting birds.

Strategy 2.B.1. Develop a forest management plan for the Complex. The plan will detail the management actions needed for long-term maintenance of healthy bottomland forest habitats, in cooperation with the Corps. The plan might include replanting flood-damaged areas, selective cutting, and/or prescribed fire in some areas. Plan implementation will result in an appropriate diversity of forest structure including diverse canopy, understory, age, and species.

Strategy 2.B.2. Maintain existing hard mast (mesic bottomland) component. The forest management plan will determine best management techniques.

Goal 2: Port Louisa NWR / Objective 2.B/ Strategies 2.B.2

Division	Acres of Existing Hard Mast Trees	Additional Information
Louisa	224	Maintain through possible selective thinning of the mature hard mast trees near Goose Pond and in the 18-acre pecan grove. Mow around saplings in pecan grove. Work with Forrest Keeling Nursery to collect pecans and maintain seed bank.
Keithsburg	31	Explore alternatives for maintaining the mature hard mast trees that survived the 1993 flood in the north end of the unit.
Big Timber	185	

Goal 2: Great River NWR / Objective 2.B/ Strategies 2.B.2

Division	Acres of Existing Hard Mast Trees	Additional Information
Long Island	1,680	Large block of mature hard mast trees.

Strategy 2.B.3. Plant hard mast (mesic bottomland) trees on suitable sites. The forest management plan will evaluate each Division in more detail to determine the best sites for planting, but these are currently thought to be potential sites:

Goal 2: Port Louisa NWR / Objective 2.B/ Strategies 2.B.3

Division	Unit	Potential Acres	Additional Information
Horseshoe Bend	Northwest corner	29	Plant higher elevations in northwest corner.

Goal 2: Great River NWR / Objective 2.B/ Strategies 2.B.3

Division	Unit	Potential Acres	Additional Information
Clarence Cannon	Bryants Creek	122	Convert Field 25 and MSU 9 to green tree reservoir by planting hard mast trees and installing two water control structures.
	GTR-7	105	Plant hard mast trees to restore 1993 flood damage. Flood periodically during fall waterfowl migration.
	Fields 3, 4, 5 and Part of Field 15	40	Supplement existing plantings with additional hard mast plantings.
Fox Island		339	Plant selected sites above elevation 488.
Long Island	Field 7	60	Approved HREP project feature.
Delair	Field 6	10	Convert to hard mast trees.
	15B, 15C, 20, 21, 22, 23, Hanei Fields	214	Supplement existing plantings with additional hard mast plantings.

Goal 2: Two Rivers NWR / Objective 2.B/ Strategies 2.B.3

Division	Unit	Potential Acres	Additional Information
Batchtown	Field 5	10	Plant portion used for HReP dredge material disposal. Remainder will be allowed to covert by natural regeneration.
Calhoun	Field 3, Field 6, Field 7	85	Agricultural fields to be planted with hard mast trees.
	AG3, AG4, AG5	246	Adaptive management focus area. May be converted to forest if future monitoring indicates low waterfowl utilization of agricultural crops.
Gilbert Lake	Field 2	28	Convert from cropland to forest.

Goal 2: Middle Mississippi NWR / Objective 2.B/ Strategies 2.B.3

Division	Unit	Potential Acres	Additional Information
Harlow	Scattered	191	Higher elevations of former cropland.
Wilkinson	Scattered	43	Higher elevations of former croplands and levees.

Strategy 2.B.4. Leave large dead trees in place on all divisions for Indiana bats and cavity-nesting birds. Dead trees creating a safety hazard will be removed.

Strategy 2.B.5. Use the deer hunting program as a tool to maintain forest understory quality by reducing browsing damage to bottomland forests where determined necessary by monitoring.

Strategy 2.B.6. (Great River NWR, Clarence Cannon). Allow cottonwood seedlings to grow to maturity along selected service roads to provide roosting sites for Bald Eagles.

Strategy 2.B.7. Study bird species composition and productivity in early successional forests of the Upper Mississippi River to evaluate the importance of this habitat type and to provide information for making forest management decisions.

Strategy 2.B.8. Work with navigation industry, the public and the COE to eliminate the forest resource damage done by approved and non-approved barge fleeting activities by 2004. Accomplished by moving fleeting out from shorelines to off shore locations under Section 10 permits.

Goal 3 Discussion. Other Terrestrial Habitats

Grassland

Floodplain grasslands are composed of mesic to xeric grasses and forbs, and may occur mixed with trees as savannas. They are intolerant of prolonged flooding. Without disturbances of fire or mowing the community tends to progress toward later successional woody stages. Grassland communities are rare compared to their former occurrence because they were widely converted to agriculture and urban development on high elevation floodplains and terraces. Most former grasslands in the AEC are now behind high levees, protected from 100-to-500 year flood events.

Grasslands provide forage for herbivores, abundant seeds, and cover. Grasshopper Sparrow and Henslow's Sparrow are AEC species of concern with a high likelihood of occurrence in grassland habitat. Many species of grassland birds have declined significantly in the past 30 years, probably due in large part to loss of habitat. Many grassland bird species are area-sensitive. Because area requirements (50 percent probability of occurrence) of Henslow's Sparrows and Grasshopper Sparrows have been shown to be relatively large in fragmented landscapes in Illinois (140 and 125 acres respectively), management for these species should focus first upon tracts of grassland as large or larger than those sizes. In less fragmented landscapes, where a high proportion of grassland exists in the matrix surrounding the patches, the same species may be less area-sensitive. Refuge Complex management will focus on areas at least 150 acres in size.

These acreages are only minimal areas for a reasonable probability of species occurrence, not minimal areas required for self-sustaining populations. Studies have shown that larger populations have a greater probability of persistence. However, little information is available on what constitutes a viable population size for most grassland species. Areas that are much larger than a species' minimum area of occurrence will likely be required to ensure the long-term survival of area-sensitive species.

Small fragments also have a greater proportion of edge habitat than larger fragments. Several studies have shown that nesting success of grassland birds is lower when nests are placed in close proximity (150-200 feet) to a forest edge, apparently due to nest predation. Grasshopper Sparrows rarely attempt to build nests near edges.

Finally, the structure of the vegetation within a patch also plays a role in determining what species are attracted to a site where patch size and landscape conditions are adequate. For example, Henslow's Sparrows seek dense, tall grass cover and a deep litter layer characteristic of relatively undisturbed prairies. Little habitat for Henslow's Sparrows exists in landscapes dominated by cropfields, annually mowed hayfields, or heavily grazed pastures. In contrast, Grasshopper Sparrows seek grass cover of intermediate height with low to moderate litter depth interspersed with patches of bare ground.

Grasslands are disturbance-adapted systems. In the absence of periodic disturbance, invasion of woody plants occurs, and fewer grassland bird species and individuals are supported. Fire is one of the most important types of disturbance for suppressing woody encroachment, decreasing litter cover, and improving grass and forb production, thereby maintaining bird species diversity. Some grassland bird species are reduced immediately following a burn, while others are increased. Grazing and mowing/haying also limit vegetation height, litter accumulation, and woody encroachment. Grazing can benefit bird species that prefer short to medium height vegetation, although moderate to heavy grazing can be detrimental to Northern Harriers, Short-eared Owls, Sedge Wrens, and Henslow's Sparrows. Bird species' response to mowing and haying is similar to their response to fire. Species such as Sedge Wren, Henslow's Sparrow, and Dickcissel are negatively affected immediately following mowing, while others such as Upland Sandpipers, Horned Larks, and Killdeer are consistently more abundant on recently burned or mowed grasslands. Management actions must be timed to reduce negative effects to nesting birds. As a result of different habitat preferences, bird responses to various forms of grassland management are variable. Some bird species are more abundant in areas recently managed by fire, grazing, or mowing, while others are more abundant in undisturbed areas. Land managers, therefore, strive for a rotational system of management that provides a mosaic of grassland habitat types.

The greatest potential for restoring large tracts of grasslands in the Midwest occurs in the Great Plains outside of the AEC for this plan. Grassland restoration within the floodplain is risky due to the potential for flood damage. In some cases, however, grassland restoration is appropriate within the Mark Twain reach of the UMR. Small tracts have been established for maintenance purposes on levees, for protection of cultural resource sites, or for use in environmental education and interpretive programs. Several remnant sand prairies, formed from sand deposited by glacial meltwaters, can be found on the Louisa and Keithsburg divisions of Port Louisa NWR. Sand prairie plant communities are a mix of native tallgrass prairie species and plants more commonly associated with the western U.S., such as prickly pear cactus. The Illinois chorus frog, a state-listed threatened species, is restricted to sandy floodplains, so sand prairies provide ideal chorus frog habitat (www.inhs.uiuc.edu). The sand prairies of Port Louisa NWR are potential seed sources for future restorations.

A large block (more than 1,500 acres) of the Horseshoe Bend Division of Port Louisa NWR has been restored successfully to native prairie, wet meadow, and wetland habitat under a management plan that was developed for the Division following acquisition. A 1995 bird survey on Horseshoe Bend found more than 100 species including Grasshopper Sparrow, Savannah Sparrow, Eastern Meadowlark, and Dickcissel. Birders on an Audubon Society visit to the unit in 1999 reported seeing and hearing Henslow's Sparrows, a highly area-sensitive grassland species.

Wet Meadow

Wet meadows are most often found along protected backwater areas, at higher elevations than emergent marshes, in areas flooded for brief to moderate periods during the growing season. Characteristic plants include prairie cord grass, rice cutgrass, panic grass, sedges, and marsh aster. An occasional willow or buttonbush also may be found in wet meadows. The dense growth provides cover and nesting habitat for reptiles and amphibians, marsh birds, and small mammals. When inundated, fish spawn in the emergent grasses and feed on insects colonizing the detritus. Three AEC species of concern (Henslow's Sparrows, Mallards, and Wood Ducks) have a high likelihood of occurrence in wet meadow habitat. Habitats such as wet meadows are affected not only by conventional grassland management activities but also by water level manipulations. Thus, water level manipulations must be carefully managed to maintain wet grassland and sedge communities. Too little water can cause conversion to forest. Too much water can alter the vegetation composition and result in lower habitat quality for grassland and wet meadow wildlife.

Scrub-Shrub

Scrub-shrub wetlands are characterized by small, woody vegetation, primarily buttonbush and scattered willows that are less than 20 feet tall. Along the Upper Mississippi and Illinois rivers, scrub-shrub wetlands represent a successional stage in the transition of an emergent wetland to a forested wetland. Unless sedimentation rates are very high, this community can be relatively stable. With high rates of sedimentation, these areas are likely to convert quickly to forest. Buttonbush can be important an important waterfowl food source by providing nutlets and associated invertebrates. The community attracts wading birds, marsh birds, upland game birds, song birds, beaver and muskrats. Of the AEC priority species, Wood Duck, Blue-winged Teal, and Mallard have a high likelihood of occurrence in scrub-shrub habitat. Buttonbush is the preferred vegetation type for the copperbelly water snake, a rare species recently confirmed on the Louisa and Big Timber divisions. Management techniques that reduce sedimentation and willow encroachment along wetland edges can promote scrub-shrub habitat.

Agriculture

Agricultural grains can provide a concentrated source of the high energy needed by waterfowl to maintain body temperature and fat reserves during migration, reproduction, and overwintering. A diversity of invertebrate and vegetative foods (agricultural and natural) is needed on migration and wintering areas to meet the nutritional demands of waterfowl and to provide them with a complete diet. Loss of wetland habitat within the Mississippi Flyway has severely reduced the amount of natural foods available to wildlife and increased the importance of agricultural foods, such as corn, to supply their nutritional needs. “Most species of ducks prefer to forage in wetlands or artificially flooded areas when sufficient food is available. However, after foods become depleted, some waterfowl species (such as Mallards and Canada Geese) readily venture into upland sites in search of waste grain and other foods” (Havera 1999).

There are extensive agricultural areas surrounding Refuge Complex lands, but efficient harvest techniques and fall plowing have resulted in little waste grain being available for waterfowl on most privately-owned fields. In addition, most private lands in the area are heavily hunted during waterfowl season. Crops on Complex lands provide feeding and resting areas for waterfowl in unhunted sanctuaries during fall migration. The Complex provides a variety of grains (including corn, wheat, rye, milo, buckwheat) for waterfowl in varying amounts annually. Soybeans provide little wildlife value, but they add nitrogen to the soil and are sometimes planted for the farmer's share under the cooperative farming program. Crops are selected based on factors such as wildlife value, crop rotation needs, drought and flood tolerance, growing season, and ability to fix nitrogen. Other wildlife, such as deer and turkeys, can also benefit from the Refuge Complex crops.

Although agricultural grains can provide a high-energy carbohydrate source for wildlife, they provide only a portion of the total nutrients needed and therefore are only used as a supplement, not a substitute, for natural wetland foods. Crops planted for wildlife are generally low in protein and lacking in minerals and other nutrients that waterfowl need for good health. In fact, ducks fed an exclusive diet of corn steadily lose weight and after 100-120 days begin to die due to nutritional deficiencies. Wetland plants generally contain a better balance of nutrients. In addition, agricultural crops benefit only a limited number of wildlife species. Fredrickson and Taylor (1982) recorded 80 percent more species visiting managed moist-soil wetlands than fields of row crops. The diverse array of species in the seasonal wetlands included mammals, herons, rails, small passerines, and upland game birds.

Agriculture also is used on the Refuge Complex as a rotational tool to set back natural succession in wetlands. Unmanaged wetlands in the UMR floodplain can quickly convert to weeds, grassland, or forest depending on their elevation and the weather conditions during the growing season. Farming is one of the tools used to maintain long-term productivity of wetland units.

A third purpose of the agriculture program in the Complex is to maintain open conditions in units prior to conversion to another habitat type. Funding and staff constraints may delay desired habitat restoration (hardwood forest, grassland, wetland) for several years. If the areas are left idle, they can quickly grow up to thick stands of willow, cottonwood, and weeds. Nearly all areas on the Complex suitable for conversion to moist soil units have already been converted. This type of seasonal wetland is most scarce along the Middle Mississippi where the Complex will seek to acquire and reduce agricultural areas to increase seasonal wetland habitats and convert to wetlands where possible.

Goal 3. Other Terrestrial Habitats:

Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl, and neotropical migrants.

Considerations: Wet meadow and scrub-shrub cover types exist in the zone between wetland and terrestrial habitats and could be considered under either category. Both are treated under the terrestrial objective for purposes of this CCP. Wet meadows are often managed in conjunction with adjacent grasslands using similar techniques. Scrub-shrub habitats typically border existing floodplain forest. Both are treated under the terrestrial objective for purposes of this CCP.

Objective 3.A. Provide three large areas (>150 acres) of contiguous native grassland/wet meadow complexes on refuge divisions by 2010 to benefit migrating as well as declining nesting populations of grassland birds.

Strategies: Protect, enhance, and restore large grassland/wet meadow complexes on refuge units shown below:

Goal 3: Port Louisa NWR / Objective 3.A/ Strategies 3.A

Strategy No.	Unit	Acres Grassland	Acres Wet Meadow	Additional Information
3.A.1	Horseshoe Bend	807	634	Maintain native grasslands through mowing, prescribed fire, possible grazing, etc.

Goal 3: Great River NWR / Objective 3.A/ Strategies 3.A

Strategy No.	Unit	Acres Grassland	Acres Wet Meadow	Additional Information
3.A.2	Fox Island: Logsden Tract	71	11	Plant native grassland and wet meadow species on 90 acres of former farm fields adjacent to 400-acre MDC Rose Pond Conservation Area grasslands.
3.A.3	Clarence Cannon: WM-2	1	229	Experiment with managing unit as wet meadow habitat through prairie cordgrass plantings, water level manipulation, burning, exotic grass control.

Objective 3.B. Maintain 500 acres of smaller patches of grassland habitat where established for levee maintenance, cultural resource protection, or environmental education using techniques such as mowing, prescribed burning, and/or spraying of undesirable vegetation as needed (typically on a 3- to 5-year cycle).

Strategies: Maintain small grasslands on the following divisions:

Goal 3: Port Louisa NWR / Objective 3.B/ Strategies 3.B

Strategy No.	Unit	Acres	Additional Information
3.B.1	Keithsburg: Sand Prairie	1	Maintain with fire to promote natural diversity of dry prairie grasses/forbs. Site provides potential seed bank for future sand prairie restorations.
3.B.2	Keithsburg Levee	45	Burn periodically to maintain switchgrass.
3.B.3	Louisa 18 and 19	18	Maintain newly restored wet prairie grasses.
3.B.4	Louisa Sand Prairie	23	Water level control will be enhanced when strategy A.24 is implemented.

Goal 3: Port Louisa NWR / Objective 3.B/ Strategies 3.B (Continued)

Strategy No.	Unit	Acres	Additional Information
3.B.5	Louisa: Teaching Prairie	5	
3.B.6	Louisa: Trail Base	8	
3.B.7	Louisa: Michael Creek Levee	9	

Goal 3: Great River NWR / Objective 3.B/ Strategies 3.B

Strategy No.	Unit	Acres	Additional Information
3.B.8	Delair: Swan Lake grassland	45	Includes Field 1; native grasses have been established to protect cultural resources.
3.B.9	Clarence Cannon: Main perimeter levee, interior dikes	214	

Goal 3: Two River NWR / Objective 3.B/ Strategies 3.B

Strategy No.	Unit	Acres	Additional Information
3.B.10	Calhoun: Office Prairie	23	Established for environmental education purposes.
3.B.11	Calhoun: GL1	41	Convert crop ground to grassland if adjacent private land is acquired and converted to grassland.
3.B.12	Calhoun: GL-2, GL 3, GL-4	95	Convert cropland to grassland to provide buffer strips.
3.B.13	Gilbert Lake, west side of GL-1	43	Native grasses have been planted to protect cultural resources.
3.B.14	Gilbert Lake, east side of GL-1	17	Establish cool season grasses on eastern portion for green browse.
3.B.15	Gilbert Lake GL-2	13	Maintain cool season grasses to protect cultural resource area.

Objective 3.C. Provide a 6-year average of 400 acres of smaller wet meadow areas for marsh and grassland birds and spring foraging waterfowl using a combination of water level manipulation, mowing, discing, and burning. Water level manipulations may occur annually; other techniques are typically necessary on a 3- to 5-year cycle. Most sites border existing wetland or grassland units.

Strategies: Manage small wet meadow sites on the following divisions:

Goal 3: Port Louisa NWR / Objective 3.C/ Strategies 3.C

Strategy No.	Unit	Acres	Additional Information
3.C.1	Keithsburg	60	
3.C.2	Louisa	159	
3.C.3	Horseshoe Bend	50	Plant two 25-acre experimental seed bank plots near Rocky Road to prairie cordgrass capable of surviving on saturated floodplain soils. Plots are adjacent to existing large grassland areas.

Goal 3: Great River NWR / Objective 3.C/ Strategies 3.C.

Strategy No.	Unit	Acres	Additional Information
3.C.4	Delair	33	
3.C.5	Clarence Cannon	179	

Goal 3: Two Rivers NWR / Objective 3.C./ Strategies 3.C

Strategy No.	Unit	Acres	Additional Information
3.C.6	Gilbert Lake	7	Manage for the enhancement of Boltonia decurrens. Develop step-down management plan in consultation with Service endangered species specialist. control encroaching willow by mowing and discing as needed.

Objective 3.D. Provide a 6-year average of 450 acres of scrub/shrub habitat for waterfowl broods and neotropical migrants through a combination of water level manipulation, mowing, discing, and burning. Water level manipulation may occur annually; other techniques typically are necessary on a 3- to 5-year cycle. Most scrub/shrub sites occur naturally at the interface between wetland and forest, but may need management action to hold back succession.

Strategies: Maintain existing scrub/shrub habitat on the following Divisions:

Goal 3: Port Louisa NWR / Objective 3.D/ Strategies 3.D

Strategy No.	Unit	Acres of Scrub/shrub	Additional Information
3.D.1	Big Timber	3	
3.D.2	Louisa	81	
3.D.3	Keithsburg	175	

Goal 3: Great River NWR / Objective 3.D/ Strategies 3.D

Strategy No.	Unit	Acres of Scrub/shrub	Additional Information
3.D.4	Delair	36	
3.D.5	Delair	2	Potential to develop partnerships with adjacent landowners to enhance water control capabilities.
3.D.6	Clarence Cannon	86	
3.D.7	Fox Island	175	These areas have limited management capabilities but provide reliable scrub/shrub habitat.

Goal 3: Two Rivers NWR / Objective 3.D/ Strategies 3.D

Strategy No.	Unit	Acres of Scrub/shrub	Additional Information
3.D.8	Batchtown	40	

Goal 3: Middle Mississippi River / Objective 3.D/ Strategies 3.D

Strategy No.	Unit	Acres of Scrub/shrub	Additional Information
3.D.9	Wilkinson Island	60	Potential for partnership with the local levee and drainage district to allow the development of seasonally flooded scrub/shrub wetlands near Reed's Creek.

Objective 3.E. Plant seed and browse crops to provide a dependable supplement to natural food sources for waterfowl, and to provide needed open-space resting areas. The amount and spacing of this refuge resource along the river corridor is based on historic concentration areas (bird use days) while considering surrounding conditions off-refuge including hunting pressures that may reduce utilization of habitats outside refuge sanctuary units. Approximately 1,000 acres will be planted annually Complex-wide.

Strategies: Plant seed and browse crops on the following units:

Goal 3: Great River NWR / Objective 3.E/ Strategies 3.E

Strategy No.	Unit and Fields	Annual Acres	Comments
3.E.1	Clarence Cannon: 14A, 14B, 14C, 15, 16	266	Use rotational cropping program on these fields on an annual basis. Fields will be monitored for bird use and evaluated for possible conversion to perched wetland, forest or grassland cover, also subject to future funding and staffing necessary to manage habitats currently maintained by cooperative farmers.
3.E.2	Delair: All designated cropland fields	325	Plant 300-400 acres annually on a rotational basis. Remaining fields will lie fallow 1-2 years to provide habitat diversity and reduce soil erosion and chemical usage. Flood farmed units periodically to enhance food availability for waterfowl. These agricultural units will be monitored for bird use and evaluations made regarding their suitability for conversion to perched wetland, forest and grassland covers, also subject to future funding and staffing necessary to manage habitats currently maintained by cooperative farmers.

Goal 3: Two Rivers NWR / Objective 3.E/ Strategies 3.E

Strategy No.	Unit and Fields	Annual Acres	Comments
3.E.3	Calhoun: AG-1a, 1b, 2	181	Utilize short season corn or harvest in strips in AG-1a to increase grain availability to migratory waterfowl, especially ducks.
3.E.4	Calhoun: AG-3, 4, 5	246	These agriculture units will be monitored for waterfowl use and evaluations made regarding their suitability for conversion to hard mast forest habitat.

Objective 3.F. Utilize agriculture as a management tool, as necessary, to maintain high-quality wildlife habitat in refuge wetlands by periodically setting back succession or invasion of undesirable species. Approximately 400 acres will be planted annually. Where practical, manage this temporary land cover type in a manner that provides supplemental food value as a secondary benefit.

Strategies: Use agriculture periodically to set back succession on the following units:

Goal 3: Port Louisa NWR / Objective 3.F/ Strategy 3.F

Strategy No.	Units	Total Unit Acres	Average Acres Planted Annually	Comments
3.F.1	Louisa: 2, 4, 6, 7, 8, 9, 10, 11, 21	326	80	Grassland and seasonally flooded areas average once every 4 years to set back succession.

Goal 3: Great River NWR / Objective 3.F/ Strategies 3.F

Strategy No.	Units	Total Unit Acres	Average Acres Planted Annually	Comments
3.F.2	Clarence Cannon: All non-forested wetland management units	2,285	300	Use cooperative farming program, rotated through all managed wetland units, to set back succession.
3.F.3	Delair: 4C, 7, 15A	68	20	Fields 4C and 7 planned for conversion to managed wetlands, if feasible.

Goal 3: Two Rivers NWR / Objective 3.F/ Strategies 3.F

Strategy No.	Units	Total Unit Acres	Average Acres Planted Annually	Comments
3.F.4	Calhoun: MSU 1-8	314	70	Use cooperative farming program, rotated through all managed wetland units, to set back succession.
3.F.5	Batchtown: MSU 1, 2, 3	84	20	

Objective 3.G. Use farming techniques to maintain 675 acres of open fields until they can be converted to another planned habitat type, such as on newly acquired lands. Conversion will occur by 2012.

Strategies:

Goal 3: Great River NWR / Objective 3.G/ Strategies 3.G

Strategy No.	Unit	Acres	Comment
3.G.1	Fox Island: Existing fields	675	Planned for reforestation through a combination of natural regeneration and hard mast tree plantings.

Goal 4 Discussion. Sedimentation and Water Quality

The two goals of increasing floodplain connectivity and reducing sedimentation are inherently at odds with each other. The sediment load in the river is deposited everywhere the waters can reach, particularly if the flow is slowed down. The main channel is designed to "self-scour" due to the rock training structures (wing dams) positioned in a perpendicular direction to flow on both sides of the shipping channel. All other locations are, by design, sediment traps. Eventually the result would be a river that includes nothing but a channel, which is not a healthy system. The problem is that adjacent areas that provide an open connection to the river provide a benefit to the river system itself, but can themselves be negatively impacted by the exposure to poor water quality. Each refuge division has been evaluated during this planning process regarding its degree of floodplain connectivity to the river. The value of a unit's contribution to floodplain connectivity was compared to the potentially negative impacts of exposure to artificial river level spiking and the associated influx of sediment and other pollutants. These evaluations must be site specific and include factors such as location in either open river or pooled river. In 1995, the National Biological Survey developed a plan, under the Quick Response program, for monitoring sedimentation rates on two units of the Complex that had experienced levee breeches. Reconstruction decisions included building a spillway to allow more frequent connections to the river during high water events. At different levels of connectivity it is predicted that proportional levels of sedimentation will occur. A plan was designed to measure the impact of several factors that may contribute to successional changes in habitats. Baseline data was gathered regarding status of floodplain forests on each unit, and the sedimentation rate on one. Higher quality water flowing down the river is the best solution for impacted riverine habitats.

Management Approaches

Although legislation has been passed that helps control contaminant discharges to the river, there are still accidents and illegal dumping in the UMR basin that affect water quality. But overall, the major pollutant inputs come from non-point sources, and include nitrates, phosphates and pesticides. Because there are no regulations to control over-application of fertilizers, anhydrous ammonia and chemicals to agricultural ground, landowners must act responsibly based on their own values and self-interests. Despite improved farm conservation practices in some locations (terraces, sediment retention basins, grassed waterways, filter strips riparian buffer strips, etc.), nutrients, contaminants and sediments still make their way to the Mississippi River.

The USDA offers several set-aside programs such as the Conservation Reserve Program (CRP), that assist farm owners and operators in conserving and improving soil, water, air, and wildlife resources by converting highly erodible and other environmentally sensitive land to a long-term resource-conserving cover. Highly erodible ground is planted with grasses or trees that help stabilize the soil, thereby decreasing erosion. When it was first introduced in the mid 1980s, the CRP was extremely popular and millions of acres of farm ground within the UMR basin were retired for 10 years. But as the easements expired, much of the cropground was returned to production. The current levels of CRP enrollment along the planning area are: Illinois 715,000 acres, Iowa 1.5 million acres and Missouri 1.4 million acres. Over 800,000 acres of the Iowa total are enrolled in the CRP continuous sign-up, which is directed toward decreasing erosion by including riparian buffer strips, grassed water ways, filter strips, contour buffers and shallow water impoundments.

Another USDA set-aside program is the Wetland Reserve Program (WRP), in which landowners are paid for permanent, 30-year or 10-year easements on cropground that is too wet to farm. These fields have been declared by NRCS to be converted wetlands, making them eligible for this program. Wetland restoration costs are also paid for in full by NRCS for permanent easements, or cost-shared with the landowner for 30- and 10-year easements. Following record flooding on the Mississippi River, USDA offered landowners the opportunity to place permanent easements on flooded cropground through the EWRP, or Emergency Wetland Reserve Program. Hundreds of landowners accepted this offer and placed thousands of acres of floodplain cropground and converted wetlands into the program. Illinois currently has 21,382 acres (174 easements) protected by the WRP, EWRP and Emergency Watershed Programs. Iowa has 91,026 acres (826 easements) in EWRP and WRP, while Missourians have placed 65,480 acres into similar easements.

The Service is in partnership with USDA on these and other programs that affect UMR water quality. These efforts must be maintained at a minimum, but to make measurable differences on Complex resources these programs will have to be accelerated in targeted areas. Refuge land acquisition funds have been used to purchase the residual value of fee title lands along with the USDA payment for an easement of flood-prone farmland in the corridor. This has the benefit of stretching FWS funding through the partnership to acquire the lands that can be restored and contribute to water quality, habitat and floodplain goals. In some instances, landowners are attracted to an easement but don't want to hold lands they cannot farm and the Service partnership is necessary to complete an agreement to remove a flood-prone field from crop production efforts. Opportunities to partner with USDA will be a considered factor in prioritizing future land acquisition within the expanded Complex boundary.

An effort currently under way to try to slow down the eutrophication of river backwaters involves public and private interests from Minnesota, Iowa, Wisconsin, Illinois and Missouri that have developed a 10-year initiative to reduce the amount of sedimentation and nutrients entering the UMR. The Upper Mississippi River Stewardship Initiative, if funded, is to identify major sources of sediments and nutrients, target technical and financial assistance, develop and implement new solutions and to create a basin-wide monitoring network to coordinate public and private activities. The Complex refuges will be involved in initiatives such as this in the watershed in order to meet CCP goals and objectives.

Mark Twain Complex staff work with private landowners and other agencies to improve the water quality within the UMR basin through the Service's Partners for Fish and Wildlife (PFW) program. This program provides an avenue for refuge staff to interact with landowners and provide technical and cost share assistance for wetland and native grass restorations. Thousands of wetland acres have been restored throughout the UMR basin via private lands partnerships. This total acreage has little effect on the river itself due to scale. However, these efforts can make a measurable difference to refuge wetlands and other corridor resources when the projects are located on adjacent or nearby lands. Refuge staff will seek to expand these efforts in order to increase the scale of effect in UMR tributaries.

The Environmental Management Program (EMP) was legislated through the 1986 Water Resources Development Act. The COE, Service, USGS, and all five UMRS states are partners in the process of design, construction and evaluation of Habitat Rehabilitation and Enhancement Projects (HREPs), the largest component of the program. Goals of these projects include reduction of sediment deposition to backwaters, prevention of shoreline erosion and restoration of aquatic habitat for fish and migratory waterfowl. Several projects contain upland components aimed at reducing hillside erosion into backwater units of the AEC. To date, more than 60,000 acres of UMRS fish and wildlife habitat have been restored, protected or enhanced through HREPs. The WRDA was re-authorized by Congress in 1999 providing for continuing river water quality improvements and restoration projects. The Complex will remain an active partner in the EMP and will attempt to utilize the program authority to accomplish the appropriate goals and objectives of this plan. In addition, the COE has coordinated with the Service and made many modifications to river structure in the past decade that are intended to restore side channel habitats through their channel maintenance program.

Goal 4. Sedimentation and Water Quality:

Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.

Objective 4.A. Continue current and develop new partnerships with government agencies and private landowners to reduce the effects of erosion and contaminant runoff affecting fish and wildlife resources in the Upper Mississippi River watershed.

Goal 4: Mark Twain NWR Complex / Objective 4.A/ Strategies 4.A

Strategy No.	Strategies	Comments
4.A.1	Work in partnership with NRCS to encourage private landowners to adopt sustainable agricultural practices within the UMR watershed through programs such as CRP.	Practices include conservation tillage, terraces, sediment control basins, etc.
4.A.2	Work in partnership with agencies and private landowners to encourage wetland restoration projects through programs such as PFW, WRP, EWRP, etc.	
4.A.3	Work in partnership with agencies and private landowners to encourage restoration of terrestrial habitat through programs such as CRP, FSA easements, etc.	
4.A.4	Provide technical and financial assistance for watershed improvement projects on targeted tributaries such as the Iowa River Corridor, Fox River and Michael Creek.	Specific attention will be given to watersheds that affect Refuge lands.
4.A.5	Continue coordination with NRCS to identify landowners within the Refuge acquisition boundary who are willing to participate in a WRP easement if they can sell the residual value to a third party.	Leverage Service land acquisition dollars with NRCS easements.
4.A.6	Work with partner agencies to promote Environmental Pool Management to consolidate flocculent bottom sediments and improve overall habitat quality.	
4.A.7	Ensure that appropriate Refuge personnel are trained to assist with interagency spill response efforts on the River.	

Objective 4.B. Reduce sedimentation and improve overall water quality on Refuge System lands by 2010 for the benefit of fish and wildlife populations.

Goal 4: Objective 4.B / Strategies Common to All Complex Refuges

Strategy No.	Division	Strategies	Comments
4.B.1	All	Complete Containment Assessment program (CAP) reports on Refuge divisions that have not yet been assessed. Includes Louisa, Big Timber, Clarence Cannon, Long Island, Batchtown, and Delair.	Requires assistance of Rock Island Ecological Services Office Contaminants biologist.
4.B.2		Analyze ditch runoff for contaminants at points that enter Refuge divisions.	Use Service Contaminant Assessment Program and GIS models to assist with this effort.
4.B.3		Partner with COE and states to develop and construct habitat restoration projects to improve water quality through authorities such as EMP, 1135, etc.	
4.B.4		Evaluate identified tracts within Refuge expanded boundary proposal for each site's potential to contribute to nutrient recycling and other water quality improvements.	Evaluation used for land acquisition priority and site development plans.
4.B.5		Use integrated pest management techniques to address invasive species issues, where practical.	
4.B.6		Ensure that an updated Spill Prevention, Control and countermeasure Plan is available for each Refuge.	

Goal 4: Port Louisa NWR / Objective 4.B / Strategies 4.B

Strategy No.	Division	Strategies	Comments
4.B.7	Keithsburg	Create "No Wake Zone" to reduce shoreline erosion and decrease turbidity.	
4.B.8		Reduce contaminant and nutrient loading by creating a treatment wetland north of the Spring Slough Road.	Treating non-point source pollution prior to its reaching the rest of the Division will slow down the nutrient loading process.
4.B.9		Dredge deep water areas to prevent low dissolved oxygen levels during drawdowns.	

Goal 4: Port Louisa NWR / Objective 4.B / Strategies 4.B (Continued)

Strategy No.	Division	Strategies	Comments
4.B.10	Louisa	Create “No Wake Zone” to reduce shoreline erosion and decrease turbidity and wildlife disturbance.	All navigable waters north of Lake Odessa State Game Area.
4.B.11	Big Timber	Create “No Wake Zone” to reduce shoreline erosion and decrease turbidity and wildlife disturbance.	
4.B.12	Horseshoe Bend	Create “No Wake Zone” to reduce shoreline erosion and decrease turbidity and wildlife disturbance.	Access primarily during Iowa River high water periods.
4.B.13	All Divisions	Allow commercial fishing (by special use permit only) to reduce exotic fish populations.	Reduction of exotic fish numbers to improve water clarity and enhance growth of aquatic vegetation.

Goal 4: Great River NWR / Objective 4.B/ Strategies 4.B

Strategy No.	Division	Strategies	Comments
4.B.14	Clarence Cannon	Develop a program to monitor water quality and sedimentation during flooding resulting from the increased connectivity to the River due to the lowered spillway.	
4.B.15	Clarence Cannon	Conduct comprehensive contaminant survey of wetlands to identify potential water quality or sediment contaminant issues.	Preliminary sampling conducted in the 1980s indicated potential problems.
4.B.16	Long Island	Dredge lower O’Dell Chute and construct closing structure at head of chute to reduce sediment loading and provide deep water fisheries habitat.	HREP feature. Monitoring efforts will be needed to assess changes within this system.
4.B.17	Delair	Conduct comprehensive contaminant survey of wetland to identify water quality or sediment contaminant issues.	A cement plant that burns chemical wastes is located in the vicinity.

Goal 4: Two Rivers NWR / Objective 4.B/ Strategies 4.B

Strategy No.	Division	Strategies	Comments
4.B.18	Calhoun	Draw down Swan Lake periodically to consolidate flocculent bottom and thereby reduce the effects of sedimentation.	
4.B.19	Batchtown	Dredge deep water holes to improve water quality (low dissolved oxygen) for fish.	HREP project features.

Goal 4: Two Rivers NWR / Objective 4.B/ Strategies 4.B (Continued)

Strategy No.	Division	Strategies	Comments
4.B.20	Gilbert Lake	Dredge deep water holes to improve water quality (low dissolved oxygen) for fish.	

Goal 4: Middle Mississippi NWR / Objective 4.B/ Strategies 4.B

Strategy No.	Division	Strategies	Comments
4.B.21	Harlow Island	Dredge side channel areas to improve water quality (low dissolved oxygen) and overwintering habitat for fish.	
4.B.22	Wilkinson Island	Dredge side channel areas to improve water quality (low dissolved oxygen) and overwintering habitat for fish.	

Goal 5 Discussion. Floodplain Management

Natural River Hydrologic Cycle

Periodic flooding and drought are characteristic features of large river floodplain ecosystems, including the Mississippi. These changing water levels are the major force responsible for maintaining the complex physical structure, and rich plant and animal diversity of the river system. In free-flowing rivers, floods create an ever-changing system of sloughs, islands, sandbars, and backwaters. Some habitats, such as patches of mature floodplain forest, are destroyed by floods while others, like sand islands, are created; but over time, the river maintains a balance between these various habitats. Not only is periodic flooding important, but also low water periods and occasional droughts are essential for a healthy, dynamic floodplain river system. The timing and duration of high and low water levels are critical for productive fish and wildlife habitat.

Low water levels in the summer allow wetlands to dry out, which consolidates mucky bottoms and encourages the growth of wetland vegetation. The vegetation in floodplain wetlands and the associated invertebrates provide important feeding and resting areas for migratory birds during fall and spring migration. Fish use flooded vegetation for spawning and feeding areas during spring high water events. The wetlands also absorb nutrients, sediments, and floodwaters that otherwise would be carried downstream. These functions improve water quality and reduce flood height.

River Modifications and Modified Hydrology

Historically, the Mississippi River fit this model of a free-flowing, ever-changing system of riverine and floodplain habitats. However, as the River became an increasingly important travel and trade route, Congress began authorizing a series of navigation improvements to be implemented by the Corps of Engineers. Wingdams, closing structures, and a series of locks and dams were built to constrict the channel and control its depth. The COE also was given flood control responsibilities and began building levees to protect agricultural lands and growing cities. These changes to the natural flow of the river have created a reliable 9-foot-deep navigation channel and have increased protection from flooding in most of the historic floodplain. While some flow management structures are advantageous to fish, the overall navigation and flood control systems have altered the natural river hydrology in a manner deleterious to pre-project native fish and wildlife habitat.

Flood control levees have isolated the river from much of its floodplain. The levees act like lateral dams, effectively eliminating the floodplain from normal high water. This loss of floodplain connectivity prevents the creation of new wetlands, prevents the deposition of nutrient-rich sediment, and reduces the amount of fish spawning and nursery habitat. Levees protect about 3 percent of the floodplain north of Rock Island, 50 percent of the floodplain between Rock Island and St. Louis, about 80 percent of the floodplain south of St. Louis, and 60 percent of the floodplain on the Lower Illinois River. Channelization has cut off river meanders and isolated side channel and backwater habitats. Loss of a functional floodplain not only affects the ecosystem, but also significantly impacts its ability to store and convey flood waters. The water between the levees has nowhere to go but up, which raises flood elevations downstream by forcing the waters to pass through a narrow opening between the levees. Flood heights have increased over time, and the number of days water elevations are above flood stage also is increasing. Present-day floods on the Mississippi River at St. Louis tend to be 9 feet higher than historic floods. A plot of the 10 greatest floods at St. Louis shows they were all recorded after 1942. In the last 60 years, a major flood (at least 12 feet above flood stage) has occurred at St. Louis about once every 6 years on average (Galloway).

Prior to human modification of the hydrograph, floods normally occurred in the spring and fall, wetlands dried out in the summer, and changes in water levels were fairly gradual. Floodplain flora and fauna were adapted to these water level variations. Now, however, the lock and dam system has created a series of navigation "pools" resembling shallow reservoirs, so many areas that used to dry out during the summer months are now permanently flooded. In addition, water level fluctuations from upstream dam releases are now more rapid and irregular with sharper increases and decreases. Rooted aquatic plants find it extremely difficult to germinate and grow under these conditions, leaving many shallow areas devoid of vegetation. Sudden dam releases can leave fish stranded in upstream backwaters. And in areas with permanently higher water levels, many mature forests have died, reducing species diversity and developing into monocultures of silver maple.

Dams also can adversely affect migration of fish between pools on the UMR. A total of 25 species are either known to be migratory in the UMR or are probably migratory, based on their behavior in other river systems. Upper Mississippi River migratory fishes include lake sturgeon, shovelnose sturgeon, paddlefish, skipjack herring, bigmouth and smallmouth buffalo, blue sucker, and blue, channel, and flathead catfish. Lock and dam 19 presents a complete barrier to fish passage. Other locks and dams can allow limited fish passage for some species either through the locks with barges or through the dams during open river conditions. Restricted fish passage and limited geographic range may reduce the size and health of some fish populations. Hydraulic conditions, migratory fish behavior, and potential operational changes and structural modifications at the dams are all being studied to develop alternatives for improving fish passage in the UMR.

Increased sedimentation is another major cause of deteriorating fish and wildlife habitat in the UMR. Impoundment, channelization, agriculture, and development have all played a role in drastically altering the River's sediment transport mechanisms. While impoundment for navigation created a variety of backwater and side channel habitats, these dams also slowed river currents, increasing the retention of sediment. Runoff has increased because water storage in the watershed has been reduced by drainage of wetlands, urbanization, and other factors. Thousands of square miles of historical wetlands, prairies, and forests have been converted to agricultural and urban areas, increasing the velocity and erosiveness of waters flowing through the watershed. Sediment from soil erosion reduces water clarity, fills backwaters, prevents the growth of aquatic vegetation, and destroys fish spawning and overwintering habitat.

Floodplain Management and the Flood of '93

The negative effects of navigation, flood control, and development on the UMR were becoming apparent by the 1970s. The natural hydrology had been altered so that the Mississippi was no longer a free-flowing river. In this altered state, connectivity of the river to its floodplain could actually be detrimental to wetland habitat due to unnatural water level fluctuations and high rates of erosion and sedimentation. On the other hand, completely isolating the floodplain from the river with high levees prevented the inflow of nutrients, cut off important fisheries habitat, and increased flood heights.

Federal and state land managers began examining ways to balance the need for floodplain connectivity with the need for high quality, reliable fish and wildlife habitat. Spillways in levees would reconnect the floodplain to the river more often and reduce the chances of repeated levee breaks. Facilities and development in the floodplain could be reduced to minimize flood damage costs. Farming programs (and associated erosion and chemical use) on public lands subject to frequent flooding could be reduced. And marginal agricultural land in the floodplain could be purchased and reconnected to the river.

The record-setting 1993 Midwest flood accelerated the move toward a more balanced floodplain management approach. The ‘93 flood was notable for its extent, duration, and volume of runoff. During nearly the entire growing season, from April 1 to Sept. 30, 1993, the Mississippi River remained above flood stage at St. Louis. The Upper Mississippi, Lower Missouri, and Illinois rivers experienced extensive damage to training structures and levee systems. It was one of the most damaging floods in the nation's history, causing billions of dollars in damages and displacing thousands of people.

Negative ecological effects of the '93 flood included water-quality degradation by massive inputs of agricultural chemicals, sewage, livestock waste, and industrial and household chemicals; high tree mortality in floodplain forests; the loss of wetland plant production to support migratory waterfowl, and the drowning of mammals, reptiles, and amphibians as levees were breached and levee districts flooded overnight. However, the extended flood pulse was beneficial to fish as they regained access to the floodplain. Aquatic insects flourished on the decaying plants and fish moved in to feed on the abundant food resources and to spawn in the expanded habitat.

Some areas were so damaged by the '93 flood that there was uncertainty as to whether these lands could, or should, be restored to pre-flood conditions. National attention was focused on the need for an integrated approach to floodplain management; an approach that balances flood protection and economic development with the need to reduce flood damage, enhance fish and wildlife habitat, and reconnect the river to its floodplain.

Mark Twain Complex Floodplain Management

The Complex refuges will continue to be managed using an integrated approach to floodplain management. When making floodplain management decisions within the AEC, refuge managers will consider a range of desirable options including:

- Connecting the river to its floodplain.
- Reducing backwater sedimentation.
- Managing water levels to re-create natural wet/dry cycles.

Table 10: Connectivity and Sedimentation, Mark Twain NWR Complex

Refuge	Division	Acres (From GIS Data)		
		Open to River	Levee with Spillway (Connectivity Every 1 to 5 Years)	Major Levee
Great River	Fox Island	2,019	0	90
	Long Island	6,300	0	0
	Delair	0	0	1,737
Clarence Cannon		150	3,600	0
Two Rivers	Cahoun	0	4,836	0
	Gilbert Lake	0	736	0
	Batchtown	1,149	995	0
	Portage Islands	230	0	0
Port Louisa	Big Timber	1,758	0	0
	Horseshoe Bend	2,606	0	0
	Keithsburg	0	1,400	0
	Louisa	0	2,609	0
Middle Mississippi	Harlow Island	1,224	0	0
	Wilkinson Island	2,532	0	0
	Meissner	78	0	0
Total	34,049	18,046	14,176	1,830

- Reducing agriculture and facilities in flood-prone areas.
- Promoting partnerships and interagency coordination to encourage a balanced floodplain management program throughout the AEC.

All of these options cannot be applied to every Division. Decisions on how to manage each unit are based on local and system-wide habitat needs; area elevation, geomorphology and landscape features; authorized purposes of the unit; political and social considerations; and funding limitations.

Connectivity and Sedimentation

The divisions of the Complex have varying amounts of water level control, flood control, and floodplain connectivity. Some divisions are completely open to the river and its flood pulses; others are partially protected by levees with spillways; and two divisions (Delair and Louisa) receive protection from major levees constructed by the COE and private agricultural drainage districts prior to Service acquisition (Table 10).

Wilkinson Island, Harlow Island and Horseshoe Bend are primarily former agricultural lands purchased fee title after the '93 flood. Existing levees on these Divisions were not repaired following acquisition, so an additional 6,400 acres now are open to the river at these units. Big Timber, Long Island, Portage Islands and the upper end of Batchtown also have complete connectivity to the river. This plan includes factors and priorities for additional land acquisition within the AEC. One factor considered in selecting tracts is the ability to restore river connectivity. Complete connectivity provides unrestricted high water fisheries access and flood storage, but also gives managers no ability to control water levels and often results in high rates of sedimentation.

Keithsburg, Clarence Cannon, Gilbert Lake, Calhoun, and the lower end of Batchtown are protected by levees of varying heights with spillways that overtop during floods. These spillways provide periodic river connectivity during 1-year to 5-year flood events, but still provide protection from the artificial daily fluctuations caused by the lock and dam system. Other benefits of the levee/spillway system are reduced sediment input into the divisions, reduced likelihood of a levee breach during flood events, and the ability to manage wetland water levels during years of normal river flow. This spillway concept balances the need for floodwater storage with the need to provide high quality wildlife habitat through continued management programs on the Refuge Complex.

Since it was purchased in 1964, the main perimeter levee of Clarence Cannon NWR had been overtopped or breached an average of once every 5 years until 1993. The record '93 flood also caused record damage to the levee, resulting in 16 levee breaks. The decision was made to repair the breaks, but also to construct an 800-foot spillway in the levee. Since the spillway was constructed in 1995, the river has overtopped three times, in the spring of 1996, 1998 and 2001. Each time the Refuge was entirely flooded to an average depth of 4-6 feet. Because this spillway project was precedent setting with uncertain long-term effects, ongoing monitoring will examine frequency of flooding, sedimentation rates, habitat quality in wetlands and moist-soil units, and effects on fish and wildlife resources. As waters slowly receded following the 1996 and 1998 floods, tremendous numbers of fish fry were observed being released into the river. Future monitoring will include efforts to quantify this potentially significant benefit to fisheries resources.

The Swan Lake Habitat Restoration and Enhancement Project (Calhoun Division) provides another example of the balanced approach to river connectivity that has been implemented at the Complex. Prior to the project, Swan Lake had been completely open to the river and was filling rapidly with sediment. Between 1940 and 1990, the average sedimentation rate was 0.5 inch per year. Sedimentation and uncontrolled flooding had also caused the loss of almost all wetland vegetation. As part of the restoration, a levee was constructed to enclose the lake, gain some control of water levels, and reduce sediment input. A spillway was constructed in the levee to provide regular river connectivity during floods.

In order to create greater habitat diversity, the Service-managed portion of the lake was divided by a cross-dike into two compartments to allow some independent management options. The stoplog structure in lower Swan Lake will be open to the river during most years for complete floodplain connectivity and fish access. The middle Swan Lake structure will normally be closed to the river to allow more control over water levels and to promote the growth of wetland plants. Both units will flood when the river rises, which will only be during the spring runoff period. Both units will also be completely drawn down periodically to consolidate bottom sediments and reduce water turbidity. Habitat and wildlife responses will be monitored and the water management regime will be modified as necessary to achieve the best mix of backwater aquatic habitat types.

Re-creation of Natural Wet/dry Cycles

In order to meet its main purpose (migratory bird habitat), the Complex simulates natural water level fluctuations on units where some level of water control is possible. This managed flooding usually involves re-creating fall and spring wet periods and the summer dry cycle. Stoplog structures, gates, pumps, and gravity flow are used to control water levels. The levees on these units keep out the unnatural water level changes caused by dam flow regulation.

Reduction of Farming and Facilities in the Floodplain

Farming in the floodplain has been reduced on refuge lands since the 1970s. At that time, management emphasis started shifting to enhancement of wetlands, forests and grasslands that provide natural foods and habitat for a greater diversity of wildlife species. Reduction of farming in low, frequently flooded areas has also reduced crop loss, soil erosion, and chemical use. Farming will be reduced further with implementation of this plan. The goal is not to eliminate farming completely, but to farm only enough to support migratory waterfowl and manage other habitat. Former croplands will be restored to wetlands, forests, or other native flood-tolerant habitats. Acquisition of other flood-prone areas in the AEC will contribute to the floodplain goals and objectives listed in this section, as well as the Habitat and Water Quality goals.

Repair of flood-damaged roads, signs, and other facilities is costly, so they will be constructed outside of frequently flooded areas whenever possible. When facilities are necessary at lower elevations, they will be simple and designed to be flood-resistant to reduce repair costs following floods.

Partnerships and System-wide Floodplain Management

The Complex will work with the States, COE, other organizations, private landowners, private organizations, and the public to encourage a balanced floodplain management program on a system-wide level beyond the immediate refuge boundary. Environmental pool management (EPM), for example, is an interagency partnership to modify dam operations for fish and wildlife benefits within entire navigation pools. Modification of water release schedules for navigation dams can benefit plants and animals over extensive reaches of the river and floodplain, beyond single moist soil units or even individual refuges. The Service is working with the COE and the States to promote improved water level management on a pool-wide scale. (See Environmental Pool Management in the Management Considerations Section)

As another example, the Service is partnering with the COE and the States of Illinois, Missouri and Iowa to develop comprehensive “pool plans” for each of the navigation pools. A similar effort is under way on the un-pooled Middle Mississippi River, which is extensively leveed but not impounded by navigation dams. The plans will look at overall floodplain needs within each pool and throughout the system and recommend areas for habitat restoration projects, river connectivity improvements, and land acquisition needed to facilitate these projects.

Other Considerations

Fish and Wildlife Service policy recognizes that intensive habitat management is sometimes necessary in highly altered ecosystems. Under guidelines set out in a 2001 Service Manual chapter (601 FW 3: Biological Integrity), refuges will be managed to maintain biological integrity, natural biological diversity, and environmental health by restoring or replicating natural conditions. In highly modified ecosystems where natural conditions cannot be restored, the Service favors management actions that mimic natural ecological processes, even when intensive actions and technological methods may be required. Within the UMR system, where natural flooding regimes have been eliminated as a result of altered hydrology, Complex refuges will continue to use water control structures, pumps, and delivery canals to re-create historic flooding cycles where feasible.

Because of the unpredictability of the river and variations between refuge units, not every refuge division can produce ideal habitat for every species of fish and wildlife every year. As stated by Sparks, Nelson, and Yin (1998), "Adaptive management recognizes that the structure and function of natural and restored systems vary across space and time; indeed that variation (disturbance regime) is required to maintain many ecosystems." For example, drought years may result in poor fish spawning and recruitment, but good wetland plant growth due to increased ability to dry out backwaters. And flood years may result in poor growth of wetland plants, but great fish spawning and recruitment. If enough habitat is available in the floodplain, then "most species' habitat requirements will be met somewhere, if not on the same site every year." This level of variation and change is natural and desirable in large river floodplain ecosystems. Therefore, the desired outcome of floodplain management for the Refuge Complex is not to create a static system, but to restore river function according to this concept of dynamic equilibrium.

Goal 5. Floodplain Management:

Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.

Objective 5.A. Conduct activities and promote partnerships and interagency coordination that encourage a balanced floodplain management program throughout the AEC.

Goal 5: Mark Twain NWR Complex / Objective 5.A/ Strategies 5.A

Strategy No.	Strategies
5.A.1	Promote adoption of Environmental Pool Management (EPM) in the pooled portions of the River to recreate natural wet and dry cycles. Work to acquire privately owned lands from willing sellers necessary to move pool control "hinge points," or other actions to remove obstacles in order to facilitate this management approach.
5.A.2	Participate in interagency development of habitat improvement plans for pooled and unpooled River reaches in a manner that also contributes to other Complex goals, such as floodplain management and water quality.
5.A.3	Partner with COE, states and non-governmental organizations to develop and construct habitat restoration projects to enhance habitat, water quality, and floodplain management through possible funding sources and authorities, such as EMP, Section 1135, Avoid and Minimize, Ducks Unlimited, Marsh, North American Waterfowl Management Plan, WRP, etc.
5.A.4	Work in partnership with NRCS to encourage primate landowners to adopt sustainable agricultural practices within the UMR watershed through programs such as CRP or WRP on their most erodible ground, and to promote other conservation practices in basin uplands.
5.A.5	Participate in COE dredged material management program to enhance system topographic and bathymetric diversity, and other floodplain functions.
5.A.6	Explore solutions to fish passage through COE locks and lateral obstructions, such as levees, drain pipes and water control structures, to enhance migration and spawning opportunities for big river fish species.
5.A.7	Work on AEC system waters to reduce the impacts of sedimentation through the location of river training structures (wing dams, etc.) that direct flows in a manner that creates or maintains diversity in areas that would otherwise fill with fine silt or coarse bed-load material.
5.A.8	Encourage the COE to utilize their full operation authorities to minimize artificial spikes in river levels throughout the year.

Goal 5: Mark Twain NWR Complex / Objective 5.A/ Strategies 5.A (Continued)

Strategy No.	Strategies
5.A.9	Acquire up to 27,659 acres of floodplain lands from willing sellers during the 15-year planning period that will contribute to restoring floodplain function and improve the habitat and water quality conditions within AEC and downstream areas.
5.A.10	Work with Ameren/Union Electric on improving river conditions and the privately owned Pool 19.

Objective 5.B. Manage refuge lands for wildlife first, while considering UMR floodplain functions and contributing to improving those values.

Goal 1: Mark Twain NWR Complex / Objective 5.B/ Strategies 5.B

Strategy No.	Strategies
5.B.1	Evaluate effects of Refuge management activities on sedimentation, water quality, wetland vegetation, and fish passage. For example, monitor floodplain function factors of Keithsburg and Clarence Cannon spillways, and the lower Swan Lake water control structure.
5.B.2	Evaluate identified tracts within Refuge expanded boundary proposal for each site's potential to contribute to nutrient recycling, River connectivity as well as potential habitat improvement.
5.B.3	Restore backwater and side channel habitat on Refuge lands. Increase bathymetric diversity, including fish overwintering habitat.
5.B.4	Manage wetland impoundments to recreate natural wet/dry cycles where possible.
5.B.5	Continue to study River hydrology to evaluate the feasibility of improving connectivity at Refuge units with some level of levee protection while monitoring high-quality wetland or other habitats. Use of 1- to 10-year flood level spillways at locations such as Keithsburg Division or some newly acquired areas.

Goal 6 Discussion. Public Use and Education

In 1962, the Refuge Recreation Act authorized recreational uses of national wildlife refuges when such uses do not interfere with the primary purpose of a refuge. In 1966, the National Wildlife System Administration Act established a "compatibility standard" for allowing public uses on refuges. This Act introduced for the first time the requirement only "compatible uses" would be permitted on refuge lands. However, standards that would guide Refuge Managers on the implementation of this requirement throughout the National Wildlife Refuge System in a consistent manner were not developed until the mid-1980s. In 1997, Congress passed the National Wildlife Refuge Improvement Act (RIA) which spoke more specifically to the compatibility issue. It reinforced the requirement that no refuge use, including some non-recreational uses, may be allowed unless it is first determined to be compatible by the refuge manager. A compatible use was defined as a use that, in the sound professional judgment of the Director, will not materially interfere with or detract from the fulfillment of the mission of the System or the purposes of the refuge. The term 'sound professional judgement' means the determination is consistent with principles of sound fish and wildlife management and administration, available science and resources, and adherence to applicable laws.

Refuge Purpose Statements are primary to the management of each refuge within the System. The Purpose Statement is derived from the legislative authority used to acquire specific refuge lands and is, along with Refuge System goals, the basis on which primary management activities are determined. Additionally, these statements are the foundation from which “allowed” uses of refuges are determined through a defined “compatibility process.” Purpose Statements for Mark Twain Refuge Complex:

- “... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds...”, 16 U.S.C. - 715d (Migratory Bird Conservation Act)
- “... shall be administered by [Secretary of the Interior] directly or in accordance with cooperative agreements .... and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon, ...“, 16 U.S.C. - 664 (Fish and Wildlife Coordination Act)
- “... suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species ...”, 16 U.S.C. - 460k-1 (Refuge Recreation Act)
- “.... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions ...”, 16 U.S.C - 3901(b) 100 Stat. 3583 (Emergency Wetlands Resources Act of 1986)
- “....for conservation purposes”, (1985 Food Security Act in conjunction with the transfer of Farm Service Agency, formerly Farmers Home Administration, property)

The Refuge Manager also has the authority and responsibility on Service fee title lands to deny any use, regardless of compatibility, if it is deemed an inappropriate use on the refuge for other reasons. The same authority and responsibility applies to General Plan lands unless the issue relates to an authority retained by the Corps of Engineers, as defined by the Cooperative Agreement.

The 1997 Refuge Improvement Act gives priority to certain wildlife-dependent recreational uses of national wildlife refuges when compatible. The Act states that, first and foremost, the purpose of the National Wildlife Refuge System should be focused on wildlife conservation. Because the legislation states that each refuge shall be managed to fulfill both the mission of the Refuge System and the individual refuge purposes, Congress recognized that certain public uses should take priority and would not detract from the Refuge System's mission of wildlife, fish and plant conservation. These wildlife-dependent recreational uses are hunting, fishing, wildlife observation and photography, and environmental education and interpretation.; they are commonly referred to within the Service as the “Big 6.” These uses are deemed by the legislature to be programmatically legitimate and appropriate public uses on refuges, conditioned that they are dependent upon healthy wildlife populations, and are found to be compatible.

Wildlife viewing and hunting within the UMR ecosystem provide a significant economic benefit to the five-state region. Direct retail sales associated with hunting and viewing total over $670 million (Black et al., 1999). An economic study sponsored by the FWS found that non-consumptive use of wildlife at refuges generated more economic activity than hunting and fishing. Nationally, non-consumptive wildlife users generally stay for shorter periods of time and spend less, but their numbers at many refuges far exceed those of hunters and anglers (Laughland 1997). Within the Complex, each of these uses can be accommodated to various degrees.

Not every division in the Complex is open to all six wildlife-dependent public uses. Some refuge divisions are open year-round for public use (e.g., Big Timber, Long Island), while the Delair Division is closed year-round to all public use, except for specific events, as a condition of its acquisition from the previous owners. Many of the divisions are closed to public access in the fall and early winter to provide sanctuary for migratory birds.

The Mark Twain Complex Refuges are located in more rural regions of Iowa, Missouri and Illinois. However, each Refuge is within 50 miles of a metropolitan area. Two Rivers NWR, Great River NWR and Middle Mississippi River NWR are near St. Louis, and Port Louisa NWR is near the Quad Cities (Moline and Rock Island, Illinois, and Davenport and Bettendorf, Iowa). Tourism is increasing within the UMR corridor (Black et al., 1999), which provides additional opportunities for wildlife education and interpretation. The Great River Road, a network of federal, state and county roads covering 3,000 miles, which parallels the Mississippi River, passes very close to each refuge. Each office has an inadequate visitor contact station and public use/education activities account for no more than 10 to 15 percent of staff members' job duties at current staffing levels.

In general, the only sites where interpretive panels are currently found include the refuge headquarters and trails on higher ground. Because most of the land managed by the Complex is found within the Mississippi River floodplain, care must be exercised regarding the building of structures (observation decks and platforms) due to the impacts of flooding. Sign and structure maintenance and replacement caused by floodwater stains and rotting wood could be time-consuming and costly if these facilities are inappropriately located. In this plan, new observation decks and interpretive signs are being proposed at several divisions at optimal, higher elevations. Each refuge recreation program will be conducted in a manner that is compliant with Americans with Disabilities Act (ADA).

Bird and wildlife viewing have become increasingly popular in America. Since about 40 percent of all waterfowl in North American rely on the Mississippi Flyway, the opportunities for the public to visit Complex Refuges and view waterfowl and other migrating birds is great. Designated hiking trails on the Mark Twain Complex are currently limited, but visitors can walk, bike and/or drive their cars on service roads within several divisions during open seasons. The development of several new trails are proposed in this plan, while most other areas are opened but undeveloped for this use. There are currently no specific facilities on the Complex for photography, although visitors are encouraged to participate in this use along with their wildlife viewing and bird watching activities. Wildlife and environmental education programming has been limited due to staff availability, but each station has conducted special events or field trips on an opportunistic basis.

Hunting and fishing regulations that were in place for the 2000-2001 season are summarized below for the Complex. Any major changes or additions to the existing refuge program are listed in the Public Use strategies tables that follow. However, these programs are reviewed annually with regulations published and distributed locally. Future minor adjustments to the program will be addressed in this manner and will not trigger a revision process of this plan.

Recreational fishing is permitted on 13 refuge divisions. Clarence Cannon NWR and Delair Division are the only two units closed to fishing (except fishing by boat in Bryants Creek is permitted on Clarence Cannon NWR). Fishing is permitted year-round on Big Timber, Long Island, Harlow Island and Wilkinson Island Divisions in accordance with state seasons and regulations. Bank and/or boat fishing is available at all other divisions during designated times.

Big game (deer) hunting is permitted on seven divisions. Big Timber, Long Island and Wilkinson Divisions are open in accordance with state seasons and regulations. The Fox Island and Horseshoe Bend Divisions have been open for late state seasons. Archery hunting is permitted at Harlow Island Division. A special muzzleloader deer hunt is offered by special permit only on the Great River NWR, Delair Division. The deer hunt on Delair Division was specifically instituted in 1991 to try to improve habitat conditions within the unit, which is otherwise closed to all public use. A managed hunt was initiated on Clarence Cannon NWR in January 2002 to help control an expanding deer population. Similar hunts may be necessary on other refuge divisions as a habitat protection measure due to increasing midwestern deer populations. Potential opportunities for disabled hunters or youth hunts will be explored for specially conducted hunts.

Upland game such as Pheasants, rabbits, squirrels, Quail and Turkey may be hunted in accordance with state seasons and regulations on Big Timber, Long Island, Harlow Island and Wilkinson Island Divisions. Fox Island, Horseshoe Bend and Keithsburg Divisions are open with restricted seasons or limited species. All refuge divisions are closed to nighttime hunting of furbearers. Hunters must possess and use only non-toxic shot while hunting all permitted birds, except Wild Turkeys. Lead shot may be used for hunting Wild Turkeys.

Waterfowl hunting is permitted on Big Timber, Long Island and Wilkinson Island Divisions. At the Big Timber Division hunters have applied hunting areas by entering a lottery to build a season-long “permanent” blind. This practice began in 1991 due to competition between parties for certain spots. Elimination of seasonal blinds is proposed at the division in this plan by 2004. Instead, waterfowl hunters will be permitted temporary daily concealment or boat blinds that would be removed following the day's hunt. Migratory waterfowl hunting is permitted on the Long Island Division, but is permitted only from blinds constructed on sites posted by the Illinois DNR. Portable blinds are permitted for migratory waterfowl hunting on the Wilkinson Island Division, but they must be removed at day's end.

Although allowed under provisions of some state fishing or hunting license regulations, the taking of turtles and frogs is prohibited on all Refuge Complex Divisions.

By policy, refuges prepare visitor services step-down plans, which are tiered down plans based on the goals, objectives and strategies for visitor services included in this document.

St. Louis Area Wildlife Education and Urban Outreach – Riverlands Demonstration Area

The Riverlands Environmental Demonstration Area, located in West Alton, Missouri, was established by the COE in association with the relocation of Lock and Dam No. 26. The Rivers Project Office implements a comprehensive interpretive services and outreach program designed to enhance the public's understanding of and appreciation for the lands and waters managed by the COE. The program aims to educate visitors on the natural, cultural, historical and socio-economic importance of the Mississippi watershed. Educational programs are offered on prairies, wetlands, riverine ponds and the river. Another part of the program involves the development of the National Great Rivers Museum, which will be dedicated to tell the story of the river in a comprehensive way. The Museum will include a Distance Learning Center, where interactive video teleconferencing will enable the center to offer opportunities to students and the public at other locations.

In 1997, the COE Rivers Project Office entered into a Memorandum of Agreement with the Service establishing a resource-sharing partnership that enabled the two agencies to work together on public education programs centered on the river. The purpose of the partnership is to enhance public understanding of basic fish, wildlife, and water related issues pertaining to the Mississippi River. This agreement provides for a Service employee from Mark Twain National Wildlife Refuge Complex Office to utilize the Rivers Project Office facilities in West Alton, Missouri and to conduct joint programing with the Corps. Service presence at the Riverlands Project will help provide the metro area public with a better understanding of Service involvement in the Nation's wetlands, fish and wildlife resources, and how the two agencies' share responsibilities on these important matters. Urban Outreach and wildlife education highlighting the natural resources of the Mississippi River are key components of each education program. Due to an increasingly urban and suburban society, the Complex seeks to work with kids and adults where they live – away from the refuge – to help them understand the basic factors that support life, including safe water supplies. The Refuge Park Ranger works with groups on-site at the Riverlands Demonstration Area, off-site at St. Louis area schools and other outreach venues, and serves collateral public use program duties for the entire Refuge Complex, such as development of signs, leaflets and special programming.

Goal 6. Public Use and Education:

Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts consistent with the vision statement in this document by developing and improving refuge programs and facilities based on or allied with the issues in this document, and partnering with others to increase awareness of the Mark Twain NWR Complex, the Mississippi River, and the National Wildlife Refuge System.

Objective 6.A. Enhance visitor experiences involving wildlife observation and photography. This will be accomplished in part by constructing observation platforms, trails, and auto tour routes where appropriate. All facilities will be ADA-compliant and where necessary, "flood friendly". Two platforms will be constructed by 2005 and two trails by 2008.

Goal 6: Port Louisa NWR / Objective 6.A/ Strategies 6.A

Strategy No.	Division	Strategies	Comments
6.A.1	Horseshoe Bend	Provide parking area and trail on east side of Division.	Requires acquisition of additional tracts.
6.A.2		Develop overlook at Rush Lake near visitor parking lot.	
6.A.3		Maintain and improve newly developed Blue Bird Trail.	
6.A.4	Louisa	Replace existing observation deck on auto tour route and Fox Pond. Add spotting scope.	
6.A.5	Keithsburg	Maintain and improve the levee top trail surrounding the unit.	

Goal 6: Great River NWR / Objective 6.A/ Strategies 6.A

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.A.6	Clarence Cannon	Develop auto tour route with associated directions signs and a seasonal Mississippi River overlook.	✔ Pullouts, wider roads, and directional signs will improve visitor safety.
6.A.7		Construct loop nature trail with interpretive information.	✔
6.A.8	Fox Island	Improve public road access, where practical, by coordination and partnership with Clark County Highway Department and Wayland Special Road District.	✔

Goal 6: Two Rivers NWR / Objective 6.A/ Strategies 6.A

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.A.9	Calhoun	Construct short grassland trail from Visitor Center west toward old home site. Install observation platform with interpretive panels just below old home site.	✔
6.A.10		Construct forest trail adjacent to Swan Lake Boat Ramp area from gate to edge of lake with parking area near trail head. Construct three observation blinds along route.	✔ Trail and blinds to remain open year-round. This trail will connect with grassland trail in previous strategy via the access road. Areas of elevated boardwalk required.
6.A.11		Construct entrance drive from County Road 1 to Headquarters along terrace. Include turnouts, interpretive panels, and elevated observation deck overlooking moist soil units, Swan Lake, Illinois River, and Gilbert Lake.	✔ Requires acquisition of area CAL-1
6.A.12		Construct parking area at lower Swan Lake water control structure. Widen access road and construct spillway in road if needed to manage flood water events.	Allow vehicle access unless flooded or road conditions require temporary closure.
6.A.13	Calhoun	Construct an observation deck and parking area just east of the Pump Station Road gate.	

Goal 6: Two Rivers NWR / Objective 6.A/ Strategies 6.A (Continued)

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.A.14	Gilbert Lake	Construct parking area along levee road south of Highway 100 on east side of the Division.	Will improve visitor safety by eliminating need to park on the highway.
6.A.15		Construct raised observation deck with interpretive panels on west side of ditch in agricultural field.	Also needs parking area nearby. Will provide view of Gilbert Lake.

Goal 6: Middle Mississippi NWR / Objective 6.A/ Strategies 6.A

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.A.16	Harlow Island	Develop public access at end of County Road AA.	Requires acquisition of 90-acre Kimmswick Isle of Capri Casino property.
6.A.17		Work with MDOC to improve road/ parking area on Big Hollow Road for access to south end of Division.	Approved as FHWA Federal Lands Discretionary Project.
6.A.18	Harlow Island	Develop 1.5 miles of hiking trails from newly constructed access point at Big Hollow Road/Truman Park.	
6.A.19	Wilkinson Island	Construct three public parking areas on or adjacent to the COE levee.	
6.A.20		Maintain one trail from each parking area into the interior of the unit for public access.	

Objective 6.B. Enhance the education and interpretive program on Complex refuges by providing visitors key river resource messages through contact stations, kiosks, interpretive panels, educational programs and special events. The visitors experience will focus on the messages of: changes in the floodplain, wildlife management choices in this changed setting, and the public's opportunity to be involved in river issues and the Refuge Complex responses.

Goal 6: Port Louisa NWR / Objective 6.B/ Strategies 6.B

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.1	Horseshoe Bend	Develop and install interpretive panels at new observation platform.	✔

Goal 6: Port Louisa NWR / Objective 6.B/ Strategies 6.B (Continued)

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.2	Louisa	Expand headquarters/visitor contact station. Expand and improve interpretive and educational exhibits HQ.	✔
6.B.3		Develop replacement interpretive panels for observation deck at HQ.	✔
6.B.4		Provide outdoor classroom facilities in HQ area and develop local wildlife education programming to assist area teachers when using these facilities.	✔
6.B.5		Conduct Refuge-sponsored events that provide opportunities for interpretive bus or auto tours at times and locations that are compatible.	
6.B.6	Keithsburg	Develop and install interpretive panels at the boat ramp parking lot kiosk.	
6.B.7	Big Timber	Develop and install interpretive panels and kiosk at the boat ramp parking lot.	
6.B.8	Overall Refuge	Develop an interpretive information brochure for local Spanish speaking populations that would include Refuge rules and regulations.	

Goal 6: Great River NWR / Objective 6.B/ Strategies 6.B

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.9	Clarence Cannon	Expand headquarters/visitor contact station. Expand and improve interpretive and education exhibits in visitor center.	✔ Install 1.4-mile water line to provide safe drinking water.
6.B.10		Provide interpretive panels on proposed auto tour route to enhance visitor knowledge of the Refuge System, management practices and potential wildlife sightings.	✔

Goal 6: Great River NWR / Objective 6.B/ Strategies 6.B (Continued)

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.11	Delair	Construct vehicle turnout with interpretive signs along public road to COE Gosline boat access.	
6.B.12		Improve education activities and curriculum material used by local schools.	
6.B.13		Conduct public open house every 3 years (open to public to drive through).	Staff and portable displays available during event.

Goal 6: Two Rivers NWR / Objective 6.B/ Strategies 6.B

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.14	Calhoun	Expand headquarters/visitor contact station. Expand and improve interpretive and education exhibits in visitor contact area.	✔ Examine alternative entrance road directions to provide safer access.
6.B.15		Install interpretive panels on grassland trail, forest trail, wildlife drive, at lower Swan Lake stoplog structure, and at both Swan Lake boat ramps.	✔
6.B.16	Gilbert Lake	Install interpretive panels along State Highway Rt. 100 turnout road over looking the Division.	Include short messages that can be read from a vehicle.
6.B.17		Provide interpretive eagle viewing tours in January and February.	✔ Partnership effort with Pere Marquette State Park.

Goal 6: Middle Mississippi NWR / Objective 6.B/ Strategies 6.B

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.18	Harlow Island and Meissner Island	Develop one interpretive panel for each of the three Middle Mississippi NWR divisions.	
6.B.19		Provide interpretive eagle viewing tours in April at Wilkinson Island.	

Goal 6: Mark Twain NWR Complex / Objective 6.B/ Strategies 6.B

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.B.18	All	Install flood-friendly kiosks on Louisa (including Schafer's and Sand Run accesses on Lake Odessa) Big Timber, Horseshoe Bend, Keithsburg, Long island, Fox Island, Harlow Island, Batchtown (Prairie Pond) Gilbert Lake and Calhoun.	✔ Will include general Refuge information, interpretive panels, and regulation panels.
6.B.19		Develop Refuge celebration program for International Migratory Bird Day, National Wildlife Refuge Week, Earth Day, and other wildlife events.	✔
6.B.20		Develop general information brochures for the complex, the Refuges, and the Divisions. Continue providing annual hunting/fishing brochures for Refuges and overall Complex.	
6.B.21		Develop comprehensive species lists for birds, mammals, reptiles/amphibians for the AEC and for each Refuge.	✔ Wildlife inventories are needed for some divisions.
6.B.22		Develop and conduct Refuge-specific wildlife education curriculum modules for children and adults.	✔
6.B.23		Produce informational videos for the Complex and for each Refuge.	
6.B.24		Develop annual special events calendar pertaining to outreach and education.	Distribute to each Refuge and to local communities.
6.B.25		Develop public outreach program material on the issue of "casual mooring" and its effects on forest and aquatic habitats owned by the government.	Include information on alternative approaches, and effect change by 2004.

Objective 6.C. Enhance outreach through off-refuge activities by conducting education and interpretive programs for schools, youth, civic and conservation groups to increase understanding and appreciation of wildlife and wildlife habitat on the river corridor.

Goal 6: Port Louisa NWR/ Objective 6.C/ Strategies 6.C

Strategy No.	Strategies	Comments *✔ Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.1	Continue to partner with Louisa County conservation Board to provide wildlife-dependent interpretive and educational activities.	

Goal 6: Great River NWR/ Objective 6.C/ Strategies 6.C

Strategy No.	Strategies	Comment *✔ Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.2	Continue annual participation in Big River Days in Clarskville, Missouri.	
6.C.3	Work cooperatively with Clarksville, Missouri, to provide interpretive display for the proposed Heritage Center, if built.	

Goal 6: Two Rivers NWR/ Objective 6.C/ Strategies 6.C

Strategy No.	Strategies	Comment *✔ Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.4	Develop Refuge exhibit with information on FWS, the Two Rivers Refuge and river habitat management to locate at Pere Marquette State Park. (Visitor Center, lodge, campground, or boat ramp area.)	✔
6.C.5	Develop partnership with Calhoun County to develop annual wildlife celebration event. Ideas include Bald Eagles, White Pelicans, and waterfowl.	Would focus local attention on the Refuge and support county tourism.
6.C.6	Continue annual co-sponsorship of Two Rivers Family Fishing Fair at Pere Marquette State Park during National Fishing Week.	

Goal 6: Two Rivers NWR/ Objective 6.C/ Strategies 6.C (Continued)

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.7	Develop Environmental Education and interpretive program for students and visitors, on and off-site. Recruit, organize, and equip a cadre of volunteers to provide these educational opportunities.	✔ Would meet need generated by Riverlands outreach efforts.
6.C.8	Install Refuge/Complex/Service information kiosk near Brussels Ferry.	Partnership with Illinois DOT.

Goal 6: Middle Mississippi NWR/ Objective 6.C/ Strategies 6.C

Strategy No.	Strategies	✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.9	Continue to develop environmental education partnerships with local schools in the Middle River floodplain.	
6.C.10	Continue to provide public information, displays and programs at area fairs and other events.	

Goal 6: Complex and Riverlands Project/ Objective 6.C/ Strategies 6.C

Strategy No.	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.11	Create a portable exhibit showcasing Refuge resources, delivering Refuge messages, and elevating awareness of River resources to the public.	In cooperation with COE.
6.C.12	Develop and conduct complementary off-site wildlife education curriculum modules for children and adults.	
6.C.13	Develop a Complex website that includes maps, visitor and volunteer information, wildlife species information, River information, special events and links.	
6.C.14	Develop Service kiosks and displays on partner-managed land (COE, Illinois, Iowa, Missouri)	The Complex will also seek partnerships at other appropriate municipal locations for these outreach efforts.
6.C.15	Prepare briefing folder about mission, goals, objectives, strategies and program highlights for Congressional State, and local representatives.	

Goal 6: Complex and Riverlands Project/ Objective 6.C/ Strategies 6.C (Continued)

Strategy No.	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.16	Develop interpretive panels for the kiosk at Riverlands Environmental Demonstration Area. Focus on Mississippi River, its watershed, and the FWS/COE partnership.	Requires close coordination with COE Public Relations Coordinator.
6.C.17	Maintain urban environmental education efforts by continued partnership with COE. Refuge will provide staff time for outreach opportunities at Riverlands facility near St. Louis. Educational materials, exhibits, displays and support services such as bus rentals are needed to provide a more complete vision of the Service, Refuge System, and Complex connection to the Mississippi River.	
6.C.18	Develop partnership with local chapters of Eco-Watch organization and other groups to assist with River monitoring activities, special events, community outreach, and volunteer program.	
6.C.19	Co-produce with COE an education video for teachers that highlights our curriculum-based programs. This may be accompanied by an educator's guide to assist and encourage more teachers to use Riverlands and Complex refuges as outdoor classrooms.	
6.C.20	Assist with development and installation of exhibits in COE National Great Rivers Museum in Alton, Illinois.	

Goal 6: Mark Twain NWR Complex/ Objective 6.C./ Strategies 6.C

Strategy No.	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.21	Provide news releases to local media regarding refuge events and achievements. Consider monthly columns for newspapers. Investigate short-range radio broadcasts highlighting our refuges and seasonal activities.	✔
6.C.22	Expand level of speeches and presentations to civic and other community organizations describing the value of the Refuge complex lands and the role of the FWS on the Mississippi River.	✔
6.C.23	Develop and use traveling education trunks to increase awareness about the refuges, the River and its resources, and the Service mission.	✔

Goal 6: Mark Twain NWR Complex/ Objective 6.C./ Strategies 6.C (Continued)

Strategy No.	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.C.24	Expand the volunteer program to increase public appreciation and support for the Refuges.	✔ Could include programs such as Friends Groups and National Audubon Society "Refuge Keepers."
6.C.25	Incorporate Refuge information into Great River Road highway kiosks, visitor centers, etc.	Requires partnership with state/ local coordinators. Great River Road is a designated National Scenic Byway.
6.C.26	Support formation and maintenance of Friends Groups at individual refuges throughout the Complex.	

Objective 6.D. Increase fishing opportunity by improving access at five Divisions by 2010.

Goal 6: Port Louisa NWR/ Objective 6.D/ Strategies 6.D

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.D.1	Big Timber	Modify the north end of Big Timber boat landing, including relocating the ramp.	

Goal 6: Great River NWR/ Objective 6.D/ Strategies 6.D

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.D.2	Fox Island	Evaluate feasibility of constructing boat ramp and parking area at old Lone Star Bridge site.	In coordination with MDOC, Clark County Highway Department and Fox River Drainage District.

Goal 6: Two Rivers NWR/ Objective 6.D/ Strategies 6.D

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.D.3	Calhoun	Install ADA-compliant fishing pier and transfer dock at Swan Lake boat ramp.	
6.D.4		Improve parking facilities for bank fishing in lower Swan Lake.	
6.D.5	Batchtown	Upgrade prairie pond and Gilead boat ramps and parking areas to meet ADA standards.	
6.D.6	Gilbert Lake	Improve parking facilities for fishing access at lower portion of Gilbert Lake.	Also improve visitor safety.

Goal 6: Middle Mississippi NWR/ Objective 6.D/ Strategies 6.D

Strategy No.	Divisions	Strategies	Comment
6.D.7	Harlow Island	Maintain fishing access trail from Big Hollow Road parking area to the River, approximately one-half mile.	
6.D.8	Wilkinson Island	Improve fishing access trail from the southern parking area to Reed's Creek, approximately .15 mile, and potentially to the Wilkinson side channel when completed.	

Objective 6.E. Improve the quality, as measured through visitor satisfaction surveys, and safety of the hunting program and increase opportunity, where appropriate, in accordance with sound biological management objectives by 2008.

Goal 6: Port Louisa NWR/ Objective 6.E/ Strategies 6.E

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.E.1	Big Timber	Division to remain open to waterfowl hunting as per state regulations. Eliminate drawing for permanent waterfowl hunting blinds by 2004. set a minimum distance of 200 yards between hunters. Restrict permanent blind construction.	Temporary daily concealment only; it would be removed following each day's hunt.

Goal 6: Great River NWR/ Objective 6.E/ Strategies 6.E

Strategy No.	Division	Strategies	Comments
6.E.2	Clarence Cannon	Continue special deer hunt at levels appropriate to protect habitat.	In coordination with the Missouri Department of Conservation.
6.E.3	Long Island	Coordinate annually with the Illinois DNR on waterfowl hunting program and on the placement of waterfowl blinds before each drawing period.	
6.E.4	Delair	Continue special deer hunt at levels appropriate to protect habitat.	In coordination with Illinois DNR.
6.E.5	Fox Island	Continue to monitor deer populations and state special seasons, and adjust seasons if necessary to control deer and provide hunting opportunity when possible.	In coordination with Missouri Department of Conservation.

Goal 6: Two Rivers NWR/ Objective 6.E/ Strategies 6.E

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.E.6	Calhoun	Open lands east of Illinois River Road to upland and big game, consistent with DNR Mississippi River State Game Area seasons and regulations.	

Goal 6: Middle Mississippi NWR/ Objective 6.E/ Strategies 6.E

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.E.7	Wilkinson Island	Provide seasonal access to hunters on the upper end of Wilkinson Island by repairing a bridge, nd surfacing a three-quarter-mile segment of the old Wilkinson Landing road. Access to a central parking area would be allowed between October 1 and January 31.	

Objective 6.F. Increase protection of refuge visitors, natural resources, and facilities through enhanced law enforcement, boundary marking, and sign programs. Refuge facility vandalism and habitat damage will be reduced by 75 percent by 2010.

Goal 6: Mark Twain NWR Complex/ Objective 6.F/ Strategies 6.F

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.F.1	All Divisions	Conduct regular law enforcement patrols of each division (three times per week on average) to protect Refuge resources and visitors, and to deter illegal activities such as vandalism, tree cutting, poaching and camping.	✔
6.F.2		Continue partnerships with local law enforcement authorities and State conservation officers to protect wildlife/habitat resources. Assist with law enforcement patrols on State-managed General Plan lands.	✔
6.F.3		Develop and implement new sign plan to include entrance, regulatory, directional, boundary, and interpretive signs at their locations.	
6.F.4		Ensure proper boundary posting on all Refuge divisions. Maintain existing survey monuments.	✔ Surveys may be necessary to assure correct property lines.
6.F.5		Ensure proper boundary posting of all Farm Service Agency conservation easements.	✔

Goal 6: Port Louisa NWR/ Objective 6.F/ Strategies 6.F

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.F.6	Louisa	Install gate at headquarters entrance to prevent off-hours traffic from accessing the area.	
6.F.7	Keithsburg and Louisa	Modify Division closed for sanctuary period dates to September 16 to December 15.	

Goal 6: Port Louisa NWR/ Objective 6.F/ Strategies 6.F (Continued)

Strategy No.	Division	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.F.8	Horseshoe Bend	Modify Division closed for sanctuary period dates to September 16 to December 15.	Changes in waterfowl season dates could result in these closed periods being adjusted and posted locally.

Goal 6: Two Rivers NWR/ Objective 6.F/ Strategies 6.F

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.F.9	All Divisions	Change closed sanctuary period to October 15-December 31 each year.	Previously October 15-December 15. Access is permitted at designated locations.
6.F.10	Batchtown	Install gate on Prairie Pond levee to prevent traffic past the Mississippi River boat ramp during the closed period in the fall.	

Goal 6: Middle Mississippi NWR/ Objective 6.F/ Strategies 6.F

Strategy No.	Division	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
6.F.11	Harlow Island	Install gate at County Road AA access point to prevent vehicle trespass.	
6.F.12	Wilkinson Island	Install gates at three existing access roads to prevent vehicle trespass.	
6.F.13	All divisions	Ensure proper boundary posting on all refuge divisions and complete, maintain and update boundary surveys.	

Goal 7 Discussion. Monitoring

Monitoring of wildlife, habitat and public use on refuges accomplishes several purposes: it allows for evaluation of current land use and management practices, it can provide early warning of problems in the system, and it provides the foundation for future management decisions. Service policy on refuges (701 FW 2) is to (1) collect baseline information on plants, fish, and wildlife, (2) monitor, as resources permit, critical parameters and trends of selected species and species groups on and around Service units, and (3) base management on biologically and statistically sound data derived from such inventory and monitoring. When operating with limited budgets and personnel, the monitoring program on Complex

Refuges will focus on a few reliable surveys designed to evaluate and improve specific management actions. Priority surveys will focus on the Mark Twain Complex species of concern and their preferred habitats.

In addition, there are numerous other parties involved in monitoring efforts conducted within the Area of Ecological Concern. The Complex will integrate these larger-scale river corridor monitoring efforts with refuge site-specific data to the degree applicable. Normally the subject of monitoring would not be treated as a separate goal topic in Comprehensive Conservation Planning, but rather as individual component strategies under other management actions, such as habitat manipulations. This type of site-specific monitoring will be a major part of the Mark Twain program. However, the magnitude of the interagency monitoring efforts throughout the entire UMR System have led the Complex to treating the subject separate from other management proposals in this document. A step-down Monitoring Plan will detail the program associations with on-refuge management actions as well as ecological and biological conditions throughout the river corridor.

The Long Term Resource Monitoring Program (LTRMP), a component of EMP, conducts much of the current monitoring within the UMR corridor, both within defined areas and on a systematic scale. The LTRM program is managed by the COE in partnership with the USGS Upper Midwest Environmental Science Center (UMESC) in LaCrosse, Wisconsin. The mission of the LTRMP is to "provide decision makers with the information needed to maintain the Upper Mississippi River System as a sustainable large river ecosystem given its multiple use character." Six state-operated field stations have been established for data collection in Lake City, Minnesota (Pool 4); Onalaska, Wisconsin (Pool 8); Bellevue, Iowa (Pool 13); Alton, Illinois (Pool 26); Jackson, Missouri (Open River); and Havana, Illinois (Illinois River). Since shortly after the program was established in 1986, the field stations have gathered baseline data on fisheries, macroinvertebrates, water quality, and vegetation in each of these "key pools." Recently, discussions have begun about the future direction of the LTRMP. Planned modifications to the program include monitoring more pools, increased emphasis on data analysis, and developing systemic elevation and bathymetry coverages for the UMRS.

The UMRS Habitat Needs Assessment (HNA) provides additional corridor-wide habitat information for use by land managers. The initial HNA was completed in 2000 as part of the EMP program. It provides a first approximation of a system-wide set of objectives for use in planning habitat protection and restoration projects on the UMRS. The interagency HNA team evaluated existing habitat conditions, reviewed and refined the "predicted" future habitat conditions, and identified "desired" future habitat conditions. Habitat needs were identified on system-wide, river reach, and pool levels by comparing the current, predicted, and desired conditions.

A GIS-based "query tool" was developed as part of the HNA to help managers evaluate potential distribution of species and habitat types throughout the river corridor. The user may query on a species to obtain likely habitat types, or may query on a habitat to obtain likely species information. The query tool also provides several analytical tools to describe habitat diversity measures (e.g. shoreline length, number of islands, number of species, etc.). However, this initial version of the query tool is focused only on adult, mid-summer habitat needs of species and is based on 1989 land cover maps with incomplete coverage of the AEC. Future versions of the HNA will incorporate updated, refined, and expanded habitat and species information. For example, UMESC is now using aerial photos taken in 2000 to digitize updated land cover maps for the entire 500-year floodplain based on the HNA cover classes.

There are many other examples of monitoring and research programs being conducted by Service partners on the UMR and some include locations on Refuge-managed lands. The Illinois Natural History Survey conducts weekly aerial waterfowl flights on many sections of the river during fall migration. The Rock Island District of COE conducts forest inventories on General Plan lands, timber stand improvement studies, and red-shouldered hawk and forest songbird monitoring. Federal and State fisheries biologists monitor fish populations annually. Paddlefish activity, for instance, has been studied in Swan Lake since 1994. Biologists also have been monitoring the effects of Environmental Pool Management on wetland vegetation and fisheries, and USGS has developed a protocol to evaluate the effects of spillways (e.g. Clarence Cannon and Keithsburg) on sedimentation and vegetation response. There are many additional partners involved in monitoring and research efforts within the AEC, including the Upper Mississippi River Conservation Committee (UMRCC), Environmental Protection Agency (EPA), Mississippi Interstate Cooperative Resource Association (MICRA), Columbia Environmental Research Center (CERC - USGS), state universities, and non-governmental organizations such as Audubon Society and RiverWatch.

In addition to these systemic efforts by Service partners, on-refuge data is collected by staff and volunteers whenever possible. For example, waterfowl and shorebird counts, songbird point counts, frog call counts, and vegetation transects have all been conducted on various refuge divisions. Due to personnel and funding limitations, however, refuge-specific monitoring has been sporadic, and data compilation and analysis are incomplete.

The monitoring priorities of the Complex will focus on data pertinent to Service policies and on management objectives of the refuge units. The Complex monitoring program will be integrated with UMESC, other FWS offices, and other partner efforts along the river corridor. The data collected will be compatible with the standards of UMESC and the HNA. The HNA cover types are becoming the UMR standard for habitat data collection. Table 11 shows how the habitat categories used in this CCP are related to the HNA cover types.

Table 11: Cover Types for CCP Habitat Management Strategies

Cover Types for CCP Habitat Management Strategies	HNA Cover Type	Typical Species
Open Water	Open Water	No vegetation
Permanently Flooded Aquatics	Submersed Bed	Wild celery, coontail
Semipermanently Flooded Emergents	Semi-permanently Flooded Emergent Annual	Wild iris
	Semi-permanently Flooded Emergent Perennial	Cattail, arrowhead, giant bur-reed, hardstem bulrush
Seasonally Flooded Emergents	Seasonally Flooded Emergent Annual	Wild millet, beggartick, smart-weed
	Seasonally Flooded Emergent Perennial	Yellow nutsedge, sedge meadows
Sand/Mud	Sand/Mud	Exposed sand beaches and mud flats
Wet Meadow	Wet Meadow	Reed canary grass, rice cut-grass, prairie cord-grass
Scrub-Shrub	Scrub-Shrub	Buttonbush, false indigo
Grassland	Grassland	Big bluestem, foxtail, roadside/levee grass

Table 11: Cover Types for CCP Habitat Management Strategies (Continued)

Cover Types for CCP Habitat Management Strategies	HNA Cover Type	Typical Species
Wet Floodplain Forest	Salix Community	Willow-dominated shrubs
	Populus Community	Cottonwood-dominated floodplain forest
	Wet Floodplain forest	Silver maple, green ash, black willow
Mesic Bottomland Forest	Mesic Bottomland Forest	Oaks, hickories
Agriculture	Agriculture	Cultivated fields

The Complex will develop a step-down inventory and monitoring plan for wildlife and habitat according to the guidance in 701 FW 2. Public use monitoring also will be implemented in order to minimize visitor impacts to the resource, to evaluate visitor activities and needs, and to develop improved public recreation and education programs.

A well-designed monitoring program for the Complex will improve refuge management by focusing limited resources on specific management questions and enabling the adoption of adaptive management techniques. Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Adaptive management acknowledges uncertainty and the value of experimentation and learning from experience. Some of the differentiating characteristics of adaptive management are:

- Acknowledgment of uncertainty about what is "best" for the particular management issue,
- Thoughtful selection of the policies and practices to be applied,
- Careful implementation of a plan of action designed to reveal the critical knowledge that is currently lacking,
- Monitoring of key response indicators,
- Analysis of management outcomes in consideration of the original objectives, and
- Incorporation of the results into future decisions.

The AEC is a highly variable, constantly changing system due to floods, droughts, and the effects of man-made features, such as locks, dams, and flood-control levees. These changing conditions, together with a steady stream of new information from the LTRMP, make adaptive management an essential approach to implementation of this CCP. The Refuge Complex will use adaptive management techniques to assess and modify management strategies to achieve the planned goals and objectives. Individual refuges will implement minor modifications to management strategies if warranted by changing circumstances. Any major modifications of program direction will be reflected in formal revisions of this CCP.

Goal 7. Monitoring:

Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of Refuge management programs and to provide information for adaptive management strategies.

Objective 7.A. Monitor habitat communities within the Refuge Complex to evaluate the effects of current management actions and gather data to improve future management practices.

Goal 7: Mark Twain NWR Complex / Objective 7.A/ Strategies 7.A

Strategy No.	Strategies	Comments ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.A.1	Establish annual transects on wetland units to evaluate the quality of vegetation communities and the need for additional management action.	✔
7.A.2	Complete baseline forest inventory for all Refuge divisions. Continue to monitor forest block size and diversity every 5 years.	✔ Partnership with COE
7.A.3	Evaluate Refuge grassland and wet meadow annually for species composition, litter layer, woody vegetation, etc. to determine the need for management action. Run vegetation transects after prescribed burns according to Service policy.	✔ Post-burn monitoring now required by FWS burn program.
7.A.4	Develop step-down inventory and monitoring plan with specific survey locations and protocols.	

Objective 7.B. Monitor wildlife use of refuge to verify a response to habitat management efforts, and to contribute to systematic scale evaluations on the Mississippi River with our partners.

Goal 7: Mark Twain NWR Complex / Objective 7.B Strategies

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.B.1	Monitor waterfowl use of wetland and agricultural areas during spring and fall migration.	
7.B.2	Monitor shorebird use of Refuge wetlands during spring and fall migration.	
7.B.3	Monitor migrating and nesting neotropical songbirds on Refuge forests, grasslands and wet meadows.	✔
7.B.4	Monitor size of deer populations and habitat damage where necessary to determine need for population control.	

Goal 7: Mark Twain NWR Complex / Objective 7.B Strategies (Continued)

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.B.5	Develop step-down inventory and monitoring plan with specific survey locations and protocols to cover above effects.	

Objective 7.C. Monitor public use and environmental education programs to ensure compatibility with wildlife purposes, visitor satisfaction/safety and outreach effectiveness.

Goal 7: Mark Twain NWR Complex / Objective 7.C Strategies

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.C.1	Track visitor numbers and activities at major public use sites.	✔
7.C.2	Monitor public use effects on wildlife and habitat in areas of compatibility concern.	✔
7.C.3	Evaluate visitor satisfaction with recreational facilities and interpretive and environmental education programs – comment cards, interviews, etc.	✔
7.c.4	Evaluate environmental education and interpretation programs for effectiveness, including off-refuge programs and activities.	✔

Objective 7.D. Work with partners to monitor systemic fish, wildlife, and habitat resources of the UMR floodplain and gather data to assist with resource management decision-making.

Goal 7: Mark Twain NWR Complex / Objective 7.D Strategies

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.D.1	Identify and promote research projects designed to answer specific resource management questions or problems.	Partners include USGS, universities and the COE.
7.D.2	Promote continued monitoring of key fish, wildlife and habitat resources in the river corridor through programs such as LTRM, INHS aerial flights, COE forest inventories, etc.	Partners include USGS, States, COE.
7.D.3	Work with partners to expand monitoring efforts on water quality and contaminants in the UMRS.	Partners include USGS, EPA, other FWS offices.

Goal 7: Mark Twain NWR Complex / Objective 7.D Strategies (Continued)

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.D.4	Work with partners to evaluate flood-plain management, connectivity and sedimentation in the River corridor and on Refuge divisions (Environmental Pool Management, fish passage at Swan Lake, effects of clarence Cannon spillway, etc.).	Partners include USGS, COE, NRCS
7.D.5	Work with partners to monitor status and trends of threatened and endangered species (*Boltonia*, pallid sturgeon, Indiana bat, etc.) and other species of concern within the River corridor.	Partners include universites, USGS, other FWS offices.

Objective 7.E. Develop and implement an effective record-keeping and data analysis system, compatible with HNA, to facilitate adaptive management decision-making.

Goal 7: Mark Twain NWR Complex / Objective 7.E Strategies

Strategy No.	Strategies	Comment ✔ *Indicates that strategy requires a fractional addition of Refuge staff to accomplish*
7.E.1	Keep records of management actions and conditions (water level, prescribed fire history, etc.) for all Refuge divisions.	Data associated with GIS assigned polygons where applicable.
7.E.2	Develop system of databases/graphs/tables to facilitate management and analysis of monitoring data.	
7.E.3	Maintain updated GIS database at Refuge Complex level on lower half of UMR.	
7.E.4	Annually compare monitoring data with CCP strategies. Modify management actions as needed.	✔ Major modifications to be reflected in the CCP update.
7.E.5	Promote interagency HNA process to point out deficiencies in UMR habitats that could identify gaps to be addresed through land acquisition or partnership projects.	

Chapter 5: Refuge Boundary Expansion

USFWS

This CCP contains an expanded boundary of approximately 27,659 acres for four of the five Complex refuges. While this represents a large effort, the total area identified is rather modest within the context of a larger than 1.3-million acre Area of Ecological Concern. It also represents only a portion of the 130,000 additional habitat need identified for the Mark Twain Reach in the Interagency Habitat Needs Assessment cosponsored by the USGS and USACE. Whether viewed as large or modest, the identified parcels are those that best contribute to the goals of the plan. In the aggregate the proposal delineates a reasonable approach to address Service habitat and floodplain concerns with willing sellers during the 15-year plan horizon. The land acquisition and subsequent implementation of habitat restoration efforts represent essential strategies to achieving plan goals and objectives on a systemic scale within Area of Ecological Concern (AEC).

Land Acquisition Factors

The selected alternative of the associated environmental assessment (see Appendix H) includes an expanded land acquisition component. The concept of identifying up to 60,000 acres spread over 487 miles of the River to the Complex's potential acquisition boundary originated in the early 1990s, when the Service initiated efforts to examine a larger section of the Upper Mississippi River corridor. This evaluation included the “Middle Mississippi River” (local name for the lower 200 miles of the UMR), which had not been included in earlier efforts.

The Galloway Report (see the Relationship to Other Plan section in Chapter 1) contained several quotes, such as the following:

> "Even before the Great Flood of 1993, we had started to realize that some of the areas within our levees should have never been cleared for farming. The events of the last year have driven this point home. Many farmers with marginal and sub marginal land are tired of fighting the river and want to find a way to get out from under their financial burdens."
>
> *Letter from Union County Board of Commissioners to U.S. Senator Paul Simon (IL), April 1994.*

In response to the Great Flood of 1993, the Service prepared a Big Rivers Ascertainment Initiative that proposed strategies for evaluating lands to be acquired for the protection and restoration of sustainable representative habitats along the Illinois, Missouri and Mississippi rivers. There was also a smaller, more focused PPP prepared for four areas in the Middle Mississippi River in response to the flood. Congress funded the Complex for this land acquisition as part of a broader federal strategy to assist flood prone farm landowners and to restore some floodplain function. This effort was initially referred to as the Tanahkwe District of the refuge, but the unit was not staffed as a separate station at the time. No lands were purchased at Powers Island. In spite of a great deal of initial interest there, was eventually a very low percentage of landowners applied to enroll in the Wetland Reserve Program. Lands were purchased at Wilkinson Island, Harlow Island and Meissner Island. The Shawnee National Forest also acted to address the flood issue by purchasing some of the Wetland Reserve Program (WRP) easements on floodplain lands and has evaluated a proposal to extend their boundary westward to the river's edge between Grand Tower and Thebes. This effort has been called the Inahgeh addition to the forest. The American Land Conservancy has worked in partnership with the Shawnee National Forest since the start of the post flood project. The presence of this government/non-government joint endeavor on the Illinois side of the Middle Mississippi River is the reason the CCP Area of Ecological Concern (AEC) was adjusted to exclude this section from further Refuge land protection consideration.

In 1997, final approval was obtained from the Washington Office to study the potential addition of up to 60,000 acres to the Mark Twain NWR Complex. Since the CCP planning effort was scheduled to begin soon, it was decided that the detailed evaluation of the expansion would be incorporated into the comprehensive plan. Evaluating locations that best contribute to accomplishing the goals and objectives outlined in this plan identified specific parcels. Prioritizing areas into four tiers further refined this process and identified approximately 56,000 acres for consideration. The top priority tier in this process contains 27,659 acres; tier 2 contains 14,084 acres; tier 3 contains 8,537 acres; tier 4 contains 5,393 acres. Following evaluations of these tiered options at the Regional and Washington Office levels, the refuge was approved to advance the planning process at the tier one level. This top priority level is split between four refuges in the following amounts: Port Louisa NWR, 6,681 acres; Great River NWR, 5,237 acres; Two Rivers NWR, 983 acres; Middle Mississippi River NWR, 14,758 acres.

Considerations for selecting specific parcels and their priority in this expansion include:

- refuge purposes;
- the goals and objectives of this CCP;
- interagency input, such as the jointly prepared Middle Mississippi River Habitat Rehabilitation Initiative, and other habitat focus areas

- the sites' potential to restore riverine wetland and forest values;
- Levee District flood histories;
- the Habitat Needs Assessment (HNA) developed by the Corps, Service, USGS and five UMR states; and
- the opportunity to remove agriculture from the most flood prone and erodible areas;
- providing additional recreational access in areas where existing access is limited.

Parcels contained in the project boundary will not only contribute to the goals of the CCP, but these lands will also assist with public policy matters addressed by other federal, state, and local agencies. Nutrient cycling on additional floodplain lands will contribute to the reduction of nitrogen flowing down the river and a subsequent reduction in Gulf Hypoxia. By opening the width of the floodplain and increasing floodwater storage, the potential damage to urban areas and other developed and protected lands is reduced. Also, some flood prone farmlands have been more expensive to the government through disaster relief payments in recent years than the fee value of the land to purchase. The increase of recreational opportunity is another positive in addition to the primary goal of restored habitat values. The identified lands all contribute to the habitat needs within the River corridor. They also complement broader federal government goals and responsibilities for fiscal management and good government practices beyond the Interior Department objectives.

Much of the land within the proposed boundary is located in the Middle Mississippi River reach of the UMR. Very little public ownership exists there and floods have been particularly hard on floodplain farmers in that portion of the river. Most of the lands there will be managed for forest and aquatic habitats. The forests will provide a contiguous corridor for nesting and migrating birds and aquatic habitats will be managed for the benefit of big river fish. Expansions of the flood zone will contribute to the floodplain management and water quality goals. An exact prediction of the habitat types that will result in any area cannot be made until the areas have been acquired and various detailed options can be explored on-site. However, it is estimated that locations of the expansion above St. Louis will result in habitat types that are proportioned close to the distribution that now occurs in those refuges. This distribution generally being: forest types 50 percent, wetland and aquatic types 30 percent, and other terrestrial types 20 percent. Since there will be an increased emphasis on connectivity rather than isolated wetlands in the Middle Mississippi River section, the proportions there are estimated to be 65 percent forest, 20 percent wetland, and 15 percent other terrestrial habitats.

The initial demarcation of the proposed boundary was accomplished using refuge Geographical Information System (GIS) data, which is used primarily for biological analysis at the refuge. As such, the potential units listed by this means totaled 31 areas containing approximately 134 landowners. The total acreage of the 31 separate areas equals 27,659 acres. However, that acreage figure may be high because it contains some parcels that include open water areas between fee title lands, such as backwater channels within an island complex. These figures will be refined by means of a tract-by-tract evaluation of the parcels as they are recorded in county courthouses.

During the 15-year planning period outlined in this plan, it is not expected that the Complex will actually acquire an interest in all the lands included in the proposed boundary. It is recognized that under normal budget conditions, acquiring 12,000 to 15,000 acres is a realistic estimate during the 15-year plan period. However, it is still important to plan for a larger project area. The needed habitat for a sustainable system is estimated to be an additional 130,000 acres, according to the HNA. Partner agencies, particularly the COE, have looked to the Fish and Wildlife Service to identify the highest priority lands for meeting sustainable system needs. The areas identified in the CCP boundary expansion proposal, including tiers 2 through 5, will also be used by those partners as specific resource information along the corridor in the event of another disaster mobilization. It is anticipated that other authorities, such as the COE or FEMA, could be used to purchase lands in the event of another flood on the scale of 1993. The proposed boundary will help delineate the highest priority areas for system scale resource attention.

In addition to the parcels detailed in plan maps, the Complex has also been coordinating on this issue with the Ameren/Union Electric power corporation. The company owns some land in the pool 19 river area since their hydroelectric plant was built in Keokuk, Iowa, in 1913, which predated the 9-foot navigation channel project. There are also many private parcels both along this shoreline and submerged that have a long history of resource value, particularly for fish and diving ducks. The lower pool is too large to include exact parcel information regarding key submerged lands. However two "generic" parcels have been included in the CCP top tier land protection proposal. Port Louisa Refuge will explore purchase, or long-term leases, of small, key parcels that enable an open water restoration project "anchor point" have been discussed as a possibility for EMP projects or other restoration activities.

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It is estimated that the cost to acquire nearly 28,000 acres would be anywhere from $20 million to $27 million. Since acquisition would only be on a willing seller basis, it is likely that if this acquisition were to occur, it would be over a period of decades. The estimate for the 15-year planning period is $13 million for the 12,000 to 15,000 acres. Public and private partnerships will be utilized to reduce this cost to the Service.

The estimate for long-term Operations and Maintenance funding needs to manage these lands is relatively low for two reasons. First, most of the land will simply be opened to the River and farming practices stopped. Subsequent much of the forests and wetlands will develop naturally under those conditions. Posting will be required and additional law enforcement coverage may be needed to accommodate the additional public use on the expanded refuge areas. The second reason O&M costs will be lower than normal situations is the presence of partnerships in place on the River. Lands that contain a particularly high restoration value if some level of development is applied can be achieved through programs such as the COE's EMP, or other authority to improve environmental conditions on the River. In all instances, the "forces of the river" will be employed in attempts to mimic natural conditions and reduce O&M costs wherever possible.

Maps showing the existing and proposed boundaries are included in Appendix M.

Revenue Sharing

The U.S. Fish and Wildlife Service, as a federal agency, is exempt from taxation. As refuge lands are acquired, that acreage is removed from county tax rolls. In 1935, the Service began to make revenue sharing payments in lieu of property tax payments to counties that contained Service land. The revenue originally consisted of receipts from the sale of refuge products such as grazing fees, haying, farming, timber sales and oil and gas royalties. Some larger refuges also charge an entrance or user fee, however the Mark Twain NWR Complex charges no entrance fees.

Counties with refuge land initially received 25 percent of the revenue generated from the sale of refuge products within their borders. This worked well for some counties, but not all refuges produce income. Much of the Mark Twain NWR is COE General Plan land, not Service fee title. Revenue returned to each county is based on revenue generated from fee title land. In addition, where farming occurs within the fee title acreage of the Mark Twain NWR, crops are split on a crop share basis. Land is not cash rented. However in 1964 the law was changed to allow all affected counties a portion of revenue money even if no income was generated in their county that year.

The Refuge Revenue Sharing Act authorizes annual payments based on the greatest return to counties and is calculated under one of three formulas: 1) 25 percent of revenues generated by refuge sales; 2) $0.75 per acre; or 3) three-quarters of 1 percent of the appraised value of the Service land in the county. Appraised value is determined on the type of use at the time of purchase and is re-evaluated every 5 years.

Beginning in 1976, shortages in revenue sharing payments caused reductions to be less than the full eligible payment to local counties. Even though the Refuge Revenue Sharing Act, as amended in 1978, authorizes Congress to supplement the fund to enable full payment, which has happened only once, in 1981. Since 1981, the Service's average annual payments have been 75 percent of the eligible payment. In fiscal year 2003 the payments were 49 percent of the eligible payments.

Chapter 6: Plan Implementation

Funding

In the preceding chapters, the Mark Twain Refuge Complex Comprehensive Conservation Plan has outlined a vision for the Area of Ecological Concern and included the management strategies needed to realize that vision. The current level of refuge funding will not move the Complex beyond a slow deterioration of the current habitat and public use condition. Pre-plan staff levels do not allow adequate interactions with the public for education, interpretation, information, safety or enforcement purposes. In addition, habitat management strategies are not achievable with minimum staffing. The rate at which each refuge achieves its full potential of contributing to locally, regionally and nationally important wildlife outputs will depend on the resources provided for those purposes. Increased staffing and funding on each refuge unit will result in long-lasting protection, maintenance and enhancements to river habitats and public use facilities and programs.

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One of the most significant elements contained in this plan is the 27,659-acre boundary expansion. Land acquisition funds and other options to protect identified lands will occur outside the normal Operations and Maintenance funding process for refuges. However, it is predicted that the future Operations and Maintenance costs for much of the proposed expansion area will be quite low. This is because the majority of identified areas would be managed through initial natural succession or by partnerships for forest restoration. Although the Complex ranks extremely high nationally in the Service objective based Land Acquisition Priority System (LAPS), considerable work will be needed to work with willing seller landowners, conservation organizations and political interests to coordinate the Refuge Complex program with larger public policy efforts on the floodplain. The needed Realty program support to implement this plan will depend on the land acquisition funding devoted to the AEC each year. There is not a Realty Specialist identified in the Complex Organization Chart. However, due to the close proximity of the AEC to other Service projects with expanded boundaries, co-locating a

Realty Specialist at the Complex could serve several stations in the southern part of the Region.

The following tables list the projects identified to implement the CCP. They also represent the best known approach to address habitat and facility needs. Changes to project plans will occur as new data becomes available and adaptive management strategies are implemented. As such, this information will be updated annually with the Refuge Operations Needs (RONS) system and the Maintenance Management System (MMS), which are used to track and manage refuge operations and maintenance budgeting each year. These changes will focus on "means" adjustments, while major changes to the desired future condition will be documented in future CCP revisions. Some adjustments to the means of getting to the defined future condition may also occur when step-down plans, such as a forest management plan, are prepared and greater levels of detail developed.

Table 12: Mark Twain NWR Complex Funding Needs Summary as of September 2002

Refuge	RONS Projects	MMS Deferred Maintenance Cost
Mark Twain NWR Complex	$971,000	NA
Port Louisa NWR	$4,522,000	$665,000
Great River NWR	$1,830,000	$1,725,000
Two Rivers NWR	$2,533,000	$1,611,000
Middle Mississippi NWR	$750,000	$368,000
Complex-wide Totals	$10,606,000	$4,360,000

Table 13: Port Louisa NWR Funding Needs Summary / RONS Tier 1

Activity	Project Title	Project No.	Costs
Monitoring and Studies	Develop GIS database that aids in Refuge management decision-making efforts.	970015	$123,000
Habitat Management	Moist soil management area enhancement.	98002	$118,000
Public Education and Recreation	Provide erosion control and boardwalk on interpretive trail.	98006	$38,000
Public Education and Recreation	Expand wildlife-dependent public use program.	97002	$82,000
Habitat Restoration	Wetland restoration of Mud Bottoms and Diggin's Pond of the Horseshoe Bend Division.	00001	$27,000
Habitat Management	Control invasive species and provide supplemental food.	97003	$41,000
Public Education and Recreation	Install direction signs.	99003	$26,000
Monitoring and Studies	Evaluate public use impacts on wildlife.	99005	$49,000
Public Use and Recreation	Minimum Refuge operation needs.	99006	$86,000

Table 13: Port Louisa NWR Funding Needs Summary / RONS Tier 1 (Continued)

Activity	Project Title	Project No.	Costs
Monitoring and Studies	Wildlife response to habitat restoration investigation.	97009	$49,000
Public Education and Recreation	Observation deck and interpretive exhibits.	98009	$61,000
Public Education and Recreation	Provide interpretive/educational trails.	98008	$36,000
Public Education and Recreation	Placement of kiosks and interpretive panels.	99001	$40,000
Habitat Restoration	Fisheries enhancement at Keithsburg Division.	99004	$49,000
Monitoring and Studies	Fish utilization of floodplain-connected habitats on Keithsburg Division.	00003	$324,000
RONS Tier 1 Total Costs:			$1,149,000

Table 14: Port Louisa NWR Refuge Funding Needs Summary / RONS Tier 2

Activity	Project Title	Project No.	Costs
Habitat Management	Enhance Refuge land management and provide private land and interagency assistance.	00002	$129,000
Habitat Management	Conservation easement regulation and enhancement.	98011	$67,000
Habitat Management	Nongame bird response to post-flood changes.	97012	$44,000
Public Education and Recreation	Public use accessibility enhancement.	97011	$67,000
Habitat Management	Experimental prairie cordgrass plots and seed bank.	97010	$37,000
RONS Tier 2 Total Cost:			$373,000

Table 15: Port Louisa NWR Funding Needs Summary / MMS Deferred Maintenance Projects

Project No.	Project Title	Property No.	Costs
99108889	Repair deteriorated observation platform at the Louisa Division.	10013891	$46,000
99108500	Rehabilitate the deteriorated Louisa boat ramp.	10013817	$60,000
00109154	Repair erosion on Keithsburg levee spillway.	10013818	$68,000
86109077	Replace deteriorated concrete boat ramp at Big Timber.	10013900	$163,000
00109135	Repair washouts on Rocky Road on the Horseshoe Bend unit.	10013909	$131,000
00109154	Repair erosion on the Louisa levees.	10013818	$68,000
00109170	Repair displaced riprap on the Keithsburg river levee.	10013869	$157,000
00109002	Replace worn out diesel engine on the Fox Pond Pump Station.	10013836	$30,000
02120561	Replace deteriorated Fox Pond Water Control Structure	10013820	$125,000
02118449	Replace rusted out culverts and gates at several locations on the Division.	10013844	$35,000

Table 15: Port Louisa NWR Funding Needs Summary / MMS Deferred Maintenance Projects (Continued)

Project No.	Project Title	Property No.	Costs
02120562	Replace the non functioning pump station at Keithsburg Division.	10013879	$325,000
Deferred Maintenance Projects Total Cost			$1,208,000

Table 16: Great River NWR Funding Needs Summary / RONS Tier 1

Activity	Project Title	Project No.	Costs
Monitoring and Studies	Improve/increase understanding of biological issues and needs along the Mississippi River.	98005	$139,000
Public Education and Recreation	Improve environmental education facilities for the public	97002	$567,000
Public Education and Recreation	Improve environmental education/wildlife observation facilities.	97005	$195,000
Public Education and Recreation	Increase/improve environmental education and outreach program.	98008	$139,000
Habitat Management	Minimum Refuge Operations Need	99002	$106,000
Monitoring and Studies	Study the effects on Refuge flooding from new spillway on fish spawning and nursery success.	99001	$86,000
Resource Protection	Conduct contaminant investigations on three units of the Refuge.	98006	$107,000
Habitat Restoration	Restore native wet prairie vegetation	97010	$169,000
Monitoring and Studies	Improve migratory bird and habitat management through comprehensive surveys.	98014	$57,000
Great River NWR has 10 additional RONS			
86108822	Replace gravel on deteriorated roads at the Delair unit.	10013922	$28,000
96108906	Replace deteriorated storage shed at Delair Division.	10013920	$69,000
02120456	Clean out silted-in ditches on the Delair Unit.	10013926	$168,000
Deferred Maintenance Projects Total Cost:			$1,830,000

Table 17: Clarence Cannon NWR Funding Needs Survey / Maintenance Management System (MMS) and Deferred Maintenance Projects

Project No.	Project Title	Property No.	Costs
97108694	Repair sloughing slopes on Bryant's Creek levee.	10013942	$400,000
99108727	Repair erosion on top of the main spillway.	10013950	$150,000
00237	Replace deficient interpretive displays.	8000	$60,000
88108984	Repair erosion on Big Pond dike slopes.	10013942	$384,000

Table 17: Clarence Cannon NWR Funding Needs Survey / Maintenance Management System (MMS) and Deferred Maintenance Projects (Continued)

Project No.	Project Title	Property No.	Costs
99109047	Repair deteriorated wooden walkways on the pump station.	10013941	$384,000
00109388	Replace deficient Hemphill Crossing Bridge.	Pending	$250,000
01100749	Energy retrofit the office building.	10013928	$34,000
01110751	Equipment storage building repairs.	10013929	$31,000
02118565	Repair moist-soil unit dikes.	10013943	$116,000
00108941	Replace deficient interpretive facilities in the Visitor Contact area.	10013926	$168,000
02118566	Replace six rusted out water control structures.	10013933	$46,000
01110752	Clean out silt from main ditches.	10013944	$463,000
02118567	Repair two vertical lift pumps at the pump station.	10013941	$51,000
02120450	Replace rusting out moist-soil unit 8b outlet structure.	10013934	$60,000
02120449	Replace rusted out moist-soil unit 8a outlet structure.	10013934	$60,000
Deferred Maintenance Projects Total Cost			$2,411,000

Table 18: Two Rivers NWR Funding Needs Summary / RONS Tier 1

Activity	Project Title	Project No.	Costs
Habitat Management	manage water level and habitat in Swan Lake.	99001	$119,000
Monitoring and Studies	Develop biological monitoring program.	99101	$139,000
Monitoring and Studies	Monitoring wildlife and habitat on Swan Lake.	00001	$55,000
Habitat Management	Improve upkeep of wildlife and visitor facilities.	99103	$99,000
Public Education and Recreation	Develop public use facilities.	99034	$107,000
Habitat Management	Improve water-level control in Batchtown moist-soil units.	00003	$193,000
Resource Protection	Provide better security and faster law enforcement response time.	00005	$167,000
Resource Protection	Survey boundary of Apple Creek WMA and several FmHA easements.	99023	$108,000
Public Education and Recreation	Enhance wildlife viewing opportunity at Gilbert Lake Division.	00010	$106,000
Public Education and Recreation	Provide disabled accessible bank fishing opportunity at Bloom's Landing Recreation Area.	99026	$56,000
Public Education and Recreation	Enhance protection of Refuge visitors and natural resources.	00011	$80,000
Refuge Operations Needs Total Cost:			$1,229,000

Table 19: Two Rivers NWR Refuge Funding Needs Summary / RONS Tier 2

Activity	Project Title	Project No.	Costs
Habitat Management	Increase seasonally flooded wetland habitat at the Gilbert lake Division.	00008	$252,000
Resource Protection	Enhance protection of Refuge visitors and natural resources.	99039	$131,000
Public Education and Recreation	Improve environmental education, recreation and outreach programs.	99036	$129,000
Resource Protection	Enhance Refuge operations through seasonal personnel recruitment.	00006	$162,000
Resource Protection	Restore wetland habitat in the Prairie Pond Impoundment.	99012	$88,000
Resource Protection	Restore wetland habitat in Gilbert Lake.	00002	$54,000
Resource Protection	Improve boundary maintenance and natural resource protection.	00007	$488,000
Two Rivers NWR had 11 additional RONS projects totaling $1,816,000.			
Refuge Operations Needs Total Costs:			$1,304,000

Table 20: Two Rivers NWR Funding Needs Summary, Maintenance Management System and Deferred Maintenance Projects

Activity	Project Title	Property No.	Costs
00109214	Rehabilitate eroded Bloom's Landing boat ramp.	10013762	$36,000
89118	Repair deteriorated exhibits in visitor center.	1	$47,000
95109158	Renovate deteriorated Calhoun wetlands pump station.	10013738	$466,000
97109096	Repair deteriorated siding and other items on office building.	10013733	$91,000
97109123	Replace deteriorated siding and other items on shop buildings.	10013724	$55,000
99109198	Renovate deteriorated boat ramp at the Prairie Pond Unit.	10013790	$53,000
97109276	Remove silt from Gilbert Lake channel.	10013779	$93,000
95109307	Rehabilitate eroded Bilead boat ramp.	10013791	$166,000
97109291	Replace missing Refuge signs.	10013776	$25,000
00108942	Repair deteriorated decking on the observation platform.	10013733	$16,000
Two Rivers NWR Deferred Maintenance Projects Total Cost			$1,048,000

Table 21: Middle Mississippi NWR Funding Needs Summary, Maintenance Management System and Deferred Maintenance Projects

Project No.	Project Title	Property No.	Costs
98158	Replace deteriorated harlow Island culvert bridge.	Pending	$368,000
Middle Mississippi NWR Deferred Maintenance Projects Total Cost			$368,000

Table 22: Mark Twain NWR Complex RONS Projects

Activity	Project Title	Project No.	Costs
Public Education and Recreation	Install Refuge Complex signs, Service recognition and interpretive/education information off Refuge in river corridor.	00007	$81,000
Public education and Recreation	Develop new leaflets, maps and regulatory information for Refuge Complex stations.	00002	$41,000
Monitoring and Studies	Floodplain forest and grasslands scrub/shrub surveys (UMRS GIS) for adoptive management purposes.	00009	$157,000
Monitoring and Studies	Improve management of refuge fisheries resources and fisheries habitat within UMRS.	00008	$150,000
Monitoring and Studies	Refuge GIS capabilities.	00003	$27,000
Habitat and Restoration	Restore bottomland hardwood forest in cooperation with the COE on refuge fee title lands.	00005	$150,000
Public Education and Recreation	Public and urban outreach program support.	00010	$25,000
Resource Protection	Mark Twain Complex “Area of Ecological Concern” aerial photography project planning and CCP monitoring.	00004	$32,000
Public Education and Recreation	Traveling displays for special events and urban outreach.	00011	$65,000
Habitat Restoration	Purchase rubber tracked 200-HP tractor to operate in wet and post-spring flood conditions for use throughout the Complex.	00015	$118,000
Resource Protection	Purchase “MoTrim” type hydraulic deck and weight balanced tractor to be used on refuges throughout the Complex.	00016	$125,000
Refuge Operations Needs Total Cost:			$971,000

Personnel Needs

The Complex staffing chart (Figure 2) lists the current level of staffing as well as the proposed staff needed to implement this plan. There are currently 21 positions filled on the Complex, with the Fire Management Officer covering a three-state area. There are 18 and three-quarters full-time equivalent (FTE) positions identified to bring the Complex up to full operations as addressed in this plan, including the additional duties associated with expanded boundary.

Step-down Management Plans

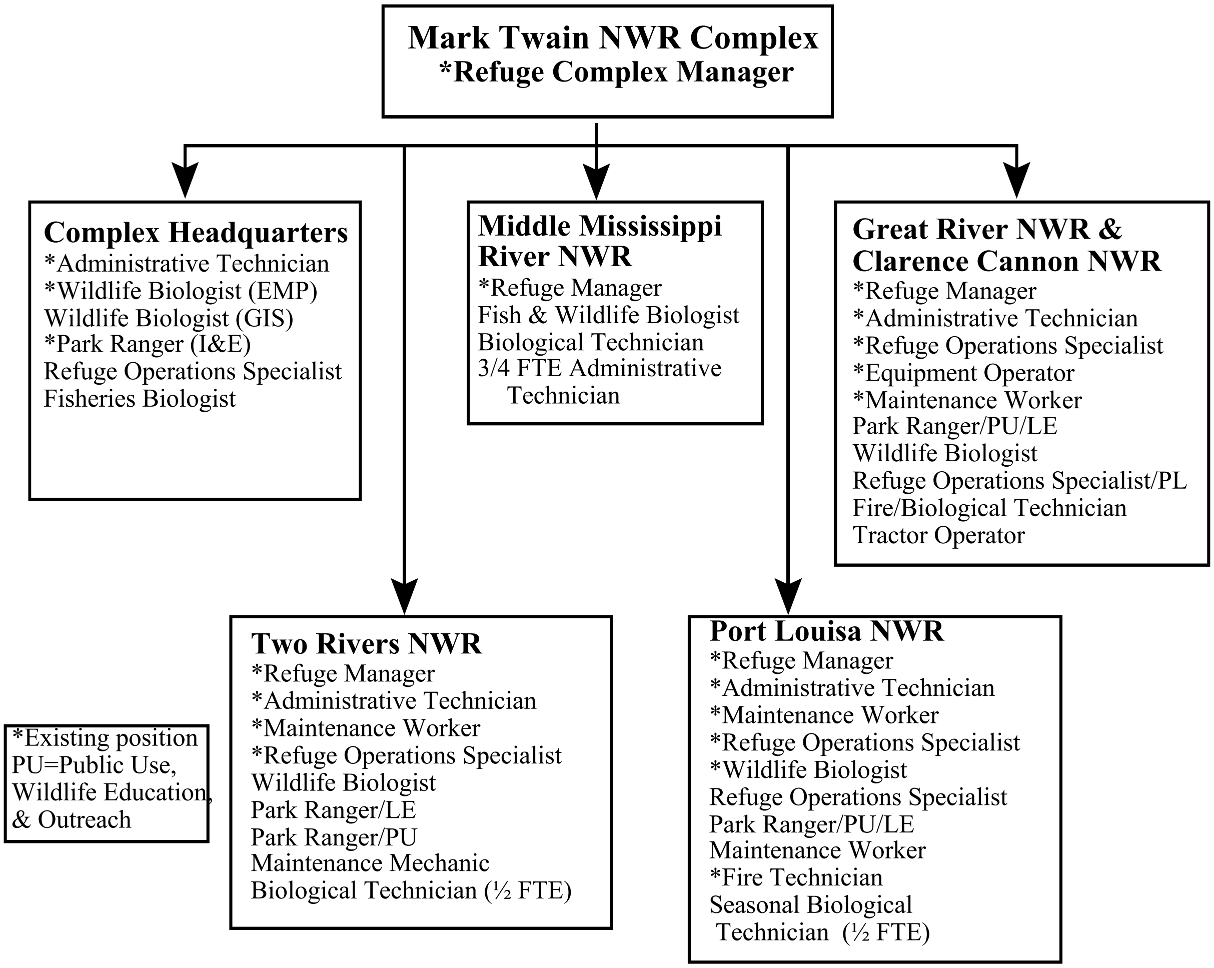
Existing plans that are current with the new CCP direction include: Fire Management Plans for each refuge. The Complex Spill Response Plan is also complete.

New step-down management plans that will be prepared as a result of the CCP include: Habitat Management Plans, as per new policy guidance; and the Inventory and Monitoring Plan, which will be completed by December 2006.

Partnerships

Many active partnerships are discussed in the CCP, and in fact some strategies relate to these efforts. The relationships between the Complex and the Rock Island and St. Louis COE districts, the Illinois DNR, the Iowa DNR, and the Missouri DOC are very strong, although occasional disagreements are inevitable. Throughout the Complex, many other partnerships are in place at the federal, state, local and non-governmental levels. The Complex is committed to partners as the goals in this document cannot be realized through our efforts alone. Each station in the Complex will continue to seek appropriate partnerships with public and private groups as opportunities arise.

Figure 4: Mark Twain NWR Complex Staffing Chart



Appendices

Appendix A: Refuge Complex Maps

Area of Ecological Concern

Current Land Cover

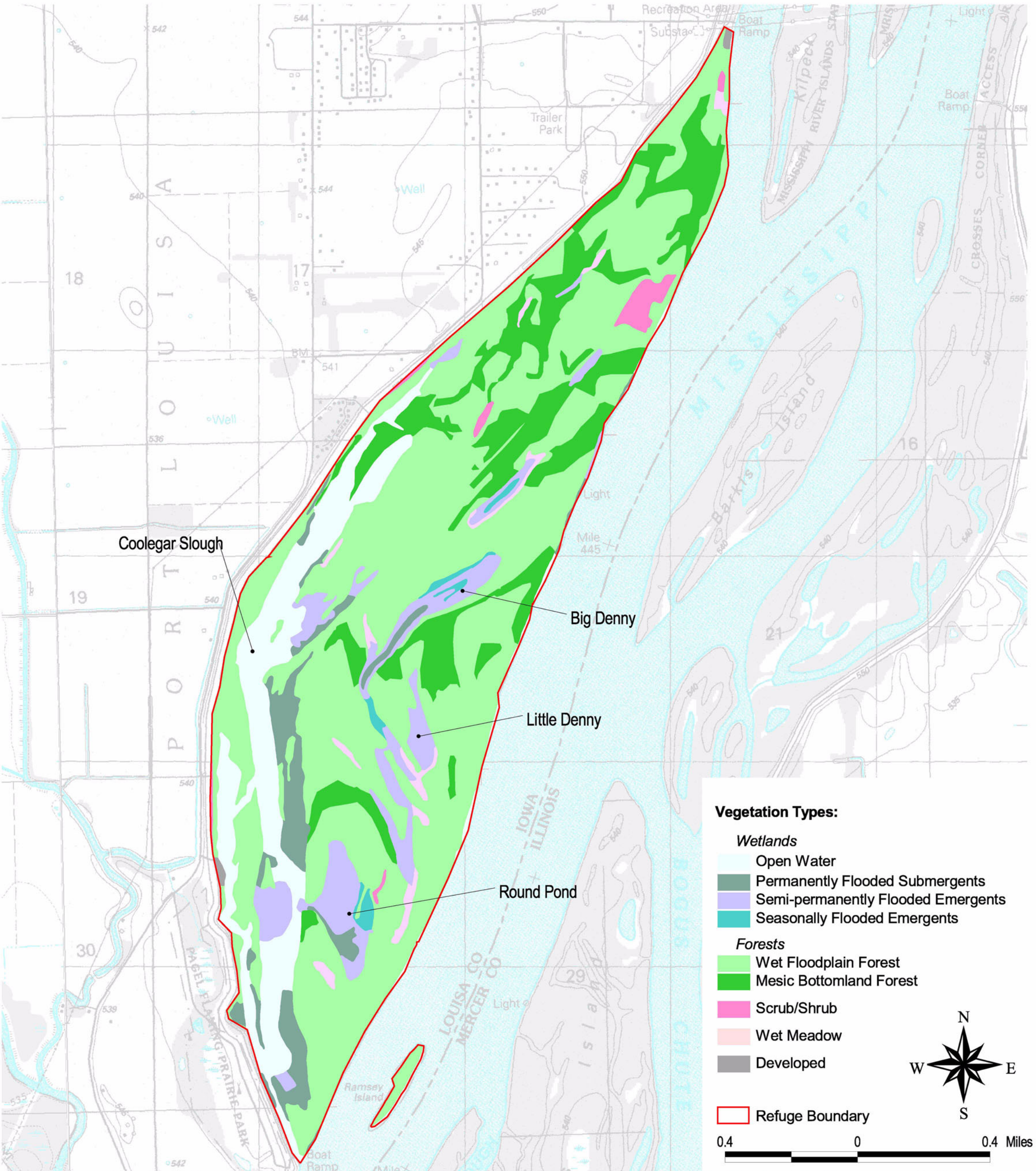
Existing Public Use Facilities

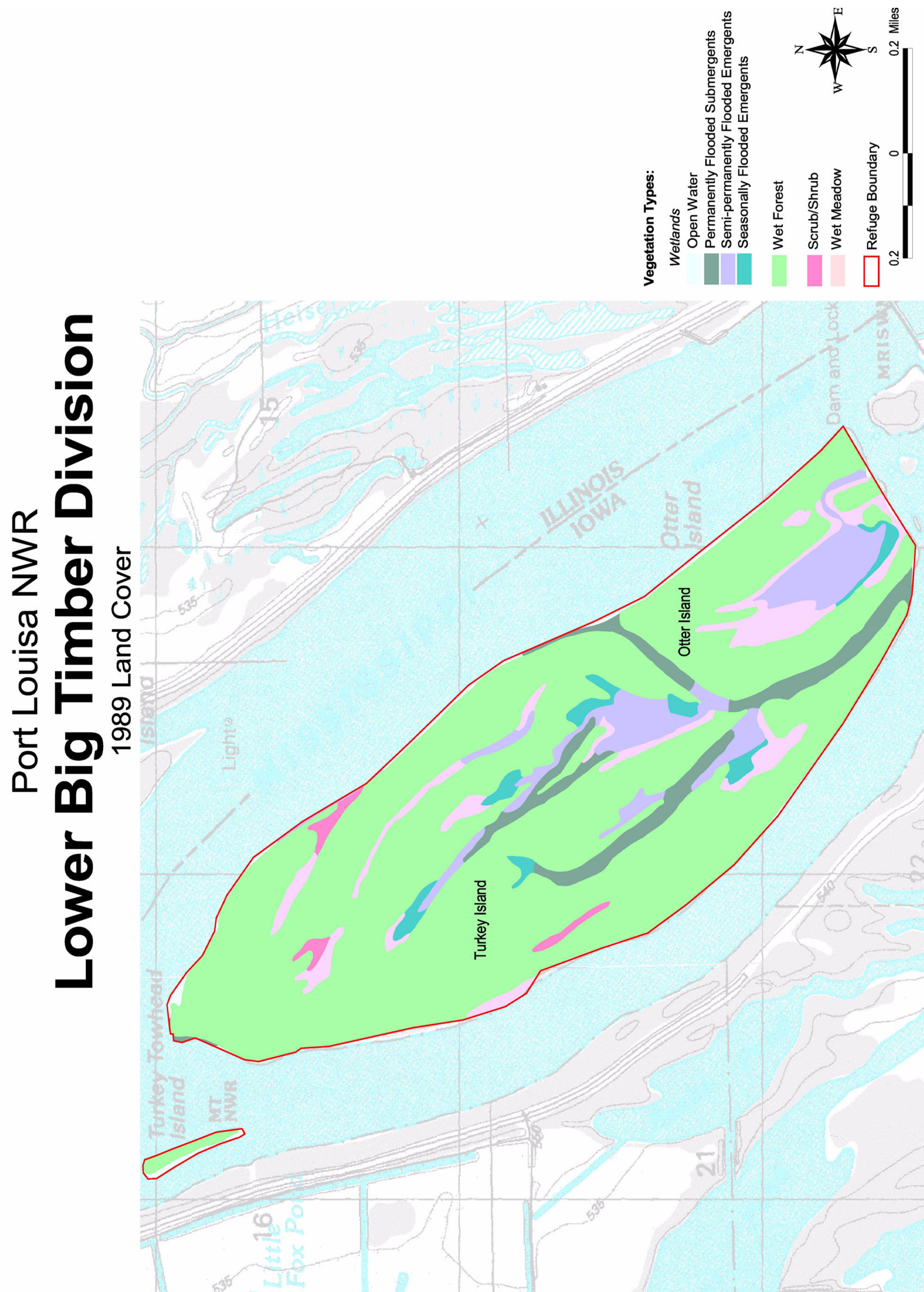
Future Land Cover

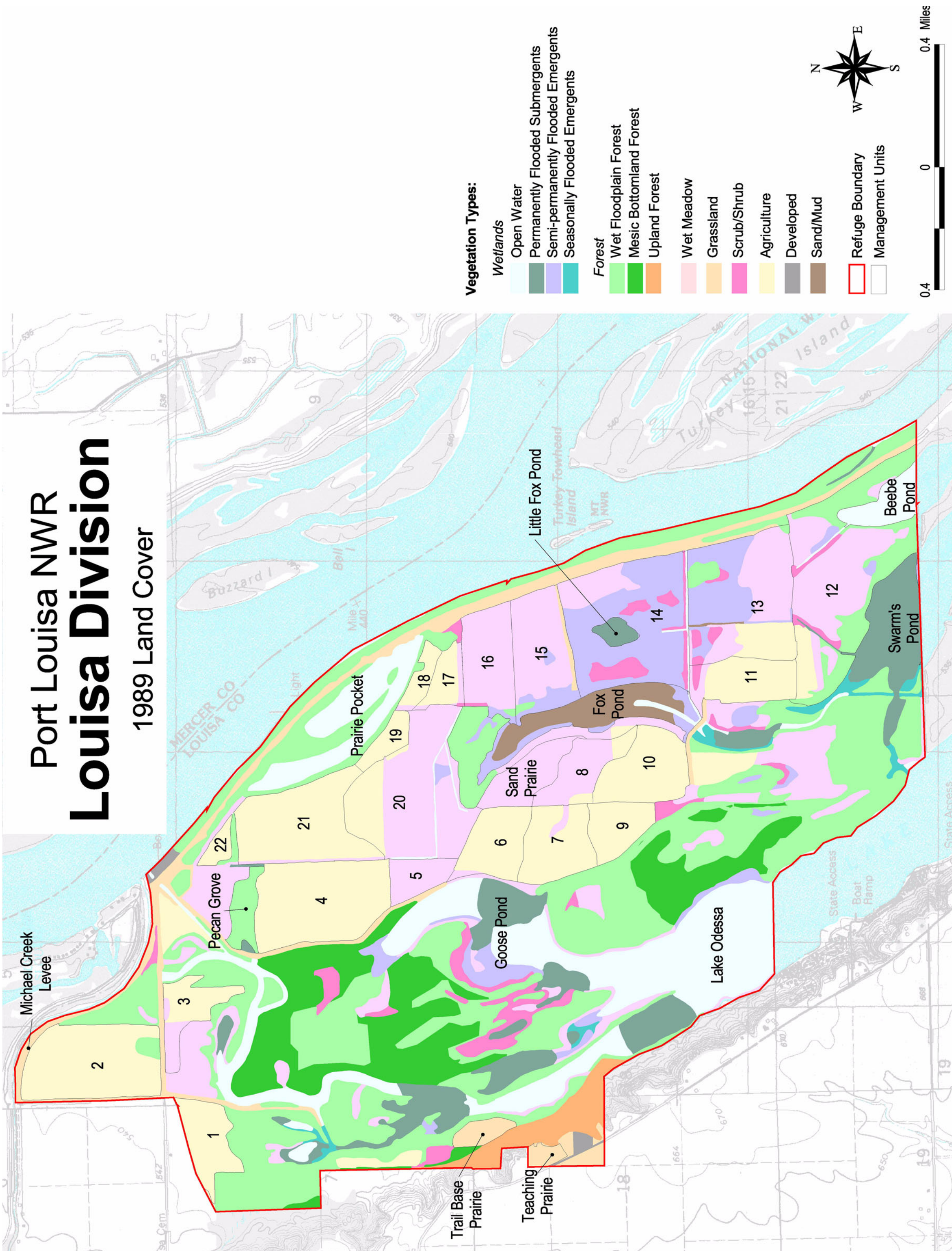

Mark Twain Refuge Complex Planning Area
"Area of Ecological Concern"
Quad Cities
Quincy
St. Louis
Cape Girardeau
Existing Refuge Boundaries Mark Twain NWR
Urban Areas
Area of Ecological Concern (500yr Flood Plain)
60
0
60
120 Miles
N
W
E
S

Current Land Cover

Port Louisa NWR
Upper Big Timber Division
1989 Land Cover




Port Louisa NWR
Lower Big Timber Division
1989 Land Cover
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Wet Forest
Scrub/Shrub
Wet Meadow
Refuge Boundary
N
E
S
W
0.2
0
0.2 Miles
Otter Island
Turkey Island
ILLINOIS
IOWA
Dam and Lock
Turkey Towhead Island
Little Fox Point



Port Louisa NWR
Louisa Division
1989 Land Cover
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Upland Forest
Wet Meadow
Grassland
Scrub/Shrub
Agriculture
Developed
Sand/Mud
Refuge Boundary
Management Units
N
E
S
W
0.4
0
0.4 Miles
Michael Creek Levee
Pecan Grove
Prairie Pocket
Little Fox Pond
Fox Pond
Sand Prairie
Goose Pond
Lake Odessa
Swarm's Pond
Beebe Pond
Trail Base Prairie
Teaching Prairie
1
2
3
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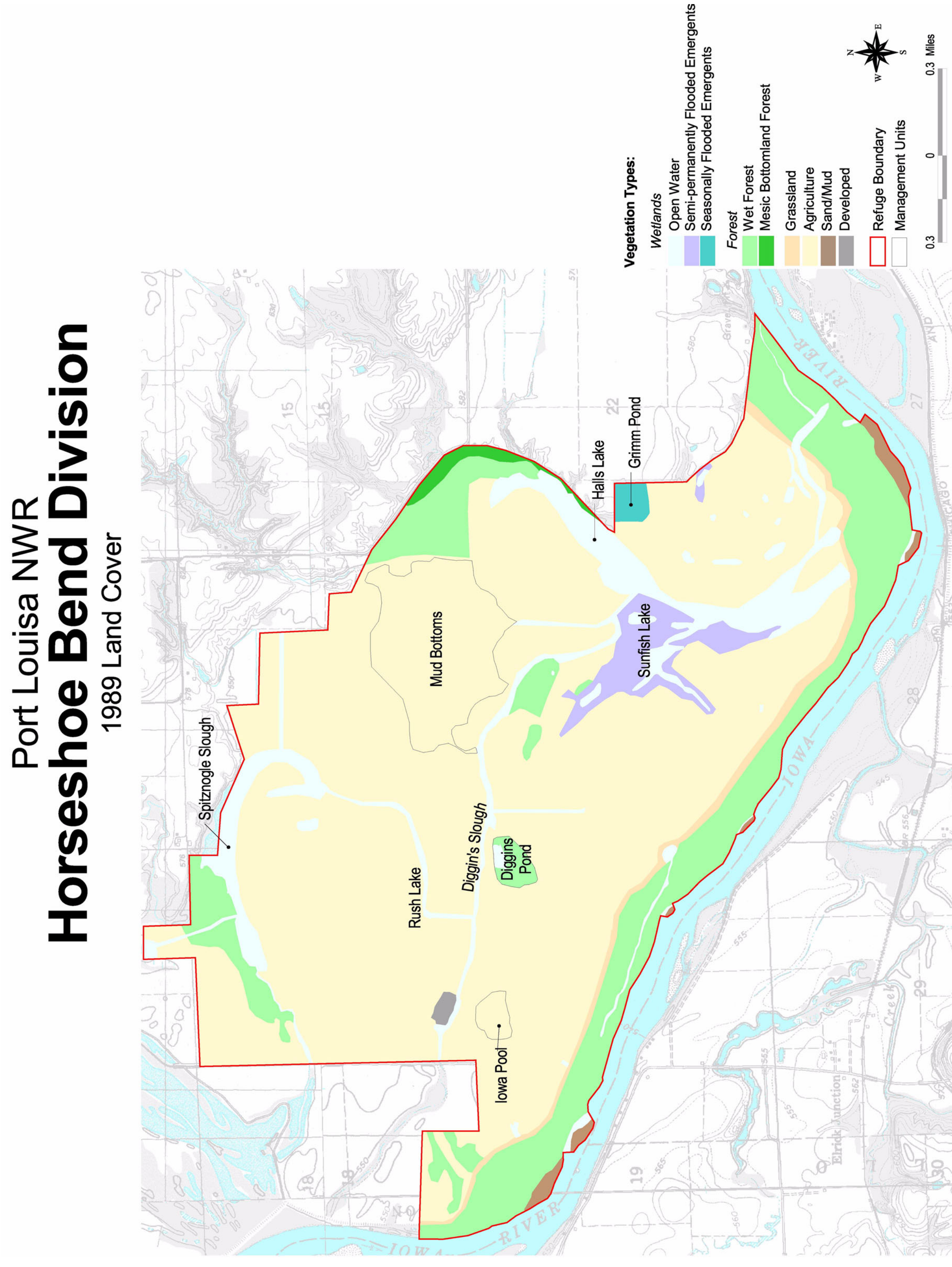
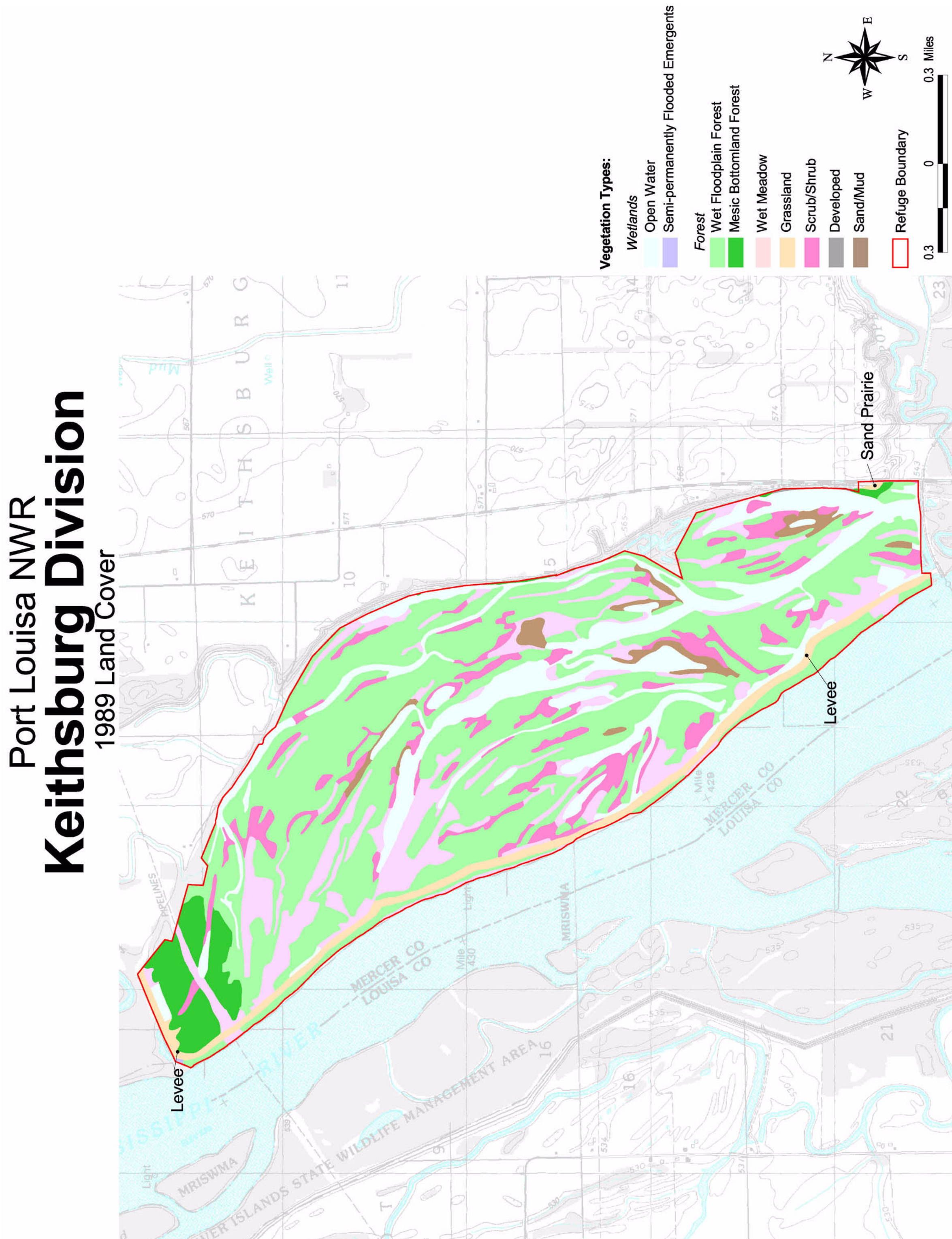
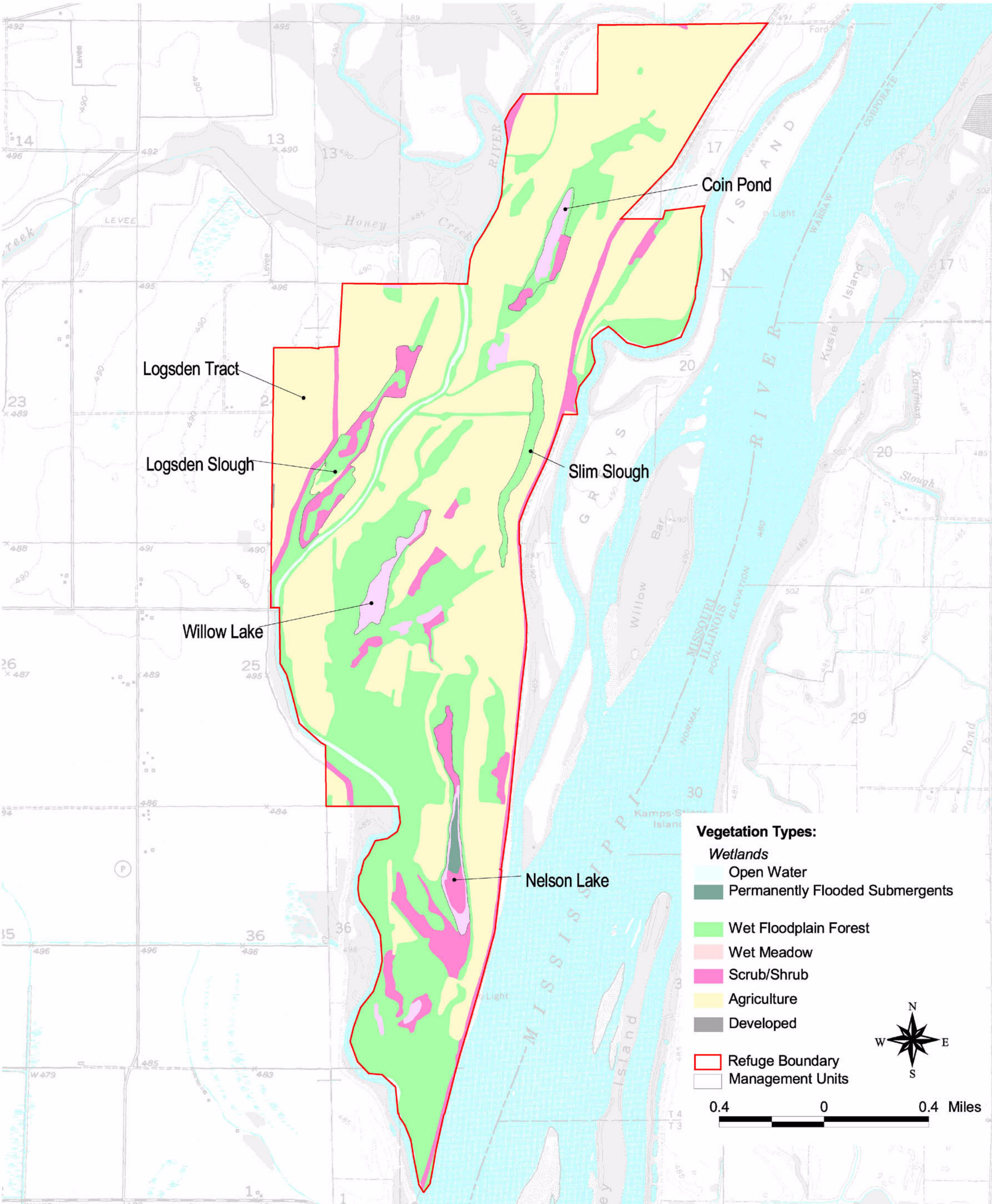
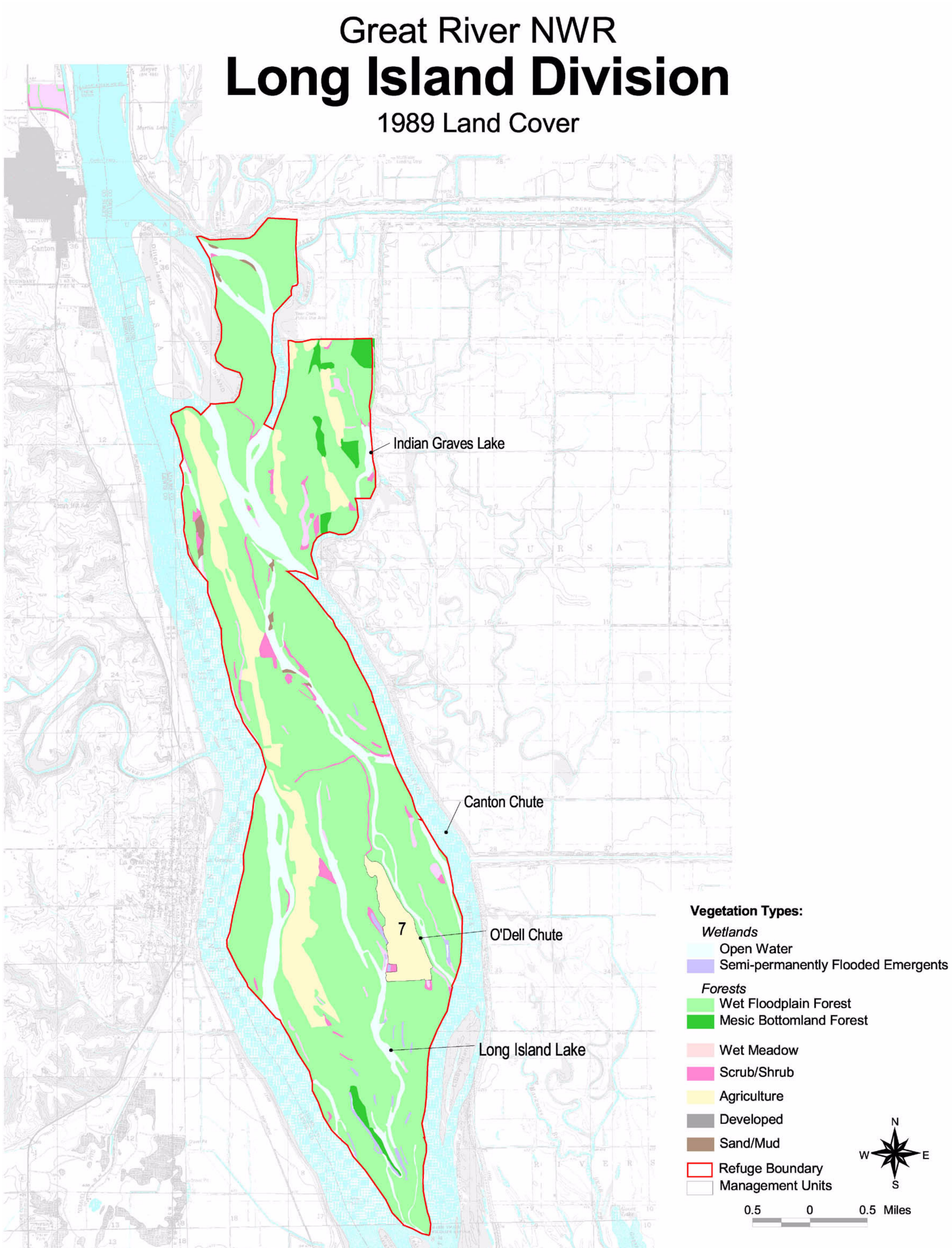


Port Louisa NWR
Horseshoe Bend Division
1989 Land Cover
Spitznogle Slough
Rush Lake
Diggin's Slough
Diggins Pond
Iowa Pool
Mud Bottoms
Sunfish Lake
Halls Lake
Grimm Pond
Vegetation Types:
Wetlands
Open Water
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Forest
Mesic Bottomland Forest
Grassland
Agriculture
Sand/Mud
Developed
Refuge Boundary
Management Units
0.3
0
0.3 Miles

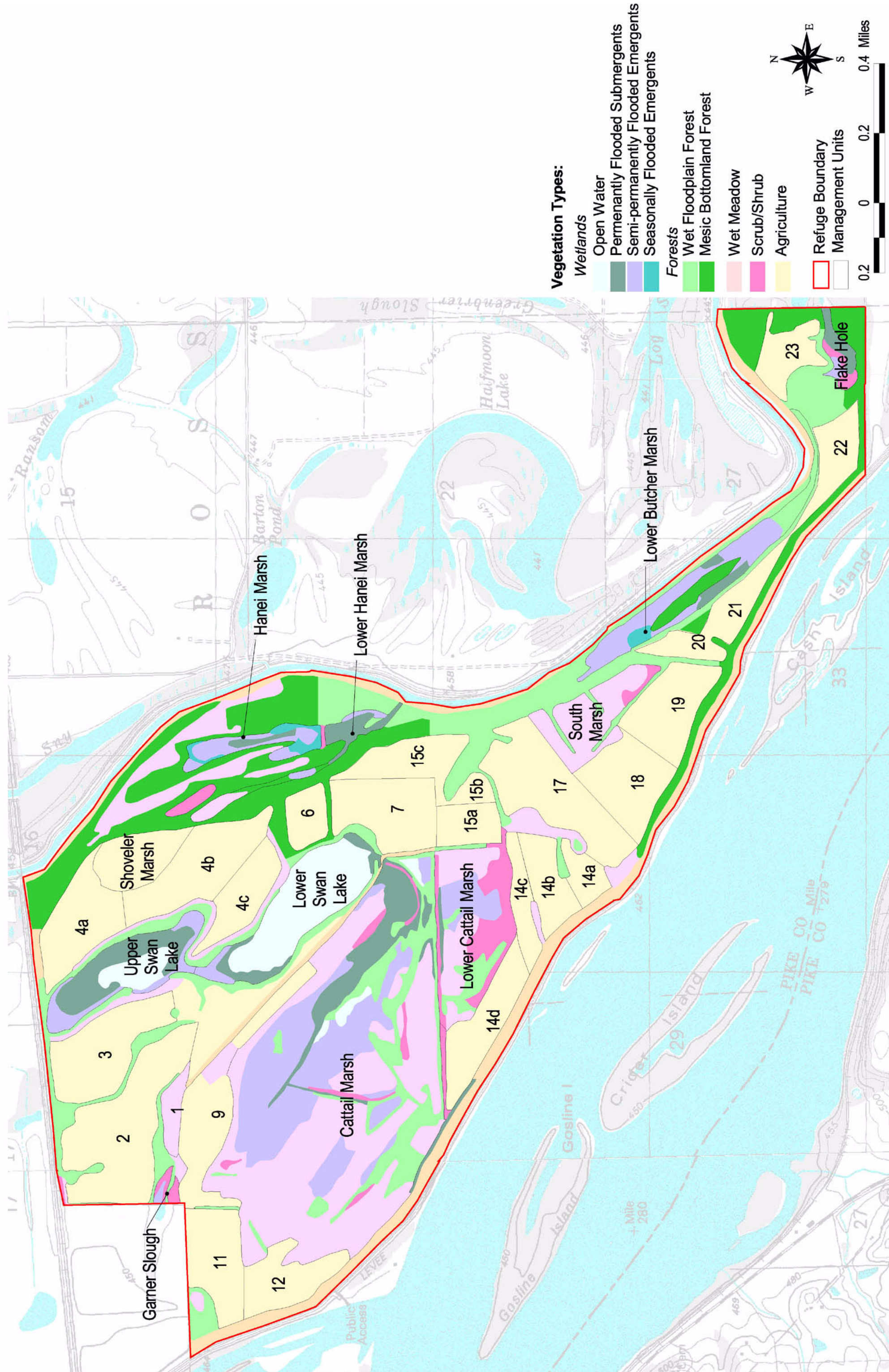

Port Louisa NWR
Keithsburg Division
1989 Land Cover
Vegetation Types:
Wetlands
Open Water
Semi-permanently Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Developed
Sand/Mud
Refuge Boundary
N
S
E
W
0.3
0
0.3 Miles
Levee
Levee
Sand Prairie
MERCER CO
LOUISA CO
MRISWMA
RIVER ISLANDS STATE WILDLIFE MANAGEMENT AREA

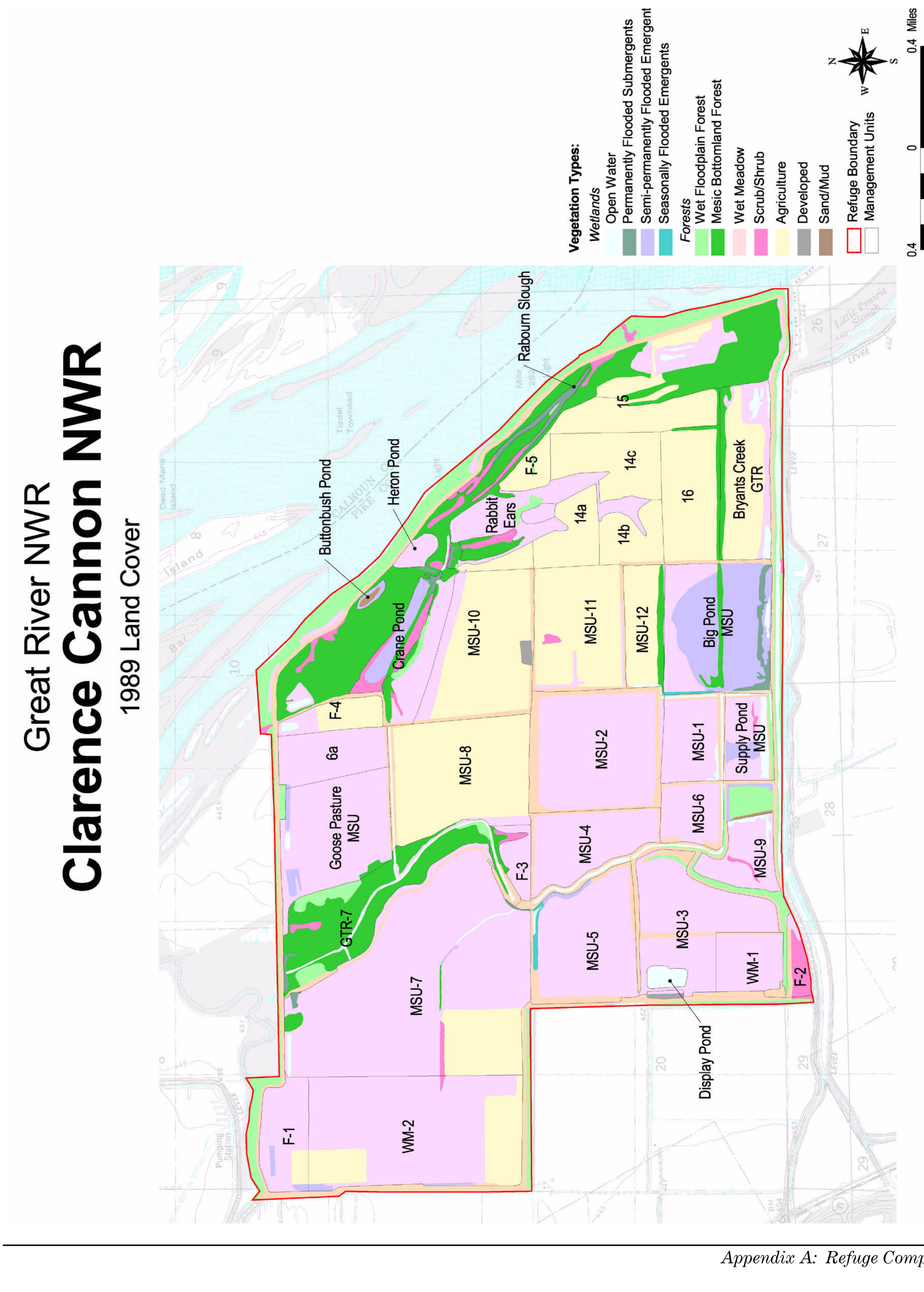
Great River NWR
Fox Island Division
1989 Land Cover

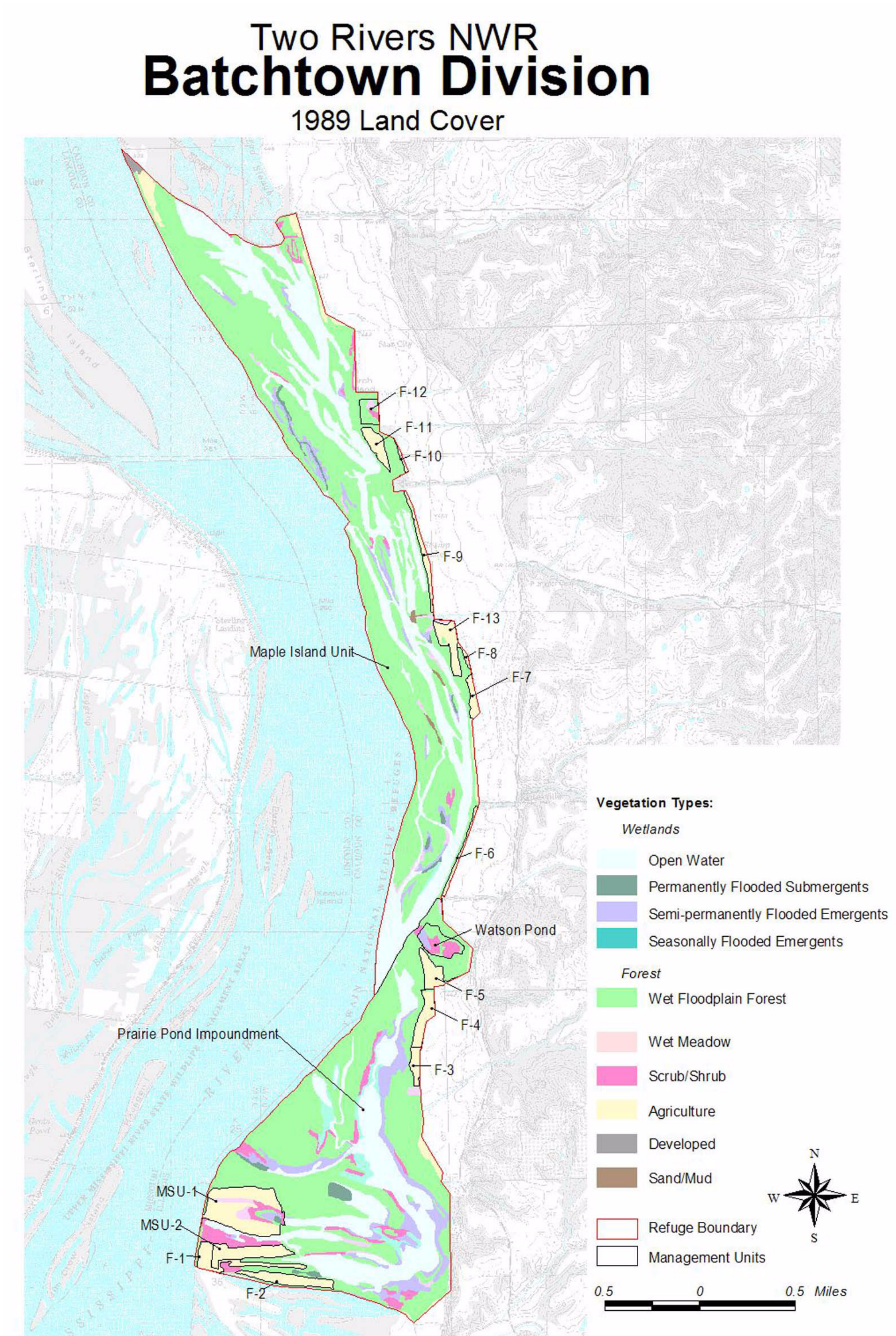


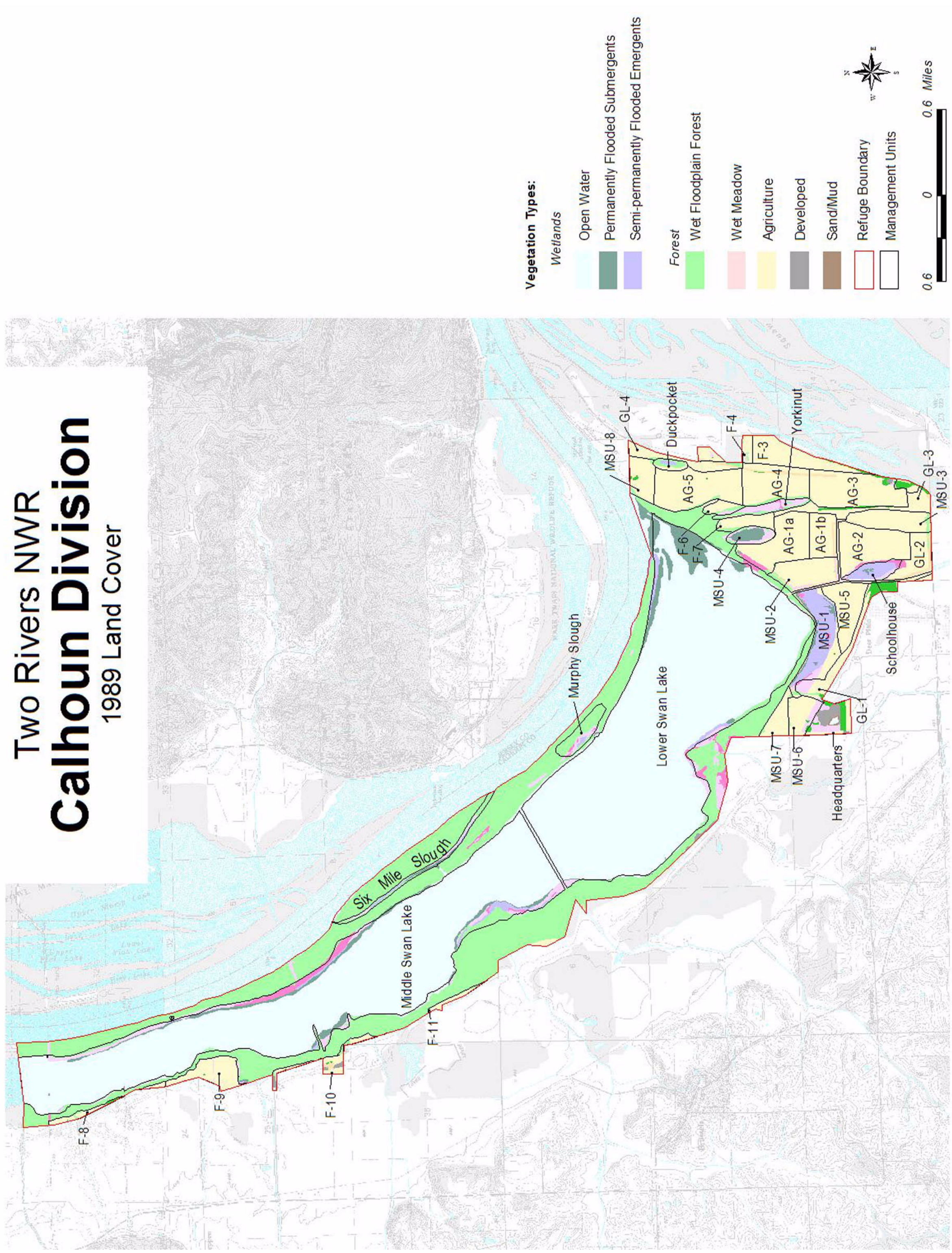

Great River NWR
Long Island Division
1989 Land Cover
Indian Graves Lake
Canton Chute
O'Dell Chute
7
Long Island Lake
Vegetation Types:
Wetlands
Open Water
Semi-permanently Flooded Emergents
Forests
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Scrub/Shrub
Agriculture
Developed
Sand/Mud
Refuge Boundary
Management Units
N
W
E
S
0.5 0 0.5 Miles

Great River NWR
Delair Division
1989 Land Cover




Great River NWR
Clarence Cannon NWR
1989 Land Cover
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergent
Seasonally Flooded Emergents
Forests
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Scrub/Shrub
Agriculture
Developed
Sand/Mud
Refuge Boundary
Management Units
N
E
S
W
0.4
0
0.4 Miles
Buttonbush Pond
Heron Pond
Rabourn Slough
Crane Pond
Rabbit Ears
F-5
15
14c
14a
14b
16
Bryants Creek GTR
MSU-10
MSU-11
MSU-12
Big Pond MSU
F-4
6a
Goose Pasture MSU
MSU-8
MSU-2
MSU-1
Supply Pond MSU
MSU-6
MSU-4
F-3
MSU-9
GTR-7
MSU-7
MSU-5
MSU-3
WM-1
F-2
Display Pond
F-1
WM-2

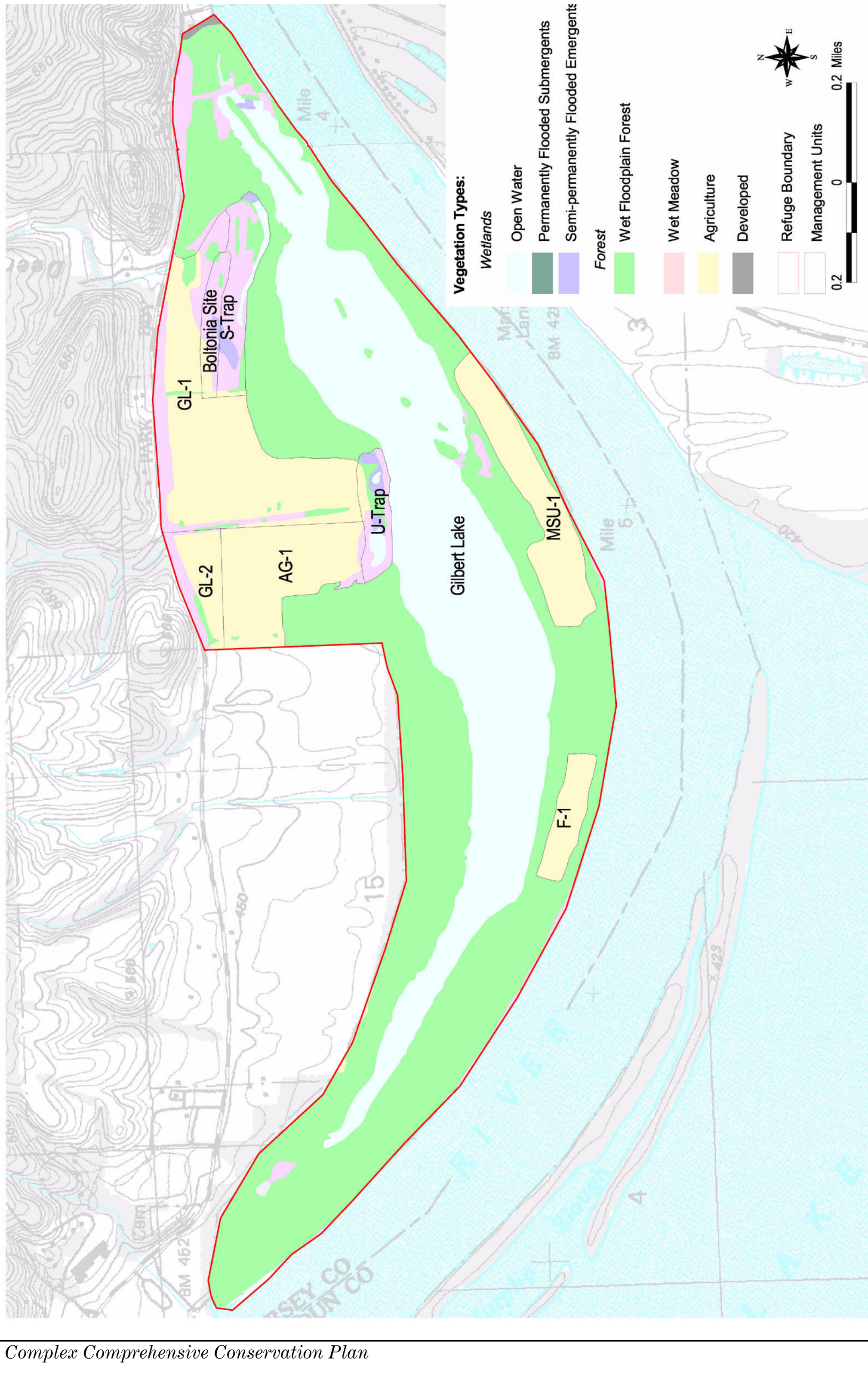

Two Rivers NWR
Batchtown Division
1989 Land Cover
F-12
F-11
F-10
F-9
F-13
F-8
F-7
Maple Island Unit
F-6
Watson Pond
F-5
F-4
F-3
Prairie Pond Impoundment
MSU-1
MSU-2
F-1
F-2
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Wet Meadow
Scrub/Shrub
Agriculture
Developed
Sand/Mud
Refuge Boundary
Management Units
N
W
E
S
0.5 0 0.5 Miles


Two Rivers NWR
Calhoun Division
1989 Land Cover
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Forest
Wet Floodplain Forest
Wet Meadow
Agriculture
Developed
Sand/Mud
Refuge Boundary
Management Units
0.6
0
0.6 Miles
Six Mile Slough
Murphy Slough
Middle Swan Lake
Lower Swan Lake
Duckpocket
Yorkinut
Schoolhouse
Headquarters
F-3
F-4
F-6
F-7
F-8
F-9
F-10
F-11
GL-1
GL-2
GL-3
GL-4
AG-1a
AG-1b
AG-2
AG-3
AG-4
AG-5
MSU-1
MSU-2
MSU-3
MSU-4
MSU-5
MSU-6
MSU-7
MSU-8

Two Rivers NWR

Gilbert Lake Division

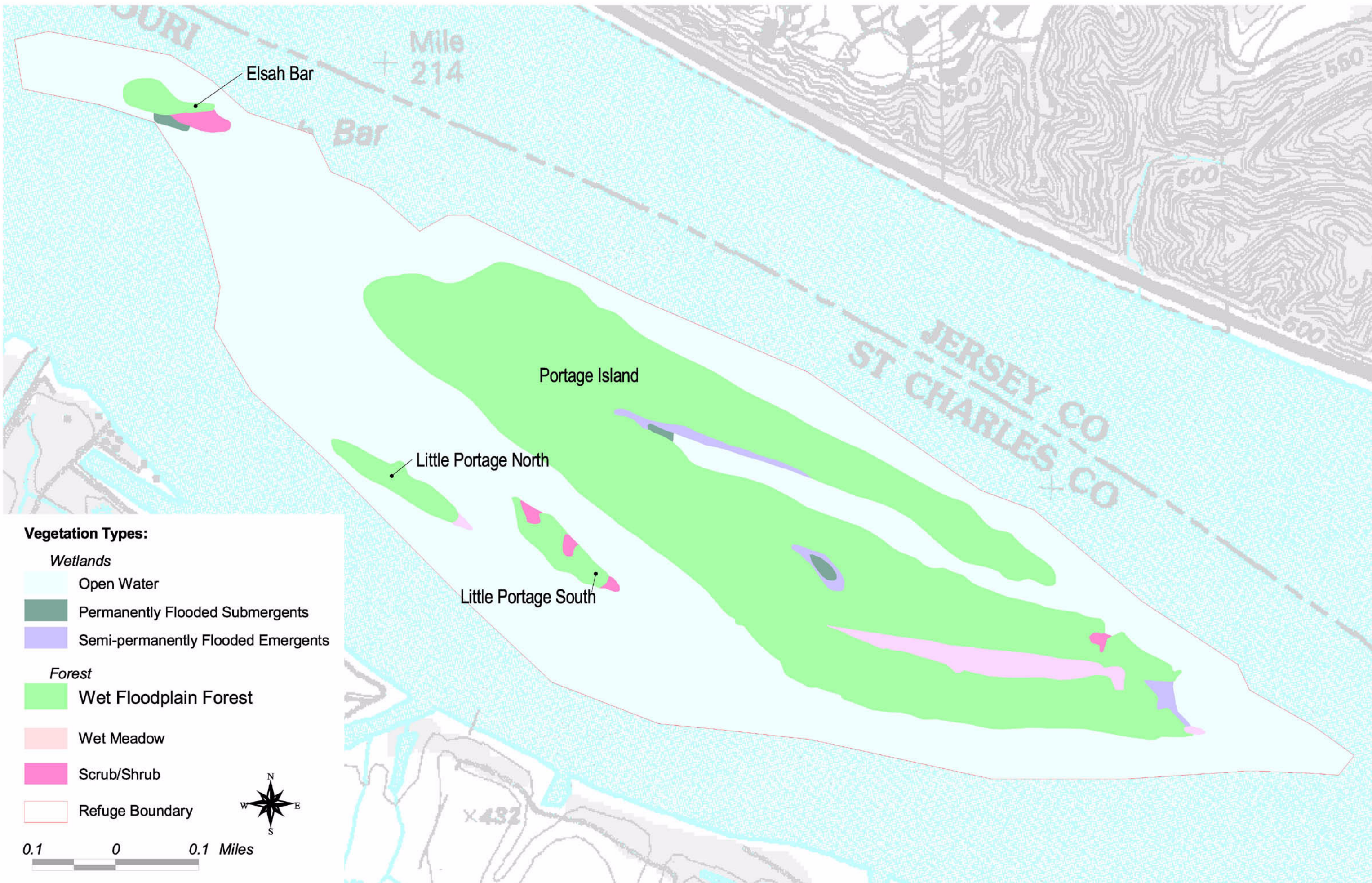
1989 Land Cover

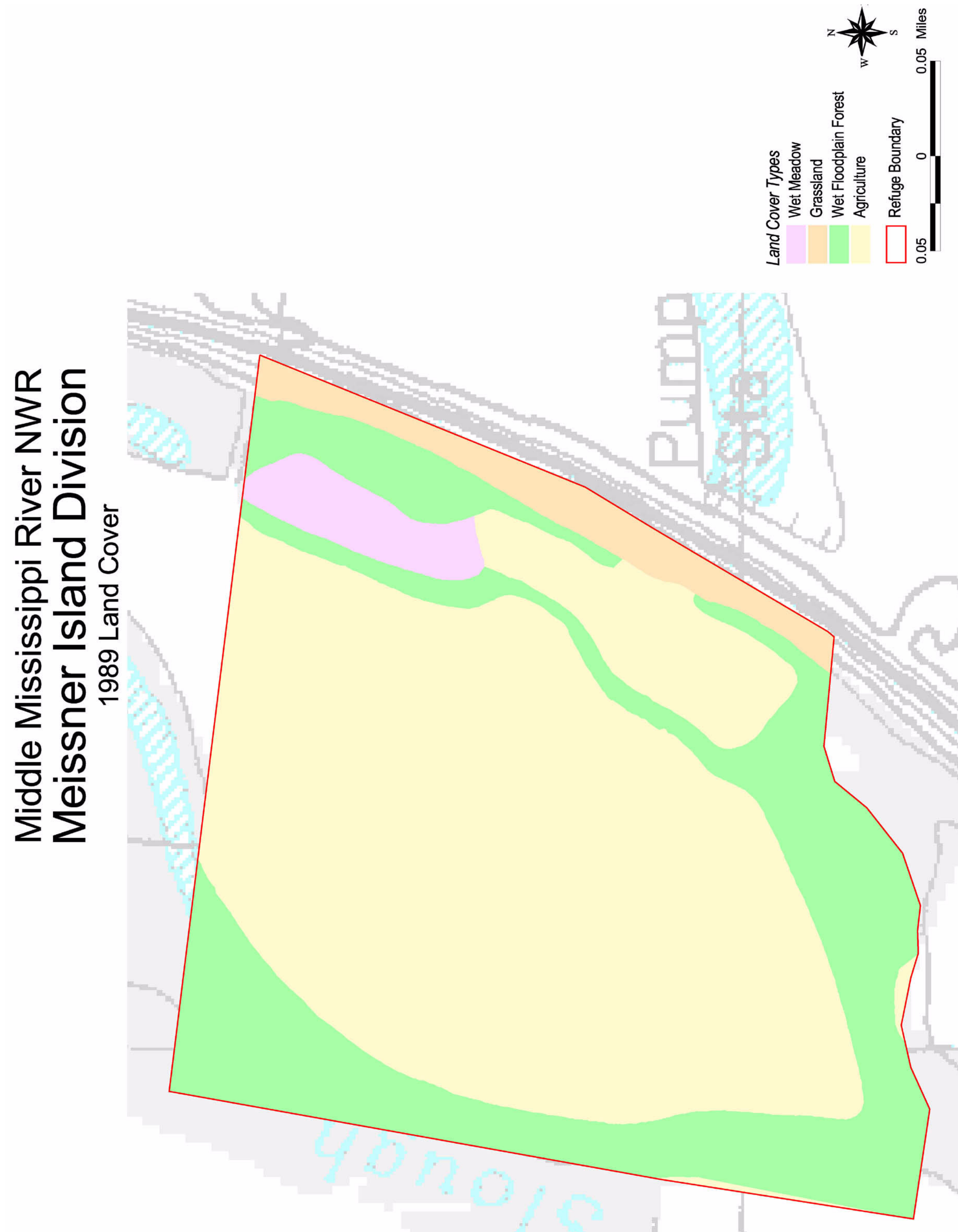


Two Rivers NWR

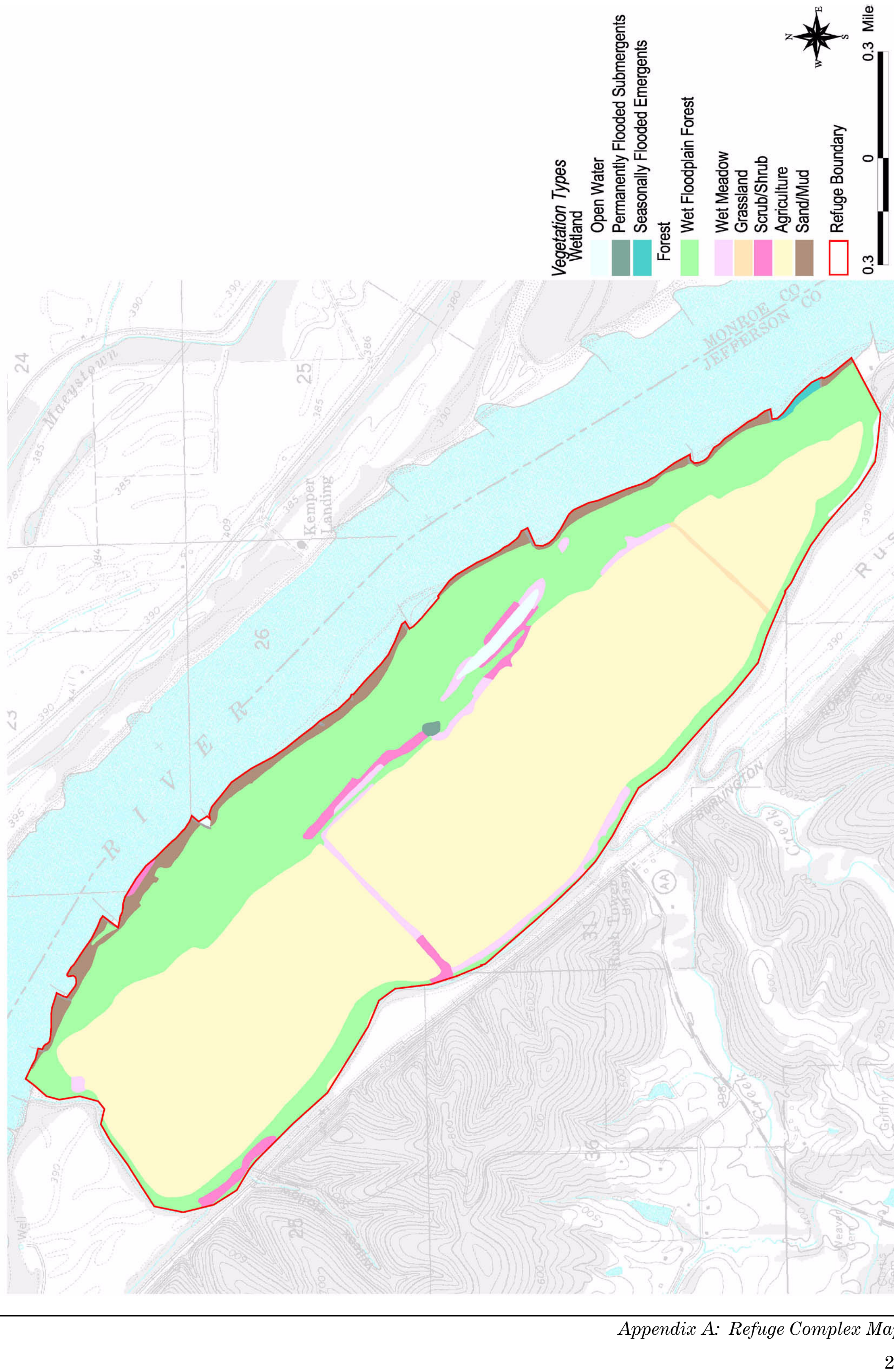
Portage Island Division

1989 Land Cover

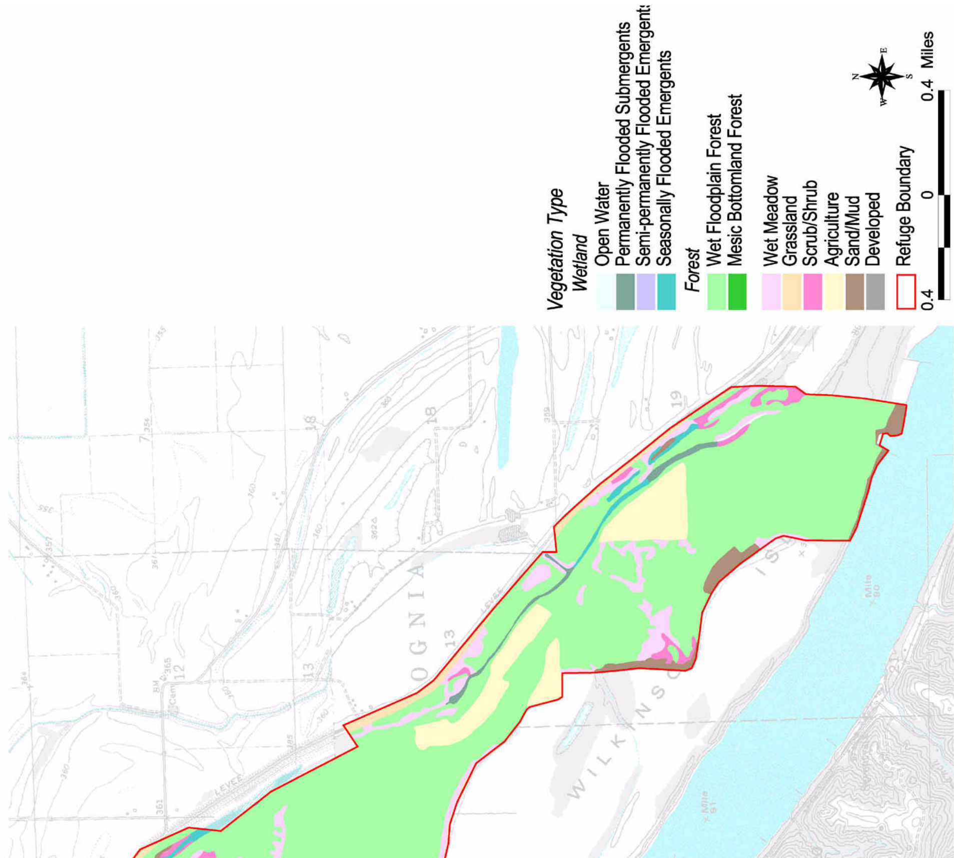



Middle Mississippi River NWR
Meissner Island Division
1989 Land Cover
Land Cover Types
Wet Meadow
Grassland
Wet Floodplain Forest
Agriculture
Refuge Boundary
0.05 0 0.05 Miles
N
S
W
Pump Sta
Slough

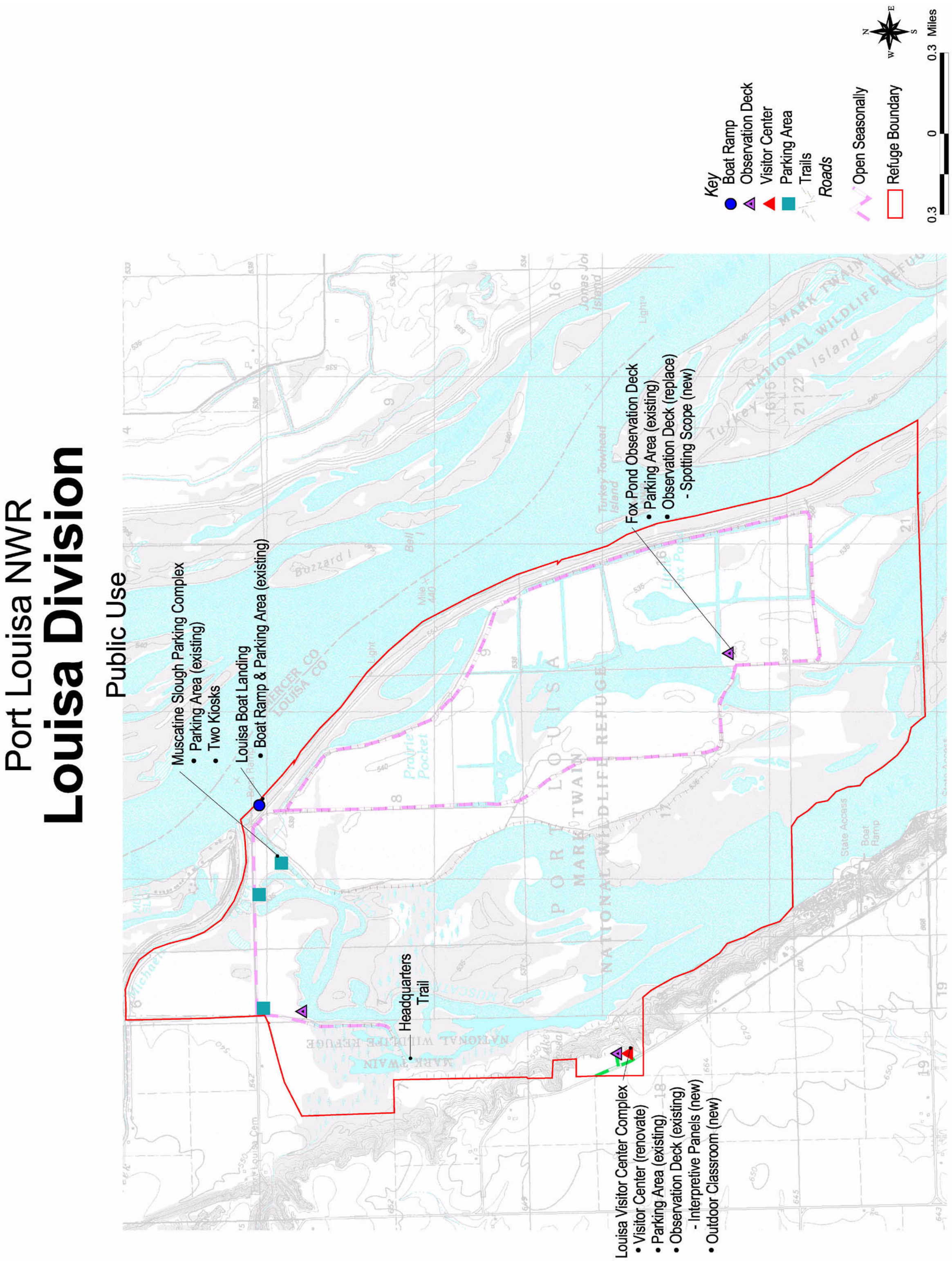
Middle Mississippi River NWR
Harlow Island Division
1989 Land Cover



Middle Mississippi River NWR
Wilkinson Island Division
1989 Land Cover



Existing Public Use Facilities

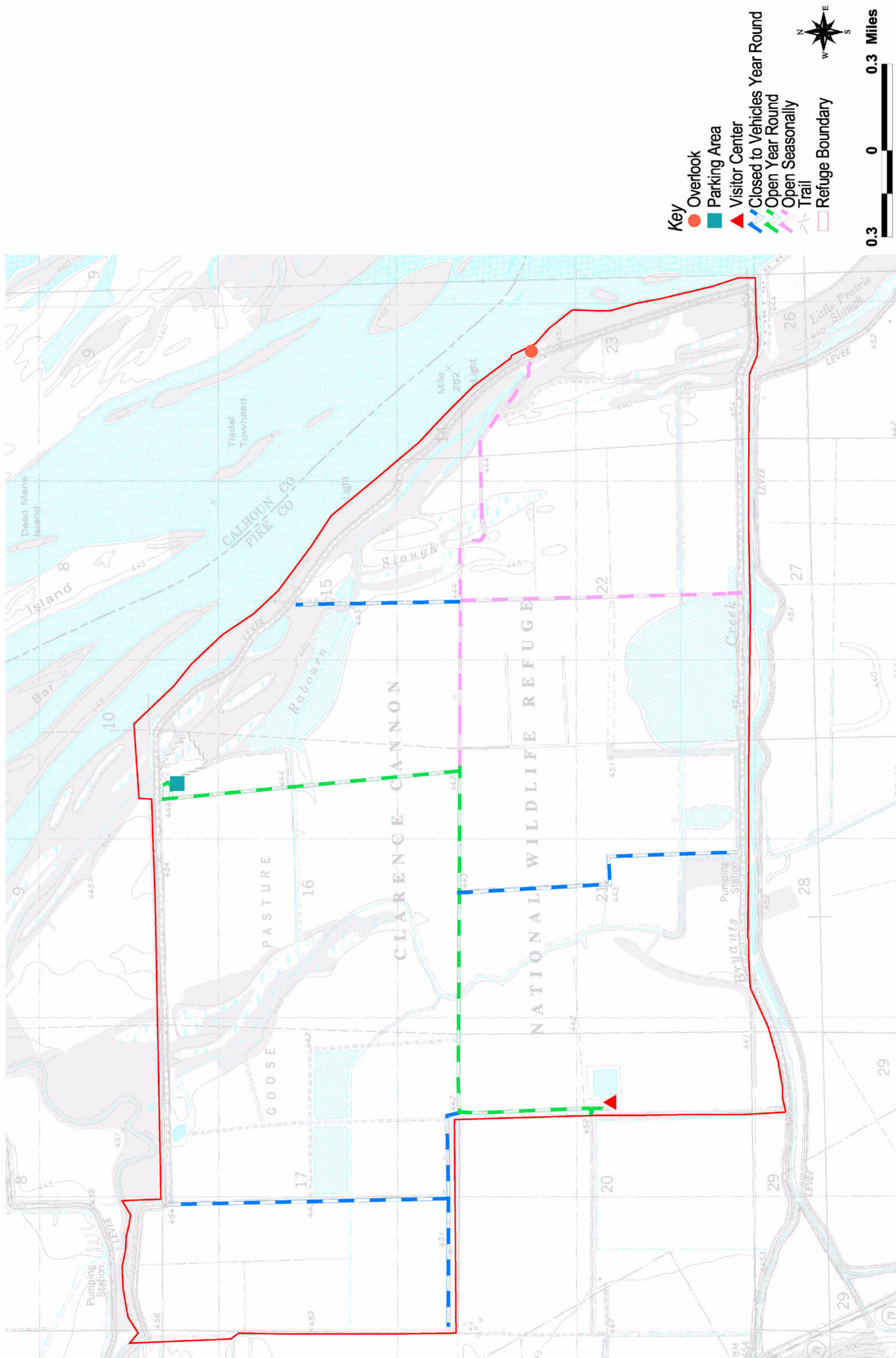


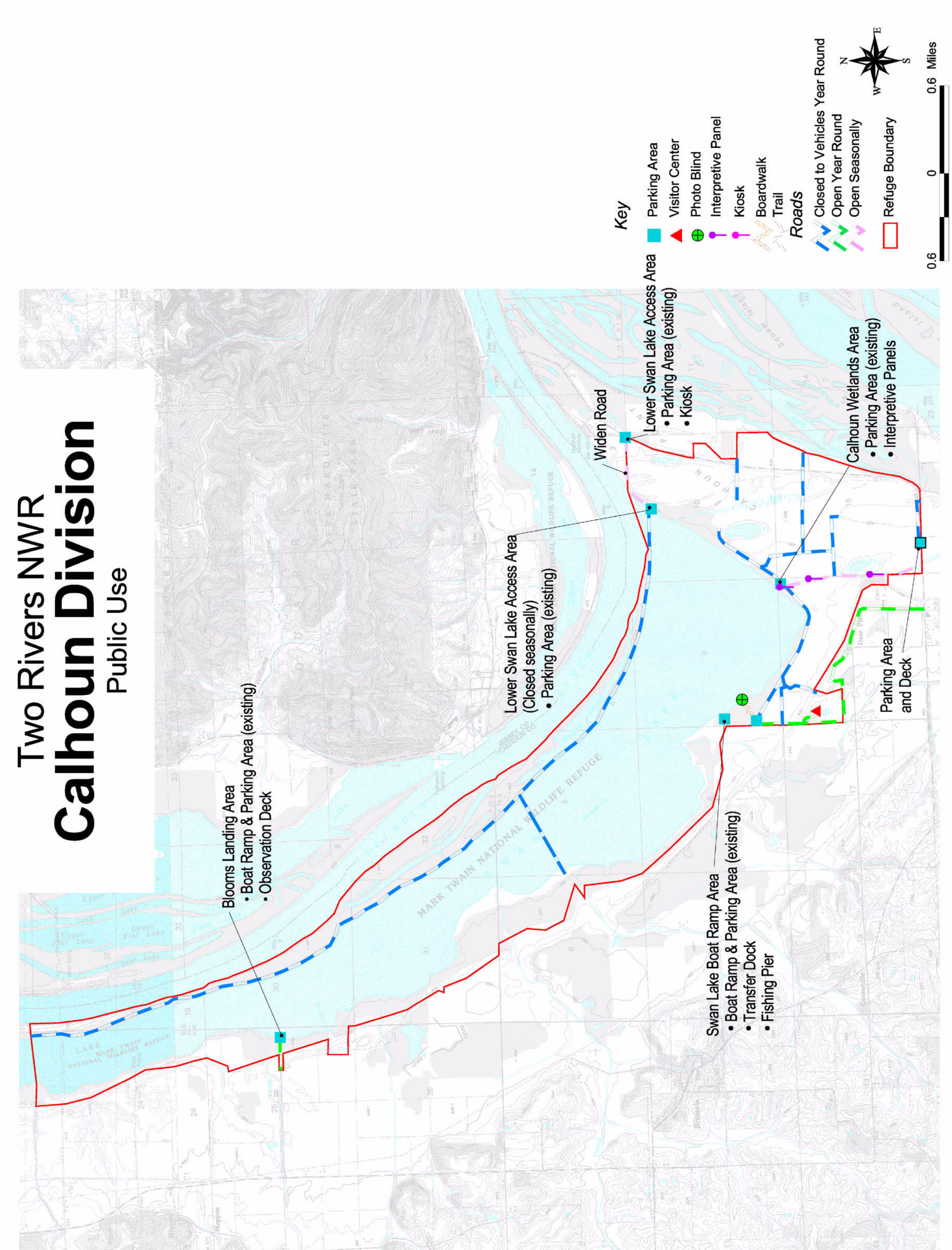
Port Louisa NWR
Louisa Division
Public Use
Muscatine Slough Parking Complex
• Parking Area (existing)
• Two Kiosks
Louisa Boat Landing
• Boat Ramp & Parking Area (existing)
Fox Pond Observation Deck
• Parking Area (existing)
• Observation Deck (replace)
- Spotting Scope (new)
Headquarters Trail
Louisa Visitor Center Complex
• Visitor Center (renovate)
• Parking Area (existing)
• Observation Deck (existing)
- Interpretive Panels (new)
• Outdoor Classroom (new)
PORT LOUISA
MARK TWAIN
NATIONAL WILDLIFE REFUGE
Buzzard I
Prairie Pocket
MERCER CO
LOUISA CO
Turkey Island
State Access Boat Ramp
Key
Boat Ramp
Observation Deck
Visitor Center
Parking Area
Trails
Roads
Open Seasonally
Refuge Boundary
0.3
0
0.3 Miles

Great River NWR

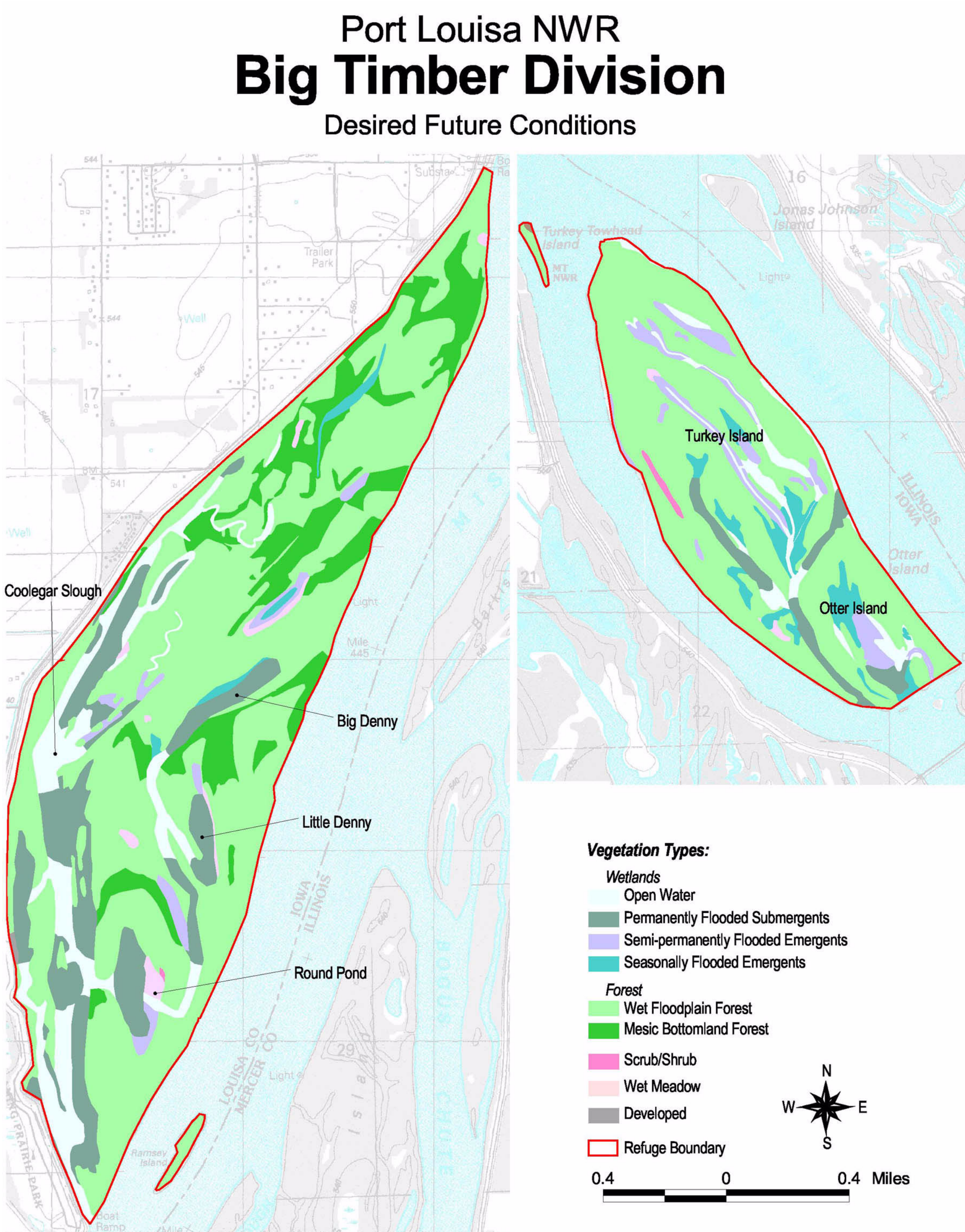
Clarence Cannon NWR

Public Use

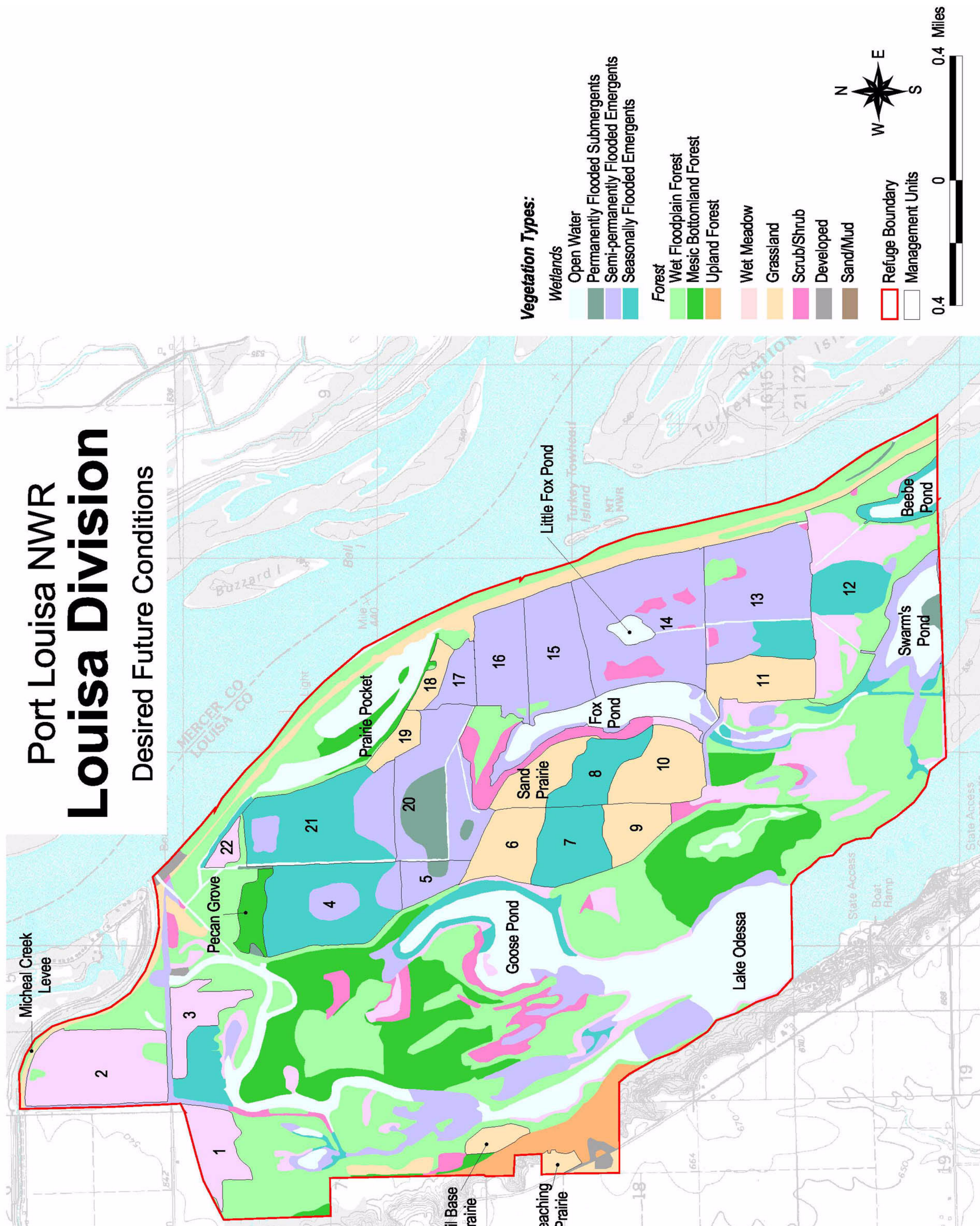


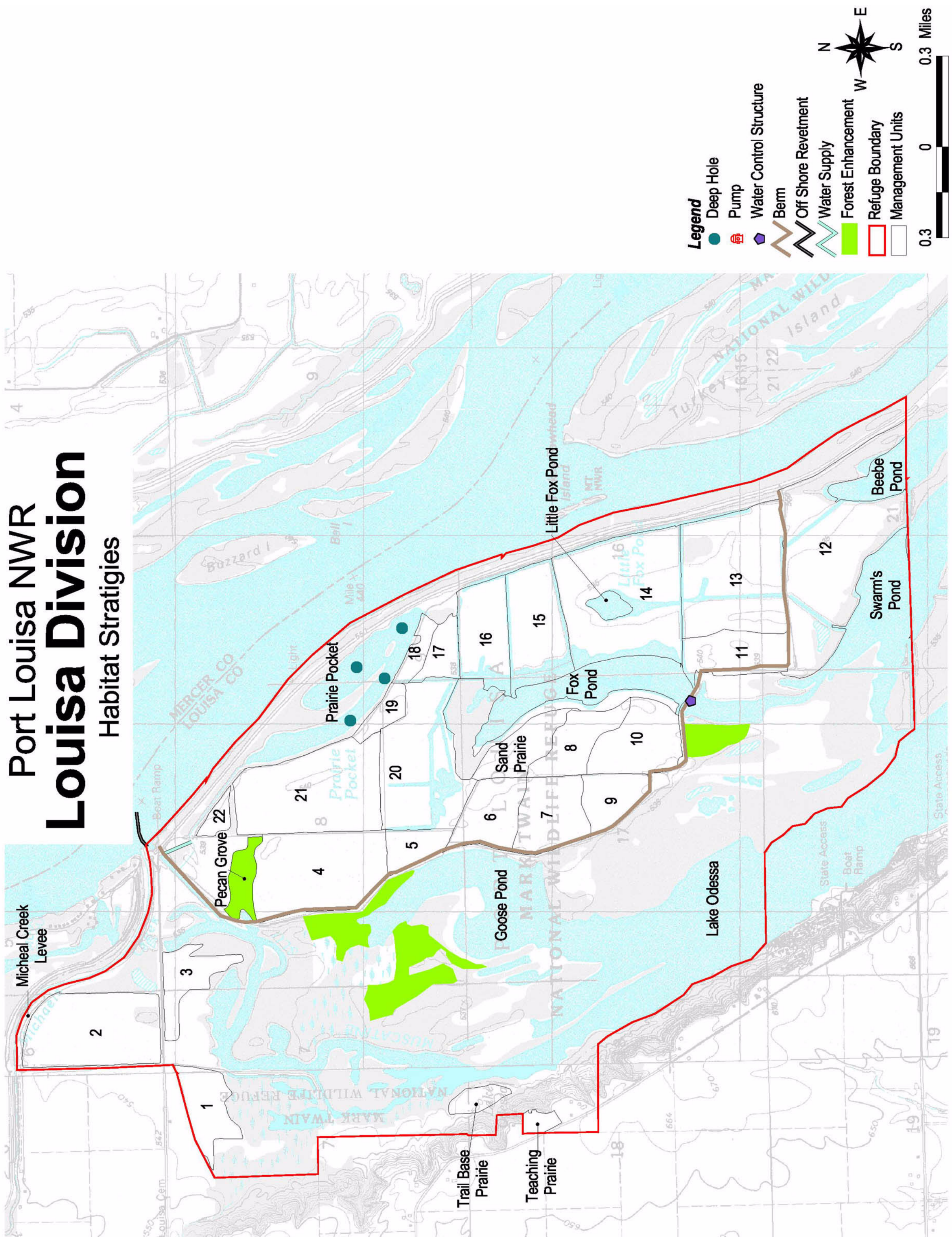

Two Rivers NWR
Calhoun Division
Public Use
Blooms Landing Area
• Boat Ramp & Parking Area (existing)
• Observation Deck
Lower Swan Lake Access Area
(Closed seasonally)
• Parking Area (existing)
Widen Road
Lower Swan Lake Access Area
• Parking Area (existing)
• Kiosk
Swan Lake Boat Ramp Area
• Boat Ramp & Parking Area (existing)
• Transfer Dock
• Fishing Pier
Calhoun Wetlands Area
• Parking Area (existing)
• Interpretive Panels
Parking Area
and Deck
Key
Parking Area
Visitor Center
Photo Blind
Interpretive Panel
Kiosk
Boardwalk
Trail
Roads
Closed to Vehicles Year Round
Open Year Round
Open Seasonally
Refuge Boundary
0.6
0
0.6 Miles
N
S
E
W
MARK TWAIN NATIONAL WILDLIFE REFUGE

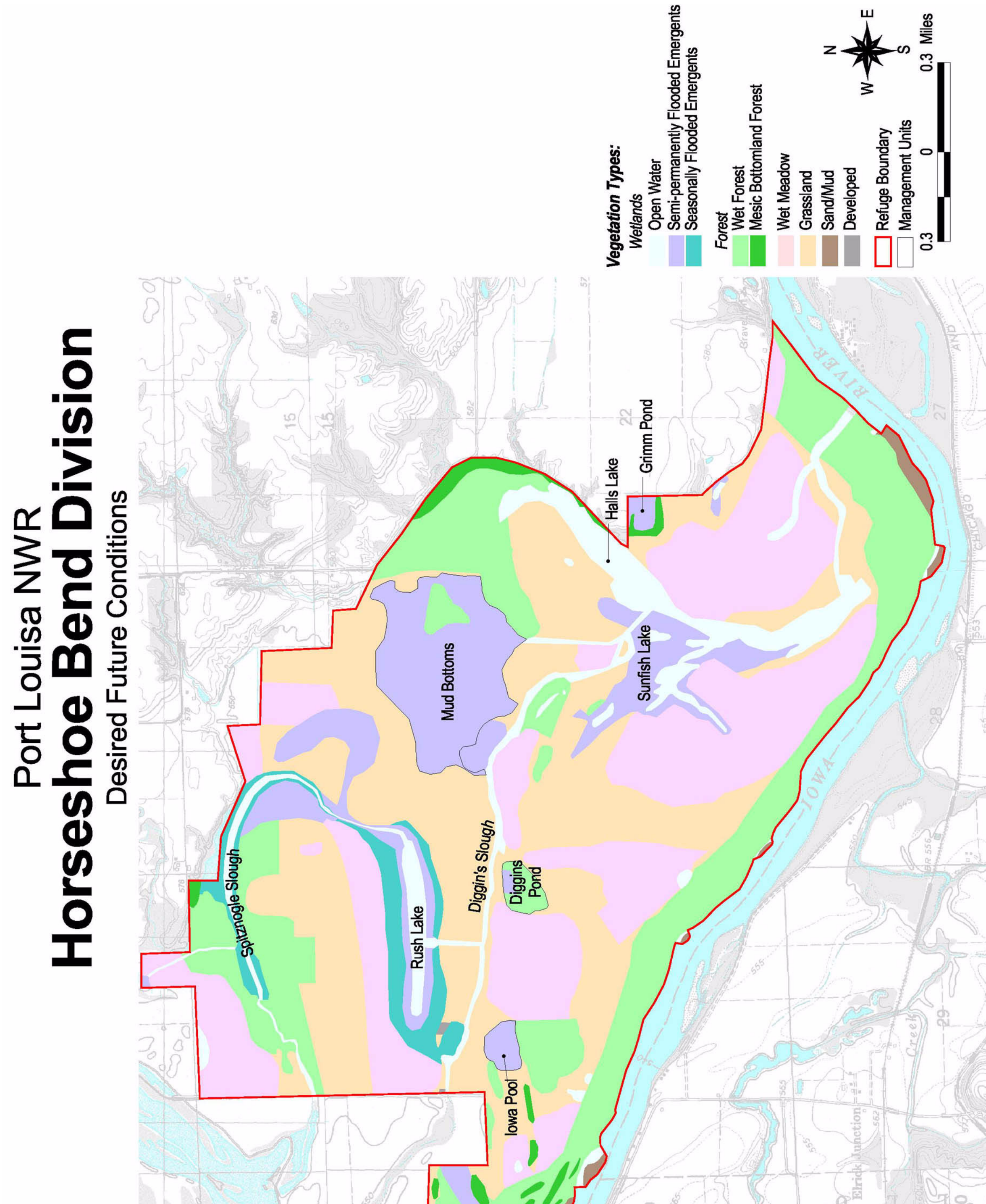
Future Land Cover

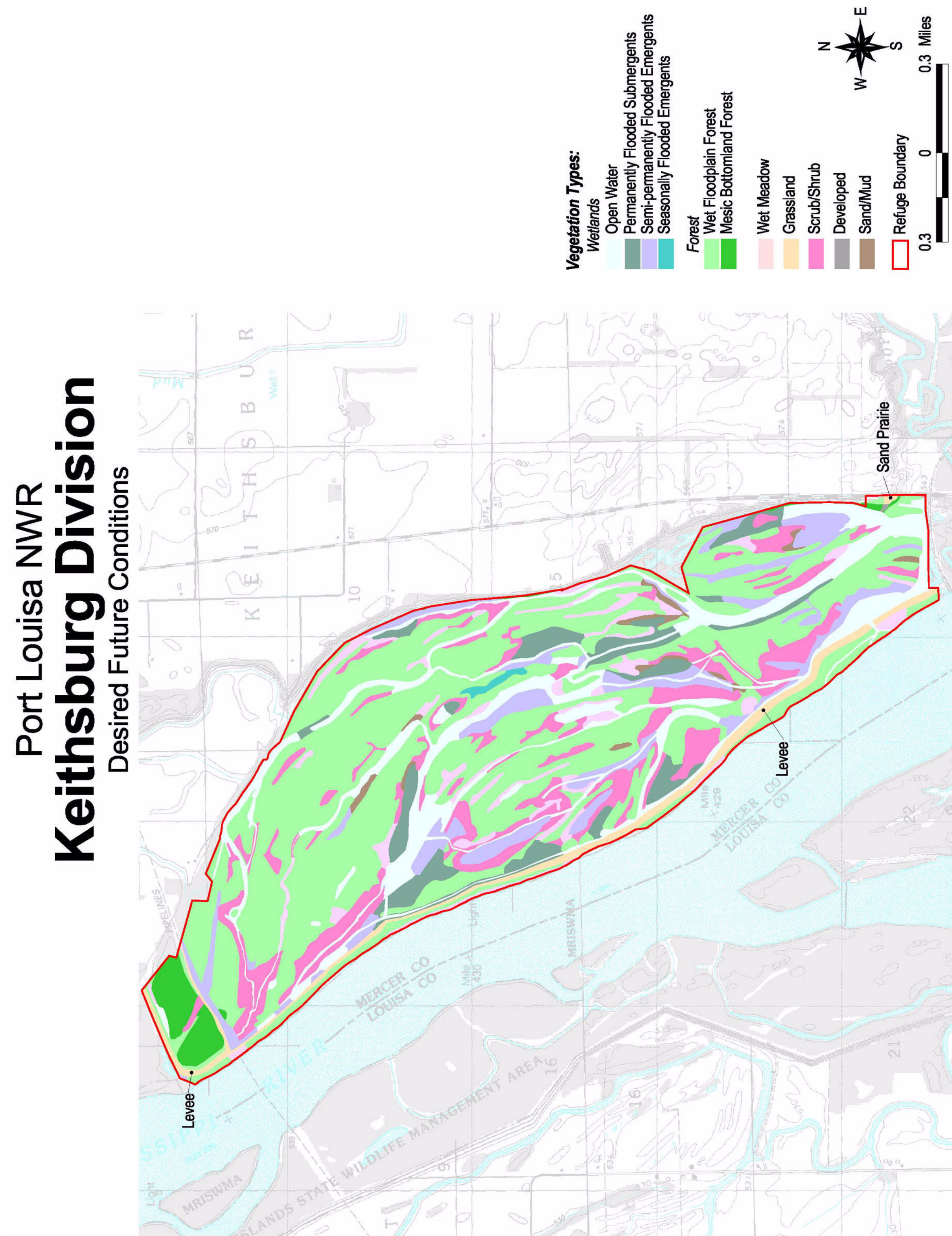


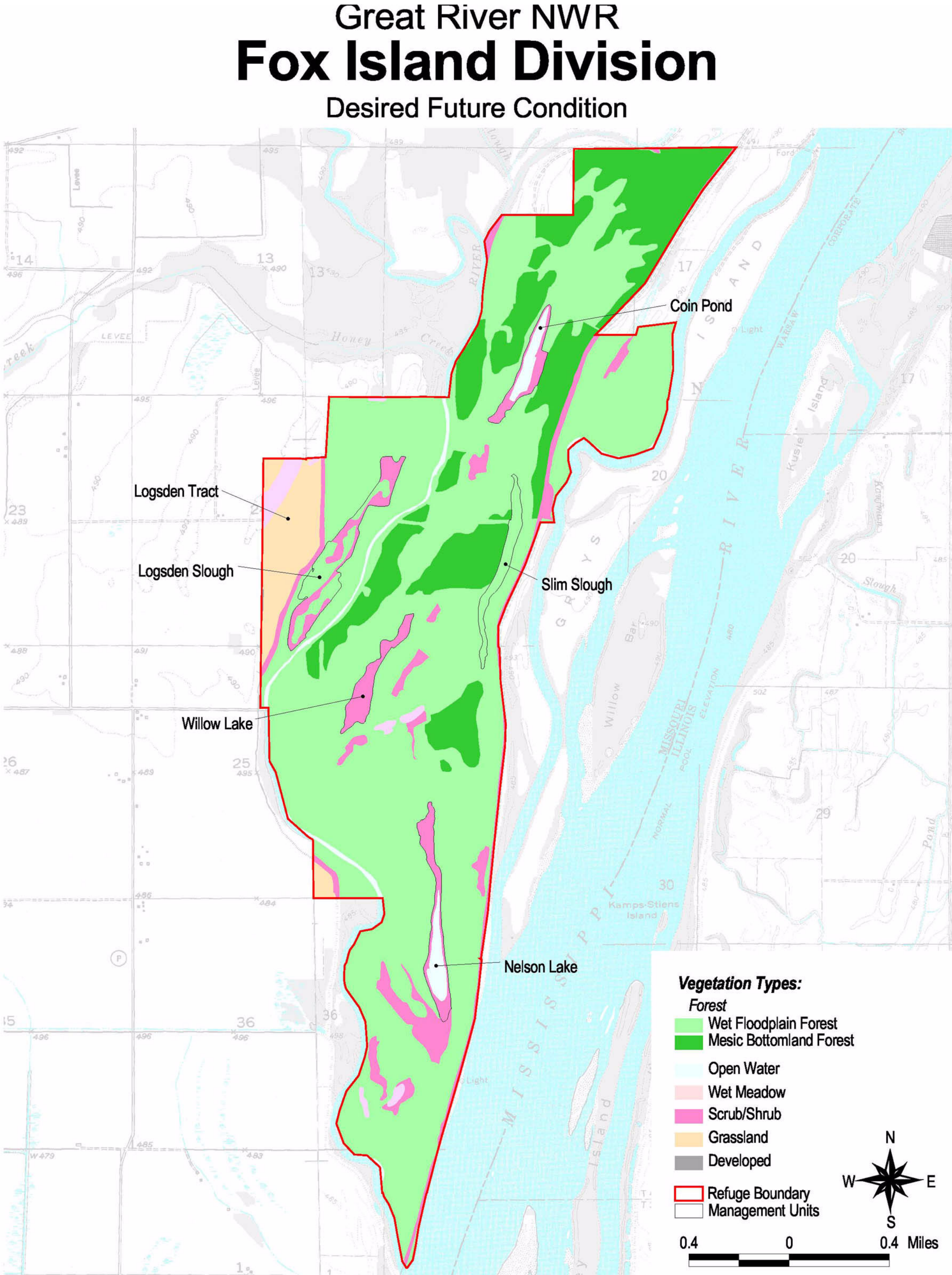
Port Louisa NWR
Big Timber Division
Desired Future Conditions
Coolegar Slough
Big Denny
Little Denny
Round Pond
Turkey Island
Otter Island
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Scrub/Shrub
Wet Meadow
Developed
Refuge Boundary
N
W
E
S
0.4
0
0.4 Miles


Port Louisa NWR
Louisa Division
Desired Future Conditions
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Upland Forest
Wet Meadow
Grassland
Scrub/Shrub
Developed
Sand/Mud
Refuge Boundary
Management Units
N
E
S
W
0.4
0
0.4 Miles
Micheal Creek Levee
Pecan Grove
Prairie Pocket
Goose Pond
Lake Odessa
Sand Prairie
Fox Pond
Little Fox Pond
Beebe Pond
Swam's Pond
Trail Base Prairie
Teaching Prairie
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

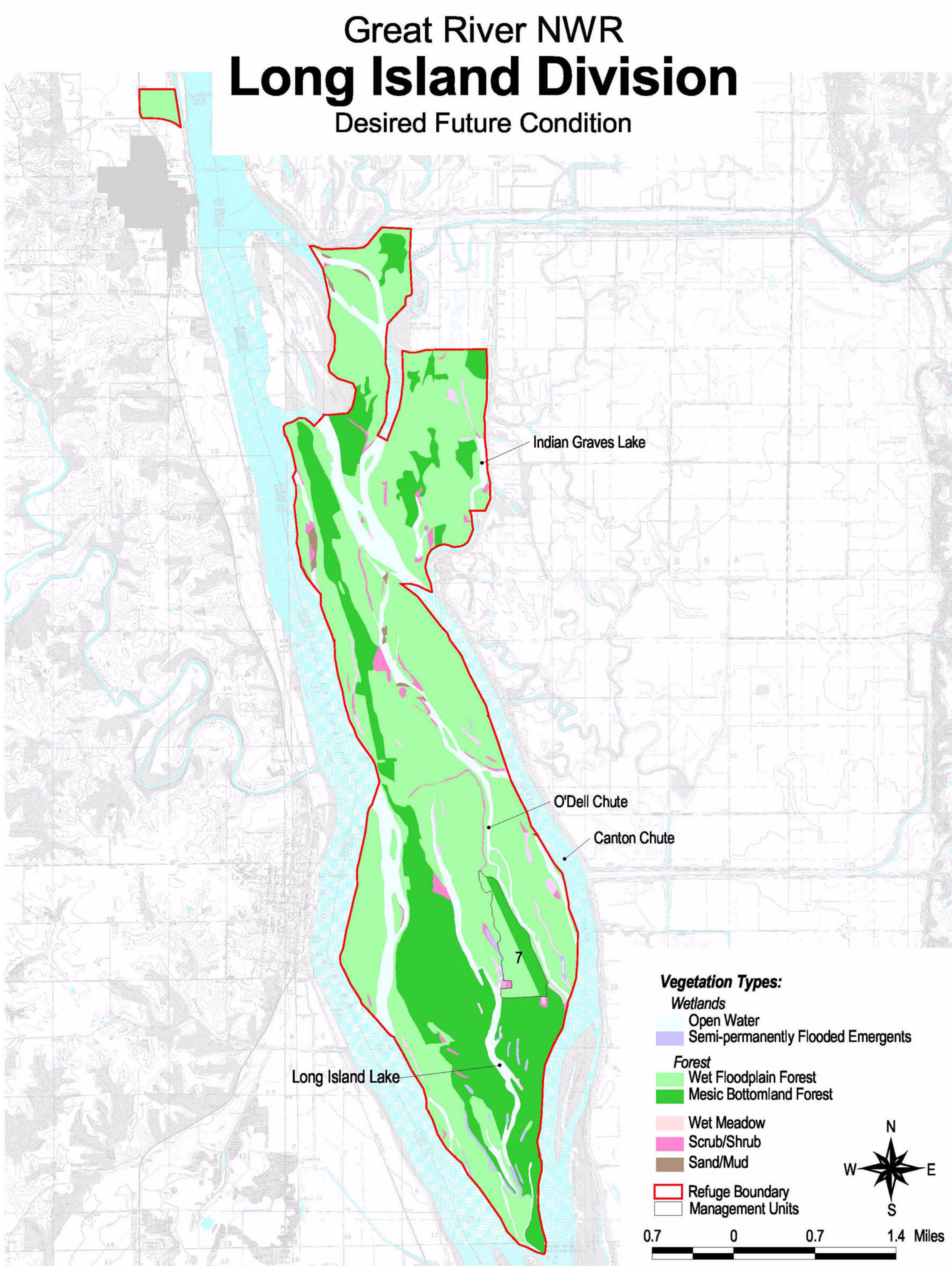

Port Louisa NWR
Louisa Division
Habitat Stratigies
Legend
Deep Hole
Pump
Water Control Structure
Berm
Off Shore Revetment
Water Supply
Forest Enhancement
Refuge Boundary
Management Units
0.3
0
0.3 Miles
N
E
S
W
Micheal Creek Levee
Pecan Grove
Prairie Pocket
Little Fox Pond
Fox Pond
Sand Prairie
Goose Pond
Lake Odessa
Swarm's Pond
Beebe Pond
Trail Base Prairie
Teaching Prairie
MERCER CO
LOUISA CO
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22

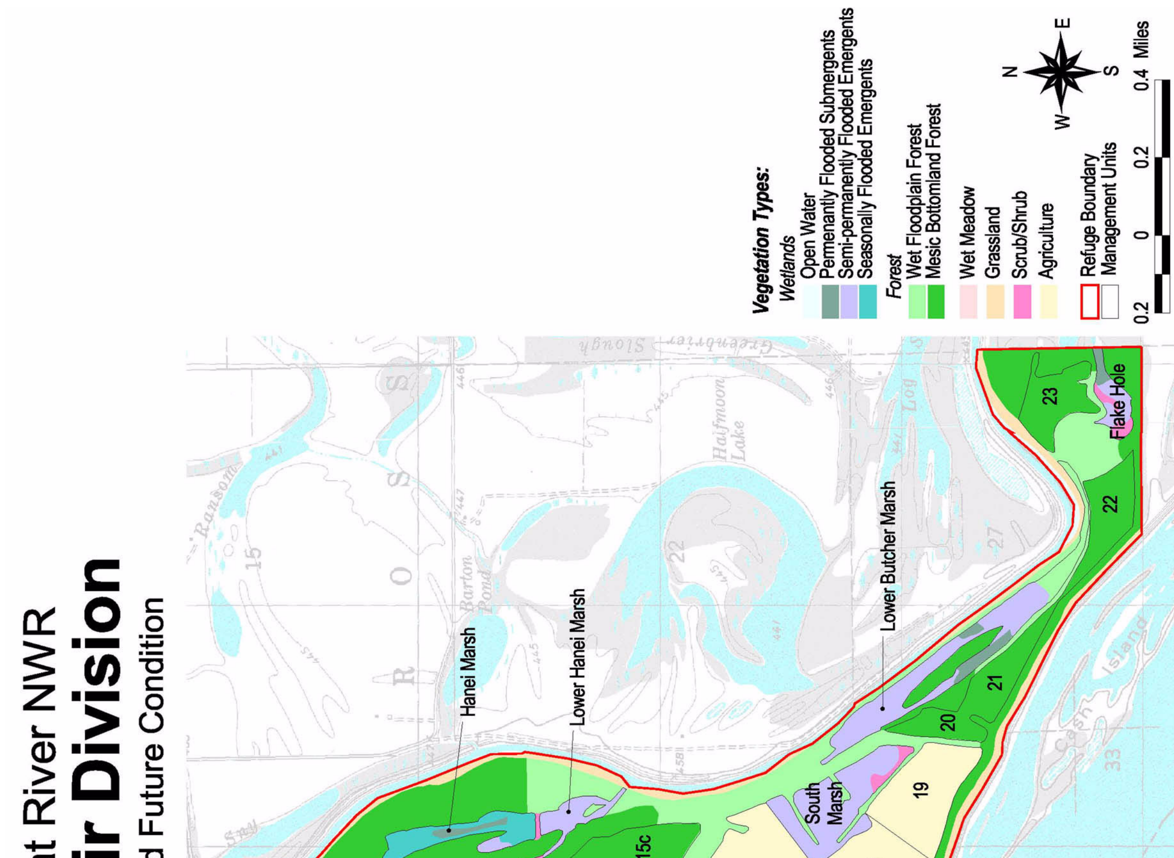

Port Louisa NWR
Horseshoe Bend Division
Desired Future Conditions
Vegetation Types:
Wetlands
Open Water
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Sand/Mud
Developed
Refuge Boundary
Management Units
N
E
S
W
0.3
0
0.3 Miles
Spitznogle Slough
Rush Lake
Diggin's Slough
Diggins Pond
Iowa Pool
Mud Bottoms
Sunfish Lake
Halls Lake
Grimm Pond
IOWA RIVER
Elrick Junction

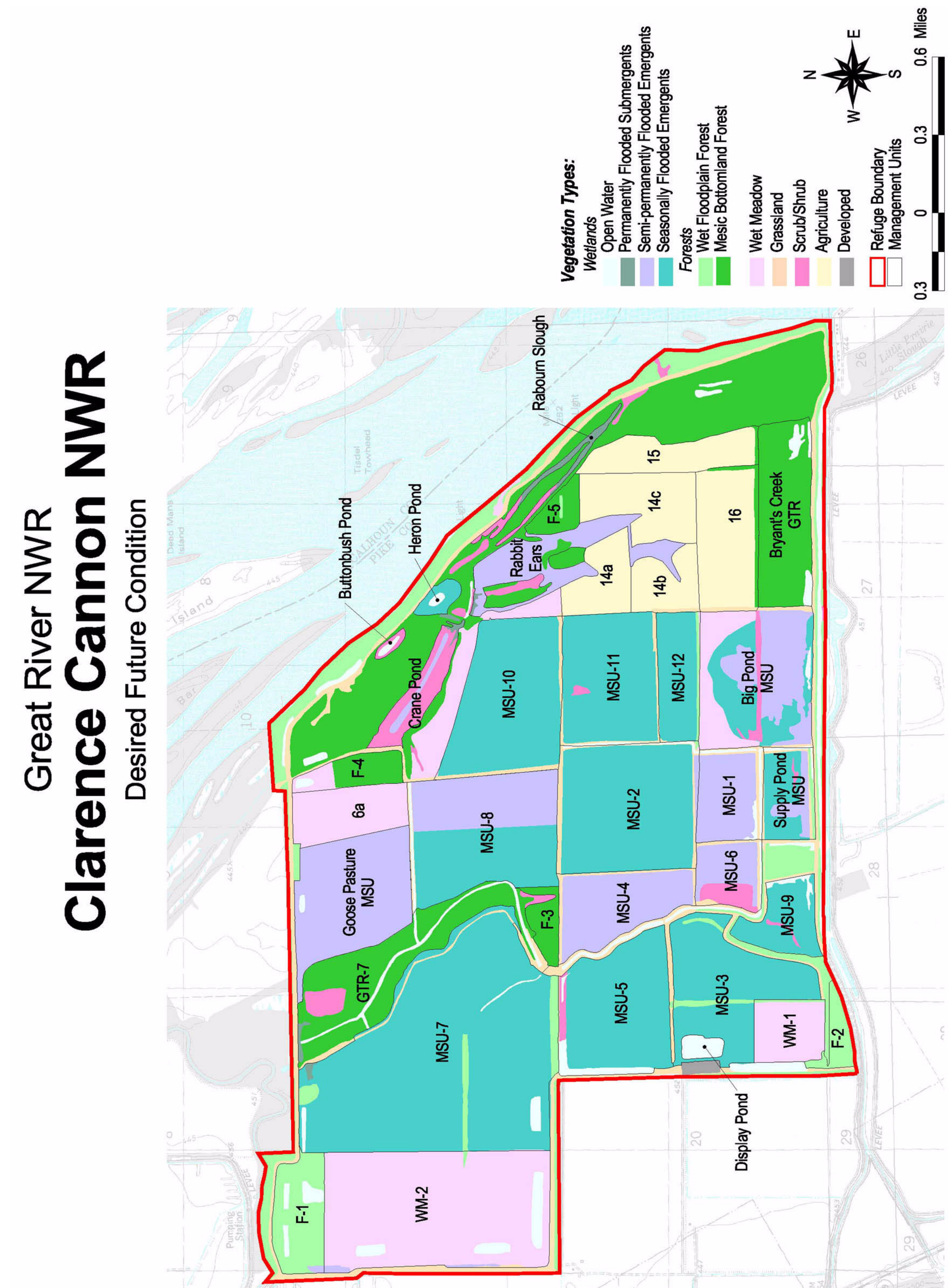

Port Louisa NWR
Keithsburg Division
Desired Future Conditions
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Developed
Sand/Mud
Refuge Boundary
0.3 0 0.3 Miles
N
E
S
W
Levee
Levee
Sand Prairie
MERCER CO
LOUISA CO
MRISWMA

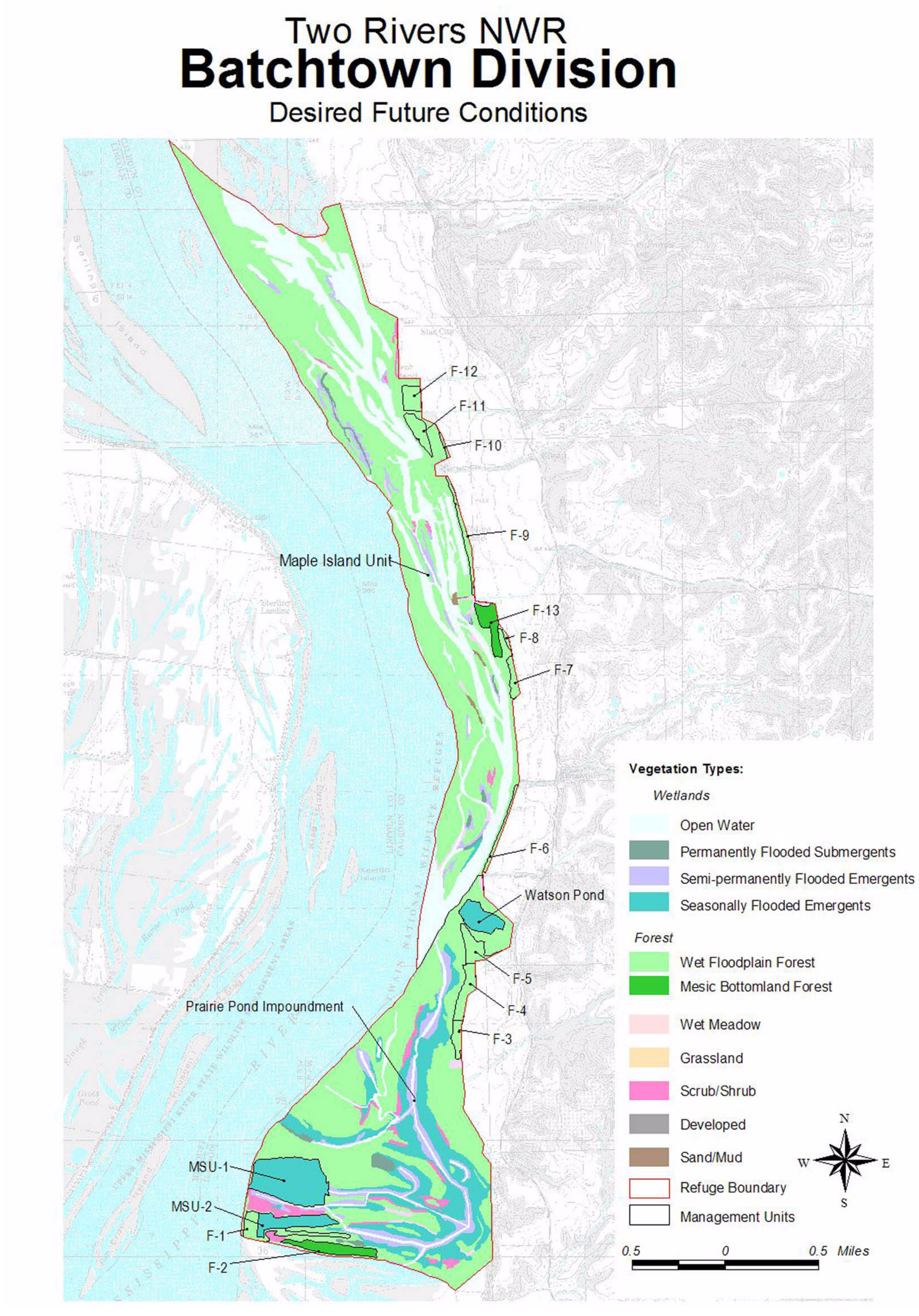


Great River NWR
Fox Island Division
Desired Future Condition
Coin Pond
Logsden Tract
Logsden Slough
Slim Slough
Willow Lake
Nelson Lake
Vegetation Types:
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Open Water
Wet Meadow
Scrub/Shrub
Grassland
Developed
Refuge Boundary
Management Units
N
W
E
S
0.4
0
0.4 Miles

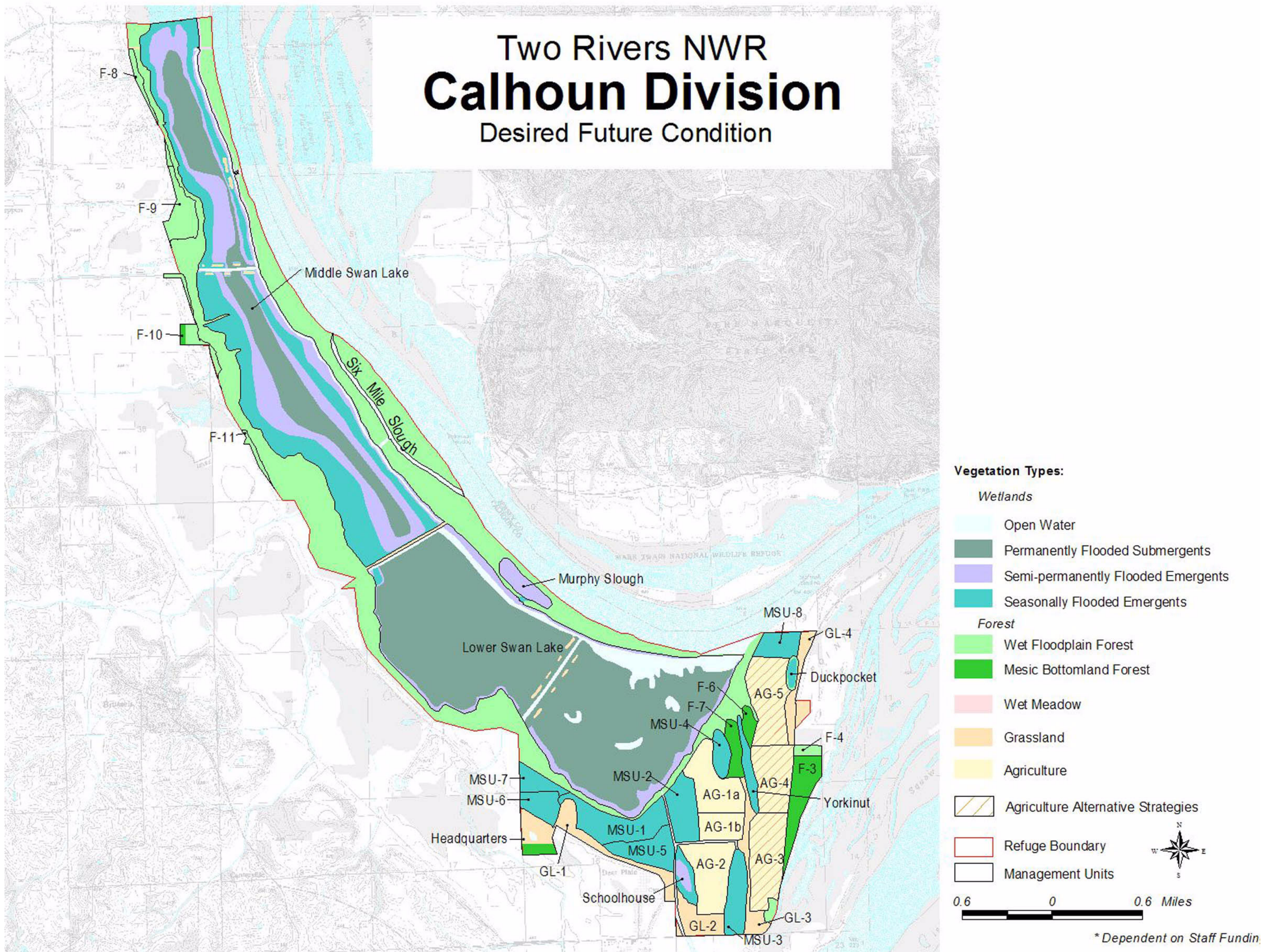

Great River NWR
Long Island Division
Desired Future Condition
Indian Graves Lake
O'Dell Chute
Canton Chute
7
Long Island Lake
Vegetation Types:
Wetlands
Open Water
Semi-permanently Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Scrub/Shrub
Sand/Mud
Refuge Boundary
Management Units
N
W
E
S
0.7 0 0.7 1.4 Miles

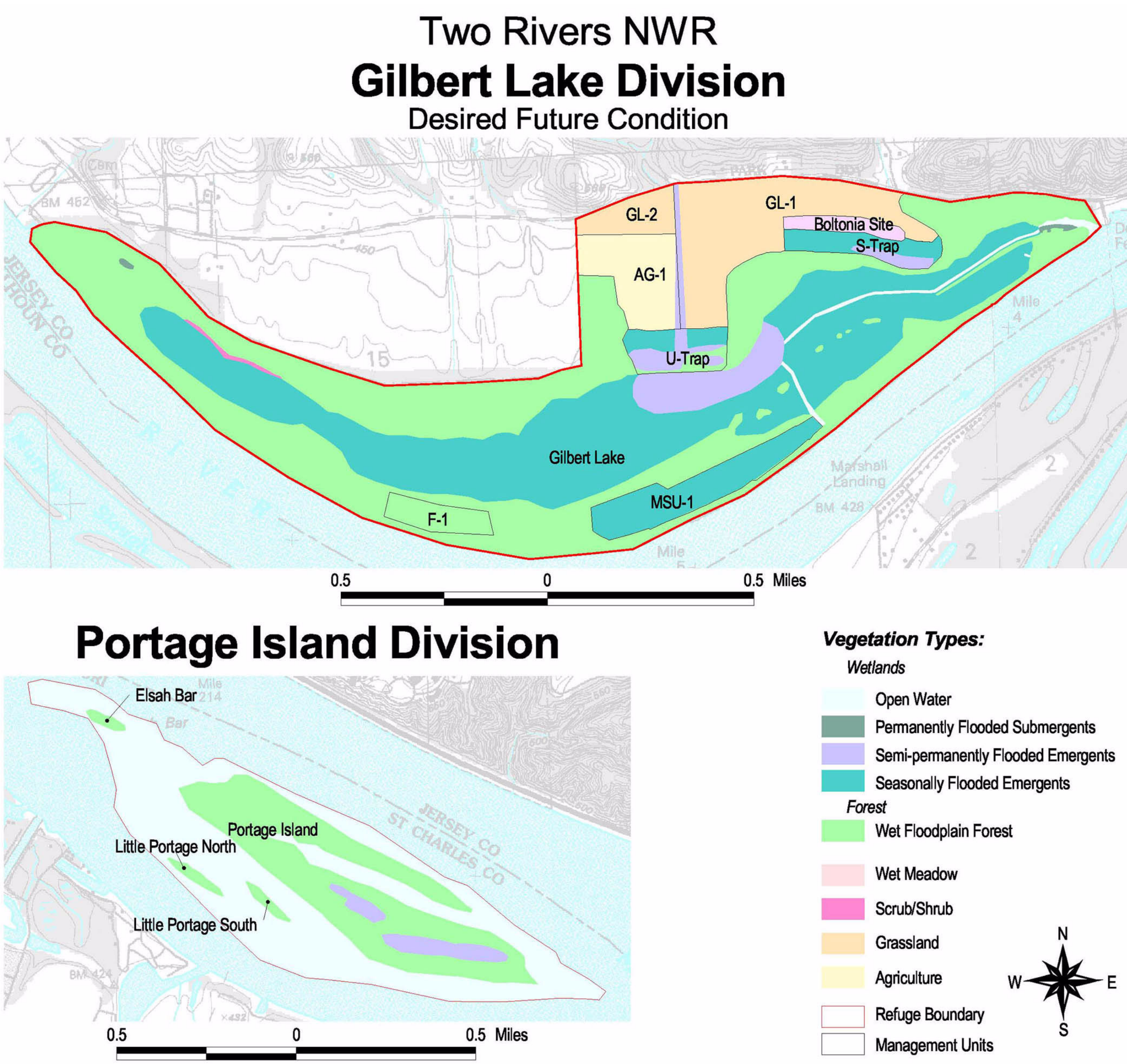

Great River NWR
Delair Division
Desired Future Condition
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Agriculture
Refuge Boundary
Management Units
N
E
S
W
0.2
0
0.2
0.4 Miles
Upper Swan Lake
Shoveler Marsh
Lower Swan Lake
Hanei Marsh
Lower Hanei Marsh
Cattail Marsh
Lower Cattail Marsh
South Marsh
Lower Butcher Marsh
Garner Slough
Flake Hole
1
2
3
4a
4b
4c
6
7
9
11
12
14a
14b
14c
14d
15a
15b
15c
17
18
19
20
21
22
23

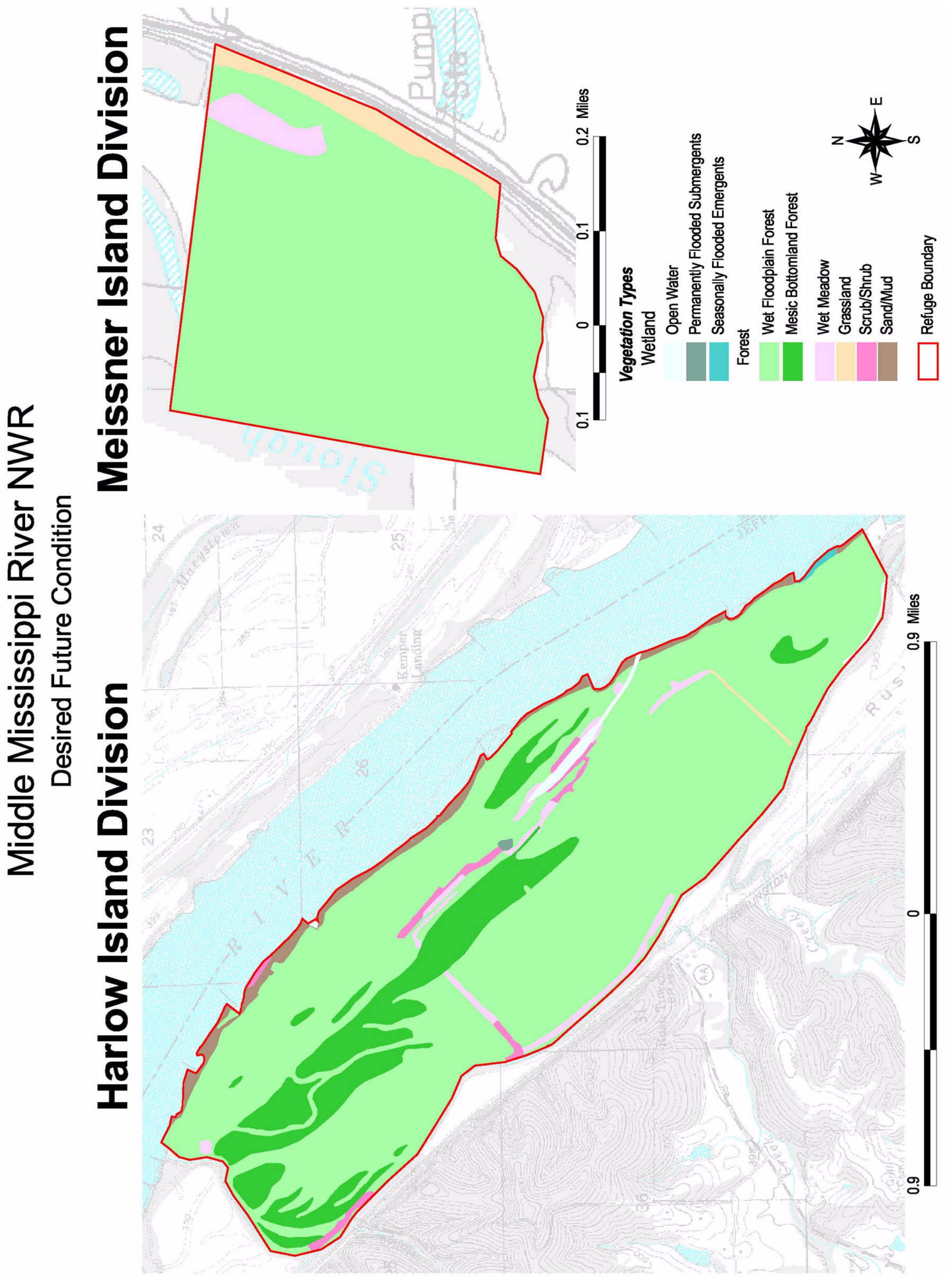

Great River NWR
Clarence Cannon NWR
Desired Future Condition
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forests
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Agriculture
Developed
Refuge Boundary
Management Units
N
E
S
W
0.3
0
0.3
0.6 Miles
F-1
WM-2
MSU-7
GTR-7
Goose Pasture MSU
6a
F-4
MSU-8
F-3
MSU-10
Crane Pond
Buttonbush Pond
Heron Pond
Rabbit Ears
F-5
Rabourn Slough
14a
14b
14c
15
16
Bryant's Creek GTR
MSU-11
MSU-12
Big Pond MSU
MSU-2
MSU-1
Supply Pond MSU
MSU-4
MSU-6
MSU-9
MSU-5
MSU-3
WM-1
F-2
Display Pond

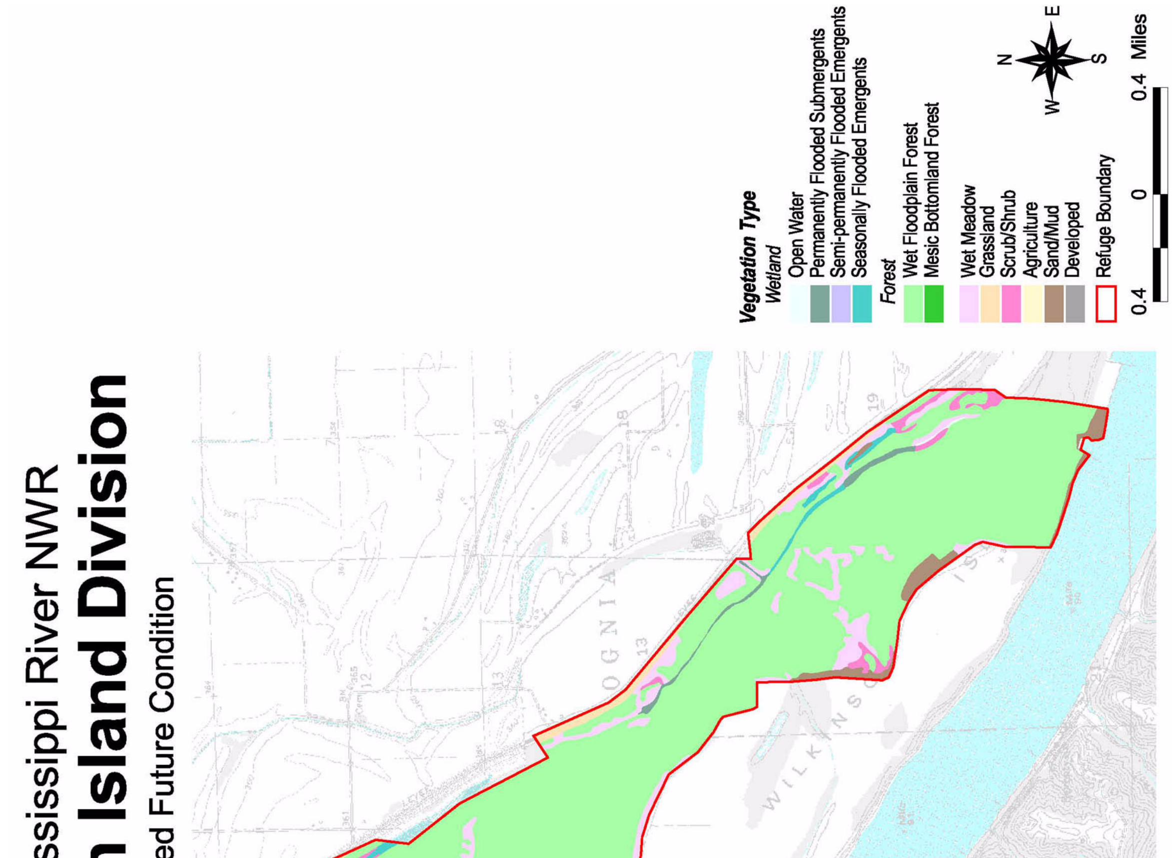


Two Rivers NWR
Batchtown Division
Desired Future Conditions
F-12
F-11
F-10
F-9
Maple Island Unit
F-13
F-8
F-7
F-6
Watson Pond
F-5
F-4
F-3
Prairie Pond Impoundment
MSU-1
MSU-2
F-1
F-2
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Developed
Sand/Mud
Refuge Boundary
Management Units
N
W
E
S
0.5
0
0.5 Miles


Two Rivers NWR
Calhoun Division
Desired Future Condition
F-8
F-9
F-10
F-11
Middle Swan Lake
Six Mile Slough
Murphy Slough
Lower Swan Lake
MSU-8
GL-4
Duckpocket
AG-5
F-6
F-7
MSU-4
F-4
F-3
MSU-2
AG-1a
AG-4
Yorkinut
MSU-7
MSU-6
AG-1b
Headquarters
MSU-1
MSU-5
AG-2
AG-3
GL-1
Schoolhouse
GL-2
GL-3
MSU-3
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Agriculture
Agriculture Alternative Strategies
Refuge Boundary
Management Units
0.6
0
0.6 Miles
* Dependent on Staff Fundin


Two Rivers NWR
Gilbert Lake Division
Desired Future Condition
GL-2
GL-1
Boltonia Site
S-Trap
AG-1
U-Trap
Gilbert Lake
MSU-1
F-1
0.5
0
0.5 Miles
Portage Island Division
Elsah Bar
Portage Island
Little Portage North
Little Portage South
JERSEY CO
ST CHARLES CO
0.5
0
0.5 Miles
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Wet Meadow
Scrub/Shrub
Grassland
Agriculture
Refuge Boundary
Management Units
N
W
E
S


Middle Mississippi River NWR
Desired Future Condition
Harlow Island Division
Meissner Island Division
Vegetation Types
Wetland
Open Water
Permanently Flooded Submergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Sand/Mud
Refuge Boundary
0.1 0 0.1 0.2 Miles
0.9 0 0.9 Miles
N
E
S
W


Middle Mississippi River NWR
Wilkinson Island Division
Desired Future Condition
Vegetation Type
Wetland
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Seasonally Flooded Emergents
Forest
Wet Floodplain Forest
Mesic Bottomland Forest
Wet Meadow
Grassland
Scrub/Shrub
Agriculture
Sand/Mud
Developed
Refuge Boundary
N
E
S
W
0.4
0
0.4
Miles
MISSISSIPPI R
WILKINSON IS
ILLINOIS
MISSOURI

Appendix B: Species List

Amphibians

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Amphiuma																						
Amphiuma, Three-toed	Amphiuma tridactylum					2	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Frogs and Toads																						
Bullfrog	Rana catesbeiana					1	1	3	1	3	1	1	1	0	0	0	0	0	0	2	1	2
Frog, Green	Rana clamitans					0	0	1	0	1	1	2	3	1	1	1	1	1	2	0	0	0
Frog, Illinois Chorus	Pseudacris streckeri			T		0	0	0	0	1	2	2	3	2	0	0	0	2	1	1	0	0
Frog, Northern Blanchard's Cricket	Acris crepitans					0	0	1	0	2	2	1	1	0	1	1	1	1	0	1	0	2
Frog, Northern Crawfish	Rana areolata		E			0	0	0	0	0	0	2	3	2	0	0	0	0	0	1	1	0
Frog, Northern Leopard	Rana pipiens					1	1	2	0	2	2	2	2	1	1	1	1	1	1	1	1	1
Frog, Pickerel	Rana palustris					0	0	1	0	0	2	2	2	0	0	0	0	2	2	0	0	0
Frog, Plains Leopard	Rana blairi					1	1	2	0	2	2	2	2	1	1	1	1	1	1	1	1	1
Frog, Southern Leopard	Rana sphenocephala					1	1	2	0	2	2	2	2	1	1	1	1	1	1	1	1	1
Frog, Western Chorus	Pseudacris triseriata					0	0	0	0	1	2	2	3	2	0	0	0	2	1	1	0	0
Frog, Wood	Rana sylvatica					0	0	0	0	0	0	2	3	0	0	0	0	3	3	0	0	0
Peeper, Spring	Pseudacris crucifer					0	0	1	0	1	2	2	2	0	1	1	1	3	2	1	1	0
Spadefoot, Eastern	Scaphiopus holbrookii					0	0	0	0	2	2	3	2	3	0	0	0	1	1	2	1	0
Spadefoot, Plains	Scaphiopus bombifrons					0	0	0	0	2	2	3	2	3	0	0	0	1	1	2	1	0
Toad, American	Bufo americanus					0	0	0	0	2	2	3	2	1	1	1	1	3	3	1	1	1
Toad, Eastern Narrowmouth	Gastrophryne carolinensis					0	0	1	0	0	2	2	2	0	0	0	0	2	2	0	0	0
Toad, Woodhouse	Bufo woodhousii					0	0	0	0	2	2	3	2	3	0	0	0	1	1	2	1	0
Treefrog, Bird-voiced	Hyla avivoca			T		0	0	0	0	1	1	2	1	0	0	1	1	3	3	0	1	0
Treefrog, Cope's Gray	Hyla chrysoscelis					0	0	0	0	1	1	2	1	0	0	1	1	3	3	0	1	0
Treefrog, Gray	Hyla versicolor					0	0	0	0	1	1	2	1	0	0	1	1	3	3	0	1	0
Treefrog, Green	Hyla cinerea					0	0	0	0	1	1	2	1	0	0	1	1	3	3	0	1	0
Salamanders																						
Hellbender, Eastern	Cryptobranchus alleganiensis			E	E	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Mudpuppy	Necturus maculosus		E			2	3	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0

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Amphibians

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Salamanders (Cont.)																						
Newt, Central	Notophthalmus viridescens		T			1	3	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0
Salamander, Blue-spotted	Ambystoma laterale		E			0	1	1	1	1	1	1	3	0	0	0	0	1	0	0	0	0
Salamander, Cave	Eurycea lucifuga					0	0	0	0	0	0	1	3	0	0	0	0	3	2	0	0	0
Salamander, Eastern Tiger	Ambystoma tigrinum					0	1	1	1	1	1	1	3	1	0	0	0	2	3	0	0	0
Salamander, Four-toed	Hemidactylium scutatum			T		0	0	0	0	0	0	1	3	0	0	0	0	3	2	0	0	0
Salamander, Jefferson	Ambysoma jeffersonianum			T		0	1	1	1	1	1	1	3	1	0	0	0	2	3	0	0	0
Salamander, Longtail	Eurycea longicauda					0	0	0	0	0	0	1	3	0	0	0	0	3	2	0	0	0
Salamander, Marbled	Ambystoma opacum					0	1	1	1	1	1	1	3	1	0	0	0	2	3	0	0	0
Salamander, Mole	Ambystoma talpoideum					0	1	1	1	1	1	1	3	1	0	0	0	2	3	0	0	0
Salamander, Ringed	Ambystoma annulatum					0	1	1	1	1	1	1	3	1	0	0	0	1	3	0	0	0
Salamander, Slimy	Plethodon glutinosus					0	0	0	0	0	0	1	3	0	0	0	0	3	2	0	0	0
Salamander, Smallmouth	Ambystoma texanum					0	1	1	1	1	1	1	3	1	0	0	0	2	3	1	1	0
Salamander, Spotted	Ambystoma maculatum					0	1	1	1	1	1	1	3	1	0	0	0	1	3	0	0	0
Siren																						
Siren, Lesser	Siren intermedia					2	1	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0

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Birds

Common Name	Species (Scientific Name)	Abundance	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Avocets and Stilts																							
Avocet, American	Recurvirostra americana	R					0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	3
Blackbirds and Allies																							
Blackbird, Brewer's	Euphagus cyanocephalus	R					0	0	1	2	2	2	2	3	3	3	3	1	0	0	2	3	0
Blackbird, Red-winged	Agelaius phoeniceus	A					0	0	2	3	3	3	3	3	2	3	3	1	0	0	2	2	0
Blackbird, Rusty	Euphagus carolinus	U					0	0	1	2	2	2	3	2	0	3	2	1	0	0	0	0	0
Blackbird, Yellow-headed	Xanthocephalus xanthocephalus	R			E		0	0	2	3	3	3	3	3	0	1	1	0	0	0	0	0	0
Bobolink	Dolichonyx oryzivorus	U					0	0	0	0	0	0	0	3	3	0	0	0	0	0	3	0	0
Cowbird, Brown-headed	Molothrus ater	C					0	0	0	0	0	0	0	0	3	1	1	2	3	3	2	3	0
Grackle, Common	Quiscalus quiscula	A					0	0	0	1	1	1	1	2	2	2	2	2	3	1	3	3	2
Meadowlark, Eastern	Sturnella magna	C					0	0	0	0	0	0	0	3	3	0	0	0	0	0	3	0	0
Meadowlark, Western	Strunella neglecta	C					0	0	0	0	0	0	0	2	3	0	0	0	0	0	3	0	0
Oriole, Baltimore	Icterus galbula	C					0	0	0	0	0	0	0	0	0	2	2	2	3	2	2	2	0
Oriole, Orchard	Icterus spurius	U					0	0	0	0	0	0	0	0	0	2	2	2	3	2	1	2	0
Cardinals and Allies																							
Bunting, Indigo	Passerina cyanea	C					0	0	0	0	0	0	0	0	2	2	1	1	3	3	2	1	0
Bunting, Snow	Plectrophenax nivalis	O					0	0	0	0	0	0	0	2	3	0	0	0	0	0	2	1	2
Cardinal, Northern	Cardinalis cardinalis	C					0	0	0	0	0	0	0	0	0	3	3	3	3	3	1	3	0
Dickcissel	Spiza americana	C					0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0
Grosbeak, Rose-breasted	Pheucticus ludovicianus	C					0	0	0	0	0	0	0	0	0	0	0	2	3	3	0	0	0
Chickadees and Titmice																							
Chickadee, Black-capped	Parus atricapillus	A					0	0	0	0	0	0	0	0	0	2	3	3	3	3	2	3	0
Chickadee, Carolina	Parus carolinensis	C					0	0	0	0	0	0	0	0	0	2	3	3	3	3	2	3	0
Titmouse, Tufted	Parus bicolor	C					0	0	0	0	0	0	0	0	0	3	3	3	3	3	1	1	0
Cormorants																							
Cormorant, Double-crested	Phalacrocorax auritus	R					3	3	2	0	0	0	0	0	0	0	0	3	3	0	0	0	2

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Birds

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Cranes																							
Crane, Sandhill	Grus canadensis	R			T		0	0	0	3	3	3	3	3	2	2	0	0	0	0	3	0	0
Creepers																							
Creeper, Brown	Certhia americana	U			T		0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	0	0
Crows and Jays																							
Crow, American	Corvus brachyrhynchos	A					0	0	0	0	0	1	1	1	1	2	2	3	3	3	3	3	0
Crow, Fish	Corvus ossifragus	O					0	0	0	0	0	0	0	1	0	3	3	3	2	2	0	3	1
Jay, Blue	Cyanocitta cristata	A					0	0	0	0	0	0	0	0	0	2	3	3	3	3	2	3	0
Cuckoos																							
Cuckoo, Black-billed	Coccyzus erythropthalmus	O					0	0	0	0	0	0	0	0	1	2	2	3	2	2	0	0	0
Cuckoo, Yellow-billed	Coccyzus americanus	C					0	0	0	0	0	0	0	0	1	2	3	3	2	2	0	0	0
Doves																							
Dove, Mourning	Zenaida macroura	C					0	0	0	0	0	0	0	0	0	0	0	0	2	3	3	3	0
Dove, Rock	Columba livia	O					0	0	0	0	0	0	0	0	1	0	0	0	0	2	3	3	0
Ducks, Geese and Swans																							
Bufflehead	Bucephala albeola	U					3	3	3	2	2	2	2	1	0	2	2	2	2	0	0	0	1
Canvasback	Aythya valisineria	C					2	3	2	3	2	3	1	0	0	0	0	0	0	0	0	0	0
Duck, American Black	Anas rubripes	U					3	3	3	3	3	3	3	3	0	2	1	0	0	0	0	0	3
Duck, Ring-necked	Aythya collaris	A					3	3	3	3	3	3	3	1	0	1	1	0	0	0	0	0	1
Duck, Ruddy	Oxyura jamaicensis	C					3	3	3	3	3	3	3	2	0	0	0	0	0	0	0	0	0
Duck, Wood	Aix sponsa	A					1	2	3	3	3	3	3	3	0	3	2	1	3	2	0	1	1
Gadwall	Anas strepera	C					3	3	3	3	3	3	3	3	1	3	1	0	0	0	0	0	1
Goldeneye, Common	Bucephala clangula	A					3	3	3	2	2	2	2	2	0	1	1	1	1	0	0	0	1
Goose, Canada	Branta canadensis	A					1	2	2	3	3	3	3	1	0	1	0	0	0	0	3	3	2
Goose, Greater White-fronted	Anser albifrons	U					3	3	3	3	3	3	3	1	0	1	0	0	0	0	2	2	1
Goose, Ross's	Chen rossii	R					3	3	3	3	3	3	3	1	1	3	2	0	0	0	1	0	1
Goose, Snow	Chen caerulescens	C					3	3	3	3	3	3	3	1	0	1	0	0	0	0	2	2	1

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Birds

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Ducks, Geese and Swans (Cont.)																							
Mallard	Anas platyrhynchos	A					1	2	2	3	3	3	3	3	1	3	2	0	0	0	2	0	2
Merganser, Common	Mergus merganser	A					3	3	3	2	2	2	2	1	0	2	2	2	2	0	0	0	0
Merganser, Hooded	Lophodytes cucullatus	C					3	3	3	2	2	2	2	1	0	2	2	2	2	0	0	0	0
Oldsquaw	Clangula hyemalis	X					3	3	3	3	3	1	1	1	0	0	0	0	0	0	0	0	1
Pintail, Northern	Anas acuta	A					3	3	3	3	3	3	3	3	2	3	3	0	0	0	2	0	3
Redhead	Aythya americana	O					3	3	3	3	3	3	3	1	0	0	0	0	0	0	0	0	1
Scaup, Greater	Aythya marila	O					3	3	3	2	2	2	2	1	0	1	0	0	0	0	0	0	1
Scaup, Lesser	Aythya affinis	A					2	3	2	2	2	2	1	0	0	0	0	0	0	0	0	0	0
Scoter, Black	Melanitta nigra	X					3	3	2	1	1	1	1	1	0	0	0	0	0	0	0	0	1
Scoter, White-winged	Melanitta fusca	X					3	3	2	1	1	1	1	1	0	0	0	0	0	0	0	0	1
Shoveler, Northern	Anas clypeata	A					3	3	3	3	3	3	3	3	0	3	1	0	0	0	1	0	3
Swan, Trumpeter	Cygnus buccinator	X					3	3	3	3	3	3	3	1	0	0	0	0	0	0	0	0	1
Swan, Tundra	Cygnus columbianus	R					3	3	3	3	3	3	3	1	0	0	0	0	0	0	0	1	1
Teal, Blue-winged	Anas discors	A					1	2	2	3	3	3	3	2	1	3	1	0	0	0	2	0	1
Teal, Green-winged	Anas crecca	A					3	3	3	3	3	3	3	2	0	3	2	0	0	0	0	0	1
Wigeon, American	Anas americana	A					3	3	3	3	3	3	3	3	1	3	2	1	0	0	1	0	1
Emberizid Finches, Sparrows and Allies																							
Junco, Dark-eyed	Junco hyemalis	A					0	0	0	0	0	0	0	0	0	3	3	2	2	2	1	3	0
Longspur, Lapland	Calcarius lapponicus	O					0	0	0	0	0	0	0	3	3	0	0	0	0	0	2	1	0
Sparrow, American Tree	Spizella arborea	A					0	0	0	0	0	0	0	0	0	2	3	2	1	1	2	2	0
Sparrow, Chipping	Spizella passerina	C					0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	2	0
Sparrow, Clay-colored	Spizella pallida	R					0	0	0	0	0	0	0	1	3	2	2	2	0	0	1	0	0
Sparrow, Field	Spizella pusilla	U					0	0	0	0	0	0	0	1	3	1	1	1	0	0	3	0	0
Sparrow, Fox	Passerella iliaca	U					0	0	0	0	0	0	0	0	0	2	2	2	3	3	0	0	0
Sparrow, Grasshopper	Ammodramus savannarum	O					0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0
Sparrow, Harris'	Zonotrichia querula	R					0	0	0	0	0	0	0	0	1	3	2	2	1	2	0	0	0

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Birds

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Emberizid Finches, Sparrows and Allies (Cont.)																							
Sparrow, Henslow's	Ammodramus henslowii	X		T	E		0	0	0	0	0	0	0	3	3	0	0	0	0	0	1	0	0
Sparrow, Lark	Chondestes grammacus	O					0	0	0	0	0	0	0	3	3	1	0	0	0	0	3	0	0
Sparrow, Le Conte's	Ammodramus leconteii	X					0	0	0	0	0	0	0	3	1	1	0	0	0	0	1	0	0
Sparrow, Lincoln's	Melospiza lincolnii	O					0	0	0	0	0	0	0	3	1	3	3	1	0	0	0	0	0
Sparrow, Savannah	Passerculus sandwichensis	U					0	0	0	0	0	0	0	3	3	2	0	0	0	0	2	0	0
Sparrow, Song	Melospiza melodia	C					0	0	0	1	1	1	1	2	1	3	3	2	3	2	2	1	0
Sparrow, Swamp	Melospiza georgiana	U					0	0	0	3	3	3	3	3	1	2	1	0	0	0	0	0	0
Sparrow, Vesper	Pooecetes gramineus	U					0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0
Sparrow, White-crowned	Zonotrichia leucophrys	U					0	0	0	0	0	0	0	3	2	2	2	1	0	0	1	3	0
Sparrow, White-throated	Zonotrichia albicollis	A					0	0	0	0	0	0	0	0	1	0	1	1	3	3	1	1	0
Towhee, Eastern	Pipilo erythrophtlalmus	U					0	0	0	0	0	0	0	0	0	3	3	3	3	3	1	1	0
Falcons																							
Falcon, Peregrine	Falco peregrinus	R		E	E	E	1	0	0	0	0	0	0	3	1	3	3	3	3	2	1	1	0
Kestrel, American	Falco sparverius	C					0	0	0	0	0	0	0	0	3	0	0	2	2	2	3	2	0
Merlin	Falco columbarius	R					0	0	0	0	0	0	0	0	0	0	0	2	3	3	2	1	0
Finches																							
Crossbill, Red	Loxia curvirostra	X					0	0	0	0	0	0	0	0	0	0	0	0	0	3	1	1	0
Crossbill, White-winged	Loxia leucoptera	X					0	0	0	0	0	0	0	0	0	0	0	0	2	3	1	1	0
Finch, House	Carpodacus mexocanus	C					0	0	0	0	0	0	0	0	0	0	0	1	1	3	2	3	0
Finch, Purple	Carpodacus purpureus	U					0	0	0	0	0	0	0	0	0	0	0	1	1	3	1	3	0
Goldfinch, American	Gcaruelis tristis	C					0	0	0	0	0	0	0	1	1	3	3	3	2	1	2	3	0
Grosbeak, Evening	Coccothraustes verpertinus	R					0	0	0	0	0	0	0	0	1	1	1	1	2	3	1	1	0
Redpoll, Common	Carduelis flammea	X					0	0	0	0	0	0	0	1	1	2	1	2	1	2	3	2	0
Siskin, Pine	Carduelis pinus	O					0	0	0	0	0	0	0	0	2	0	0	1	1	2	2	2	0
Gnatcatchers																							
Gnatcatcher, Blue-gray	Plioptila caerulea	U					0	0	0	0	0	1	1	3	0	3	3	3	3	3	0	0	0

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Common Name	**Species (Scientific Name)**																						
Grebes																							
Grebe, Eared	Podiceps nigricollis	R					3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Grebe, Horned	Podiceps auritus	O					3	3	3	3	3	2	2	1	0	2	0	0	0	0	0	0	0
Grebe, Pied-billed	Podilymbus podiceps	C			T		3	3	3	3	3	2	2	1	0	2	0	0	0	0	0	0	0
Grebe, Western	Aechmophorus occidentalis	O					3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Gulls and Terns																							
Gull, Bonaparte's	Larus philadelphia	U					3	3	1	1	1	1	1	2	1	2	0	1	2	3	0	0	3
Gull, Franklin's	Larus pipixcan	O					3	3	2	3	3	3	3	3	0	0	0	0	0	0	1	0	3
Gull, Glaucous	Larus hyperboreus	R					3	3	1	1	1	1	1	2	2	0	0	0	0	0	2	2	3
Gull, Herring	Larus argentatus	A					3	3	1	1	1	1	1	2	2	2	2	1	0	0	2	2	3
Gull, Ring-billed	Larus delawarensis	A					3	3	1	1	1	2	2	3	0	2	0	0	0	0	2	2	3
Gull, Thayer's	Larus thayeri	R					3	3	1	1	1	1	1	2	2	0	0	0	0	0	2	2	3
Tern, Black	Chlidonias niger	U			E		3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	2
Tern, Caspian	Sterna caspia	U					3	3	2	2	2	2	2	1	0	0	0	0	0	0	0	0	3
Tern, Common	Sterna hirundo	O			E		3	3	3	3	3	2	2	2	1	0	0	0	0	0	0	0	3
Tern, Forster's	Sterna forsteri	U			E		3	3	3	3	3	2	2	2	1	0	0	0	0	0	0	0	3
Tern, Least	Sterna antillarum	O	E	E	E	E	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	1	3
Hawks, Kites and Eagles																							
Eagle, Bald	Haliaeetus leucocephalus	A	T	E	T	E	3	1	0	0	0	1	1	0	0	1	1	2	3	3	1	0	2
Eagle, Golden	Aquila chrysaetos	R					0	0	0	0	0	0	0	1	3	0	0	0	1	1	1	0	0
Goshawk, Northern	Accipiter gentilis	R					0	0	0	0	0	0	0	0	2	1	1	2	3	3	1	0	0
Harrier, Northern	Circus cyaneus	U		E	E	E	0	0	0	2	2	3	3	3	3	3	2	1	0	0	2	0	0
Hawk, Broad-winged	Buteo platypterus	O					0	0	0	0	0	0	0	1	1	2	3	3	3	2	1	0	0
Hawk, Cooper's	Accipiter cooperii	U					0	0	0	0	0	0	0	0	2	2	1	3	3	3	2	0	0
Hawk, Red-shouldered	Buteo lineatus	O		E	T		0	0	0	0	0	0	0	1	1	2	3	3	3	3	1	0	0
Hawk, Red-tailed	Buteo Jamaicensis	C					0	0	0	0	0	0	0	0	3	1	1	2	3	3	2	1	0
Hawk, Rough-legged	Buteo lagopus	U					0	0	0	0	0	0	0	2	3	0	0	1	1	1	3	0	0

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Birds		Abundance	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Common Name	**Species (Scientific Name)**																						
Hawks, Kites and Eagles (Cont.)																							
Hawk, Sharp-shined	Accipiter striatus	U					0	0	0	0	0	0	0	0	2	3	2	2	3	3	2	0	0
Hawk, Swainson's	Buteo swainsoni	X			E		0	0	0	0	0	0	0	0	3	0	0	2	3	3	3	0	0
Kite, Mississippi	Ictinia mississippiensis	O			E		0	0	0	0	0	0	0	1	1	1	1	3	3	2	1	0	0
Osprey	Panion haliaetus	U			E		3	1	0	0	0	0	0	3	1	1	1	2	3	2	0	0	1
Herons, Egrets, and Bitterns																							
Bittern, American	Botaurus lentiginosus	U			E	E	0	0	0	2	3	2	3	2	1	1	1	0	0	0	0	0	0
Bittern, Least	Ixobrychus exilis	O			T		0	0	0	3	3	2	3	2	0	0	0	0	0	0	0	0	0
Egret, Cattle	Bubulcus ibis	O					0	2	2	2	2	2	2	3	2	3	3	3	2	1	2	1	1
Egret, Great	Casmerodius albus	C					0	2	1	3	3	3	3	2	0	0	0	3	3	0	1	0	1
Egret, Snowy	Egretta thula	R			E	E	0	2	1	3	3	3	3	2	0	0	2	3	3	0	1	0	1
Heron, Black-crowned Night-	Nycticorax nycticorax	U			E		0	0	0	2	2	2	2	1	0	3	3	3	3	0	0	0	1
Heron, Great Blue	Ardea herodias	C					0	2	2	3	3	1	1	1	0	0	0	3	3	0	0	0	1
Heron, Green	Butorides striatus	C					0	0	0	2	2	2	2	1	0	3	2	0	1	0	0	0	0
Heron, Little Blue	Egretta caerulea	R			E		0	2	1	3	3	3	3	2	0	3	2	3	3	0	1	0	1
Heron, Yellow-crowned Night-	Nycticorax violaceus	O			E		0	0	0	2	2	2	2	1	0	3	3	3	3	0	0	0	1
Hummingbirds																							
Hummingbird, Ruby-throated	Archilochus colubris	C					0	0	0	0	0	0	0	0	0	2	2	3	3	2	0	3	0
Ibises																							
Ibis, Glossy	Plegadis falcinellus	R					0	3	3	3	3	3	3	3	0	3	3	2	2	0	0	3	2
Ibis, White-faced	Plegadis chihi	R					0	3	3	3	3	3	3	3	0	3	2	0	0	0	0	3	1
Kingfishers																							
Kingfisher, Belted	Ceryle alcyon	U					3	3	3	3	3	3	3	3	1	3	3	2	1	1	1	1	3
Kinglets																							
Kinglet, Golden-crowned	Regulas satrapa	C					0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0
Kinglet, Ruby-crowned	Regulas calendula	C					0	0	0	0	0	0	0	0	0	0	0	2	2	3	0	0	0

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Birds

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Larks																							
Lark, Horned	Eremophila alpestris	C					0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	1	0
Loons																							
Loon, Common	Gavia immer	O					3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Mockingbirds and Thrashers																							
Catbird, Gray	Dumetella carolinensis	C					0	0	0	0	0	0	0	2	0	3	3	2	1	1	1	1	0
Mockingbird, Northern	Mimus polyglottos	O					0	0	0	0	0	0	0	0	2	2	3	3	3	3	2	3	0
Thrasher, Brown	Toxostoma rufum	C					0	0	0	0	0	0	0	0	1	2	3	3	2	0	2	1	0
Nightjars																							
Chuck-will's-widow	Caprimulgus carolinensis	O					0	0	0	0	0	0	0	0	0	0	1	3	3	3	1	0	0
Nighthawk, Common	Chordeiles minor	C					0	1	1	1	1	1	1	1	3	0	0	0	0	2	3	3	0
Whip-poor-will	Caprimulgus vociferus	U					0	0	0	0	0	0	0	1	1	3	3	3	3	2	2	0	0
Nuthatches																							
Nuthatch, Red-breasted	Sitta canadensis	U					0	0	0	0	0	0	0	0	0	0	1	2	3	3	1	1	0
Nuthatch, White-breasted	Sitta carolinensis	C					0	0	0	0	0	0	0	0	0	0	1	2	3	3	1	3	0
Owls																							
Owl, Barn	Tyto alba	X		E	E	E	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3	1	0
Owl, Barred	Strix varia	C					0	0	0	0	0	0	0	2	1	3	3	3	3	2	2	0	0
Owl, Eastern Screech-	Otus asio	U					0	0	0	0	0	0	0	0	2	3	3	3	2	0	1	1	0
Owl, Great Horned	Bubo virginianus	C					0	0	0	0	0	0	0	3	2	2	2	3	3	3	2	0	0
Owl, Long-eared	Asio otus	R		T			0	0	0	0	0	0	0	0	2	1	2	3	3	3	2	0	0
Owl, Short-eared	Asio flammeus	O		E	E		0	0	0	0	0	0	0	1	3	2	1	1	1	0	1	0	0
Owl, Snowy	Nyctea scandiaca	X					0	0	0	0	0	0	0	0	1	0	0	1	2	3	2	0	0
Old World Sparrows																							
Sparrow, Eurasian Tree	Passer montanus	U					0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	3	0
Sparrow, House	Passer domesticus	A					0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	3	0

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Birds

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Pelicans																							
Pelican, American White	Pelecanus erythrothynchos	C					3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Pheasants, Grouse, and Quail																							
Bobwhite, Northern	Clinus virginianus	U					0	0	0	0	0	0	0	0	3	0	1	2	1	1	3	0	0
Pheasant, Ring-necked	Phasianus colchicus	C					0	0	0	0	0	0	0	1	3	0	1	2	2	2	3	0	0
Turkey, Wild	Meleagris gallopavo	U					0	0	0	0	0	0	0	0	1	0	1	3	3	3	2	0	0
Pipits																							
Pipit, American	Anthus rubescens	R					0	0	0	0	0	0	0	2	3	0	0	0	0	0	3	0	3
Plovers																							
Killdeer	Charadrius vociferus	C					0	0	0	0	0	0	0	0	3	1	0	0	0	0	3	2	2
Plover, American Golden-	Pluvialis dominica	O					0	0	0	0	0	0	0	3	3	1	0	0	0	0	0	0	1
Plover, Black-bellied	Pluvialis squatarola	O					0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	3
Plover, Piping	Charadrius melodus	R	T	E	E		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	3
Plover, Semipalmated	Gharadrius semipalmatus	U					0	0	0	0	0	0	0	3	3	1	0	0	0	0	0	0	3
Rails and Coots																							
Coot, American	Fulica americana	A					3	3	3	3	3	3	3	1	0	0	0	0	0	0	0	0	1
Moorhen, Common	Gallinula chloropus	R			T		3	3	3	3	3	3	3	2	0	1	1	0	0	0	0	0	1
Rail, King	Rallus elegans	U		E	E	E	0	0	1	3	3	2	2	1	0	3	0	0	0	0	0	0	0
Rail, Virginia	Rallus limicola	O					0	0	1	3	3	3	3	2	0	0	0	0	0	0	0	0	0
Rail, Yellow	Colurnicops noveboracensis	X					0	0	1	3	3	3	3	2	0	0	0	0	0	0	0	0	0
Sora	Porzana carolina	U					0	0	1	3	3	3	3	2	0	1	0	0	0	0	0	0	0
Sandpipers and Allies																							
Dowitcher, Long-billed	Limnodromus scolopaceus	U					0	0	0	0	0	2	2	3	2	2	1	0	0	0	0	0	3
Dowitcher, Short-billed	Limnodromus griseus	U					0	0	0	0	0	2	2	1	0	1	1	0	0	0	0	0	3
Dunlin	Calidris alpina	R					0	0	0	0	0	2	2	2	1	0	0	0	0	0	1	0	3
Godwit, Marbled	Limosa fedoa	X					0	0	0	2	2	2	2	3	3	2	0	0	0	0	3	0	3

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Sandpipers and Allies (Cont.)																							
Knot, Red	Calidris canutus	O					0	0	0	1	1	2	2	3	0	2	0	0	0	0	0	0	3
Phalarope, Red-necked	Phalaropus lobatus	R					3	3	3	3	3	3	3	3	0	0	0	0	0	0	0	0	1
Phalarope, Wilson's	Phalaropus tricolor	R			E		3	3	3	3	3	3	3	3	0	2	1	0	0	0	0	0	1
Sanderling	Calidris alba	R					0	0	0	0	0	1	1	1	2	0	0	0	0	0	0	0	3
Sandpiper, Baird's	Calidris bairdii	O					0	0	0	0	0	0	0	3	3	1	1	0	0	0	1	0	3
Sandpiper, Buff-breasted	Tryngites subruficollis	R					0	0	0	1	1	1	1	1	3	1	0	0	0	0	0	0	0
Sandpiper, Least	Calidris minutilla	C					0	0	0	0	0	2	2	2	1	0	0	0	0	0	1	0	3
Sandpiper, Pectoral	Calidris melanotos	C					0	0	0	0	0	2	2	3	3	2	1	0	0	0	0	0	2
Sandpiper, Semipalmated	Calidris pusilla	C					0	0	0	1	1	3	3	3	0	0	0	0	0	0	0	0	3
Sandpiper, Solitary	Tringa solitaria	C					0	0	0	1	1	1	1	3	0	3	2	2	2	1	0	0	3
Sandpiper, Spotted	Actitis macularia	C					0	0	0	1	1	1	1	2	3	1	1	0	0	0	1	0	3
Sandpiper, Stilt	Calidris himantopus	O					0	0	0	0	0	2	3	3	1	0	0	0	0	0	0	0	3
Sandpiper, Upland	Bartramia longicauda	R			E		0	0	0	0	0	0	0	1	3	0	0	0	0	0	2	1	0
Sandpiper, Western	Calidris mauri	R					0	0	0	1	1	2	2	3	0	0	0	0	0	0	0	0	3
Sandpiper, White-rumped	Calidris fuscicollis	O					0	0	0	0	0	2	2	2	1	2	2	0	0	0	0	0	3
Snipe, Common	Gallinago gallinago	U					0	0	0	0	0	2	2	3	1	3	1	0	0	0	0	0	3
Willet	Catoptophorus semipalatus	R					0	0	0	2	2	2	2	3	0	3	3	0	0	0	0	0	3
Woodcock, American	Scolopax minor	U					0	0	0	0	0	0	0	2	2	3	3	2	2	2	1	0	1
Yellowlegs, Greater	Tinga melanoleuca	U					0	0	0	2	2	2	2	3	0	2	1	0	0	0	0	0	3
Yellowlegs, Lesser	Tringa flavipes	C					0	0	0	2	2	2	2	3	0	3	2	0	0	0	0	0	3
Shrikes																							
Shrike, Loggerhead	Lanius ludovicianus	R			T		0	0	0	0	0	0	0	0	1	2	3	2	2	1	2	0	0
Starlings																							
Starling, European	Strunus vulgaris	A					0	0	0	0	0	0	0	0	3	2	2	3	3	3	3	3	0
Swallows																							
Martin, Purple	Progne subis	U					2	2	2	2	2	2	2	2	3	1	0	0	0	0	3	3	0

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Birds

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Swallows (Cont.)																							
Swallow, Bank	Riparia riparia	C					3	3	3	3	3	3	3	3	3	3	2	0	0	0	2	0	3
Swallow, Barn	Hirundo rustica	C					3	3	3	3	3	3	3	3	3	3	2	0	0	0	3	0	2
Swallow, Cliff	Hirundo pyrrhonota	C					3	3	3	3	3	3	3	3	3	3	2	0	0	0	2	0	2
Swallow, Northern Rough-winged	Stelgidopteryx serripennis	A					3	3	3	3	3	3	3	3	3	3	2	0	0	0	2	0	2
Swallow, Tree	Tachycineta bicolor	A					3	3	3	3	3	3	3	3	1	3	3	2	1	1	2	0	0
Swifts																							
Swift, Chimney	Chaetura vauxi	C					0	0	0	0	0	0	0	0	0	0	0	0	2	3	3	3	0
Tanagers																							
Tanager, Scarlet	Piranga olivacea	U					0	0	0	0	0	0	0	0	0	1	2	3	3	3	0	0	0
Tanager, Summer	Piranga rubra	R					0	0	0	0	0	0	0	0	0	1	2	3	3	3	0	0	0
Thrushes and Allies																							
Bluebird, Eastern	Sialia sialis	U					0	0	0	0	0	0	0	2	3	2	2	2	2	2	3	0	0
Robin, American	Turdus migratorius	A					0	0	0	0	0	0	0	0	2	2	2	3	3	3	3	3	0
Thrushes and Allies																							
Thrush, Gray-cheeked	Catharus minimus	U					0	0	0	0	0	0	0	0	0	3	3	3	2	2	0	0	0
Thrush, Hermit	Catharus guttatus	U					0	0	0	0	0	0	0	0	0	0	1	2	3	3	0	0	0
Thrush, Swainson's	Catharus ustulatus	U					0	0	0	0	0	0	0	1	0	2	3	3	2	0	1	0	0
Thrush, Wood	Hylocichla mustelina	O					0	0	0	0	0	0	0	0	0	1	3	3	3	3	1	1	0
Veery	Catharus fuscescens	O					0	0	0	0	0	0	0	1	2	2	3	3	2	1	0	0	0
Tyrant Flycatchers																							
Flycatcher, Acadian	Empidonax virescens	R					0	0	0	0	0	0	0	1	0	2	2	2	3	3	2	0	0
Flycatcher, Alder	Empdonax alnorum	R					0	0	0	0	0	0	0	0	0	3	3	2	1	1	0	0	0
Flycatcher, Great Crested	Myiarchus crinitus	C					0	0	0	0	0	0	0	0	2	1	2	3	3	3	2	1	0
Flycatcher, Least	Empidonax minimus	U					0	0	0	0	0	0	0	1	0	1	1	3	3	3	0	1	0
Flycatcher, Olive-sided	Contopus borealis	O					0	0	0	0	0	0	0	0	0	2	2	2	3	3	0	0	0

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Tyrant Flycatchers (Cont.)																							
Flycatcher, Willow	Empidonax traillii	O					0	0	0	0	0	0	0	0	0	3	3	2	1	1	0	0	0
Flycatcher, Yellow-bellied	Empidonax flaviventris	U					0	0	0	0	0	0	0	0	0	3	3	2	3	2	0	0	0
Kingbird, Eastern	Tyrannus tyrannus	U					0	0	0	0	0	0	0	2	2	3	3	3	2	2	3	1	0
Pewee, Eastern Wood-	Contopus virens	C					0	0	0	0	0	0	0	0	0	1	2	3	3	3	0	0	0
Phoebe, Eastern	Sayornis phoebe	U					0	0	0	0	0	0	0	0	0	3	3	3	3	2	2	2	0
Vireos																							
Vireo, Bell's	Vireo bellii	O					0	0	0	0	0	0	0	1	1	2	2	2	1	1	1	0	0
Vireo, Blue-headed	Vireo solitarius	U					0	0	0	0	0	0	0	0	0	1	1	1	3	3	1	1	0
Vireo, Philadelphia	Vireo philadelphicus	O					0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Vireo, Red-eyed	Vireo olivaceus	C					0	0	0	0	0	0	0	0	0	0	1	1	3	3	0	0	0
Vireo, Warbling	Vireo gilvus	C					0	0	0	0	0	0	0	0	1	2	2	2	3	3	1	1	0
Vireo, White-eyed	Vireo griseus	O					0	0	0	0	0	0	0	1	1	3	3	2	2	2	1	0	0
Vireo, Yellow-throated	Vireo flavifrons	C					0	0	0	0	0	0	0	0	1	1	1	1	3	3	1	1	0
Vultures																							
Vulture, Turkey	Cathartes aura	C					0	0	0	0	0	0	0	0	2	0	0	2	3	3	1	1	0
Waxwings																							
Waxwing, Cedar	Bonbycilla cedrorum	C					0	0	0	0	0	0	0	0	0	0	0	2	3	3	1	3	0
Wood Warblers																							
Chat, Yellow-breasted	Icteria virens	R					0	0	0	0	0	0	0	2	0	3	3	2	0	0	0	0	0
Ovenbird	Seiurus aruocapillus	U					0	0	0	0	0	0	0	0	0	0	0	1	2	3	0	0	0
Parula, Northern	Parula americana	O					0	0	0	0	0	0	0	0	0	1	1	2	3	3	0	0	0
Redstart, American	Setophaga ruticilla	C					0	0	0	0	0	0	0	0	0	2	2	2	3	3	0	0	0
Warbler, Bay-breasted	Dendroica castanea	U					0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0
Warbler, Black-and-white	Mniotilta varia	C					0	0	0	0	0	0	0	0	0	0	0	1	2	3	0	0	0
Warbler, Blackburnian	Dendroica fusca	O					0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0
Warbler, Blackpoll	Dendroica striata	U					0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0

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Birds

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Wood Warblers (Cont.)																							
Warbler, Black-throated Blue	Dnedroica caeruulescens	R					0	0	0	0	0	0	0	0	0	1	1	1	2	3	0	0	0
Warbler, Black-throated Green	Dendroica virens	U					0	0	0	0	0	0	0	0	0	1	1	1	2	3	0	0	0
Warbler, Blue-winged	Vermivora pius	O					0	0	0	0	0	0	0	2	3	3	3	3	2	2	3	0	0
Warbler, Canada	Wilsonia canadensis	O					0	0	0	0	0	0	0	0	0	2	2	3	3	3	0	0	0
Warbler, Cape May	Dendroica tigrina	O					0	0	0	0	0	0	0	0	0	0	0	1	2	3	0	0	0
Warbler, Cerulean	Dendroica cerulea	O					0	0	0	0	0	0	0	0	0	0	0	1	3	3	0	0	0
Warbler, Chestnut-sided	Dendroica pensylvanica	U					0	0	0	0	0	0	0	1	1	1	1	1	2	3	1	0	0
Warbler, Connecticut	Oporornis agilis	R					0	0	0	0	0	0	0	1	0	3	2	3	3	2	0	0	0
Warbler, Golden-winged	Vermivora chrysoptera	O					0	0	0	0	0	0	0	0	3	0	0	0	1	1	3	0	0
Warbler, Hooded	Wilsonia citrina	R					0	0	0	0	0	0	0	0	0	3	3	2	2	3	0	0	0
Warbler, Kentucky	Oporornis formosus	O					0	0	0	0	0	0	0	0	0	2	2	2	3	3	0	0	0
Warbler, Magnolia	Dendroica magnolia	U					0	0	0	0	0	0	0	0	1	1	1	1	1	3	0	0	0
Warbler, Mourning	Oporornis philadelphia	O					0	0	0	0	0	0	0	2	0	3	3	3	2	1	0	0	0
Warbler, Nashville	Vermivora ruficapilla	C					0	0	0	0	0	0	0	0	0	2	3	3	3	3	0	0	0
Warbler, Orange-crowned	Vermivora celata	O					0	0	0	0	0	0	0	0	0	2	3	3	3	3	0	0	0
Warbler, Palm	Dendroica palmarum	C					0	0	0	0	0	0	0	0	0	3	3	2	1	1	0	0	0
Warbler, Pine	Dendroica pinus	R					0	0	0	0	0	0	0	0	0	0	0	0	1	3	0	0	0
Warbler, Prothonotary	Protonotaria citrea	C					0	0	0	0	0	0	0	2	0	3	3	2	3	0	0	0	0
Warbler, Tennessee	Vermivora peregrina	C					0	0	0	0	0	0	0	3	0	2	2	1	2	3	0	0	0
Warbler, Wilson's	Wilsonia pusilla	O					0	0	0	0	0	0	0	0	0	3	3	2	1	0	0	0	0
Warbler, Worm-eating	Helmitheros vermivorous	R					0	0	0	0	0	0	0	0	0	0	0	2	3	2	0	0	0
Warbler, Yellow	Dendroica petechia	U					0	0	0	0	0	0	0	1	1	3	3	2	1	1	1	2	0
Warbler, Yellow-rumped	Dendroica coronata	A					1	1	1	1	1	1	1	1	0	1	1	1	1	3	0	0	0
Warbler, Yellow-throated	Dendroica dominica	O					0	0	0	0	0	0	0	0	0	2	2	3	3	3	0	0	0
Waterthrush, Louisiana	Seiurus motacilla	O					0	0	0	0	0	0	0	0	0	3	3	1	2	3	0	0	0
Waterthrush, Northern	Seiurus noveboracensis	C					0	0	0	0	0	0	0	1	0	3	3	1	0	0	0	0	0
Yellowthroat, Common	Geothlypis trichas	C					0	0	0	0	0	0	0	2	1	3	3	2	2	2	3	0	0

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Birds

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Woodpeckers																							
Flicker, Northern	Colaptes auratus	C					0	0	0	0	0	0	0	0	0	2	2	3	3	3	2	2	0
Sapsucker, Yellow-bellied	Sphyrapicus varius	U					0	0	0	0	0	0	0	0	0	1	2	3	3	3	1	0	0
Woodpecker, Downy	Picoides pubescens	C					0	0	0	0	0	0	0	0	0	3	3	3	3	3	1	2	0
Woodpecker, Hairy	Picoides villosus	U					0	0	0	0	0	0	0	0	0	3	3	3	3	3	1	2	0
Woodpecker, Pileated	Dryocopus pileatus	U					0	0	0	0	0	0	0	0	0	0	1	3	3	3	0	0	0
Woodpecker, Red-bellied	Melaneres carolinus	C					0	0	0	0	0	0	0	1	0	3	3	3	3	3	1	1	0
Woodpecker, Red-headed	Melaneres erythrocephalus	A					0	0	0	0	0	0	0	0	0	1	2	3	3	3	2	1	0
Wrens																							
Wren, Bewick's	Thryomanes bewickii	X			E		0	0	0	0	0	0	0	0	0	1	2	3	3	3	3	2	0
Wren, Carolina	Thryothorus ludovicianus	U					0	0	0	0	0	0	0	0	0	0	2	3	3	3	3	2	0
Wren, House	Troglodytes aedon	A					0	0	0	0	0	0	0	0	0	1	2	2	3	3	3	3	0
Wren, Marsh	Cistothrous palustris	U					0	0	0	3	3	3	3	3	0	2	1	0	0	0	0	0	0
Wren, Sedge	Cistothorus platensis	O					0	0	0	2	2	3	3	3	1	2	1	0	0	0	0	0	0
Wren, Winter	Troglodytes troglodytes	U					0	0	0	0	0	0	0	0	0	2	2	2	2	3	0	0	0

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Fish

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Bass Family																						
Bass, Striped	Morone saxatilis					3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bass, White	Morone chrysops					3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Bass, Yellow	Morone mississippiensis					3	2	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Bowfin Family																						
Bowfin	Amia calva					2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Catfish Family																						
Bullhead, Black	Ameiurus melas					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Bullhead, Brown	Ameiurus nebulosus					1	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Bullhead, Yellow	Ameiurus natalis					3	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Catfish, Blue	Ictalurus furcatus					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Catfish, Channel	Ictalurus punctatus					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Catfish, Flathead	Pylodictis olivaris					3	2	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Madtom, Freckled	Noturus nocturnus		E			3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Madtom, Tadpole	Noturus gyrinus					3	3	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Stonecat	Noturus flavus					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Cod Family																						
Burbot	Lota lota		T			3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Perch, Pirate	Aphredoderus sayanus					2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Drums																						
Drum, Freshwater	Aplodinotus grunniens					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Eels																						
Eel, American	Arguilla rostrata					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Gar																						
Gar, Longnose	Lepisosteus osseus					2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Gar, Shortnose	Lepisosteus platostomus					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0

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Gar (Cont.)																						
Gar, Spotted	Lepisosteus oculatus					1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Herring Family																						
Herring, Skipjack	Alosa chrysochloris					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Shad, Gizzard	Dorosoma cepedianum					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Shad, Threadfin	Dorosoma petenense					3	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Killifish Family																						
Topminnow, Blackstripe	Fundulus notatus					1	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Topminnow, Starhead	Fundulus dispar					1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Lampreys																						
Lamprey, Chestnut	Ichthyomyzon castaneus		T			3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Lamprey, Silver	Ichtyomyzon unicuspis					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Minnows																						
Carp, Bighead	Hypophthalmichthys nobilis					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Carp, Common	Cyprinus carpio					3	2	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Carp, Grass	Ctenopharyngodon idella					3	3	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Chub, Creek	Semotilus atromaculatus					1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chub, Flathead	Platygobio gracilis				E	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chub, Sicklefin	Macrhybopsis meeki			E		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chub, Silver	Macrhybopsis storeriana					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Chub, Speckled	Macrhybopsis aestivalis					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chub, Sturgeon	Macrhybopsis gelida			E		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dace, Southern Redbelly	Phoxinus erythrogaster					1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Goldfish	Carassius auratus					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Bluntnose	Pimephales notatus					3	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Bullhead	Pimephales vigilax					3	3	3	1	3	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Fathead	Pimephales promelas					2	2	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0

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Minnows (Cont.)																						
Minnow, Mississippi Silvery	Hybognathus nuchalis					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Plains	Hybognathus placitus					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Pugnose	Opsopoeodus emiliae					1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Suckermouth	Phenacobius mirabilis					1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Minnow, Western Silvery	Hybognathus argyritis					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Emerald	Notropis atherinoides					3	3	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Ghost	Notropis buchanani					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Golden	Notemigonus crysoleucas					1	2	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Mimic	Notropis volucellus					3	1	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Pallid	Notropis amnis					1	3	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Red	Cyprinella lutrensis					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, River	Notropis blennius					3	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Sand	Notropis stramineus					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Silverband	Notropis shumardi					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Spotfin	Cyprinella spiloptera					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Spottail	Notropis hudsonius					3	2	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Shiner, Weed	Notropis texanus		E	E		1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Mooneye Family																						
Goldeye	Hiodon alosoides					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Mooneye	Hiodon tergisus					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Mosquitofish																						
Mosquitofish, Western	Gambusia affinis					1	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Mudminnows																						
Mudminnow, Central	Umbra limi				E	1	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Paddlefish																						
Paddlefish	Polyodon spathula					3	1	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0

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Perch Family																						
Darter, Bluntnose	Etheostoma chlorosomum		E			1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Darter, Crystal	Ammocrypta asperella				E	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Darter, Iowa	Etheostoma exile			E		1	3	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Darter, Johnny	Etheostoma nigrum					3	1	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Darter, Mud	Etheostoma asprigene					1	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Darter, River	Percina shumardi					3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Darter, Slenderhead	Percina phoxocephala					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Darter, Western Sand	Ammocrypta clara			T		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Logperch	Percina caprodes					3	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Perch, Yellow	Perca flavescens					3	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Sauger	Stizostedion canadense					3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Walleye	Stizostedion vitreum					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Pike Family																						
Muskellunge	Esox masquinongy					3	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Pickeral, Grass	Esox americanus vermiculatus		T			2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Pike, Northern	Esox lucius					2	3	3	2	3	0	0	0	0	0	0	0	0	0	0	0	0
Silversides																						
Silverside, Brook	Labidesthes sicculus					2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Silverside, Inland	Menidia beryllina					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sturgeons																						
Sturgeon, Lake	Acipenser fulvescens		E	E	E	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sturgeon, Pallid	Scaphirhynchus albus	E	E	E	E	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sturgeon, Shovelnose	Scaphirhynchus platorynchus					3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Sticklebacks																						
Stickleback, Brook	Culaea inconstans					1	3	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0

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Fish

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Suckers																						
Buffalo, Bigmouth	Ictiobus cyprinellus					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Buffalo, Black	Ictiobus niger					3	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Buffalo, Smallmouth	Ictiobus bubalus					3	1	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Carpsucker, Highfin	Carpiodes velifer					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Carpsucker, River	Carpiodes carpio					3	3	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Quillback	Carpiodes cyprinus					2	3	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Redhorse, Golden	Moxostoma erythrurum					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Redhorse, Shorthead	Moxostoma macrolepidotum					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Redhorse, Silver	Moxostoma anisurum			T		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sucker, Blue	Cycleptus elongatus					3	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Sucker, Spotted	Minytrema melanops					3	3	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Sucker, White	Catostomus commersoni					3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sunfish Family																						
Bass, Largemouth	Micropterus salmoides					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Bass, Rock	Ambliplites rupestris					2	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Bass, Smallmouth	Micropterus dolomieu					3	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Bluegill	Lepomis macrochirus					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Crappie, Black	Pomoxis nigromaculatus					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Crappie, White	Pomoxis annularis					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Pumpkinseed	Lepomis gibbosus					3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Sunfish, Green	Lepomis cyanellus					3	2	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Sunfish, Orange-spotted	Lepomis humilis					2	3	2	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Warmouth	Lepomis gulosus					2	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0
Trout-perch																						
Trout-perch	Percopsis omiscomaycus					3	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0

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Invertebrates

Guild	Fed. (T or E)	IA (T or E)	IL (T or E)	MO (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Lotic Erosional Macroinvertebrates					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lotic Erosional Freshwater Mussels					3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lotic Depositional Macroinvertebrates					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lotic Depositional Freshwater Mussels					3	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Lentic Limnetic Macroinvertebrates					3	3	3	3	3	2	2	1	0	0	0	0	0	0	0	0	0
Lentic Littoral Macroinvertebrates					1	3	3	3	3	3	3	1	0	0	0	0	0	0	0	0	0
Lentic Profundal Macroinvertebrates					3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Lotic Erosional Macroinvertebrates - Invertebrate species that cling to structures such as snages, riprap and wing dams. Some are adapted to the shifting sands at the bottom of the channel. Examples: caddis flies (Hydropsychidae); chironomid species (Chironomidae; Polypedilum convictum, Rheotanytarsus sp.); mayflies and stoneflies (Heptageniidae, Heptageniidae); and Zebra Mussels.

Lotic Erosional Freshwater Mussels - Mussels found in swift flowing channel habitats, with cobble, gravel, or sand/gravel substrates with high dissolved oxygen. Examples: Unionidae family - deer toe, pink heelsplitter, spike, sandshells, and papershells

Lotic Depositional Macroinvertebrates - Invertebrates found in the soft substrates of low current velocity channel habitats. Examples: A variety of worms (Annelida), midges (Diptera; Chironomidae) burrowing mayflies (Ephemeridae), and fingernail clams (sphaeriidae).

Lotic Depositional Freshwater Mussels - Mussels that are found in moderate flow channel habitats, with sand-clay or silt-clay substrates. Examples: threeridge, washboard, and muckets.

Lentic Limnetic Macroinvertebrates - Invertebrates that float or swim in the water column. Examples: pelagic zooplankton, the phantom midge (Chaoborus sp.).

Lentic Littoral Macroinvertebrates - Invertebrates found among the vegetation in shallow backwaters and channel border habitats. Examples: very small zooplankton; large predaceous beetles; caenid mayflies (Ephemeroptera); case building caddisflies (Trichopetra); scuds (amphipods); chironomids; beetles; dragonflies and damselflies (Odonata); and true bugs.

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Mammals

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perinnial	SFE* Annuals	SFE* Perennials	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Bats																						
Bat, Big Brown	Eptescius fuscus					1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	3	1
Bat, Gray	Myotis grisescens	E		E	E	1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	3	1
Bat, Hoary	Lasiurus cinerus					0	0	0	0	0	0	0	0	0	2	2	2	3	3	1	1	0
Bat, Indiana	Myotis sodalis	E	E	E	E	1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	3	1
Bat, Northern Myotis	Myotis septentrionalis					1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	3	1
Bat, Little Brown	Myotis lucifugus					1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	3	1
Bat, Red	Lasiurus borealis					0	0	0	0	0	1	1	1	1	2	2	2	3	3	1	1	0
Bat, Silver-haired	Lasionycteris noctivagans					1	1	1	0	0	0	0	0	0	1	1	1	3	3	0	3	0
Pipistrel, Eastern	Pipistrellus subflavus					1	1	1	1	1	1	1	1	1	1	1	1	3	3	1	1	1
Carnivores																						
Badger	Taxida taxus					0	0	0	0	0	0	0	1	3	0	0	0	0	1	3	0	0
Bobcat	Lynx rufus		E			0	0	0	0	0	0	0	1	1	1	1	1	2	3	1	0	0
Coyote	Canis latrans					0	0	0	0	0	1	1	2	2	1	2	2	2	2	3	2	0
Fox, Gray	Urocyon cineroargenteus					0	0	0	0	0	0	0	1	1	1	2	2	3	3	1	0	0
Fox, Red	Vulpes vulpes					0	0	0	0	0	0	0	1	1	1	0	0	2	3	3	1	0
Mink	Mustela vison					1	1	1	1	1	1	1	0	0	2	2	2	3	0	0	0	0
Otter, River	Lontra canadensis		T	T		3	3	3	3	3	1	1	0	0	1	0	0	0	0	0	0	1
Raccoon	Procyon lotor					0	0	0	1	1	2	2	2	2	2	2	2	3	3	2	2	0
Skunk, Spotted	Spilogale putorius		T		E	0	0	0	0	0	0	0	1	1	2	2	2	2	1	2	0	0
Skunk, Striped	Mephitis mephitis					0	0	0	0	0	0	0	0	2	0	0	0	1	3	3	1	0
Weasel, Least	Mustela nivalis					0	1	1	3	3	3	3	3	3	1	1	1	1	1	0	0	0
Weasel, Long-tailed	Mustela frenata					0	0	0	0	1	1	1	2	3	2	2	2	2	2	2	0	0
Weasel, Short-tailed	Mustela ermina					0	0	0	0	0	0	0	0	1	1	1	1	3	3	1	0	0
Hooved Animals																						
Deer, White-tailed	Odocoileus virginianus					0	0	0	1	1	3	3	3	3	2	1	2	3	3	3	1	0
Insectivores																						
Mole, Eastern	Scalopus aquaticus					0	0	0	0	0	0	0	1	3	0	0	0	1	3	3	1	0

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Mammals

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annuals	SFE* Perennials	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Insectivores (Cont.)																						
Shrew, Least	Cryptotis parva		T			0	0	0	0	0	0	0	2	3	0	0	0	0	0	2	0	0
Shrew, Masked	Sorex cinereus					0	0	0	0	0	1	1	1	0	2	2	2	3	1	0	0	0
Shrew, Short-tailed	Blarina brevicauda					0	0	0	0	0	0	0	1	3	1	0	0	0	0	2	0	0
Marsupials																						
Opossum, Virginia	Didelphis marsupialis					0	0	0	0	0	0	0	1	1	1	1	1	2	3	2	1	0
Rabbits (Lagomorphs)																						
Jackrabbit, White-tailed	Lepus townsendii					0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0	0
Rabbit, Eastern Cottontail	Sylvilagus floridanus					0	0	0	0	0	0	0	0	2	0	0	0	1	1	2	2	0
Rodents																						
Beaver	Castor canadensis					3	3	3	3	3	1	1	1	0	3	3	3	1	0	0	0	0
Chipmunk, Eastern	Tamias striatus					0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	2	0
Gopher, Plains Pocket	Geomys bursarius					0	0	0	0	0	0	0	1	3	0	0	0	1	3	3	2	0
Lemming, Southern Bog	Synaptomys cooperi					0	0	0	0	0	2	2	3	3	0	0	0	0	0	0	0	0
Mouse, Deer	Peromyscus maniculatus					0	0	0	0	0	0	0	3	3	0	0	0	0	0	3	3	0
Mouse, House	Mus musculus					0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0
Mouse, Meadow Jumping	Zapus hudsonius					0	0	0	0	0	1	1	3	3	0	0	0	0	0	0	0	0
Mouse, Western Harvest	Reithrodontomys megalotis					0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	0	0
Mouse, White-footed	Peromyscus leucopus					0	0	0	0	0	0	0	0	1	2	2	2	3	3	3	1	0
Muskrat	Ondatra zibethicus					1	2	2	3	3	3	3	0	0	2	0	0	0	0	0	0	0
Nutria	Myocastor coypus					1	2	2	3	3	1	1	0	0	0	0	0	0	0	0	0	0
Rat, Norway	Rattus norvegicus					0	0	0	0	0	0	0	0	0	0	0	0	1	0	3	3	0
Squirrel, Eastern Fox	Sciurus niger					0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	3	0
Squirrel, Eastern Gray	Sciurus carolinensus					0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	3	0
Squirrel, Franklin's Ground	Spermophilus franklinii					0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	2	0
Squirrel, Southern Flying	Glaucomys volans					0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	1	0
Squirrel, Thirteen-lined Ground	Spermophilus tridecemlineatus					0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	2	0

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Mammals

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Rodents (Cont.)																						
Vole, Meadow	Microtus pennsylvanicus					0	0	0	1	1	3	3	3	3	1	0	0	0	0	1	0	0
Vole, Pine	Microtus pinetorum					0	0	0	0	0	0	0	0	0	0	1	1	3	3	0	0	0
Vole, Prairie	Microtus ochrogastor					0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	0	0
Woodchuck	Marmota monax					0	0	0	0	0	0	0	1	2	1	0	0	0	0	1	2	0

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Reptiles

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Lizards																						
Lizard, Fence	Sceloporus undulatus					0	0	0	0	0	0	0	1	1	0	0	1	2	3	0	1	0
Lizard, Slender Glass	Ophisaurus attenuatus		E			0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0
Racerunner, Six-lined	Cnemidophorus sexlineatus					0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0
Skink, Broadhead	Eumeces laticeps					0	0	0	0	0	0	0	1	0	1	0	1	3	3	0	2	0
Skink, Coal	Eumeces anthracinus					0	0	0	0	0	0	0	1	1	1	0	1	3	3	1	2	0
Skink, Five-lined	Eumeces fasciatus					0	0	0	0	0	0	0	1	1	1	0	1	3	3	1	2	0
Skink, Ground	Scincella lateralis					0	0	0	0	0	0	0	1	1	1	0	1	3	3	1	2	0
Skink, Prairie	Eumeces septentrionalis					0	0	0	0	0	0	0	1	1	1	0	1	3	3	1	2	0
Snakes																						
Bullsnake	Pituophis melanoleucus					0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	0	0
Coachwhip, Eastern	Masticophis flagellum			E		0	0	0	0	0	0	0	1	3	0	0	0	1	1	2	1	0
Copperhead	Agkistrodon contortrix		E			0	0	0	0	0	0	0	1	1	0	0	0	3	3	1	1	0
Cottonmouth	Agkistrodon piscivorus					2	2	3	1	2	1	1	0	0	1	1	1	0	0	0	0	1
Kingsnake, Prairie	Lampropeltis calligaster					0	0	0	0	0	0	0	3	3	0	0	0	0	0	2	1	0
Kingsnake, Speckled	Lampropeltis getula		E			0	0	0	0	0	1	1	3	1	1	1	0	2	1	0	0	0
Massasauga	Sistrurus catenatus		E	E	E	0	0	0	0	0	0	1	3	3	0	0	0	0	0	0	0	0
Racer, Blue	Coluber constrictor					0	0	0	0	0	0	0	1	3	0	0	0	1	1	2	1	0
Rattlesnake, Timber	Crotalus horridus			T		0	0	0	0	0	0	0	1	0	0	0	1	3	3	0	0	0
Snake, Black Rat	Elaphe obsoleta					0	0	0	0	0	0	0	1	1	0	0	1	3	3	1	1	0
Snake, Broad-banded Water	Nerodia fasciata			E		2	2	2	1	3	1	2	1	0	1	1	1	1	0	1	1	1
Snake, Brown	Storeria dekayi					0	0	0	0	0	0	0	2	1	0	0	0	3	3	1	1	0
Snake, Diamondback Water	Nerodia rhombifer		T			2	2	2	1	1	1	1	0	0	1	1	1	0	0	0	0	0
Snake, Eastern Garter	Thamnophis sirtalis					0	0	1	1	1	2	2	3	1	1	1	1	2	1	2	1	1
Snake, Eastern Hognose	Heterodon platirhinos					0	0	0	0	0	0	1	3	1	0	0	1	3	2	1	1	0
Snake, Eastern Ribbon	Thamnophis sauritus			E		0	0	1	1	1	2	2	3	3	1	1	1	2	2	1	1	0
Snake, Flathead	Tantilla gracilis			T		0	0	0	0	0	0	0	1	3	0	0	0	1	1	2	1	0
Snake, Fox	Elaphe vulpina				E	0	0	0	0	0	0	0	3	3	0	0	0	0	0	2	1	0

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Reptiles

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Snakes (Cont.)																						
Snake, Graham's Crayfish	Regina grahamii					1	1	2	1	1	1	3	1	0	1	1	1	0	0	0	0	0
Snake, Great Plains Rat	Elaphe guttata			T		0	0	0	0	0	0	0	3	3	0	0	0	0	0	2	1	0
Snake, Green Water	Nerodia cyclopion			T	E	2	2	2	1	1	1	1	0	0	1	1	1	0	0	0	0	0
Snake, Kirtland's	Clonophis kirtlandi			T		0	0	0	0	0	0	0	3	3	0	0	0	0	0	1	2	0
Snake, Lined	Tropidoclonion lineatum					0	0	0	0	0	0	0	3	3	0	0	0	0	0	1	2	0
Snake, Milk	Lampropeltis triangulum					0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0
Snake, Mud	Farancia abacura					2	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0
Snake, Northern Red-bellied	Storeria occipitomaculata					0	0	0	0	0	0	0	1	0	0	0	0	3	3	0	0	0
Snake, Northern Water	Nerodia sipedon					2	2	2	1	3	1	2	1	0	1	1	1	1	0	1	1	1
Snake, Plains Garter	Thamnophis radix					0	0	0	0	0	0	0	3	3	0	0	0	0	0	1	2	0
Snake, Plains Hognose	Heterodon nasicus					0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	0	0
Snake, Ringneck	Diadophis punctatus					0	0	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0
Snake, Rough Green	Opheodrys aestivus					0	0	0	0	0	0	1	2	0	2	2	2	0	0	1	1	0
Snake, Smooth Earth	Virginia valeriae					0	0	0	0	0	0	0	2	1	0	0	0	2	3	0	0	0
Snake, Western Ribbon	Thamnophis proximus					0	0	1	1	1	1	1	2	3	1	1	1	1	1	1	0	0
Snake, Western Smooth Green	Opheodrys vernalis		T			0	0	0	0	0	0	1	2	0	2	2	2	0	0	1	1	0
Snake, Western Worm	Carphophis amoenus		T			0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0
Snake, Yellowbelly Water	Nerodia erythrogaster		E			2	2	3	1	2	1	1	0	0	1	1	1	0	0	0	0	1
Turtles																						
Cooter, River	Pseudemys concinna			E		1	3	3	1	2	1	1	0	0	0	0	0	1	1	2	2	1
Stinkpot	Sternotherus odoratus		T			1	2	2	1	2	1	1	0	0	1	0	0	1	0	1	0	1
Turtle, Alligator Snapping	Macroclemys temminckii			E		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Turtle, Blanding's	Emydoidea blandingii			T	E	0	1	2	1	1	1	1	3	1	0	0	0	0	0	0	0	0
Turtle, Chicken	Deirochelys reticularia				E	1	3	3	1	3	1	1	0	0	0	0	0	1	1	2	2	1
Turtle, Eastern Box	Terrapene carolina					0	0	0	0	1	0	1	3	1	1	0	0	3	3	1	1	0
Turtle, False Map	Graptemys pseudogeographica					2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Turtle, Map	Graptemys geographica					2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

* E=Endangered ; T=Threatened; SAB=Submersed Aquatic Bed;FLAB=Floating Leaved Aquatic Bed; SPE=Semi-Permanently Flooded Emergents; SFE=Seasonally Flooded Emergents; | Potential Species Occurrence: 0 = none; 1 = low; 2=moderate; 3=high

Reptiles

Common Name	Species (Scientific Name)	Federally (T or E)	Iowa (T or E)	Illinois (T or E)	Missouri (T or E)	Open Water	SAB*	FLAB*	SPE* Annual	SPE* Perennial	SFE* Annual	SFE* Perennial	Wet Meadow	Grassland	Scrub/Shrub	Salix Community	Populus Community	Wet Forest	Mesic Forest	Agriculture	Developed	Sand/Mud
Turtles (Cont.)																						
Turtle, Mississippi Mud	Kinosternum subrubrum					1	2	2	1	2	1	1	0	0	1	0	0	1	0	1	0	1
Turtle, Ornate Box	Terrapene ornata		T			0	0	0	0	0	0	0	1	3	0	0	0	0	0	1	0	0
Turtle, Painted	Chysemys picta					1	3	3	1	3	1	1	0	0	0	0	0	1	1	2	2	1
Slider, Red-eared	Trachemys scripta					1	3	3	1	2	1	1	0	0	0	0	0	1	1	2	2	1
Turtle, Smooth Softshell	Apalone mutica					3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Turtle, Snapping	Chelydra serpentina					1	2	2	1	2	1	1	1	0	1	1	1	1	0	2	1	1
Turtle, Spiny Softshell	Apalone spinifera					3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Turtle, Wood	Clemmys insculpta		E			0	1	2	1	1	1	1	3	0	0	0	0	2	0	0	0	0
Turtle, Yellow (Illinois) Mud	Kinosternon flavescens		E	E	E	0	0	1	2	1	1	0	3	2	0	0	0	0	0	1	0	1

* E=Endangered ; T=Threatened; SAB=Submersed Aquatic Bed;FLAB=Floating Leaved Aquatic Bed; SPE=Semi-Permanently Flooded Emergents; SFE=Seasonally Flooded Emergents; | Potential Species Occurrence: 0 = none; 1 = low; 2=moderate; 3=high

Appendix C: List of Abbreviations and Acronyms

Appendix C: List of Abbreviations and Acronyms

AEC – Area of Ecological Concern
ARPA – Archeological Resource Protection Act
ATV – All Terrain Vehicle
CAP – Contaminant Assessment Program
CCNWR - Clarence Cannon National Wildlife Refuge
CCP – Comprehensive Conservation Plan
CFR – Code of Federal Regulations
CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora
COE – Corps of Engineers
CRP – Conservation Reserve Program
DNR – Department of Natural Resources
DO – Dissolved Oxygen
EA – Environmental Assessment
EMP – Environmental Management Program
EMTC – Environmental Management Technical Center (administers LTRMP)
ESA – Endangered Species Act
EWRP – Emergency Wetland Reserve Program
FONSI – Finding Of No Significant Impact
FmHA – Farmer's Home Administration (now FSA)
FSA – Farm Service Agency
FTE – Full Time Equivalent
FWCA – Fish and Wildlife Coordination Act
GIS – Geographic Information System
GP – General Plan (lands)
HNA – Habitat Needs Assessment
HQ – Headquarters
HREP – Habitat Rehabilitation and Enhancement Project
IADNR – Iowa Department of Natural Resources
ILDNR – Illinois Department of Natural Resources
IPM – Integrated Pest Management
IRCP – Iowa River Corridor Project
LCCB – Louisa County Conservation Board
L/D – Lock and Dam
LE – Law Enforcement
LTRMP – Long Term Resource Monitoring Program
MICRA – Mississippi Interstate Cooperative Resource Association
MODOC – Missouri Department of Conservation
MMR – Middle Mississippi River (from UMR River Mile 0 to 200, at Alton, IL)
MMS – Maintenance Management System
MSU – Moist Soil Unit
NAWMP – North American Waterfowl Management Plan
NEPA – National Environmental Policy Act
NRCS – Natural Resources Conservation Service
NWR – National Wildlife Refuge
NWRS – National Wildlife Refuge System
PFW – Partners for Fish and Wildlife
PIF – Partners in Flight
RIFO – Rock Island Field Office of the U.S. Fish and Wildlife Service
RM – River Mile
RONS – Refuge Operating Needs System

ROS – Refuge Operations Specialist
SUP – Special Use Permit
UMR – Upper Mississippi River (mainstem river from the confluence with Ohio River at Cairo, IL, to St. Paul, MN)
UMRCC – Upper Mississippi River Conservation Committee
UMR – Upper Mississippi River (Mississippi River north of the Ohio River confluence)
UMRS – Upper Mississippi River System (UMR and navigable tributaries, including the Illinois River, but excluding the Missouri River)
USC – United States Code
USDA – United States Department of Agriculture
USEPA – United States Environmental Protection Agency
USFWS – United States Fish and Wildlife Service
USGS – United States Geological Survey
WMA – Wildlife Management Area
WRP – Wetland Reserve Program

Appendix D: Glossary

Appendix D: Glossary

Alternative — A set of objectives and strategies needed to achieve refuge goals and the desired future condition.

Biological Diversity — The variety of life forms and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur.

Compatible Use — A wildlife-dependent recreational use, or any other use on a refuge that will not materially interfere with or detract from the fulfillment of the mission of the Service or the purposes of the refuge.

Comprehensive Conservation Plan — A document that describes the desired future conditions of the refuge, and specifies management actions to achieve refuge goals and the mission of the National Wildlife Refuge System.

Ecosystem — A dynamic and interrelated complex of plant and animal communities and their associated non-living environment.

Ecosystem Approach — A strategy or plan to protect and restore the natural function, structure, and species composition of an ecosystem, recognizing that all components are interrelated.

Ecosystem Management — Management of an ecosystem that includes all ecological, social and economic components that make up the whole of the system.

Endangered Species — Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register.

Environmental Assessment — A systematic analysis to determine if proposed actions would result in a significant effect on the quality of the environment.

Extirpation — The local extinction of a species that is no longer found in a locality or country, but exists elsewhere in the world.

Goals — Descriptive statements of desired future conditions.

Interjurisdictional Fish — Fish that occur in waters under the jurisdiction of one or more states, for which there is an interstate fishery management plan or which migrates between the waters under the jurisdiction of two or more states bordering on the Great Lakes.

Issue — Any unsettled matter that requires a management decision. For example, a resource management problem, concern, a threat to natural resources, a conflict in uses, or in the presence of an undesirable resource condition.

National Wildlife Refuge System	All lands, waters, and interests therein administered by the U.S. Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish, wildlife and plant resources.
Objectives	Actions to be accomplished to achieve a desired outcome.
Offset Levee	A levee set back from the original alignment of an existing levee (typically 3 feet to 5 feet setback).
Preferred Alternative	The Service's selected alternative identified in the Draft Comprehensive Conservation Plan.
Scoping	A process for determining the scope of issues to be addressed by a comprehensive conservation plan and for identifying the significant issues. Involved in the scoping process are federal, state and local agencies; private organizations; and individuals.
Species	A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.
Strategies	A general approach or specific actions to achieve objectives.
Wildlife-dependent Recreational Use	A use of refuge that involves hunting, fishing, wildlife observation and photography, or environmental education and interpretation, as identified in the National Wildlife Refuge System Improvement Act of 1997.
Threatened Species	Those plant or animal species likely to become endangered species throughout all of or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the Federal Register.
Vegetation	Plants in general, or the sum total of the plant life in an area.
Vegetation Type	A category of land based on potential or existing dominant plan species of a particular area.
Watershed	The entire land area that collects and drains water into a stream or stream system.
Wetland	Areas such as lakes, marshes, and streams that are inundated by surface or ground water for a long enough period of time each year to support, and that do support under natural conditions, plants and animals that require saturated or seasonally saturated soils.
Wildlife Diversity	A measure of the number of wildlife species in an area and their relative abundance.

Appendix E: Cooperative Agreement

AMENDED
COOPERATIVE AGREEMENT
Between the
Department of the Army, Corps of Engineers
and the
Department of the Interior, U.S. Fish and Wildlife Service

This amendment made and entered into this __________ day of __________,)1, between the Department of the Army through the Corps of Engineers, hereinafter erred to as the Corps, and the Department of the Interior through the U.S. Fish and ldlife Service, hereinafter referred to as the Service, amends the Cooperative reement between the parties dated February 14, 1963;

WHEREAS the United States through the Corps, has acquired certain lands in for the improvement of navigation in the Upper Mississippi River to provide a 9-foot annel from the Missouri River to Minneapolis, and portions of the Illinois River, reinafter referred to as the Navigation Project, and

WHEREAS, pursuant to Section 3 of the Fish and Wildlife Coordination Act (48 at. 401 as amended by 60 Stat. 1080 and 72 Stat. 563; 16 U.S.C. 661 et seq.), lands all be made available to the Service, consistent with navigation as the primary rpose of the Project, for the conservation, maintenance, and management of fish and ldlife and its habitat. There have been General Plans formulated for the use of lands id waters of the Navigation Project for fish/wildlife conservation and management and e same have been approved by the Secretary of the Army, the Secretary of the terior, and the heads of the State agencies exercising administration over fish and ldlife resources within the States of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. ertain segments of the land subject to this Amended Agreement, as indicated in the eneral Plan, may be allocated to the States of Illinois, Iowa, Missouri, Minnesota, and isconsin for conservation management through subsequent agreements between the ervice and those states, and

WHEREAS the Corps cannot abrogate its stewardship role for the conservation, maintenance, and management of fish and wildlife and its associated habitats as required by subsequent legislation such as, but not limited to the National Environmental Policy Act, Comprehensive Environmental Response, Compensation and Liability Act, the Forest Cover Act, the Historic Preservation Act, and as directed by Agency policy, guidance and regulations for the Corps' stewardship role for the conservation, maintenance, and management of these natural resources, and

WHEREAS the Corps and the Service shall continue to foster and maintain partnerships through specific regional working groups for addressing Navigation project issues that impact the conservation, maintenance and management of fish/wildlife resources specific to the lands addressed by the Amended Agreement.

Now therefore, in accordance with the aforesaid Section 3 of the Fish and Wildlife Coordination Act and the aforesaid General Plans, the Corps and Service hereby amend the Cooperative Agreement of February 14, 1963.

The Corps pursuant to the language of the third paragraph of the first page of this amendment hereby makes available to the Service the land and water areas of the Navigation Project substantially as identified on the exhibits attached to the General Plans referred to above, and by reference made a part hereof, for the conservation, maintenance, and management of fish/wildlife resources thereof, and its habitat thereon, in connection with the national migratory bird management and other fish/wildlife species programs in accordance with said General Plans. The Service shall manage these lands consistent with the National Wildlife Refuge System. This Amendment to the Cooperative Agreement of February 14, 1963 shall be subject to the provisions and conditions of the said General Plans and to the following additional conditions:

Paragraph 1 of the Cooperative Agreement is amended to read:

1. The Corps reserves all rights in and to the lands above described, which are not herein specifically granted, including, but not limited to, the operation and maintenance of the Navigation Project for its primary purpose of navigation. The Corps agrees that in fulfilling this primary purpose and other stewardship roles, as required by law and defined within Corps policies and regulations, that operation and maintenance activities will be carried out in accordance with current approved documents such as Master Plans, Operational Management Plans and Channel Maintenance Plans, and any future agency directive or legal requirement specific to the continued operation and maintenance of the Navigation Project.

Paragraph 2 of the Cooperative Agreement is amended to read:

2. The use and occupation of the said premises shall be without cost or expense to the Corps, under the general supervision of the Division Engineer, U.S. Army Division, Mississippi Valley Division, Vicksburg, Mississippi, herein after referred to as the "Division Engineer," and subject also to such rules and regulations in the interest of navigation and flood control as the Corps may from time to time prescribe.

Paragraph 3 of the Cooperative Agreement is amended to read:

3. Any damage to the property above described which results as an incident to the exercise of the privileges herein granted, shall be promptly corrected by the Service to the satisfaction of the Division Engineer. The Service will post appropriate project boundary lines, while the Corps will provide survey data, to the extent that it is available, for this purpose. The Service shall also take appropriate action to prevent and resolve minor trespass or unauthorized use of said property. The Service shall immediately report instances of unauthorized land use or serious trespass to the appropriate Corps Project Office. The Corps and Service shall coordinate enforcement efforts or legal actions taken against those responsible.

Paragraph 4 of the Cooperative Agreement is amended to read:

4. The exercise of the privileges granted shall in no way interfere with navigation and shall be subject at all times, without approval of the Service, to the occupation and use by the public for specific and related Navigation Project purposes and by the Corps for navigation, flood control, and all other Navigation Project related purposes, including, but not limited to, change in water surface elevations, dredging and placement of dredged material there from, and construction of training works, bank protection, and navigation aids.

Paragraph 5 of the Cooperative Agreement is deleted.

Paragraph 6 of the Cooperative Agreement is deleted.

Paragraph 7 of the Cooperative Agreement is amended to read:

7. It is understood that the privileges hereby granted do not preclude the necessity of obtaining from the Corps permits for work and structures in, under or over navigable waters as may be required under the provisions of Section 404 of the Clean Water Act of 1977, or Section 10 of the Rivers and Harbors Act of 1899, as amended,

Paragraph 8 of the Cooperative Agreement is amended to read:

8. No significant additions to or alterations of the premises, such as buildings, bridges, pump stations, roads, etc., shall be made by the Service without prior written consent of the appropriate District Engineer unless included in the Refuge Comprehensive Conservation Plan approved by the agencies.

Paragraph 9 of the Cooperative Agreement is amended to read:

9. In accordance with the aforesaid General Plans, authority to administer the lands and waters covered by this agreement may be delegated to the heads of the State agencies exercising administration over the wildlife resources of the aforesaid

States by cooperative agreements entered into pursuant to the provisions of Sections 1 and 4 of the said Fish and Wildlife Coordination Act. Copies of each such agreement, revisions, or amendments shall be furnished to the Division and District Engineers, respectively, promptly upon execution.

Paragraph 10 of the Cooperative Agreement is amended to read:

10. In development of lands described for public and agency use, as identified on the exhibits attached to the general plans referenced above, the Corps may in accordance with approved management plans and other appropriate agency documents, develop public use facilities or issue leases, licenses, and easements for the same purpose, issue special use licenses authorizing non-exclusive private uses which do not interfere with public use of areas involved, maintain and construct access roads, and issue outgrants. As appropriate, these actions will be coordinated with the Service and appropriate States to insure agency involvement and input into the Corps processes for implementation of these actions. During the development and implementation of these actions, the Service and States will be given the opportunity to provide recommendations regarding perceived impacts of the actions on the lands and waters defined by this amended agreement. The instruments provided for in this condition shall be issued only by the Corps and shall contain appropriate provisions prescribed by the Service regarding fish/wildlife management, including the continuing rights of the Service to post and patrol to enforce hunting regulations; however, the Service shall not have the right to deny access to or use of planned and developed, Corps-managed public use areas. Any planned developments for public and agency use shall address appropriate provisions prescribed by the Service regarding fish/wildlife management

Paragraph 11 of the Cooperative Agreement is deleted.

Paragraph 12 of the Cooperative Agreement is deleted.

Paragraph 13 of the Cooperative Agreement is amended to read:

13. The use of all agricultural treatments on lands covered hereunder shall be in compliance with laws, rules, and regulations administered by the Department of Agriculture and applicable to this type of land; provided that no part of the foregoing shall be construed as prohibiting the use of sharecrop agreements. All agricultural crops accruing to the Service or the pertinent States shall be used exclusively for wildlife, or wildlife habitat management purposes on the described lands, and for no other purpose. In the event that all the yield thus made available for wildlife or habitat management is not used for that purpose, the Service or the States shall, in order to avoid waste, sell for cash the remainder thereof in such a manner as to protect the public interest. Pursuant to Section 4 of the Act of Congress approved 22 December 1944, as amended (76 Stat. 1195; 16 U.S.C. 460d), all proceeds from the disposal of surplus production may be used by the Service or States in the development, conservation, management, and utilization of such lands; provided, that any balance of proceeds, not so utilized shall be paid to the Division Engineer at five-year intervals. In connection therewith, the Service shall establish and maintain adequate accounts and render statement of receipts and expenditures to the Division and District Engineers in an annual report that will be furnished not later than 30 calendar days prior to the scheduled annual meeting.

Paragraph 14 of the Cooperative Agreement is amended to read:

14. The Service shall administer and maintain the premises made available for wildlife conservation and management in accordance with current approved management plans for both agencies. An annual coordination meeting shall be organized by the Service each year on or before April 1 with each of the three Corps Districts (St. Louis, Rock Island, and St. Paul) and the states managing General Plan lands subject to this Agreement (Illinois, Iowa, and Missouri). The contents of the meeting shall include information specific to any changes and activities during the previous calendar year and information concerning proposed future projects. Issues covered shall include, but not be limited to, those management issues listed below:

(a) Boundary Management problems, including actions to address trespass or unauthorized uses;

(b) Report of completed construction and improvements, including project costs;

(c) Report of planned future construction, as approved in existing management plans;

(d) Report of conceived changes in management strategy;

(e) Cropland acreage utilized; amount of crop that was deemed excess to wildlife management needs including amount of receipts for sale of such crops; and amount and nature of expenditures derived from surplus crop funds;

(f) The Service liaison for the Agreement will consolidate a concise written annual report from the material presented at the meeting for submission to the Corps;

Paragraph 15 of the Cooperative Agreement is amended to read:

15. This agreement may be suspended or revoked at the discretion of the Department of the Army in case of national emergency or disaster declared by the President of the United States. In the event that problems are identified in compliance with any of the terms and conditions of this agreement, the following dispute resolution procedures will be followed:

(a) Service Refuge Managers and Corps District Operations Managers will meet to discuss the pertinent issue and seek resolution;

(b) In the event that informal efforts to resolve the issue at the field level are not successful, the appropriate Service Assistant Regional Director will meet with the appropriate District Engineer to seek written resolution; and

(c) Finally, if the matter remains unresolved, it will be referred to the Division Engineer whose decision will be final.

Paragraph 16 of the Cooperative Agreement is amended to read:

16. This agreement may be relinquished by the Service at any time by giving to the Division Engineer at least one-year's notice in writing.

Paragraph 17 of the Cooperative Agreement is amended to read:

17. If this agreement is relinquished or revoked as provided above, the Service shall vacate the premises, remove all property of the Service there from, and subject to the availability of funds, restore the premises to a condition satisfactory to the Division Engineer, ordinary wear and tear and damages beyond the control of the Service excepted, within such time as the Secretary of the Army may designate.

Paragraph 18 of the Cooperative Agreement is deleted.

The following paragraph is added to the Cooperative Agreement :

19. The Corps retains responsibility to provide protection of forest or other vegetative cover on reservoir areas, including navigation projects, in compliance with P.L. 86-717, the Forest Cover Act, and to establish and maintain other conservation measures on these areas. Corps management programs are to promote future resources and to increase the value of such areas for conservation, recreation, and other beneficial uses, provided that management is compatible with other uses of the project. The development of plans or other natural resource management activities will be coordinated with the Service for input and review of impacts of proposed actions on wildlife management use of the project. The Service will identify forest habitat goals and objectives in Refuge Comprehensive Conservation Plans to provide guidance to the Corps in this partnership effort. Revenue from sale of any timber in conjunction with the Forest Cover Act Program shall be credited to the Corps.

The following paragraph is added to the Cooperative Agreement :

20. The Corps retains the right to use and/or improve existing roads as a means of ingress and egress to and from the Mississippi River and to any areas that the Corps administers.

5 Jul 01
(Date)

By EDWIN J. ARNOLD, JR.
Brigadier General, U. S. Army
Division Engineer
Mississippi Valley Division

7/31/01
(Date)

Marvin E. Moriarty
Acting Regional Director

By ~~WILLIAM F. HARTWIG~~
Regional Director, Region 3
U.S. Fish And Wildlife Service
Department of the Interior

Appendix F: Compatibility Determinations

Appendix F: Compatibility Determinations

As part of the planning process, compatibility determinations were drafted and published in the Draft Comprehensive Conservation Plan, which was available for public review in July-September 2003. The approved compatibility determinations are available for review at Refuge headquarters. The following public uses were found compatible with Refuge Complex purposes:

- Education and Environmental Interpretation
- Farming and Haying
- Fishing
- Hunting
- Mushroom and Berry Picking
- Wildlife Observation, Photography and Auto Tours
- Research
- Trapping
- Commercial Fishing

Appendix G: Mailing List

Appendix G: Mailing List

The following is an initial list of elected officials, government offices, private organizations, and individuals who will receive notice of the availability of the draft CCP. We continue to add to this list.

Elected Officials

U.S. Rep. Jim Leach
U.S. Rep. Jerry Costello
U.S. Rep. Lane Evans
U.S. Rep. Leonard Boswell
U.S. Rep. Todd Akins
U.S. Rep. Dick Gephardt
U.S. Rep. JoAnn Emerson
U.S. Rep. Kenny Hulshof
U.S. Sen. Charles Grassley
U.S. Sen. Tom Harkin
U.S. Sen. Jim Talent
U.S. Sen. Peter Fitzgerald
U.S. Sen. Richard Durbin
U.S. Sen. Christopher Bond

Illinois Sen. Vince Demuzio

Gov. Rod Blagojevich

Local Government

City of Quincy, Illinois
City of Canton, Missouri
City of Grafton, Illinois
City of Keithsburg, Illinois
City of La Grange, Missouri
City of Muscatine, Iowa
City of Portage Des Sioux, Missouri
City of Wapello, Iowa
Village of Batchtown, Illinois
Village of Elsah, Illinois
Village of Hamburg, Illinois
Calhoun County, Illinois
Calhoun County Planning Committee, Illinois
Calhoun County Commissioners, Illinois
Cape Girardeau County Emergency, Missouri
Greene County Board, Illinois
Jersey County Board, Illinois
Louisa County Conservation Board, Iowa
Muscatine County Conservation Board, Iowa

Government Agencies

Columbia Environmental Research, Columbia, Missouri
Commander Marine Safety Office, St. Louis, Missouri
Corps of Engineers, Riverlands Area, West Alton, Missouri
Corps of Engineers, St. Louis District, St. Louis, Missouri
Department of the Army, Rock Island, Illinois
Environmental Protection Agency, Chicago, Illinois
Environmental Protection Agency, Kansas City, Kansas
Environmental Research Center, Columbia, Missouri
Group Upper Mississippi River, Keokuk, Iowa
Henderson County FSA, USDA Building, Monmouth, Illinois
Illinois River National Wildlife and Fish Refuge, Havana, Illinois
Lock and Dam 21, Quincy, Illinois
Louisa County FSA, Wapello, Iowa
Louisa County NRCS, Wapello, Iowa
LTRMP Mississippi River, Alton, Iowa
LTRMP Mississippi River, Jackson, Missouri
Mercer County NRCS, Aledo, Illinois
Natural Resource Conservation Service, Jackson, Missouri
Natural Resource Conservation Service, Hardin, Illinois
Natural Resource Conservation Service, Des Moines, Iowa
Natural Resource Conservation Service, Columbia, Missouri
Natural Resource Management, Pleasant Valley, Iowa
Natural Resource Conservation Service, Quincy, Illinois
Natural Resource Conservation Service, Champaign, Illinois
Natural Resource Conservation Service, Waterloo, Illinois
Natural Resource Conservation Service, Madison, Wisconsin
NRCS District Conservationist, Murphysboro, Illinois
Riverlands Area, Clarksville, Missouri
Shawnee National Forest, Murphysboro, Illinois
Henderson County NRCS, Stronghurst, Illinois
Wapello Post Office, Wapello, Iowa
U.S. Army Corps of Engineers, St. Louis, Missouri
U.S. Army Corps of Engineers, Vicksburg, Mississippi
U.S. Army Corps of Engineers, Muscatine, Iowa
U.S. Fish and Wildlife Service, Winona, Minnesota
U.S. Fish and Wildlife Service, Marion, Illinois
U.S. Fish and Wildlife Service ES Office, Rock Island, Illinois
Upper Midwest Science Center, LaCrosse, Wisconsin
USDA/NRCS, Carrollton, Illinois
USDA/NRCS, Jerseyville, Illinois
USDA/NRCS, Hardin, Illinois
Bellevue Research Station, Bellevue, Iowa
District 11 Illinois State Police
Illinois Department of Natural Resources, Carrollton, Illinois
Illinois Department of Natural Resources, Pittsfield, Illinois
Illinois Department of Natural Resources, Aledo, Illinois
Illinois Department of Natural Resources, Sterling, Illinois
Illinois Department of Natural Resources, Greenville, Illinois
Illinois Department of Natural Resources, Sparta, Illinois
Illinois Department of Natural Resources, Springield, Illinois
Illinois Department of Natural Resources, Cambridge, Illinois
Illinois Department of Natural Resources, Alton, Illinois

Illinois Department of Natural Resources, Grafton
Institute of Hydraulic Research, Iowa City, Iowa
Iowa Department of Natural Resources, Des Moines, Iowa
Iowa Department of Natural Resources, Bellevue, Iowa
Iowa Department of Natural Resources, Wapello, Iowa
Iowa State University, Extension Service, Ames, Iowa
Mississippi River Corridor Study, Hannibal, Missouri
Mississippi River Parkway Commission, Edwardsville, Illlinois
Missouri Department of Conservation, Elsberry, Missouri
Missouri Department of conservation, Hannibal, Missouri
Missouri Department of Conservation, Jefferson City, Missouri
Missouri Department of Conservation, Kirksville, Missouri
Missouri Department of Conservation, Kirkwood, Missouri
Missouri Department of Conservation, Poplar Bluff, Missouri
Pere Marquette State Park, Grafton, Illinois
Shawnee Resource Conservation, Marion, Illinois
Southern Illinois University, Edwardsville, Illinois
State Extension Services, University of Missouri, Columbia, Missouri
University of Illinois, State Extension Office, Urbana, Illinois

Organizations

Bassmasters
Ducks Unlimited
Friends of the Upper Mississippi River
Golden Eagle Wildlife Preserve
Great Rivers Chapter, Illinois Audubon Society
Greater Alton Twin Rivers Convention and Visitors Bureau
Green Strategies
Illinois EcoWatch
Illinois Rivers Project
Illinois Wildlife Foundation
Illinois-Indian Sea Grant College
Iowa Bass Chapter Federation
Iowa Natural Heritage Foundation
Iowa Raptor Foundation
Iowa Wildlife Federation, Inc.
Izaak Walton League, Davenport Chapter
Izaak Walton League of America, Inc.
Illinois Federation of Outdoor Resources
Louisa County Izaak Walton League
MARC 2000
Migratory Waterfowl Hunters, Inc.
Mississippi Interstate Cooperative
Mississippi River Basin Alliance
Missouri Chapter American Fisheries
Missouri Conservation Foundation
Missouri State Chapter
Missouri Wildlife Society
Muscatine County Ducks Unlimited
National Audubon Society
National Wildlife Foundation
The Nature Conservancy

Nature Institute
Northeast Midwest Institute
Partners for Wetlands
Piasa Palisades Chapter
Pike County Tourism Bureau
Principia College
Resource Studies Center
Sierra Club
Sierra Club, Kaskaskia Group
Sny Island Levee Drainage District
Southwestern Illinois Resource
St. Louis Ducks Unlimited
St. Louis Audubon Society
American Fisheries Society
American Fisheries Society, Illinois Chapter
Audubon Council of Missouri
Clean Water Fund
Conservation Federation of Missouri
Conservation Fund
Illinois Audubon Society
Illinois Bass Chapter Federation
Illinois Chapter Federation
Illinois Environmental Council
Illinois Natural Heritage Foundation
Iowa Audubon Council
Iowa Environmental Council
Izaak Walton League of America
Missouri Audubon Council
Missouri Bass Chapter Federation
Missouri Prairie Foundation
National Waterways Conference
National Wildlife Refuge Association
Natural Resources Council
Quad Cities Audubon Society
Sierra Club
Two Rivers RC&D
Wildlife Society, Iowa Chapter
Wildlife Society, Missouri Chapter
Treehouse Wildlife Center
Upper Mississippi River Campaign
Upper Mississippi River Conservation
Webster Groves nature Study Society
Wildlife Management Institute

Appendix H: Environmental Assessment

FINDING OF NO SIGNIFICANT IMPACT

Mark Twain Complex of Refuge Comprehensive Conservation Plan and Environmental Assessment

For the reasons briefly presented below and based on an evaluation of the information contained in the supporting references enumerated below, I have determined that adoption and implementation of the Comprehensive Conservation Plan (CCP) covering the Mark Twain Complex of national wildlife refuges (Port Louisa, Great Rivers, Clarence Cannon, Two Rivers, and Middle Mississippi River National Wildlife Refuges) is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. An Environmental Impact Statement will, accordingly, not be prepared.

Reasons:

- Threatened or endangered species occurring or possibly occurring in the affected area will not be negatively impacted and will generally benefit under the CCP implementation
- The CCP provides a clear statement of direction for future management of the Complex.
- The CCP gives refuge neighbors, visitors and the general public an understanding of the Service's management actions on and around Complex refuges.
- The CCP ensures that Complex management actions and programs are consistent with the mandates of the National Wildlife Refuge System.
- The CCP ensures that Complex management is consistent with federal, state and county plans.
- The CCP provides a basis for the development of sound budget requests reflecting Complex refuges' operation, maintenance, and capital improvement needs.
- All issues raised were addressed.

Supporting References:

1. Mark Twain National Wildlife Refuge Final Comprehensive Conservation Plan and Environmental Assessment
2. Statement of Compliance Checklist
3. Environmental Action Statement
4. Intra-Service Section 7 Biological Evaluation Form
5. Realty Feasibility Report

Robyn Thorson

Regional Director, FWS, Region 3

Date: JUL 27 2004

U.S. Fish and Wildlife Service
Department of the Interior

Environmental Assessment
for
Implementation of the Comprehensive Conservation Plan
for Management Direction
Mark Twain National Wildlife Refuge Complex

Abstract

The U.S. Fish and Wildlife Service is proposing to implement a Comprehensive Conservation Plan (CCP) for the Mark Twain National Wildlife Refuge Complex, consisting of various Refuges in Iowa, Missouri, and Illinois. This Environmental Assessment (EA) considers the biological, environmental, and socioeconomic effects that implementing the CCP (the preferred alternative is the proposed action) and three other alternatives would have on the most notable issues and concerns identified during the planning process. The purpose of the proposed action is to establish the management direction for the Refuges for the next 15 years. This management action will be achieved by implementing a detailed set of goals, objectives, and strategies described in a CCP.

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Chapter 1: Purpose and Need for the Proposed Action

1.1 Purpose and Need for Action

1.1.1 Purpose

The U.S. Fish and Wildlife Service is proposing to prepare and implement a Comprehensive Conservation Plan (CCP) for the Mark Twain National Wildlife Refuge Complex (Complex); the Complex, headquartered in Quincy, Illinois, includes five refuges with several divisions in Iowa, Missouri, and Illinois (Figure 1).

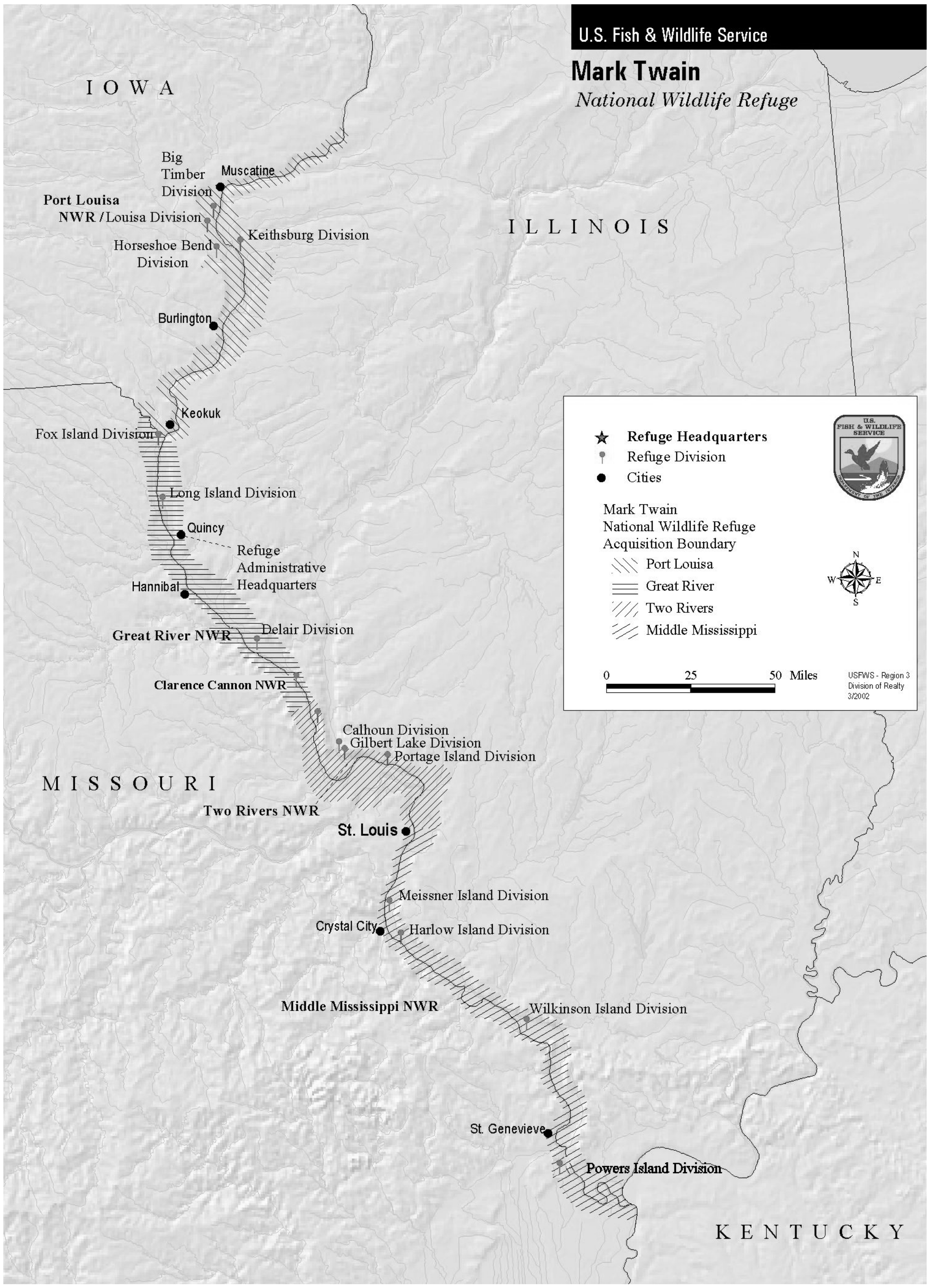
The purpose of the proposed action is to establish the management direction of the Complex for the next 15 years. The action is needed because adequate, long-term management direction does not exist for the refuge. Management is now guided by several general policies and short-term plans. Future management direction will be defined in a detailed set of goals, objectives, and strategies described in the CCP.

An additional purpose for preparing this Environmental Assessment is to analyze and adopt a separate step-down Fire Management Plan for the Complex.

Refuge Purpose Statements are primary to the management of each refuge within the System. The Purpose Statement is derived from the legislative authority used to acquire specific refuge lands and is, along with Refuge System goals, the basis on which primary management activities are determined. Additionally, these statements are the foundation from which "compatibility" uses of refuges are determined through a defined "compatibility process." Purpose Statements for Mark Twain Refuge Complex:

> "... for use as an inviolate sanctuary, or for any other management purpose, for migratory birds...", 16 U.S.C. § 715d (Migratory Bird Conservation Act)
>
> "... shall be administered by [Secretary of the Interior] directly or in accordance with cooperative agreements.... and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon,...", 16 U.S.C. § 664 (Fish and Wildlife Coordination Act)
>
> "... suitable for- (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species...", 16 U.S.C. § 460k-1 (Refuge Recreation Act)
>
> ".... the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions...", 16 U.S.C § 3901(b) 100 Stat. 3583 (Emergency Wetlands Resources Act of 1986)
>
> "....for conservation purposes", (1985 Food Security Act in conjunction with the transfer of Farm Service Agency, formerly Farmers Home Administration, property)

Figure 1: Map of the Mark Twain NWR Complex



The action is also needed to assess existing management issues, opportunities and alternatives, and then determine the best course for managing the natural resources in each refuge of the Complex. Further, this action will satisfy the legislative mandate of the National Wildlife Refuge System Improvement Act of 1997 which requires the preparation of a CCP for all National Wildlife Refuges.

This Environmental Assessment (EA) was prepared using guidelines of the National Environmental Policy Act of 1969. The Act requires us to examine the effects of proposed actions on the natural and human environment. This EA describes four alternatives for future Complex management, the environmental consequences of each alternative, and our preferred management direction. Each alternative has a reasonable mix of fish and wildlife habitat prescriptions and wildlife-dependent recreational opportunities. Selection of the identified preferred alternative was based on its environmental consequences and ability to achieve the Complex's purpose.

1.1.2 Need for Action

A Comprehensive Conservation Plan is needed to address current management issues and propose a plan of action that the Service and its partners can use to achieve the vision for the Refuge Complex. The CCP ultimately derived from this EA will set the management direction for the Complex for the next 15 years. This EA will present four management alternatives for the future of the Complex. The preferred alternative will be selected based on its ability to meet identified goals. These goals may also be considered as the primary need for action. They reflect Service trust responsibilities and priorities based upon species needs, environmental conditions and Service policy. Goals for the Complex were developed by the planning team and encompass all aspects of Complex management including public use, habitat management and maintenance operations. Each of the four management alternatives described in this EA will be able to at least minimally achieve these goals.

The goals for the Mark Twain Complex of refuges include:

1. *Wetlands and Aquatic Habitat:* Restore, enhance, and manage complex wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.
2. *Forest Habitat:* Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.
3. *Other Terrestrial Habitats:* Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl and neotropical migrants.
4. *Sedimentation and Water Quality:* Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.
5. *Floodplain Management:* Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.
6. *Public Use and Education:* Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts by developing and improving complex programs and facilities, and partnering with others to increase awareness of the Mark Twain National Wildlife Refuge (NWR) Complex, the Mississippi River, and the National Wildlife Refuge System.
7. *Monitoring:* Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of Complex management programs and to provide information for adaptive management strategies.

1.2 Decision Framework

This Environmental Assessment is an important step in the Service's formal decision-making process. In compliance with the National Environmental Policy Act, the Regional Director of the Great Lakes/Big Rivers Region will consider the information presented in this document to select a preferred management alternative.

The Regional Director will determine whether the preferred alternative is a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. If it is determined not to be a major Federal action, a Finding of No Significant Impact, (FONSI) will be issued. A FONSI means that the preferred alternative is selected and can be implemented in accordance with other laws and regulations. A Decision of Significant Impact would indicate the need to conduct more detailed environmental analysis in an Environmental Impact Statement.

1.3 Background

1.3.1 The United States Fish and Wildlife Service

The United States Fish and Wildlife Service (Service) is the primary Federal agency responsible for conserving, protecting, and enhancing the Nation's fish and wildlife resources and their habitats for the continuing benefit of the American people. Some responsibilities are shared with Federal, state, tribal, and local entities, but the Service has specific responsibilities for "trust species" – endangered species, migratory birds, interjurisdictional fish, and certain marine mammals – as well as managing and protecting lands and waters administered by the Service.

The Service's mission is "Working with others to conserve, protect, enhance and, where appropriate restore fish, wildlife and plants and their habitats for the continuing benefit of the American people."

Service goals are:

Sustainability of fish and wildlife populations: Conserve, protect, restore and enhance fish, wildlife and plant populations entrusted to our care.

Habitat Conservation: A Network of Land and Waters: Cooperating with others, we will conserve an ecologically diverse network of lands and waters – of various ownerships – providing habitats for fish, wildlife and plant resources.

Public Use and Enjoyment: Provide opportunities to the public to enjoy, understand and participate in use and conservation of fish and wildlife resources.

Partnerships in Natural Resources: Support and strengthen partnerships with tribal, state and local governments and others in their efforts to conserve and enjoy fish, wildlife, plants and their habitats.

1.3.2 The National Wildlife Refuge System

The National Wildlife Refuge System (System) is an integral component of the Service with the mission of "administering a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The Service manages more than 500 national wildlife refuges covering more than 93 million acres that are specifically managed for fish and wildlife and their habitats. The majority of these lands, almost 83 percent of the land in the Refuge System is found in the 16 refuges in Alaska, with the remaining acres spread across the remaining 49 states and several territories. More than 88 per cent of the acreage in the System was withdrawn from the Public Domain. The remainder has been acquired through purchase, from other Federal agencies, as gifts, or through easement/lease agreements.

Goals of the National Wildlife Refuge System are to:

Fulfill our statutory duty to achieve refuge purposes and further the System mission.

- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- Conserve and restore, where appropriate, representative ecosystems of the United States, including ecological processes characteristic of those ecosystems.
- Foster understanding and instill appreciation of fish, wildlife, and plants, and their conservation, by providing the public with safe, high-quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

1.3.3 Mark Twain National Wildlife Refuge Complex

The Mark Twain National Wildlife Refuge was established in 1958 under the Fish and Wildlife Coordination Act (16 U.S.C. Subsection 664), which states that the refuge "...shall be administered by him [Secretary of Interior] directly or in accordance with cooperative agreements...and in accordance with such rules and regulations for the conservation, maintenance, and management of wildlife, resources thereof, and its habitat thereon..." In addition, Migratory Bird Conservation Act legislation (16 U.S.C. Subsection 714d,) confirms the refuge "for use as an inviolate sanctuary, or for any other management purpose, for migratory birds. [16 U.S.C. § 715d]" Finally, the Refuge Recreation Act (16 U.S.C. Subsection 460k-l) states the refuge's purpose as "...suitable for - (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species..."

In the 1930s, the U.S. Army Corps of Engineers (Corps) purchased thousands of acres of river floodplain in preparation for the Mississippi River nine foot navigation channel project. In 1945, management rights on much of these lands were transferred, under the "Flood Control Act" (Pub. 534, 78th Congress, approved 2/22/44) to the Service, subsequently becoming the Mark Twain National Wildlife Refuge. Today the Service owns approximately 17,000 acres purchased in fee title (excluding the Iowa River Corridor) and manages approximately 17,000 acres in General Plan lands owned in fee title by the Corps.

In June 2000, Mark Twain Refuge was divided into five separate National Wildlife Refuges – Port Louisa NWR, Middle Mississippi River, NWR, Two River NWR, Great River NWR and Clarence Cannon NWR. This change came about during the Refuge Comprehensive Conservation Plan process. The Refuge Complex is scattered along 342 miles of the Mississippi River floodplain and short distances up the Illinois and Iowa Rivers. The Refuge Complex administration office, located in Quincy, Illinois, has retained the Mark Twain name.

The Complex provides important resting and feeding areas for thousands of migrating ducks, geese, shorebirds, and songbirds using the Mississippi Flyway. Hundreds of wintering Bald Eagles gather on and near the Complex to feed on fish and other prey in open water areas. The Complex is also home to many resident wildlife species including turkeys, owls, woodpeckers, deer, raccoon, opossum, beaver, fish, frogs, turtles, and snakes.

1.3.4 Mark Twain Refuge Complex Vision Statement for Desired Future Condition

Each spring and fall for thousands of years, the Mississippi River (River) corridor has served as an important migration route for millions of ducks, geese, shorebirds, waterbirds, songbirds, hawks, eagles and gulls. This network of wetlands, forests, and wet prairies has also provided habitat for a variety of fish and resident wildlife species. The Upper Mississippi River (UMR) and its floodplain have been greatly altered for agriculture, urbanization, navigation and flood control. The quantity and quality of wildlife habitat on the river has declined. The future is one of expanding partnerships to achieve long-term sustainability of the natural resource and economic values of the river.

The River will provide a mosaic of open water, wetland, forest, and grassland habitats to sustain healthy populations of native wildlife. Cooperative working relationships between federal and state agencies, local communities, industry, and the public are crucial to achieving a balance between commercial navigation, recreation, and riverine habitat for wildlife and ultimately, human health. Research and monitoring data must be current, readily available, and applicable to land management decision-making needs. In the future, the Complex management programs on UMR will be a national model for partnerships and science-based wildlife management.

Managed lands, such as those within the Complex, have become critical toward the goal of sustainability on the UMR. A balanced program of habitat protection, enhancement, and restoration will consider overall riverine habitat needs and the best use of land on the pool, reach, and watershed levels. In the future, the Complex will provide high-quality habitat along the UMR for migratory birds and resident wildlife. Waterfowl sanctuary areas in the fall will be of adequate quality, size, and spacing to meet the needs of migratory bird populations. Management programs will be effectively monitored for success and adapted and modified as new scientific information becomes available.

Refuge management activities are conducted with public funds and thereby enhanced public benefits are produced. While wildlife management remains the paramount responsibility of the Service, compatible public use and enjoyment of those resources are an important product of the overall management program. The Complex will provide an array of environmental and wildlife education programs as well as other related activities for the public. Wildlife abundance and quality facilities will attract thousands of visitors annually for compatible wildlife-dependent recreational opportunities. The partnership with the Corps' Riverlands Project area, located near St. Louis, Missouri, will be a model program of off-refuge wildlife and habitat education and interpretation within an metropolitan area. Our vision for the future includes local communities recognizing and appreciating the value of water quality, habitat and wildlife components of the river corridor along with its utilitarian functions. The Service will be viewed as an effective partner in enhancing and protecting these historic values.

1.3.5 Area of Ecological Concern

If the planning approach on the Mississippi River is viewed as a watershed issue, the resulting "planning area" would include a good portion of the continent. While it is helpful to consider all the cause/effect actions within the watershed, such as farming practices and runoff impacting development, this macro scale view is clearly beyond the management capability of the Complex staff. A more manageable approach to defining an Area of Ecological Concern for planning purposes was to outline the 500-year floodplain between the Quad Cities and the confluence of the Ohio River. This area was further modified as appropriate to accommodate the practical limits of Service habitat concerns. For instance, highly developed areas are not considered to be likely locations for riverine habitat restoration. However, all land types and uses are being monitored within the 500-year floodplain as a measure of river status and trends compared to the natural resources available at various times in the past, and at present. The Habitat Needs Assessment (HNA), which was required by the 1999 Water Resources Development Act, and the Long Term Resource Monitoring (LTRM) program are COE-funded efforts to monitor river conditions. Each of these efforts focus on the river within the context of the historic 500-year floodplain.

The Complex contains some of the better wildlife habitat along the lower half of the Upper Mississippi River System (UMRS). While the entire river corridor is important, particularly to the health and recruitment of aquatic species, habitat values vary greatly from one river reach to the next. Reaches where the diversity, quantity and quality of habitat are the highest are considered core areas. The entire UMRS riverine habitat base has been in decline due to inherent hydrological and sedimentation problems. As an integral part of the system, the Complex needed an integrated approach to assess its relationship to the broader river values and to identify the best opportunities for reversing habitat declines both within and beyond Complex boundaries.
The Service proposes to assure long-term availability of habitat diversity in the AEC through the implementation of a set of goals, objectives and strategies for each refuge and division of the Complex. These goals, objectives and strategies are expected to benefit fish, migratory birds and other wildlife using the floodplain. Both consumptive and non-consumptive public use opportunities will also be enhanced. The management action proposed in this EA is expected to enhance the environmental quality of the AEC in the following ways:

- Implement management activities to benefit migratory birds and provide some inviolate sanctuary within the Complex;
- Conserve, maintain and manage wildlife resources and habitat;
- Reduce the degradation/decline of wetlands, forests, grasslands and other habitats due to flood events, human development, sedimentation and exotic species;
- Provide compatible fish and wildlife-dependent recreation opportunities;

- Reduce conflicts between recreational uses and biological resource quality; Increase public awareness, appreciation and understanding of the complex's contribution to the Area of Ecological Concern;
- Expand the habitat base through acquisition of highly restorable lands within the Area of Ecological Concern and,
- Provide an organizational framework to administer interagency cooperative agreements regarding Complex lands.

1.4 Scoping and Public Involvement

The Complex hosted six open house sessions August 25-27, November 17-18, and December 15, 1998, to inform the public of our planning process. These open houses were held at Wapello, Iowa, Keithsburg, Illinois, Alexandria and Annada, Missouri, and Ursa and Brussels, Illinois, respectively. Complex staff answered questions from visitors and provided maps, information on the National Wildlife Refuge System, and brochures. Constituents attending each open house were asked to express their concerns regarding refuge operations; issues were recorded and are on file at Complex headquarters. News releases were issued to local media prior to each open house. News and/or television media covered four of the open houses. In addition, meetings with the Corps of Engineers, the Iowa Department of Natural Resources, the Illinois Department of Natural Resources and the Missouri Department of Conservation officials assisted the staff in identifying most of the natural resource related issues.

The National Audubon Society (NAS) and Upper Mississippi River Conservation Commission (UMRCC) hosted twelve Habitat Needs Assessment public meetings in April and May 1999 to gather public input on current and future priorities for the river system. Mark Twain Complex staff participated in six (those held in the Area of Ecological Concern) of the meetings as an integrated part of our CCP public involvement. Staff consulted with the public, non-governmental organizations and personnel from other Federal and State agencies. Issues discussed below were compiled from written statements made by individuals attending the meetings.

Mailing lists were compiled of interested individuals, non-governmental organizations, State and Federal agencies, and elected officials, and from attendance sheets for each open house and public meeting. Comprehensive Conservation Plan updates were mailed in May 1999 and February 2000, to these parties. The updates informed our constituents of progress in our planning process, and requested any additional input they had to offer. The planning mailing list includes more than 500 contacts, including the media.

A diverse range of issues emerged during the scoping process with input from the general public, governmental agencies, and non-governmental organizations. The issues were consolidated into the categories listed below. Each category is included in the environmental effects matrix in Table 3 at the end of Chapter 4. Management goals, objectives and strategies of the Complex are also based on these categories.

1.4.1 Issues and Concern

Listed Species and Other Species of Interest – Issues in this category relate to protection and perpetuation of Federally listed threatened and endangered species as well as other Service trust species such as migratory birds and interjurisdictional fish. These issues will be addressed primarily through habitat and public use management activities.

Habitat Management – The Complex includes habitats of concern to managers such as wetlands and aquatic vegetation, floodplain forest and other terrestrial habitats (grasslands); managers must determine how management of these habitats could affect wildlife populations. Issues identified in this area focused on:

<u>Wetland and Aquatic Habitat</u>

- restoration of backwaters, side channels, and associated wetlands
- assure availability of habitat for waterfowl while providing for overall healthy wildlife populations, achieving habitat and species abundance
- enhance fishery resources

<u>Forest Habitat</u>

- forest management and restoration;
- assure availability of habitat for waterfowl and non-game migratory birds, providing for healthy wildlife populations, achieving habitat and species abundance

<u>Other Terrestrial Habitats</u>

- management of agricultural lands
- native grassland restoration

These issues relate to achieving a balance of varied habitats and land use to meet diverse species needs.

Sedimentation and Water Quality – Issues include:

- reduce siltation and sedimentation
- improve water quality; reduce contaminants

These issues relate to identification and reduction of the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.

Floodplain Management – This category would cover system-wide interagency issues concerning floodplain connectivity and habitat and water level management.

These issues relate to interagency partnerships and enhancement of floodplain functions, enhancement of habitat, and mimicking historical water level fluctuations throughout the river corridor.

Public use and Education – This category will address the following issues:

- recreational opportunities
- wildlife disturbance from recreational users
- hunting, fishing, and trapping opportunities
- balances between competing uses and users of the river.

These issues relate to allowing and providing wildlife-dependent recreation opportunities where appropriate, and improving the quality and safety of the recreational experience.

Monitoring – Issues in this category relate to the need to develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of Complex management programs, and to provide information for adaptive management strategies.

Coordination and Socioeconomic Issues – Some issues are common to all alternatives and include:

- land acquisition
- effects of land acquisition on the socio-economics of the area where land may be acquired
- interagency coordination
- the Corps' Environmental Management Program
- protection of cultural resources which the Service has legal mandates to protect and preserve.
- Complex operations and maintenance

These issues relate to changing Federal budgets and other factors that necessitate prioritizing projects that compete for funding and staffing.

1.5 Legal, Policy and Administrative Guidelines

1.5.1 Legal Mandates

Administration of refuges is ultimately guided by bills passed by the United States Congress and signed into law by the President of the United States. These statutes are considered to be the law of the land; so, too, are Executive Orders issued by the President. A list of pertinent statutes establishing legal parameters and policy direction to the National Wildlife Refuge System can be found in Appendix I of the draft CCP, "Guiding Laws and Orders."

Chapter 2: Alternatives Including the Preferred Alternative

This chapter describes four alternatives considered by the Mark Twain NWR Complex, including Alternative A, the proposed action.

2.1 Rationale for Alternative Designs

The United States Congress has assigned the management of the Mississippi River and its flood plain to the Corps. When Congress authorized river improvements to aid navigation, the Corps built a series of locks and dams, wing dams, and closing structures to constrict the channel and control its depth. The Corps was also given flood control responsibilities which led to the construction of levees to protect agricultural and municipal lands. These changes to the natural flow of the river have created a reliable 9-foot-deep navigation channel and have provided a level of protection from flooding. However, the navigation and flood control systems have altered the natural river hydrology and increased backwater sedimentation, resulting in long term deterioration of fish and wildlife habitat.

The narrowing of the floodplain, through developments for flood protection of agricultural and municipal lands, is a key element contributing to increasing flood frequencies and magnitudes. The record-setting 1993 Midwest flood accelerated the move toward a more balanced floodplain management approach. Some areas were so damaged by the '93 flood that there was uncertainty as to whether these lands could, or should, be restored to pre-flood conditions. National attention was focused on the need for an integrated approach to floodplain management; an approach that balances flood protection and economic development with the need to reduce flood damage, enhance fish and wildlife habitat, and reconnect the river to its floodplain. One proposal, for example, was a series of levees set back from the river's edge, still providing flood protection while opening more of the floodplain to the river's fluctuations. Although impractical on a system-wide scale, setback levees may be feasible in some parts of the AEC in the near term. Floodplain wildlife refuges like the Mark Twain Complex can have an effect similar to setback levees when their lands are allowed to remain open to flood pulses.

The lands that once constituted the floodplain are now in various ownerships including federal, state and private, with each owner having their own management objectives, which are often in conflict. Reconnecting the river with its former or natural floodplain in some places is desirable and refuge lands can contribute to that goal.

However, fish and wildlife habitat that is not protected from the river shows continued deterioration due to sediment influx and the artificial water level fluctuations required to maintain the 9-foot channel. While impoundment for navigation created a variety of backwater and side channel habitats, the dams and training structures also slowed off-channel river currents, increasing the retention of sediment. And, historically, floods occurred in the spring and fall, wetlands dried out in summer, and changes in water level were fairly gradual. Floodplain flora and fauna were adapted to this cycle. Now, however, many areas are permanently flooded and water fluctuations are more rapid and irregular, resulting in loss of aquatic vegetation necessary for high quality fish and wildlife habitat. Areas protected behind berms or levees can be managed to re-create the historical water level regime.

The challenge for natural resource managers is to find ways to address the sometimes conflicting goals of enhanced floodplain function and high quality fish and wildlife habitat, while at the same time not negatively affecting the navigation channel or municipal/agricultural flood control needs.

2.2 Description of Alternatives

The alternatives are compared and summarized by goal in Table 1 below. A more detailed comparison of alternatives by specific objectives and general strategies may be found in Table 2 at the end of this chapter.

Table 1: Comparison of Alternatives by Refuge Complex Goals

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
1. Wetlands and Aquatic Habitat: Restore, enhance, and manage complex wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.	Manage 5,200 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 300 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 3,000 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control; increased river connectivity over no action alternative	Manage 3,500 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 300 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 2,900 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control	Manage 2,100 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 900 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 4,000 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control; maximum river connectivity	Manage 8,100 acres of seasonal, semi-permanent, and permanent wetlands and impoundments to enhance & protect wetland veg.; manage 100 acres of isolated backwaters & ephemeral wetlands in unleveed areas with little water level control; manage 1,800 acres of contiguous backwater and side channel habitat in unleveed areas using little or no local water level control; less river connectivity than other alternatives

Table 1: Comparison of Alternatives by Refuge Complex Goals (Continued)

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
2. Forest Habitat: Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.	Maintain existing floodplain forest plus restore an additional 800 acres by 2011; passive & active management strategies to conserve & enhance woody species age & diversity on 2,500 acres of floodplain forest by 2015	Maintain existing floodplain forest; natural succession as the main tool to conserve & enhance woody species age & diversity on 1,000 acres of floodplain forest by 2015	Maintain existing floodplain forest plus restore an additional 3,000 acres by 2011; passive & active management strategies to conserve & enhance woody species age & diversity on 1,000 acres of floodplain forest by 2015	Maintain existing floodplain forest plus restore an additional 800 acres by 2011; passive & active management strategies to conserve & enhance woody species age & diversity on 3,500 acres of floodplain forest by 2015
3. Other Terrestrial Habitats: Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl and neotropical migrants.	Provide 3 areas greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain 500 acres of smaller patches of grassland habitat; provide 400 acres of smaller wet meadow areas; provide 450 acres of scrub-shrub habitat; plant 1,000 acres annually of seed & browse crops; plant 400 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type	Provide 2 areas greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain existing 350 acres of smaller patches of grassland habitat; provide 200 acres of smaller wet meadow areas; provide 450 acres of scrub-shrub habitat; plant 2,500 acres annually of seed & browse crops; plant 400 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type	Provide 1 area greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain 150 acres of smaller patches of grassland habitat; provide 150 acres of smaller wet meadow areas; provide 300 acres of scrub-shrub habitat; plant 500 acres annually of seed & browse crops; plant 200 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type	Provide 3 areas greater than 150 acres of contiguous native grassland/wet meadow by 2010; maintain 500 acres of smaller patches of grassland habitat; provide 560 acres of smaller wet meadow areas; provide 600 acres of scrub-shrub habitat; plant 1,000 acres annually of seed & browse crops; plant 700 acres annually into ag. crops; maintain 675 acres in open fields until they can be converted to another habitat type
4. Sedimentation and Water Quality: Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.	Continue current and develop new partnerships; reduce sedimentation and improve overall water quality on refuge lands by 2010	Continue current partnerships; reduce sedimentation and improve overall water quality on refuge lands by 2010	Same as Alternative A	Same as Alternative A

Table 1: Comparison of Alternatives by Refuge Complex Goals (Continued)

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
5. Floodplain Management: Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.	Conduct activities & promote partnerships and interagency coordination which encourages a balanced floodplain mgmt. program throughout the AEC; manage refuge lands for wildlife first, while considering UMR floodplain functions & contributing to improving those values	Same as Alternative A	Same as Alternative A	Same as Alternative A
6. Public Use and Education: Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts by developing and improving complex programs and facilities, and partnering with others to increase awareness of the Mark Twain NWR Complex, the Mississippi River, and the National Wildlife Refuge System.	Enhance visitor experiences involving wildlife observation & photography through addition of new facilities over current levels; enhance education & interpretive programs through expanded facilities& programs over current levels; improve fishing opportunity by improving access at 5 Divisions by 2010; improve quality and safety of hunting programs & increase opportunity	Provide opportunities for wildlife observation & photography at current levels; improve quality of existing education & interpretive programs. by improving existing facilities and programs; maintain existing fishing opportunities; maintain hunting programs	Same as Alternative A	Same as Alternative A

Table 1: Comparison of Alternatives by Refuge Complex Goals (Continued)

Goals	Alternative A (Expanded boundaries, increased river connectivity) (Preferred Alternative)	Alternative B (Current Program) (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
7. Monitoring: Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of Complex management programs and to provide information for adaptive management strategies.	Actively monitor habitat communities, wildlife use, public use and environmental education programs; work with partners to monitor systematic fish, wildlife, & habitat resources of the UMR floodplain & to gather data; develop & implement a record keeping & data analysis system, compatible with HNA	Monitor habitat communities, wildlife use, public use and environmental education programs as time & resources allow; work with partners to monitor systematic fish, wildlife, & habitat resources of the UMR floodplain & to gather data; as time & resources allow, develop & implement a record keeping & data analysis system, compatible with HNA	Same as Alternative A	Same as Alternative A

2.2.1 Alternative A: Expanded Boundaries, Increased River Connectivity (Preferred Alternative)

Restore Riverine Habitat for Migratory Birds and Indigenous Fish and Increase Floodplain Functions Such As Connectivity and Flood Water Storage Via Expanded Boundary and Adaptive Management Techniques (Preferred Alternative)

Broaden Refuge Complex opportunities both to expand river/floodplain connectivity and to manage for habitat diversity for fish and wildlife resources on the Upper Mississippi River System through land acquisition (up to 27,659 acres above current authorized boundaries) and use of adaptive management techniques within the 500-year floodplain of the Area of Ecological Concern.

2.2.1.1 Background on Land Preservation Component

Alternative A includes an expanded land preservation component that could include expansion of the Refuge boundaries. The total expansion acreage is 27,659 acres. While nearly 28,000 acres represents a notable effort, the total area identified is modest when it is considered within the context of a more than 1.3-million-acre Area of Ecological Concern, or planning area.

An initial concept of identifying up to 60,000 acres spread over 487 miles of the River to the Complex's potential acquisition boundary originated in the early 1990s, when the Service initiated efforts to examine a larger section of the Upper Mississippi River corridor. This evaluation included the "Middle Mississippi River" (local name for the lower 200 miles of the UMR) which had not been included in earlier efforts.

In response to the Great Flood of 1993, the Service prepared a Big Rivers Ascertainment Initiative that proposed strategies for evaluating lands to be acquired for the protection and restoration of sustainable representative habitats along the Illinois, Missouri and Mississippi rivers. There was also a smaller, more focused PPP prepared for four areas in the Middle Mississippi River in response to the flood. Congress funded the Complex for this land acquisition as part of a broader federal strategy to assist flood prone farm landowners and to restore some floodplain function. This effort was initially referred to as the Tanahkwe District of the refuge, but the unit was not staffed as a separate station at the time. No lands were purchased at Powers Island. In spite of a great deal of initial interest there, was eventually a very low percentage of landowners applied to enroll in the Wetland Reserve Program. Lands were purchased at Wilkinson Island, Harlow Island and Meissner Island. The Shawnee National Forest also acted to address the flood issue by purchasing some of the Wetland Reserve Program (WRP) easements on floodplain lands and has evaluated a proposal to extend their boundary westward to the river's edge between Grand Tower and Thebes. This effort has been called the Inahgeh addition to the forest. The American Land Conservancy has worked in partnership with the Shawnee National Forest since the start of the post flood project. The presence of this government/non-government joint endeavor on the Illinois side of this section of the Middle Mississippi River is the reason the CCP Area of Ecological Concern (AEC) was adjusted to exclude this section of the 500-year floodplain. However the Forest Service has not expressed an interest in the islands and side channel elements in this reach, so these parts of the river corridor have been included in the CCP expanded boundary proposal, as they represent important opportunity to contribute to refuge goals and will complement rather than overlap or compete with Shawnee National Forest efforts.

In 1997, final approval was obtained from the Washington Office to study the potential addition of 60,000 acres to the Mark Twain NWR Complex. Since the CCP planning effort was scheduled to begin soon, it was decided that the detailed evaluation of the expansion would be incorporated into the plan. Specific parcels were identified by evaluating those locations that best contribute to accomplishing the goals and objectives outlined in this plan. The land acquisition and subsequent implementation of habitat restoration efforts represent essential strategies to achieving plan goals and objectives on a systemic scale within the 1.3 million-acre AEC.

Considerations for selecting specific parcels and their priority in this expansion include:

- refuge purposes;
- the goals and objectives of this CCP;
- interagency input, such as the jointly prepared Middle Mississippi River Habitat Rehabilitation Initiative, and other habitat focus areas, such as the Pool Level Management effort in Pool 25;
- the sites' potential to restore riverine wetland and forest values;
- Levee District flood histories;
- the Habitat Needs Assessment (HNA) developed by the Corps, Service, USGS and five UMR states; and
- the opportunity to remove agriculture from the most flood prone and erodible areas.

Parcels contained in the expanded project will not only contribute to the goals of the CCP, but these lands will also assist with public policy matters addressed by other federal, state, and local agencies. Nutrient cycling on additional floodplain lands will contribute to the reduction of nitrogen flowing down the river and a subsequent reduction in Gulf

Hypoxia. By opening the width of the floodplain and increasing flood water storage, the potential damage to urban areas and other developed and protected lands is reduced. Also, some flood prone farm lands have been more expensive to the government through disaster relief payments in recent years than the fee value of the land to purchase. The increase of recreational opportunity is another positive in addition to the primary goal of restored habitat values. The identified lands all contribute to the habitat needs within the River corridor. They also complement broader federal government goals and responsibilities for fiscal management and good government practices beyond the Interior Department objectives.

Much of the land within the proposed boundary is located in the Middle Mississippi River reach of the UMR. Very little public ownership exists there and floods have been particularly hard on floodplain farmers in that portion of the river. Most of the lands there will be managed for forest and aquatic habitats. The forests will provide a contiguous corridor for nesting and migrating birds and aquatic habitats will be managed for the benefit of big river fish. Expansions of the flood zone will contribute to the floodplain management and water quality goals. An exact prediction of the habitat types that will result in any area can not be made until the areas have been acquired and various detailed options can be explored on-site. However, it is estimated that locations of the expansion above St. Louis will result in habitat types that are proportioned close to the distribution which now occurs in those refuges. Generally being; forest types 50 percent, wetland and aquatic types 30 percent, and other terrestrial types 20 percent. Since there will be an increased emphasis on connectivity rather than isolated wetlands in the Middle Mississippi River section, the proportions there are estimated to be 65 percent forest, 20 percent wetland, and 15 percent other terrestrial habitats.

The initial demarcation of the proposed boundary was accomplished using refuge Geographical Information System (GIS) data, which is used primarily for biological analysis. Evaluating locations that best contribute to accomplishing the goals and objectives outlined in this plan identified specific parcels. Prioritizing areas into four tiers further refined this process and identified approximately 56,000 acres for consideration. The top priority tier in this process contains 27,659 acres; Tier 2 contains 14,084 acres; Tier 3 contains 8,537 acres; and Tier 4 contains 5,393 acres. Following evaluations of these tiered options at the Regional and Washington Office levels, the Refuge was approved to advance the planning process at the Tier 1 level. This top priority level is split among four refuges in the following amounts: Port Louisa NWR, 6,681 acres; Great River NWR, 5,237 acres; Two Rivers NWR, 983 acres; Middle Mississippi River NWR, 14,758 acres.

During the 15-year planning period outlined in this plan it is not expected that the Complex will actually acquire an interest in all the lands included in the proposed boundary. The Land Acquisition Priority System (LAPS) was revised 3 years ago to include more objective factors for assessing resource values and ecological setting contributions. Even though the Complex has rated in the top five projects nationally in each year since the revision, it is recognized that under normal budget conditions acquiring 12,000 to 15,000 acres is a realistic estimate during the 15-year plan period. This also considers the likelihood of reduced acquisition costs due to partnering with USDA set aside programs as well as possible funding through Federal Emergency Management Agency flood relief programs. However it is still important to plan for a larger project area. The needed habitat for a sustainable system is estimate to be an additional 130,000 acres according to the HNA. Partner agencies, particularly the Corps of Engineers, have looked to the Fish and Wildlife Service to identify the highest priority lands for meeting sustainable system needs. The areas identified in the CCP boundary expansion proposal will also be used by those partners as specific resource information along the corridor in the event of another disaster mobilization. It is anticipated that other authorities, such as the Corps or FEMA, could be used to purchase lands in the event of another flood on the scale of 1993. Other opportunities are possible, such as purchase of lands by the Corps for Environmental Management Program projects. State NRCS offices can also assign Special Designation Areas along the river corridor to target Wetland Reserve Program easements. The proposed boundary will help delineate he highest priority areas for system scale resource attention.

In addition to the parcels detailed in plan maps, the Complex has also been coordinating on this issue with the Ameren/Union Electric power corporation. The company owns land in the pool 19 river area since their hydro-electric plant was built in Keokuk, Iowa, in 1913, which predated the 9-foot navigation channel project. Ameren/UE was in the process of realty research to identify and clear titles in their possession during this planning process. Some of this land is submerged and has a long history of resource value, particularly for fish and diving ducks. The lower pool is too large to include in the proposed boundary without a better resolution to the legal status of the area. However the company has expressed an interest in working with the refuge at the conclusion of its research. Long-term leases to the Complex, or the sale of small, key parcels that enable an open water restoration project “anchor point,” have been discussed as a possibility.

It is estimated that the cost to acquire 27,659 acres would be anywhere from $20 million to $28 million. Since acquisition would only be on a willing seller basis, it is likely that if this acquisition were to occur, it would be over a period of decades.

The estimate for long-term Operations and Maintenance funding needs to manage these lands is relatively low for two reasons. First, most of the land will simply be opened to the River and farming practices stopped. Subsequent forests and wetlands will develop naturally under those conditions. Posting will be required and additional law enforcement coverage may be needed to accommodate the additional public use on the expanded refuge areas. The second reason O&M costs will be lower than normal situations is the presence of partnerships in place on the River. Lands that contain a particularly high restoration value if some level of development is applied can be achieved through programs such as the Corps EMP, or other authority to improve environmental conditions on the river. In all instants, the “forces of the River” will be employed in attempts to mimic natural conditions and reduce O&M costs wherever possible.

Comprehensive conservation plans provide long-term guidance for management decisions and set forth goals, objectives, and strategies needed to accomplish refuge purposes and identify the Service’s best estimate of future needs. These plans detail program planning levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning and program prioritization purposes. The plans do not constitute a commitment for staffing increases, operational and maintenance increases, or funding for future land acquisition.

2.2.1.2 Alternative A, Expanded Boundaries, Increased River Connectivity (Preferred Alternative) Description

The current divisions of the Complex have varying amounts of water level control, flood control, and floodplain connectivity. Some divisions are completely open to the river and its flood pulses; others are partially protected by levees with spillways; and two divisions (Louisa and Delair) receive protection from major levees constructed by the Corps and private agricultural drainage districts, respectively, prior to Service acquisition.

Refuges in the Complex are managed using an integrated approach to floodplain management. When making floodplain management decisions within the AEC, each refuge manager considers a range of desirable options including:

- Connecting the river to its floodplain.
- Reducing backwater sedimentation.
- Managing water levels to re-create natural wet/dry cycles.
- Reducing agriculture and facilities in flood-prone areas.
- Promoting partnerships and interagency coordination to encourage a balanced floodplain management program throughout the AEC.

Under Alternative A, refuge staff will continue using this approach on lands within the Complex. All of these options cannot be applied to every Refuge and division. The lands would be managed to accomplish the previously stated Complex goals. Decisions on how to manage each unit are based on local and system-wide habitat needs, area elevation, geomorphology and landscape features, authorized purposes of the unit, political and social considerations, and funding limitations.

Considerations to this alternative include impacts flood waters will have on private land surrounding each refuge division. The Service cannot alter the drainage of water from private land, nor allow private land to be flooded by its management actions. Conversely, the Service has no obligation to implement extraordinary measures to protect adjacent property unless appropriate legal arrangements are made.

Allowing floodplain lands to reconnect with the River may involve opening any Service-acquired levees or drainage outlets that restrict free flow onto or through the acquired lands. When such alterations are considered, they will be coordinated with the Corps and made compatible with the operations of adjacent private land owners or levee/drainage districts, and done in accordance with National Environmental Policy Act (NEPA) guidelines.

The Complex staff has developed priorities for additional land acquisition within the AEC. One factor that was considered in selecting priority tracts is the potential to restore river connectivity. Complete connectivity provides fisheries access and flood water storage, but gives managers little or no ability to control water levels and often results in high rates of sedimentation.

Additional staffing and funding would be needed with implementation of Alternative A. Also under this alternative, additional public use opportunities would be created by acquiring additional floodplain lands, and enhanced on current divisions. New nature trails, observation platforms, information kiosks and boardwalks would offer educational opportunities to the public. Visitor centers, contact stations and exhibits would be constructed and/or enhanced to provide optimal outreach efforts. Additional hunting, fishing and non-consumptive wildlife uses would be implemented where biologically compatible. Monitoring would assess biological changes to the floodplain following land acquisition and implementing adaptive management techniques.

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.2 Alternative B: Current Program

Current Management Strategies and Acquisition Within Existing Boundaries (No Action)

Limit the Mark Twain NWR Complex land acquisition to currently approved boundaries. Current management strategies would continue.

Under Alternative B, the Complex would continue to operate under the same general framework with no changes made to programs outlined under Alternative A. Land acquisition would be limited to currently approved boundaries along the lower 200 miles of the UMR from a previous expansion approved following the Flood of 1993. Refuge staff would maintain best possible management in all programs on the current acreage, with no additional staff or funding. Program improvements would remain a high priority, but would only be accommodated as limited staffing, funding and time permits.

The Complex would continue to operate using the current management strategies but opportunities to enhance river/floodplain connectivity or habitat management ability would be minimal.

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.3 Alternative C: Existing Boundaries, Maximum River Connectivity

Increase River Connectivity Via Spillways, Levee Breaches, and Acquisition Within Existing Boundaries

Increase the river/floodplain connectivity by reducing effectiveness of existing protective levees, even at the cost of increased sedimentation and loss of water level management capability.

There are currently eight divisions open to all river fluctuations. That is, as river levels rise and fall, so does the water level within Big Timber, Horseshoe Bend, Fox Island, Long Island, Portage Islands, Harlow Island, Meissner Island and Wilkinson Island Divisions. Several divisions provide some protection from small river level fluctuations, but during flood events, become contiguous with the river (Keithsburg, Gilbert Lake, Batchtown Divisions, Clarence Cannon NWR). Swan Lake on the Calhoun Division maintains connectivity through its lower unit, while the middle unit is designed to annually overtop by flood waters. Two divisions, Delair and Louisa, are isolated from the Mississippi River by tall levees. The levee bordering Delair Division is a privately owned agricultural levee, and cannot be breached, while the levee bordering Louisa Division is Corps owned. The Louisa Division and associated Lake Odessa State Wildlife Area can be selectively open or closed to the river through large gates, providing water control capabilities and fish passage.

Implementation of Alternative C would allow the Mississippi River complete access to its floodplain on all Complex lands, except Delair Division. Where levees or berms currently exist, e.g., Louisa, Gilbert Lake, Keithsburg, etc., deep notches or spillways would be cut, to allow the river access to its floodplain. On the Clarence Cannon NWR, the existing spillway would be lowered to provide greater access to the river's water level fluctuations.

Alternative C would decrease habitat quality on refuge lands and waters due to increased sediment deposition and loss of ability to re-create the historical water level fluctuations critical to effective fish and wildlife habitat management in the floodplain.

Considerations to this alternative again include impacts flood waters would have on private land surrounding each refuge division. As stated under Alternative A, the Service cannot alter the drainage of water from private land, nor allow private land to be flooded by management actions. Conversely, the Service has no obligation to implement extraordinary measures to protect adjacent property unless appropriate legal arrangements are made.

It is anticipated that Service owned lands acquired under either Alternative A or C would be opened in some capacity, to river flows thereby providing flood storage that could have a cushioning affect on flood magnitudes. This mitigative effect would be mostly local and applicable only in small to moderate flood events. Acquisitions within levee districts may provide enhanced opportunities for habitat management

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.4 Alternative D: Existing Boundaries, Least River Connectivity:

Enhance Habitat Protection Via More Flood Protection, Less River Connectivity on Refuge Lands Within Existing Boundaries

Increase flood protection on existing lands and lands in order to increase effectiveness of habitat management practices on wetlands, grasslands, and bottomland forests, even at the cost of reduced river connectivity.

As previously mentioned, many divisions provide some level of levee protection from rising river waters. Under Alternative D, berms or levees would be built up to protect 9 divisions and Clarence Cannon NWR from the river's fluctuations. For instance, Gilbert Lake and Batchtown Divisions currently have spillways cut into their berms, allowing flood water to slowly fill the units. Alternative D would provide an opportunity to build these berms up, fill in the spillways, and prevent the river from accessing its backwaters, unless by excessive flooding. Enhanced habitat management in these units would be attained with this action.

Development of Alternative D on newly acquired lands would provide additional habitat management and public use opportunities; however river connectivity would be greatly diminished by exercising this alternative.

Additional information describing this alternative can be found in Tables 1 and 2.

2.2.5 Elements Common To All Alternatives

2.2.5.1 Fire

The following section addresses aspects of the Fire Management Plan recently prepared for the Complex. An additional purpose for preparing this Environmental Assessment is to analyze and adopt a separate step-down Fire Management Plan for the Complex. Implementation of the preferred alternative in the CCP will include the objectives and strategies of the Fire Management Plan.

2.2.5.1.1 Prescribed Fire

Prescribed fire is a habitat management tool that is used on the Refuge Complex regularly. Refuge Complex staff annually burn areas of the Refuge Complex to enhance habitat for upland game, waterfowl, and other species of interest. The periodic burning of grasslands, and sedge meadows reduces encroaching vegetation such as willow. It also encourages the growth of desirable species such as cord grass.

All prescribed burns are carried out by highly trained and qualified personnel who perform the operation under very precise plans. The Refuges in the Complex have approved fire management plans that describe in detail how prescribed burning will be conducted on the Complex. No burning takes place unless it meets the qualifications of the prescription for each unit. A prescription is a set of parameters that define the air temperature, fuel moisture, wind direction and velocity, soil moisture, relative humidity, and several other environmental factors under which a prescribed burn may be ignited. This insures that there is minimal chance the fire will escape the unit boundaries and that the fire will have the desired effect on the plant community.

Prescribed burns will occasionally be conducted within or near Refuge Complex development zones, sensitive resources, and boundary area to reduce the risk from wildfire damage. To the greatest extent possible, hazard reduction prescribed fires will only be used when they complement resource management objectives.

Combustion of fuels during prescribed fire operations may temporarily impact air quality, but the impacts are mitigated by small burn unit size, the direction of winds the burns are conducted with, and the distance from population centers. All efforts will be taken to assure that smoke does not impact smoke sensitive areas such as roads and local residences.

Burn frequency will vary from every 3 to 5 years or longer on established grassland, savanna, and wet meadow units dependent on management objectives, historic fire frequency, and funding. As part of the prescribed fire program, a literature search will be conducted to determine the effects of fire on various plant and animal species, and a monitoring program will be instituted to verify that objectives are being achieved.

Prescribed fires cannot and will not be ignited when the area is at an extreme fire danger level and/or the National Preparedness level is V, without the approval of the Regional Fire Management Coordinator. In addition, the Refuge Complex will not ignite prescribed fires when adjacent counties or the State in which the burn unit is located have instituted burning bans without the applicable State DNR concurrence.

Drought can have an effect on fire severity and control. One or more drought indicators (PDI - KBI) will be used to determine the degree of drought. These indicators can be accessed on the web at *http://www.boi.noaa.gov/fwxweb/ fwoutlook.htm*

Spot fires, slop-overs, and escapes can be an expected occurrence on any prescribed fire. They can be caused by any of a number of factors that can not always be accounted for in the planning process. A few minor occurrences of these events on a prescribed burn can usually be controlled by holding forces of the burn crew. If so, they do not constitute a wildfire. The burn boss is responsible for evaluating the frequency and severity of these events and taking mitigating measures such as slowing down or stopping the burn operation, ordering additional holding forces from within Refuge Complex Staff, or taking measures to extinguish the prescribed burn. Should an escape event exceed the ability of existing holding forces to control, and additional assistance become necessary in the form of DNR involvement, the event will be classified a wildfire and controlled accordingly. Once controlled by these forces the prescribed burning operation will be stopped for the burning period. A fire number will be obtained to implement wildfire funding to cover the cost of control, a wildfire report will be generated and a Wildland Fire Situation Analysis will be prepared.

Prescribed burns can be conducted at any time of year depending on resource objectives and prescription. However, the normal prescribed fire season begins approximately April 1, and ends by May 31, due to early bird nesting. Fall burning may begin again August 15, and end October 31.

Precautions will be taken to protect threatened and endangered species during prescribed burning. Nesting trees for Bald Eagles will be protected and burning will not be conducted at a time or in a way to negatively impact any nesting eagles. If any of the approximately 20 known disjunct populations of Decurrent False Aster are in or near a burn unit, precautions will be taken to avoid the plants.

Existing firebreaks will be used. They may undergo minor improvements such as graveling or rotovation (vegetation disruption). General policy dictates that any new firebreaks or below surface improvements to existing firebreaks will be approved by the Regional Historic Preservation Officer.

The Refuge Complex Biologists will be responsible for supervising the development of resource management objectives for individual units. The Refuge Complex staff will provide assistance in the selection of the appropriate management tool needed to meet objectives. Prescribed fire is just one of a combination of tools available. If needed, the Zone Fire Management Officer (Zone FMO) will be consulted for assistance in developing a prescription that will achieve the desired results.

Burn plans (The Fire Management Plan) are written that document the treatment objectives, the prescription, and the plan of action for carrying out the burn. Burn plans are written by or under the guidance of a qualified burn boss. The burn plan follows the format in the Services Fire Management Handbook or a format approved by the Regional Fire Management Coordinator and addresses all aspects as specified in the Service's Fire Management Handbook. Details regarding fire resources and procedures may be found in the individual fire plans for each refuge in the Complex. All burn plans are reviewed by the Refuge Complex Manager, Zone FMO, and approved by the individual Refuge Managers prior to implementation.

2.2.5.1.2 Fire Prevention and Detection

Although fire may have historically played a role in the development of habitats on the Refuge Complex, human ignited fires and natural ignitions burning without a prescription are likely to result in unwanted damage to cultural and/or natural resources. In order to prevent wildfire, an educational program will be utilized to reduce the threat of human caused fires. Ongoing monitoring will be conducted by Refuge Complex staff, visitors, and cooperators to detect fire ignitions. Actions taken to implement this include:

- Fire prevention will be discussed at safety meetings, prior to the fire season, and during periods of high fire danger. Periodic training of staff in regards to fire prevention will be conducted.
- During periods of extreme fire danger, warnings will be posted at visitor information stations.

- Public contacts will be made via press releases and verbal contacts during periods of extreme fire danger.
- A thorough investigation will be conducted of all fires suspected to have been illegally set. Upon completion of the investigation, appropriate action will be taken.
- The Refuge Complex relies on neighbors, visitors, cooperators, and staff to detect and report fires. In addition, the step-up plan provides for increased patrols by Refuge Complex personnel during periods of very high and extreme fire danger.
- All fires occurring within or adjacent to (within two miles) the individual Refuges will be reported to the respective Refuge headquarters. The person receiving the report will be responsible for implementing the Fire Dispatch Plan and assume duties of Fire Dispatcher until relieved or released.
- For local fires, the Fire Dispatcher will stay on duty until: (1) all Refuge resources return; (2) relieved by another dispatcher; or (3) advised by IC that he/she can leave. The Fire Dispatcher will not be required to stay on duty if the fire occurs outside Refuge radio coverage but the dispatcher must notify the applicable State Dispatcher that a Dispatcher is not on duty at the Refuge before leaving.
- The Fire Dispatcher will be responsible for coordinating the filling and delivery of any resource orders made by the Incident Commander (IC) for all operational and logistical needs, including engines, aircraft, tools, supplies, and meals. The IC will place all resource orders through the Dispatcher, and specify what is needed, when it is needed, and where it is needed. The Dispatcher will promptly determine if the resource orders can be filled or procured locally and notify the IC. If a resource order can not be filled locally, the Dispatcher will place the order with the Nicolet Interagency Fire Dispatcher in Woodruff, Wisconsin (715-358-6863). The Zone FMO for the Refuge Complex will generally be able to assist with ordering resources from outside the area.
- Requests for assistance by cooperators on fires not threatening an individual Refuge must be made to the Refuge Manager or designee. Only qualified and properly equipped resources meeting NWCG standards will be dispatched off of the Refuge.
- Firefighter and public safety always take precedence over property and resource protection during any fire management activity. Under moderate to severe fire danger index ratings, flaming fronts are capable of moving at fast speeds in all fuel models. In order to eliminate safety hazards to the public, all public access into the burn units will be closed the day of the burn. Fire crews will be briefed that should an individual who is not a member of the fire crew be observed in the prescribed burn unit, they will be immediately escorted out of the area. The fire crew will keep the fire scene clear of people except for Service firefighters and cooperating fire crews.

2.2.5.1.3 Fire Suppression

Service policy requires the Refuge Complex to utilize the Incident Command System (ICS) and firefighters meeting NWCG qualifications for fires occurring on Refuge Complex property. All suppression efforts will be directed towards safeguarding life while protecting the Refuge Complex's resources and property from harm. Mutual aid resources responding from Cooperating Agencies will not be required to meet NWCG standards, but must meet the standards of their Agency. Mutual aid resources will report to the Incident Commander (IC) in person or by radio and receive their duty assignment. Mutual aid forces will be first priority for release from the fire. If additional firefighters are needed, appropriate procedures will be used to acquire them.

All fires occurring on the Refuge Complex and staffed with Service employees will be supervised by a qualified IC. The IC will be responsible for all management aspects of the fire. If a qualified IC is not available, one will be ordered through the appropriate area office dispatch center. All resources will report to the IC (either in person or by radio) prior to deploying to the fire and upon arrival to the fire. The IC will be responsible for: (1) providing a size-up of the fire to dispatch as soon as possible; (2) determine the resources needed for the fire; and (3) advising dispatch of resource needs on the fire. The IC will receive general suppression strategy from the Fire Management Plan, but appropriate tactics used to suppress the fire will be up to the IC to implement. Minimum impact suppression tactics (MIST) will be used whenever possible.

Severity funding may be essential to provide adequate fire protection for the Refuge Complex during periods of drought, as defined by the Palmer Drought Index or other appropriate drought indicators. Severity funds may be used to hire additional firefighters, extend firefighter seasons, or to provide additional resources. The Service Fire Management Handbook provides guidelines for use of severity funding.

The incident commander (IC) on a wildland fire or the prescribed fire burn boss on a prescribed burn will be responsible for the completion of a DI-1202 Fire Report as well as Crew Time Reports for all personnel assigned to an incident and return these reports to the Assistant Manager. The IC or burn boss should include a list of all expenses and/or items lost on the fire and a list of personnel assignments on the DI-1202. The Zone FMO will enter all data into the FMIS computer database within 10 days after the fire is declared out. The Zone FMO will also inform the timekeeper of all time and premium pay to be charged to the fire and ensure expended supplies are replaced. In addition, the following provisions will apply:

- Utilize existing roads and trails, bodies of water, areas of sparse or non-continuous fuels as primary control lines, anchor points, escape routes, and safety zones.
- When appropriate, conduct backfiring operations from existing roads and natural barriers to halt the spread of fire.
- Use burnouts to stabilize and strengthen the primary control lines.
- Depending upon the situation, either direct or indirect attack methods may be employed. The use of backfire in combination with allowing the wildfire to burn to a road or natural firebreak would be least damaging to the environment. However direct attack by constructing control lines as close to the fire as possible may be the preferred method to establish quicker control.
- Retardants may be used on upland areas.
- Constructed fire line will be rehabilitated prior to departure from the fire or scheduled for rehabilitation by other non-fire personnel.
- The Incident Commander will choose the appropriate suppression strategy and technique. As a guide: On low intensity fires (generally flame lengths less than 4 feet) the primary suppression strategy will be direct attack with hand crews and engines. If conditions occur that sustain higher intensity fires (those with flame lengths greater than 4 feet) then indirect strategies which utilize back fires or burning out from natural and human-made fire barriers may be utilized. Those

barriers should be selected to safely suppress the fire, minimize resource degradation and damage and be cost effective.

- The use of earth moving equipment for suppression activities (dozers, graders, plows) on the Refuge Complex will not be permitted without the approval of the individual Refuge Manager or his/her designated representative in the event of their absence.
- All areas in which wildfires occur on the Refuge Complex or Refuge Complex administered lands will be evaluated prior to the aerial or ground application of foams and/or retardants. Only approved chemical foams and retardants will be used (or not used) in sensitive areas such as those with riparian vegetation.
- Hazard reduction prescribed fires may be used in fire adapted communities that have not had significant fire for more than twice the normal fire frequency for that community type.
- Utilization of heavy equipment during high intensity fires will be allowed only with the approval of the individual Refuge managers of the Complex.
- Wild fire use for resource benefit will not be utilized.
- Engines will remain on roads and trails to the fullest extent possible.
- Whenever it appears a fire will escape initial attack efforts, leave Service lands, or when fire complexity exceeds the capabilities of command or operations, the IC will take appropriate, proactive actions to ensure additional resources are ordered. The IC, through dispatch or other means, will notify the Complex FMO of the situation. With Zone FMO assistance the Refuge Manager at each Complex Refuge will complete a Wildland Fire Situation Analysis (WFSA) and Delegation of Authority.
- The IC will be responsible for mop-up and rehabilitation actions and standards on Refuge Complex fires. Refuge Complex fires will be monitored until declared out.
- Rehabilitation of suppression actions will take place prior to firefighters being released from the fire. Action to be taken include: 1) All trash will be removed; 2) Fire lines will be refilled and water bars added if needed; 3) Hazardous trees and snags cut and all stumps cut flush; and 4) Damage to improvements caused by suppression efforts will be repaired, and a rehabilitation plan completed if necessary. Service policy states that only damage to improvements caused by suppression efforts can be repaired with fire funds. Service funds cannot be used to repair damage caused by the fire itself (i.e. burnt fence lines). If re-seeding is necessary, it will be accomplished according to Service policy and regulations.

2.2.5.1.4 Listed Species and Other Species of Interest

Chapter 3 of the Mark Twain National Wildlife Refuge Complex Comprehensive Conservation Plan describes the current status of fish and wildlife in the area of interest to refuge staff in development of the plan (area of ecological concern – AEC). Prescribed burning will be conducted in a manner that avoids conflicts with listed species and other species of interest. Specifically, burning will not be carried out during nesting and fledging periods. Burn units will be thoroughly surveyed for potential Indiana bat maternal colonies or summer roost trees. Burn plans will reflect consideration of the seasonal requirements of forest-dependent endangered species.

Section 7 of the Endangered Species Act outlines a mechanism for ensuring that actions taken by federal agencies do not jeopardize the existence of any listed species. We conducted a "Section 7" review concurrent with the review of the draft CCP.

2.2.6 Elements Common to All Alternatives

2.2.6.1 Cultural Resources

Archeological studies and surveys will be performed, as necessary, to assure preservation from proposed actions on acquired lands. In the event an unidentified archeological site is discovered, the project by which it was discovered, will be stopped until the resources are adequately protected.

Cultural resources would be protected as mandated by law under all alternatives.

2.2.6.2 Environmental Justice

None of the proposed management alternatives disproportionately place an adverse environmental, economic, social, or health impacts on minority or low-income populations. Improvements in any refuge facilities or expanded land base near such population centers as St. Louis will likely benefit minority or low income populations in that they will make wildlife dependent recreational opportunities more readily available to them.

2.2.6.3 Climate Change Impacts

The actions proposed under any of the alternatives would preserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 1. Wetlands & Aquatic Habitat: Restore, enhance, and manage refuge wetland and aquatic areas to provide quality diverse habitat for waterfowl, shorebirds, big river fish, and other wetland-dependent species.			
Objective 1A: Provide a 6-year average of 2200* acres (2800* acres maximum) seasonal, 1,800 acres (2,350 acres maximum) semi-permanent, and 1,200 acres (1,580 acres maximum) of permanently flooded wetland vegetation types in refuge wetland impoundments for waterfowl, shorebirds, and other wetland-dependent wildlife species. Objective acres are 80 percent of maximum potential acres available due to effects of flooding and need to set back succession in some years. Strategies: Manage wetlands and impoundments to protect and enhance wetland vegetation; convert fields to wetlands; enhance existing wetlands with installation of wells; various methods to restore and/or enhance water control: install control structure in dike; partnership with adjacent landowner.	Objective 1A: Same as Alternative A except that it involves a six-year average of 1500 acres (1900 acres maximum) seasonal, 1100 acres (1400 acres maximum) semi-permanent, and 900 acres (1200 acres maximum) of permanently flooded wetland vegetation types. Objective acres are 79 percent of maximum acres available. Strategies: Continue management of existing wetlands and impoundments. Minimal improvements as staffing and funding allow.	Objective 1A: Same as Alternative A except that it involves a six-year average of 900 acres (1500 acres maximum) seasonal, 700 acres (1200 acres maximum) semi-permanent, and 500 acres (800 acres maximum) of permanently flooded wetland vegetation types. Objective acres are 60 percent of maximum acres available. Strategies: Same as Alternative A.	Objective 1A: Same as Alternative A except that it involves a six-year average of 3400 acres (4000 acres maximum) seasonal, 3000 acres (3500 acres maximum) semi-permanent, and 1700 acres (2000 acres maximum) of permanently flooded wetland vegetation types. Objective acres are 85 percent of maximum acres available. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 1B: Protect, enhance, and maintain a six-year average of 300 acres (385 acres maximum) of isolated backwaters and ephemeral wetlands, providing seasonal and semi-permanently flooded wetland vegetation types in unleveed areas of the refuge with little water level control for the benefit of migratory birds and other wetland-dependent species. Strategies: Manage isolated wetlands to protect and enhance vegetation; determine feasibility of fall pumping; evaluate fishery resources and methods of improving winter connectivity with the Iowa River; evaluate alternatives for improving backwater habitat.	Objective 1B: Same as Alternative A Strategies: Continue management of existing unleveed backwaters with minimal improvements as staffing and funding allow.	Objective 1B: Same as Alternative A except that it involves a six-year average of 900 acres (1100 acres max) Strategies: Same as Alternative A.	Objective 1B: Same as Alternative A except that it involves a six-year average of 100 acres (130 acres max) Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 1C: Protect, enhance, and maintain 3,000 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge for migratory birds and fish. Increase bathymetric diversity and wetland plant growth in these areas as feasible by 2015 where little or no local water level control exists. Strategies: Investigate costs, need and benefits of dredging at opening mouth of lakes; dredging to enhance deep water habitat and provide habitat for over-wintering fish; investigate feasibility of re-connecting side channel and main channel, Middle Miss.; enhance wetlands using potential techniques such as deepening, improving connectivity, and construction of partial closing structures and environmental pool management (Port Louisa).	Objective 1C: Same as Alternative A except that it involves protection, enhancement, and maintenance of 2900 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge. Strategy: Maintain backwater and channel habitat by improving connectivity as time and resources allow.	Objective 1C: Same as Alternative A except that it involves protection, enhancement, and maintenance of 4000 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge. Strategies: Same as Alternative A.	Objective 1C: Same as Alternative A except that it involves protection, enhancement, and maintenance of 1800 acres of contiguous backwater and side channel habitat in unleveed areas of the refuge. Strategies: Same as Alternative A

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 2. Forest Habitat: Conserve and enhance floodplain forest to meet the needs of migrating and nesting neotropical birds and other forest-dependent wildlife.			
Objective 2A: Conserve and enhance floodplain forest block size and spatial distribution along the river corridor through management of existing 18,000 acres and restoration of an additional 800 acres by 2011 for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife. Strategies: Maintain existing tracts of floodplain forest; develop a step-down plan to determine management needs; Rip rapping bank line to protect forest habitat from further loss; convert units to floodplain forest leaving many areas idle for succession; extend off-bank rock wall to protect shoreline and prevent loss of forest and promote island growth in some areas.	Objective 2A: Conserve and enhance exiting floodplain forest of 18,000 acres for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife. Strategies: Maintain existing tracts of floodplain forest; develop a step-down plan to determine management needs.	Objective 2A: Conserve and enhance floodplain forest block size and spatial distribution along the river corridor through management of existing 18,000 acres and conversion of an additional 3000 acres by 2011 for the benefit of nesting neotropical birds, feeding and resting birds during migration, and other forest-dependent wildlife. Strategies: Same as Alternative A.	Objective 2A: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 2B: Conserve and enhance structural (age and species) diversity on 2500 acres of refuge floodplain forests by 2015 for the benefit of neotropical migrants, raptors, bats, and cavity nesting birds. Strategies: Develop a forest management plan focusing on management actions needed for maintenance of healthy bottomland forest habitats, in cooperation with the Corps; plan might include: replanting flood-damaged areas; selective cutting; and/or prescribed fire. Maintain existing hard mast (mesic bottomland) component through thinning of mature hard mast trees, mowing, maintain pecan seed bank; plant hard mast trees and install two water control structures; large dead trees will be left in place for nesting bats and birds; deer hunting program will reduce browsing damage; cottonwood seedlings will grow to maturity to provide roosting sites for bald eagles; study of bird species composition and productivity in early successional forests to evaluate habitat type; work with navigation industry, public and COE to eliminate forest resource damage; plant portion used for HREP dredge material disposal, remainder allowed to convert by regeneration; agricultural fields to be planted with hard mast trees.	Objective 2B: Same as Alternative A except that it involves the conservation and enhancement of structural (age and species) diversity on 1000 acres of refuge floodplain forests by 2015. Strategies: Use natural succession as the primary means to develop structural diversity; large dead trees will be left in place for nesting bats and birds; deer hunting program will reduce browsing damage; work with navigation industry, public and COE to eliminate forest resource damage.	Objective 2B: Same as Alternative B. Strategies: Leave dead trees... Deer hunting program... Work with nav industry...	Objective 2B: Same as Alternative A except that it involves the conservation and enhancement of structural (age and species) diversity on 3500 acres of refuge floodplain forests by 2015. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 3. Other Terrestrial Habitats: Protect, enhance, and restore other terrestrial habitats to benefit grassland birds, waterfowl, and neotropical migrants.			
Objective 3A: Provide three large areas (>150 acres) of contiguous native grassland/wet meadow complexes on refuge divisions by 2010 to benefit migrating as well as declining nesting populations of grassland birds. Strategies: Plant native grassland and wet meadow species; prairie cordgrass planting; water level manipulation; burning; exotic plant control; mowing, prescribed fire, and possible grazing.	Objective 3A: Same as Alternative A except that it involves providing two large (>150 acres) areas of contiguous native grassland/wet meadow complexes by 2010. Strategies: Same as Alternative A.	Objective 3A: Same as Alternative A except that it involves providing one large (>150 acres) area of contiguous native grassland/wet meadow complexes by 2010. Strategies: Same as Alternative A.	Objective 3A: Same as Alternative A except that it involves providing three large (>150 acres) areas of contiguous native grassland/wet meadow Strategies: Same as Alternative A.
Objective 3B: Maintain 500 acres of smaller patches of grassland habitat where established for levee maintenance, cultural resource protection, or environmental education using techniques such as mowing, prescribed burning, and/or spraying of undesirable vegetation as needed (typically on a three to five year cycle). Strategies: Maintain small grasslands; native grasses established to protect cultural resources; mowing, prescribed fire, spraying of undesirable vegetation, potential seed bank, enhancement of water level control; establish cool season grasses.	Objective 3B: Same as Alternative A except that it involves the maintenance of 350 acres of smaller patches of grassland habitat. Strategies: Maintain existing small grassland patches, no new ones will be established.	Objective 3B: Same as Alternative A except that it involves the maintenance of 150 acres of smaller patches of grassland habitat. Strategies: Maintain existing small grasslands where still feasible after new levee breaches.	Objective 3B: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 3C: Provide a 6-year average of 400 acres (500 acres maximum) of smaller wet meadow areas for marsh and grassland birds and spring foraging waterfowl using a combination of water level manipulation, mowing, discing, and burning. Water level manipulations may occur annually; other techniques are typically necessary on a three to five year cycle. Most sites border existing wetland or grassland units. Strategies: Manage small wet meadow sites; use a combination of water level manipulations; enhancement of Boltonia decurrens; develop step-down plan with endangered species specialists; control encroaching willow by mowing, discing, burning.	Objective 3C: Same as Alternative A except it will provide a 6-year average of 200 acres (300 acres maximum) of smaller wet meadow areas. Strategies: Same as Alternative A.	Objective 3C: Provide a 6-year average of 100 acres (150 acres maximum) of smaller wet meadow areas for marsh and grassland birds and spring foraging waterfowl. A combination of water level manipulation, mowing, discing, and burning will be used when possible, but management actions will be limited by lack of water level control. Strategies: Same as Alternative A.	Objective 3C: Same as Alternative A except it will provide e a 6-year average of 560 acres (700 acres maximum) of smaller wet meadow areas. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 3D: Provide a six-year average of 450 acres of scrub/shrub habitat for waterfowl broods and neotropical migrants through a combination of water level manipulation, mowing, discing, and burning. Water level manipulation may occur annually; other techniques typically are necessary on a three to five year cycle. Most scrub/shrub sites occur naturally at the interface between wetland and forest, but may need management action to hold back succession. Strategies: Maintain existing scrub/shrub habitat; use a combination of water level manipulation, mowing, discing and burning; develop partnerships with adjacent landowners to enhance water control capabilities.	Objective 3D: Same as Alternative A. Strategies: Same as Alternative A.	Objective 3D: Provide a six-year average of 300 acres of scrub/shrub habitat for waterfowl broods and neotropical migrants. Most scrub/shrub sites occur naturally at the interface between wetland and forest. Little management will be possible to hold back succession. Strategies: Maintain existing scrub-shrub as feasible with little or no water level control.	Objective 3D: Same as Alternative A except it will provide a six-year average of 600 acres of scrub/shrub habitat. Strategies: Same as Alternative A.
Objective 3E: Plant seed and browse crops to provide a dependable supplement to natural food sources for waterfowl, and to provide needed open space resting areas. The amount and spacing of this refuge resource along the river corridor is based on historic concentration areas (bird use days) while considering surrounding conditions off-refuge including hunting pressures that may reduce utilization of habitats outside refuge sanctuary units. Approximately 1000 acres will be planted annually Complex-wide. Strategies: Plant seed and browse crops.	Objective 3E: Same as Alternative A except approximately 2500 acres will be planted annually. Strategies: Same as Alternative A.	Objective 3E: Same as Alternative A, but approximately 500 acres will be planted annually. Strategies: Same as Alternative A.	Objective 3E: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 3F: Utilize agriculture as a management tool, as necessary, to maintain high-quality wildlife habitat in refuge wetlands by periodically setting back succession or invasion of undesirable species. Approximately 400 acres will be planted annually. Where practical, manage this temporary land cover type in a manner that provides supplemental food value as a secondary benefit. Strategies: Plant annually; use cooperative farming program to set back succession.	Objective 3F: Same as Alternative A except approximately 400 acres will be planted annually. Strategies: Same as Alternative A.	Objective 3F: Same as Alternative A, but approximately 200 acres will be planted annually. Strategies: Same as Alternative A.	Objective 3F: Same as Alternative A except approximately 700 acres will be planted annually. Strategies: Same as Alternative A.
Objective 3G: Use farming techniques to maintain 675 acres of open fields until they can be converted to another planned habitat type, such as on newly acquired lands. Conversion will occur by 2012. Strategies: Reforestation through combination of natural regeneration and hard mast tree planting.	Objective 3G: Same as Alternative A. Strategies: Same as Alternative A.	Objective 3G: Same as Alternative A. Strategies: Same as Alternative A.	Objective 3G: Same as Alternative A. Strategies: Combination of reforestation and conversion to managed wetland.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 4. Sedimentation and Water Quality: Identify and reduce the impacts of sedimentation and other water quality factors, such as contaminants, on fish and wildlife resources.			
Objective 4A: Continue current and develop new partnerships with government agencies and private landowners to reduce the effects of erosion and contaminant runoff affecting fish and wildlife resources in the Upper Mississippi River watershed. Strategies: Partner with agencies and private landowners to encourage participation in various agricultural and habitat programs e.g., CRP, PFW, WRP, EWRP, FSA easements; partner with agencies to promote environmental pool management; provide technical and financial assistance for watershed improvement projects; train refuge personnel to assist with spill response efforts.	Objective 4A: Continue current partnerships with government agencies and private landowners to reduce the effects of erosion and contaminant runoff affecting fish and wildlife resources in the Upper Mississippi River watershed. Strategies: Partner with agencies and landowners as feasible with limited staff.	Objective 4A: Same as Alternative A. Strategies: Same as Alternative A.	Objective 4A: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 4B: Reduce sedimentation and improve overall water quality on refuge system lands by 2010 for the benefit of fish and wildlife populations. Strategies: Develop program to monitor water quality and sedimentation during flooding; conduct comprehensive contaminant survey of wetlands; dredge and construct closing structure to reduce sediment loading and provide deep water fisheries habitat; dredge side channel areas to improve water quality and over-wintering habitat for fish; Create "No Wake Zone" to reduce shoreline erosion and decrease turbidity; create a treatment wetland to reduce contaminant and nutrient loading; dredging to prevent low dissolved oxygen levels during draw downs; allow commercial fishing, by special use permits, to reduce exotic fish populations; special use permits, to reduce exotic fish populations; draw down Swan Lake to reduce effects of sedimentation; dredge deep holes to improve water quality for fish; Complete Contaminant Assessment Program reports; analyze ditch runoff; partner with COE and states to develop habitat restoration projects; evaluate tracts for potential to contribute to nutrient recycling and other water quality improvements; use integrated pest management techniques; ensure that Spill Prevention Control and Countermeasure Plan are available.	Objective 4B: Same as Alternative A. Strategies: Same as Alternative A.	Objective 4B: Same as Alternative A. Strategies: Same as Alternative A.	Objective 4B: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 5. Floodplain Management: Enhance floodplain functions and, where practicable, mimic historical water level fluctuations in the river corridor.			
Objective 5A: Conduct activities and promote partnerships and interagency coordination which encourage a balanced floodplain management program throughout the AEC. Strategies: Promote Environmental Pool Management and work to acquire additional lands to move pool control "hinge points"; develop habitat improvement plans for pooled and unpooled river reaches, partnering with COE, states, and private organizations; encourage private landowners to participate in CRP or WRP; participate in COE dredged material management program; enhance migration and spawning opportunities for fish species; reduce impacts of sedimentation through the location of river training structures.	Objective 5A: Same as Alternative A. Strategies: Same as Alternative A.	Objective 5A: Same as Alternative A. Strategies: Same as Alternative A.	Objective 5A: Same as Alternative A. Strategies: Same as Alternative A.
Objective 5B: Manage refuge lands for wildlife first, while considering UMR floodplain functions and contributing to improving those values. Strategies: Evaluate and monitor management activities on sedimentation, water quality, wetland vegetation, and fish passage; evaluate tracts for potential to contribute to nutrient recycling, river connectivity, and potential habitat improvement/restoration; increase bathymetric diversity; manage impoundments tor recreate natural wet/dry cycles.	Objective 5B: Same as Alternative A. Strategies: Same as Alternative A, but restoration, management and monitoring will be limited by lack of funding.	Objective 5B: Same as Alternative A. Strategies: Same as Alternative A.	Objective 5B: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Goal 6. Public Use and Education: Provide wildlife-dependent recreation opportunities where appropriate, and improve the quality and safety of the recreational experience. Enhance environmental education and interpretive efforts by developing and improving refuge programs and facilities, and partnering with others to increase awareness of the Mark Twain NWR Complex, the Mississippi River, and the National Wildlife Refuge System.			
Objective 6A: Enhance visitor experiences involving wildlife observation and photography. This will be accomplished in part by constructing observation platforms, kiosks, trails, and auto tour routes where appropriate. All facilities will be ADA-compliant and where necessary, "flood friendly". Two platforms will be constructed by 2005 and two trails by 2008. Strategies: Construct and/or improve observation platforms, trails, and auto tour routes; develop/improve public access on county roads, parking areas and other accesses.	Objective 6A: Provide opportunities for wildlife observation and photography at current levels. Strategies: Maintain existing visitor facilities on the refuge.	Objective 6A: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6A: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 6B: Enhance the education and interpretive program on Complex refuges by providing visitors key river resource messages through contact stations, kiosks, interpretive panels, educational programs and special events. The visitors experience will focus on the messages of: changes in the floodplain, wildlife management choices in this changed setting, and the public's opportunity to be involved in river issues and the Refuge Complex responses. Strategies: Expand headquarters/visitor contact station (If the expansion is of a scale that requires formal environmental. impact analysis, it will be done when a design and building details are developed); improve interpretive exhibits in visitor center; provide interpretive panels on proposed auto tour route, trails, boat ramps; construct vehicle turnout with interpretive signs along public road; improve educational curriculum material used by local schools; conduct open house every 3 years; develop information brochure for Spanish-speaking population; provide interpretive eagle viewing tours; develop refuge events calendar; develop information brochures; develop comprehensive species lists for the AEC and each refuge; develop/conduct wildlife education curriculum modules; produce videos for each refuge; develop outreach program material on issue of "casual mooring" and its effects.	Objective 6B: Improve quality of existing education and interpretive programs on Complex refuges by improving existing contact stations, kiosks, interpretive panels, educational programs and special events. Strategies: Improve facilities and programs as time and resources allow.	Objective 6B: Same as Alternative A. Strategies: Same as Alternative A except fewer trails, tour routes, kiosks, and interpretive signs will be developed due to increased flooding on some divisions.	Objective 6B: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 6C: Enhance outreach through off-refuge activities by conducting education and interpretive programs for schools, youth, civic and conservation groups to increase understanding and appreciation of wildlife and wildlife habitat on the river corridor. Strategies: Continue annual event, Big River Days; partnership with an interpretive display for proposed Heritage Center; partner with county conservation board to provide interpretive and educational activities; Develop refuge exhibit to be located at state park; partnership with county to develop annual wildlife celebration event; co-sponsorship of family fishing fair at state park; develop on and off-site environmental education program; install kiosk; Create portable exhibit showcasing refuge resources/messages; develop and conduct off-site wildlife education curriculum modules; develop website containing maps, events, and other refuge information; develop kiosks for partner managed lands; prepare outreach folders; maintain urban environmental education efforts partnering with COE; develop partnership with Eco-Watch organization to assist with river monitoring and other activities; co-produce with COE a video for teachers highlighting curriculum-based programs; assist with developing and installing exhibits in COE museum; Provide news releases on events and achievements; consider monthly news column and/or radio broadcast on seasonal activities; expand public presentations describing the value of the refuge; develop educational trunks; expand volunteer program; partner with state/local authorities to incorporate refuge information into National Scenic Byway kiosks, visitor centers.	Objective 6C: Enhance outreach through off-refuge activities by conducting education and interpretive programs for schools, youth, civic and conservation groups to increase understanding and appreciation of wildlife and wildlife habitat on the river corridor. Strategies: Continue current activities; enhance outreach by improving quality of current activities.	Objective 6C: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6C: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 6D: Increase fishing opportunity by improving access at five Divisions by 2010. Strategies: Evaluate and improve boat ramps, landings and parking areas; install fishing pier and transfer dock.	Objective 6D: Maintain fishing opportunities on Complex refuges. Strategies: Maintain existing boat ramps, landings and parking areas.	Objective 6D: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6D: Same as Alternative A. Strategies: Same as Alternative A.
Objective 6E: Improve the quality, as measured through visitor satisfaction surveys, and safety of the hunting program and increase opportunity, where appropriate, in accordance with sound biological management objectives by 2008. Strategies: Open refuge for special hunt to control deer population, includes construction of several small parking lots; monitor deer populations and state special seasons and adjust if necessary; coordinate with ILDNR on waterfowl hunting program and placement and/or elimination of blinds before each drawing period; set minimum distance of 200 yards between hunters; open lands to upland and big game hunting; areas open to upland & big game hunting & fishing will be clearly posted.	Objective 6E: Maintain the hunting program in accordance with sound biological management objectives. Strategies: Coordinate with ILDNR on waterfowl hunting program and placement and/or elimination of blinds before each drawing period; set minimum distance of 200 yards between hunters; open lands to upland and big game hunting; areas open to upland & big game hunting & fishing will be clearly posted	Objective 6E: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6E: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 6F: Increase protection of refuge visitors, natural resources, and facilities through enhanced law enforcement, boundary marking, and sign programs. Refuge facility vandalism and habitat damage will be reduced by 75% by 2010. Strategies: Install entrance gate to prevent off-hours traffic, modify dates for sanctuary period; conduct regular law enforcement patrols; continue partnerships with local and state conservation officers; develop new sign plan including regulatory; ensure proper boundary posting on refuge and Farm Service Agency easements.	Objective 6F: Protect refuge visitors, natural resources, and facilities through law enforcement, boundary marking, and sign programs. Strategies: Modify dates for sanctuary period, continue partnerships, develop new sign plan.	Objective 6F: Same as Alternative A. Strategies: Same as Alternative A.	Objective 6F: Same as Alternative A. Strategies: Same as Alternative A.
Goal 7. Monitoring: Develop and implement a wildlife, habitat, and public use monitoring program, integrated with interagency efforts along the river corridor, to evaluate the effectiveness of refuge management programs and to provide information for adaptive management strategies.			
Objective 7A: Monitor habitat communities to evaluate the effects of current management actions and gather data to improve future management practices. Strategies: Establish annual transects on wetland units; complete baseline forest inventory; evaluate grassland and wet meadow for species composition, woody vegetation, etc.; run vegetation transects after prescribed burns; develop step-down inventory and monitoring plan.	Objective 7A: Monitor habitat communities to evaluate the effects of current management actions and gather data to improve future management practices as time and resources allow. Strategies: Obtain and analyze data gathered by partners.	Objective 7A: Same as Alternative A. Strategies: Same as Alternative A.	Objective 7A: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 7B: Monitor wildlife use to verify a response to habitat management efforts and to contribute to systematic scale evaluations on the river with partners. Strategies: Monitor waterfowl, shorebird, and neotropical songbird use of land during migration; monitor size of deer population and habitat damage; develop step-down inventory and monitoring plan.	Objective 7B: Monitor wildlife use to verify a response to habitat management efforts and to contribute to systematic scale evaluations on the river with partners as time and resources allow. Strategies: Monitor waterfowl use of refuges during migration; monitor size of deer population and habitat damage.	Objective 7B: Same as Alternative A. Strategies: Same as Alternative A.	Objective 7B: Same as Alternative A. Strategies: Same as Alternative A.
Objective 7C: Monitor public use and environmental education programs to ensure compatibility with wildlife purposes, visitor satisfaction and safety and outreach effectiveness. Strategies: Track visitor numbers and activities; monitor public use effects on wildlife and habitat in areas of concern; evaluate visitor satisfaction.	Objective 7C: Same as Alternative A. Strategies: Casual observation and anecdotal reports as time and resources allow.	Objective 7C: Same as Alternative A. Strategies: Same as Alternative A.	Objective 7C: Same as Alternative A. Strategies: Same as Alternative A.
Objective 7D: Work with partners to monitor systemic fish, wildlife, and habitat resources of the UMR floodplain and gather data to assist with resource management decision-making. Strategies: Promote research projects; continue partnerships and monitoring of key fish, wildlife and habitat through LTRM, INHS aerial flights, and COE; continue partnerships to evaluate floodplain management, connectivity and sedimentation; monitor status and trends of threatened and endangered species.	Objective 7D: Same as Alternative A. Strategies: Same as Alternative A.	Objective 7D: Same as Alternative A. Strategies: Same as Alternative A.	Objective 7D: Same as Alternative A. Strategies: Same as Alternative A.

Table 2: Mark Twain NWR Complex Objectives and Strategies by Alternative (Continued)

Alternative A (Expanded boundaries, increased river connectivity) (Preferred)	Alternative B Current Program (No Action)	Alternative C (Existing boundaries, maximum river connectivity)	Alternative D (Existing boundaries, least river connectivity)
Objective 7E: Develop and implement an effective record-keeping and data analysis system, compatible with HNA, to facilitate management decision-making. Strategies: Maintain records of management actions and conditions; develop database/graphs/tables to aid management and analysis of monitoring data; maintain GIS; compare monitoring data with CCP strategies annually; HNA and land acquisition.	Objective 7E: Develop and implement an effective record-keeping and data analysis system, compatible with HNA, to facilitate management decision-making as time and resources allow. Strategies: Maintain records of management actions and conditions; develop database/graphs/tables to aid management and analysis of monitoring data; maintain GIS; compare monitoring data with CCP strategies annually; HNA and land acquisition.	Objective 7E: Same as Alternative A. Strategies: Same as Alternative A.	Objective 7E: Same as Alternative A. Strategies: Same as Alternative A.
Current authorized Refuge boundaries would be expanded by 27,659 acres; land protection within this area would be accomplished through partnerships, existing programs such as WRP, through any future emergency flood programs (such as those following the 1993 floods), easements, and fee title acquisition	Refuge boundaries would not be increased beyond what is currently authorized	Same as Alternative B	Same as Alternative B

Chapter 3: Affected Environment

3.1 Description of Existing Units Within Mark Twain NWR Complex

This chapter provides a brief introduction to the existing physical and social environment of the Mark Twain NWR Complex, including the location, size and habitat of each of the five refuges that comprise the Complex, river geomorphology, sedimentation and water quality, soils, habitat, wildlife, public use activities, the social environment and cultural resources that are known to exist on Refuge lands. Greater detail on the affected environment is provided in Chapter 3 of the draft comprehensive conservation plan.

The Mark Twain National Wildlife Refuge Complex currently stretches from Muscatine, Iowa, to Gorham, Illinois, covering approximately 342 river miles (Figure 1) and encompassing over 34,000 acres managed by Complex staff. The Complex headquarters is located in Quincy, Illinois, and the Complex includes Port Louisa NWR, Great River NWR, Clarence Cannon NWR, Two Rivers NWR and Middle Mississippi NWR. The units vary in habitat from bottomland hardwoods to moist soil impoundments to grasslands and crop lands. All refuge divisions experienced dramatic habitat changes from several flood events in the 1990s.

3.1.1 Port Louisa NWR

The Port Louisa NWR is based 6.5 miles east of Wapello, Iowa, and is the northernmost Refuge of the Complex. Refuge staff manage four divisions that total 8,373 acres: Louisa, Big Timber, Keithsburg and Horseshoe Bend. Louisa, Big Timber and Keithsburg are located within the floodplain of the Mississippi River.

3.1.2 Great River NWR and Clarence Cannon NWR

The Great River NWR headquarters is located near Annada, Missouri, 40 miles north of the sprawling St. Louis, Missouri, suburbs. Refuge staff manage three divisions totaling 10,146 acres – Fox Island Division, Long Island Division, and Delair Division – and the 3,750-acre Clarence Cannon NWR.

3.1.3 Two Rivers NWR

Headquartered 20 air miles from St. Louis, Missouri, in the small town of Brussels, Illinois, Great River NWR includes four divisions totaling 8,085 acres – Batchtown, Calhoun, Gilbert Lake and Portage Islands.

3.1.4 Middle Mississippi River NWR

The Middle Mississippi River NWR planning area begins below Lock and Dam 26 at St. Louis and continues to the confluence of the Ohio River near Cairo, Illinois. There are no locks and dams in this reach, but the River has been confined to its main channel by rock training structures and large agricultural levees restrict lateral floodplain connection. The 3,835 acres currently comprising the Refuge were purchased in response to the 1993 Flood after the failure of various private levees. The Refuge is comprised of Meissner

Island Division, Harlow Island Division, and Wilkinson Island Division. None of the divisions are actual islands. River structures intended to keep water flowing to the center of the navigation channel have caused sedimentation through the decades, accreting what were once islands to the mainland and eliminating flowing side channels.

3.2 Habitat Overview

The Mark Twain Complex supports a diverse array of riverine and floodplain habitat. Habitat includes islands, sloughs, backwaters, marshes, moist soil, open waters, bottomland forests, and crop lands that assist a variety of birds, mammals, amphibians, reptiles and fish in their life cycles.

Throughout the River corridor, two of the most historically prevalent and now highly impacted habitat types are forest and aquatic vegetation. The impacts of water level fluctuation, sedimentation and development have been particularly severe south of the Quad Cities.

3.2.1 Forested Resources[34]

Forests in the UMRS are unevenly distributed along floodplain areas. Forests are more often present in periodically flooded lands adjacent to the rivers. They are less often present in areas that are rarely flooded, such as terraces and levee protected land. Despite a reduction in acreage over the past two centuries, the floodplain forests in the UMRS remain a vital component of the river ecosystem by serving the needs of fish, wildlife and human communities.

Mixed silver maple communities constitute the majority of the floodplain forests in the UMRS. Approximate composition of the UMRS floodplain forests is 80 percent mixed silver maple, 10 percent oak-hickory, 5 percent willow and cottonwood combined, and 5 percent other communities. The acreage of oak-hickory communities was reduced drastically because the rarely flooded, well-drained terraces they occupied were more desirable for cultivation and because the wood was valued for fuel and building material. In many areas, a decrease in willow and cottonwood communities came about because these communities require specific flooding and drying cycles and new depositional soil to reproduce - events that do not occur regularly since lock and dam construction.

All refuge divisions have some bottomland forest components, and a few are almost completely forested (Long Island and Big Timber Divisions). Most of the floodplain forest on the Complex was severely damaged by lengthy inundation during the flood of 1993, causing high mortality rates. The canopy has opened with the falling of dead trees, allowing new seedlings a chance to grow. This early successional growth will provide structural diversity to a variety of passerines using the forested portions of the Complex.

34. Material from this section edited from Ecological Status and Trends of the Upper Mississippi River System, 1999, USGS

3.2.2 Wetland Resources

Emergent and submersed aquatic plants were present but not abundant in the Upper Mississippi River before the construction of locks and dams in the 1930s flooded thousands of hectares of marsh, bottomland forest, and agricultural areas. The creation of navigation pools abruptly altered the hydrology of the River and the diversity, abundance and distribution of aquatic plant species.

Following lock and dam construction, the backwaters created by the impoundments teamed with new life including waterfowl, wading birds, amphibians and fish. These wetlands grew lush stands of vegetation used by wildlife for various portions of the life cycle such as feeding and spawning. However, many of these backwater wetlands have accrued fine sediments and contaminants over the decades following construction. Initially the backwaters provided firm soil conditions to support vegetative growth, but the fine silt deposited over the years will not support emergent or submergent vegetation.

As agricultural levees were constructed in the floodplain, landowners drained and filled wetlands to produce corn and other row crops. Approximately 50 percent of the natural floodplain habitat in the Lower Impounded Reach (Pools 14-26) and Illinois Rivers has been converted to agricultural uses. More than 80 percent of natural floodplain habitat has been lost in the Unimpounded Reach. Statewide, in Illinois and Iowa, 96 percent of the wetlands have been lost.

Some of this former wetland habitat has been restored in Refuge divisions within the Mark Twain NWR Complex, including Louisa, Keithsburg, Clarence Cannon, Delair and Batchtown.

3.2.3 Grassland Resources

Very little of the current Complex is in grassland habitat due to the hydrological changes in the floodplain following impoundment. However, General Land Office surveys and survey notes have helped researchers to reconstruct a picture of the habitat present in the Mississippi River Valley prior to European settlement. Prairie cordgrass, a fire-dependent grass species, was probably a predominant species in the Mississippi River floodplain. The floodplain between pools 25 and 26, (Clarksville, Missouri, to Alton, Illinois), was dominated by a prairie community prior to settlement. Timberlands were restricted to islands, the margins of the River and its tributaries, and valley slopes.

Many of the divisions in the Complex contain managed grasslands. The Horseshoe Bend Division in the Iowa River floodplain has about 250 acres of prairie restored on the highest elevations. In addition, more than 2,000 acres are managed as open grasslands and wet meadows. The Horseshoe Bend prairie is the only large grassland tract found on the Mark Twain NWR Complex. It is interesting to note that following the Flood of 1993, small patches of prairie cordgrass began to reappear on several divisions including Louisa, Horseshoe Bend and Clarence Cannon NWR. It would be desirable for this native species to continue spreading through the floodplain.

3.2.4 Invasive Species

More than 135 non-native species have been introduced to the Mississippi River Basin during the past 100 years, including non-native mammals, birds, insects, mollusks, fish and plants. Exotic, invasive or alien species cause vast ecological and economic damage, sometimes impacting human health. These species range across almost every ecosystem of the country. Invading species are usually very successful when introduced to a new environment because they have no natural enemies, and they can usually find a niche to exploit.

Many units of the Mark Twain NWR have noxious and exotic weeds that are controlled biologically, mechanically, physically or, when necessary, chemically. Missouri, Iowa and Illinois each have State noxious weed laws that require public lands to control specific weeds including marijuana (*Cannabis sativa*), musk thistle (*Carduus nutans* L.), Canada thistle (*Cirsium arvense*), Johnson grass (*Sorghum halepense*), field bindweed (*Convolvulus arvensis*) and purple loosestrife (*Lythrum salicaria*).

A new genetic strain of common reed (*Phragmites autralis*) is frequently regarded as an aggresive invader of wetlands. The species has colonized in areas just north of the Complex.

The Service has made prevention and control of invasive plant and animal species a top priority. It is the policy of the Department of Interior, the Service and Region 3 that all reasonable steps should be taken to minimize or, when feasible, eliminate dependence on chemical pest control agents. Reduction of chemical usage on Service lands is unquestionably the best thing to do for the resources in our care.

3.2.5 Sedimentation and Water Quality[35]

The quality of water and sediment in the UMR reflects both natural processes and human influences that occur across varying scales of time and space. Sediment and nutrient inputs to the system have been altered by land-use changes that occurred over more than a century and nearly 200,000 square miles of land surface. Many features of the river change naturally from upstream to downstream. For example, the reach below the confluence of the Missouri River has long differed from the reach upstream. Human activity accentuates these differences. Important natural and human-caused events also occur on small scales of space and time: localized sources of contaminants, large floods, and spills of toxic substances can have a notable effect on sediment and water quality.

In some ways water quality in the UMR has improved in recent decades. Gross pollution by domestic sewage has been reduced since passage of the Federal Water Pollution Control Act of 1972 which mandated secondary treatment of sewage effluents. However, the river continues to receive an array of contaminants from agricultural, industrial, municipal, and residential sources. The risks and threats of many of these contaminants to the biota of this riverine ecosystem are largely unknown.

All reaches of the Upper Mississippi River are contaminated with a complex mixture of agricultural chemicals and their degradation products. Mean concentrations of herbicides in water from the main stem Mississippi River during 1987- 1992 did not exceed maximum contaminant level values for drinking water. However, it is unclear whether agricultural chemicals adversely affect biological communities in the river. For example, the responses of submersed aquatic plants to inflows of herbicides after spring and summer storms are unknown.

35.Material in this section edited from the Ecological Status and Trends of the Upper Mississippi River System, 1999, USGS.

The riverine ecosystem seems to be threatened by nutrients from nonpoint and point sources. It is possible that toxic conditions in the sediment have contributed to recent widespread declines of fingernail clams in the UMR. Fingernail clams are sensitive to un-ionized ammonia, which may reach toxic concentrations in the sediments during low-flow conditions in summer. Changes in nutrient and sediment exported from the UMR basin to the Gulf of Mexico may be having an adverse affect on the Gulf ecosystem (Gulf Hypoxia.

Concentrations of dissolved heavy metals in the UMR are considerably less than U.S. Environmental Protection Agency's guidelines for maximum concentrations in drinking water and in water supporting aquatic life. However, concentrations in suspended and deposited sediments often exceed maximum contaminants levels, and toxic substances accumulated in the bed sediments could remain a potential problem for decades. In particular, contaminated fine-grained sediments deposited during the past century into Lake Pepin (Pool 4) and other depositional sites downstream from metropolitan areas along the river represent a huge reservoir of potentially available toxic substances, posing a continuing hazard to riverine biota. Juvenile bluegills exposed for 28 days to 1 g/L of resuspended sediment from Lake Pepin suffered 24 percent mortality, but the toxic agent in the sediments was not identified.

Human activity has increased the rates of sediment delivery and deposition within the Impounded Reach of the UMR, and suspended and deposited sediments have affected this ecosystem in various ways. Many areas supported dense beds of aquatic plants before an abrupt decline the late 1980s. Reestablishment and recovery of submersed aquatic vegetation in these areas has been hindered by inadequate light penetration caused by turbidity and suspended solids. A variety of water depths and current velocities support a more diverse biological community by providing suitable habitats for an array of fish and wildlife species with differing habitat requirements. Over time, however, the combined processes of erosion and sedimentation have diminished the diversity of water depths in the UMR. The conversion of backwater lakes and marshes to shallow, turbid mud flats in the Illinois River has caused the loss and ecological degradation of many backwater lakes and adversely affected habitat quality and quantity for many fish and wildlife species.

Reduction in sediment inputs to the impounded Upper Mississippi River could retain fertile soil in agricultural fields and reduce entry of sediment and associated contaminants into the river.

3.2.6 Geomorphology and Soils

3.2.6.1 Geomorphology

The upper floodplain reach of the UMR extends from the headwaters to Clinton, Iowa (Pool 14). It is characterized by a narrow river-floodplain terminating at steep bluffs. Varying floodplain topography created by glacial and geologic processes, combined with seasonal flood pulses, created many off-channel permanent and ephemeral aquatic habitats. Deepwater wetlands were present where oxbows, side channel closures, and braided channels occurred. The unregulated river consisted of deep pools separated by shallow bars (shoals) and rapids; there were many rocks and snags.

The lower floodplain reach of the UMR lies between Pool 15 and Alton, Illinois (Pool 26). It flows across glacial outwash below Clinton, Iowa to Fulton, Illinois (Pool 14); between Fulton and Muscatine, Iowa (Pool 16), it flows over or near bedrock. Below Muscatine, the floodplain expands across a wide alluvial valley between high bluffs. Between Clarksville, Missouri (Pool 24) and Alton, Illinois, the average width of the valley floor is 5.6 miles, and

the average slope is 0.5 foot per mile. The floodplain contained many wetlands of various sizes and shapes formed by channel migrations, natural levee formation, and scour. Wooded islands were common in floodplain reaches.
Below the confluence of the upper Mississippi and Missouri Rivers, the Middle Mississippi River takes on a much different character. The river flows through alluvial lowlands known as the American Bottoms to the confluence with the Ohio River. Missouri River flows contributed significant water and sediment inputs that made the Middle Mississippi environment quite different from the upper Mississippi and Illinois Rivers. The channel was deeper and wider than upstream, and many sand islands and side channels were created and destroyed with fluctuating water levels. The channel was much more dynamic than upstream because flows were greater (Theiling 1996).

About 160 kilometers downstream from St. Louis, the Mississippi River flows through Thebes Gap, which resembles the stem of an inverted funnel. Where it exits the gap, the constricted river widens as it enters an ancient sediment-filled lobe of the Gulf of Mexico called the *Mississippi Embayment.* The Mississippi River valley expands to a width of about 50 miles where it meets the mouth of the Ohio River. Floodplain geomorphology provides the template upon which plant communities and habitats develop. The geomorphology and topographic features of the river are diverse along its length, and also laterally from the channel to the bluffs. The longitudinal profile of the upper Mississippi River can be divided into at least ten major geomorphic reaches (Fig. 1 and 2; USACE 1999). The limits of the reaches are defined as:

Geomorphic Reach 1: Pools 1-3
Geomorphic Reach 2: Pool 4 (Lake Pepin)
Geomorphic Reach 3: Pools 5 – 9
Geomorphic Reach 4: Pools 10 – 13
Geomorphic Reach 5: Pools 14 - 17
Geomorphic Reach 6: Pools 18 - 19
Geomorphic Reach 7: Pools 20 – 22
Geomorphic Reach 8: Pools 24 – 26
Geomorphic Reach 9: Below Pool 26 to Thebes Gap
Geomorphic Reach 10: Thebes Gap to Ohio River confluence

The Mark Twain Complex Area of Ecological Concern begins within Reach 5, and extends through Reach 10. Additional detailed information on the geomorphology of the Mark Twain AEC can be found in the CCP.

3.2.6.2 Soils

Alluvial soil associations predominate those found within the Mark Twain NWR management divisions. Alluvium is water-transported sediment that has been deposited along rivers and streams and on stream terraces.

Many of the floodplain soil associations are defined as hydric, or hydric with inclusions (of other soil types), by the Natural Resources Conservation Service (NRCS). Hydric soil is defined as a soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic (no oxygen) conditions.

Mississippi River floodplain soils tend to be nearly level in nature and vary from poorly drained to well-drained. Some topographic relief is found within a few divisions such as Louisa and Horseshoe Bend, where some loess soil may be found in the bluffs.

Most of the soil associations mapped by NRCS have noted that they are 'well-suited' or suited to trees, habitat for wetland wildlife or crop ground.

3.3 Wildlife

3.3.1 Migratory Bird Species

The Mississippi River is a major bird flight corridor hosting nearly 300 species of migrating or nesting species. The river's north-south orientation and nearly contiguous habitat make it critical to the life cycle of many migratory birds. Diving ducks, swans, pelicans and cormorants use the river's large open water pools. Dabbling ducks, geese, herons, egrets, black terns, bitterns, rails, and numerous resident and neotropical songbirds use shallow backwater riverine wetlands. Bottomland forests support migrating and nesting populations of songbirds, bald eagles, ospreys, herons, egrets, hooded mergansers, mallards and wood ducks.

The Complex bird list contains 294 species that have been observed, with over 110 species known to nest on the divisions. Some point count surveys have been established by LTRM in key navigation pools (4, 8, 13, 26) and by refuge personnel on the Big Timber, Keithsburg and Long Island Divisions. Baseline bird data has been collected on Horseshoe Bend, Harlow and Wilkinson Island Divisions. Additional monitoring is needed to assess use of other refuge divisions and determine trends.

Agricultural, urban and industrial demands have taken their toll on riverine habitats, reducing and fragmenting the remaining critical areas. Concerns about the long-term viability of bird populations that require these habitats relates directly to the adverse effects of sedimentation, operation and maintenance of the 9-foot channel navigation project, navigational developments, industrial and municipal effluent, urban and agricultural runoff, recreation, and other human-induced influences.

Waterfowl are the most prominent and economically important group of migratory birds using the river corridor. Non-consumptive use of bird resources also is important on the Mississippi River. Bird watching at developed recreation areas accounted for approximately 15,000 public-use days in 1990.

3.3.2 Fish Species

There are at least 156 species of fish present in the mainstem Mississippi River. About 50 species are common or abundant in certain pools or reaches. Gizzard shad, common carp, and emerald shiner are the three most common species found River-wide. Although the Upper Mississippi River still hosts most of the species that were present historically, the relative abundance and distribution of some species has changed dramatically in the last 100 years. Some of these changes are attributable to events such as the introduction of the common carp, flood protection projects, and construction of the Keokuk, Iowa, hydroelectric dam in 1913 and subsequent locks and dams in the 1930s.

Fisheries management on the UMRS is critical, because, among biotic resources, fishes support the greatest number of commercial and recreational uses. Direct expenditures to support this popular activity are well over $100 million dollars per year.

Despite the continued presence of many fish species, their abundance, size, and distribution may have changed as a result of human activity. For instance, fish movement of many species has been impeded by navigational dams (e.g., skipjack herring, American eel, sturgeons, paddlefish) but other species (i.e., bluegill, largemouth bass) have increased in abundance because of their dependence on lake-like backwaters provided by the impounded waters.

The physical complexity of the unimpounded river was lost with navigation improvements such as training and closing structures. Backwaters, side channels and islands, which provide spawning and over wintering habitat for fish, have disappeared due to sedimentation and floodplain management. Species diversity in this stretch from St. Louis to Cairo, Illinois, is less than in reaches within the impounded river.

Exotic species such as the common carp, and its relatives, the grass, silver and bighead carp dominate commercial fish catches. The round goby, a native of Asia, is making its way down the Illinois River and will eventually get to the Mississippi River. These introduced species compete with native fish for habitat and prey.

3.3.3 Freshwater Mussels

In the main stem of the UMR, 51 species of freshwater mussels have been recorded, although only 30 species are thought to currently exist (Lubinski and Theiling 1999). Freshwater mussels are typically found buried in the substrate in beds containing several different species with similar habitat requirements. Most of these species require flowing water and coarse gravelly substrates, although some survive well in silty lake-like conditions in backwaters. Water and sediment quality are important habitat criteria for mussels.

3.3.4 Mammals, Upland Game Birds

Mark Twain NWR divisions are home to many resident mammal species including white-tailed deer, fox squirrels, cotton-tail rabbits, red fox, coyotes, raccoons, striped skunks, muskrats and beavers. In addition, mice, gophers, voles and moles enhance the diversity and prey base for larger mammals, snakes and raptors.

Four species of upland game birds reside on Complex lands. These are bobwhite quail, ring-necked pheasant, wild turkeys and mourning doves (although there is currently no season on mourning doves in Iowa).

3.3.5 Amphibians and Reptiles

The amphibians and reptiles using the complex are also numerous. Species regularly seen are snapping turtles, painted turtles, box turtles, fox snakes, water snakes and various garter snakes. The complex harbors numerous frog species including Blanchard's cricket frog, western chorus frog, northern spring peeper, bull frog, leopard frog and northern crawfish frog. American and Fowler's toads are also common on Complex lands.

3.3.6 Federally Listed Threatened and Endangered Species

The Area of Ecological Concern (AEC) includes 34 counties in three states with a total of 12 Federally listed endangered or threatened species. These species, the counties in which they are currently listed, and brief habitat descriptions are as follows:

3.3.6.1 Mammals

Indiana bat (*Myotis sodalis*): Muscatine, Louisa, Des Moines, and Lee Counties in Iowa; Henderson, Adams, Pike, Jersey, Madison, Monroe, Jackson, Union, and Alexander Counties in Illinois; and Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Louis, St. Charles, Jefferson, Ste. Genevieve, Perry, Cape Girardeau, Scott, and Mississippi Counties in Missouri.

During the summer, the Indiana bat frequents the corridors of small streams with well developed riparian woods as well as mature upland forests. It forages for insects along the stream corridor, within the canopy of floodplain and upland forests, over clearings with early successional vegetation (old fields), along the borders of croplands, along wooded fencerows, and over farm ponds and in pastures. It has been shown that the foraging range for the bats varies by season, age, and sex and ranges up to 81 acres (33ha). It roosts and rears its young beneath the loose bark of large dead or dying trees. It winters in caves and abandoned mines.

Gray bat (*Myotis grisescens*): Pike, Madison, Jackson, and Alexander Counties in Illinois

The gray bat occupies a limited geographic range in limestone karst areas of the southeastern United States, including Missouri and Illinois. With rare exception, the gray bat roosts in caves year-round. In winter, most gray bats hibernate in vertical (pit) caves with cool, stable temperatures below 10 degrees Celsius. Summer caves, especially those used by maternity colonies, are nearly always located within a kilometer (0.6 mile) of rivers or reservoirs over which bats feed. The summer caves are warm with dome ceilings that trap body heat. Most gray bats migrate seasonally between hibernating and maternity caves. Both types of caves are present in Missouri and Illinois. Gray bats are active at night, foraging for insects over water or along shorelines, and they need a corridor of forest riparian cover between roosting caves and foraging areas. They can travel as much as 20 kilometers (12 miles) from their roost caves to forage.

3.3.6.2 Birds

Bald Eagle (*Haliaeetus leucocephalus*), breeding: Muscatine, Louisa, and Des Moines, Counties in Iowa; Adams, Pike, St. Clair, Madison, Randolph, Jackson, Union, and Alexander Counties in Illinois; and Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Louis, St. Charles, Jefferson, Ste. Genevieve, Perry, Cape Girardeau, Scott, and Mississippi Counties in Missouri.

Bald Eagle, wintering: Scott, Muscatine, Louisa, Des Moines, and Lee Counties in Iowa. Adams, Alexander, Calhoun, Hancock Henderson, Jackson, Jersey, Madison, Mercer, Monroe, Pike, Randolph, Rock Island, St. Clair, and Union Counties in Illinois; and Clark, Lewis, Marion, Ralls, Pike, Lincoln, St. Louis, St. Charles, Jefferson, Ste Genevieve, Perry, Cape Girardeau, Scott, and Mississippi Counties in Missouri.

During the winter, this species feeds on fish in the open water areas created by dam tailwaters, the warm water effluents of power plants and municipal and industrial discharges, or in power plant cooling ponds. The more severe the winter, the greater the ice coverage and the more concentrated the eagles become. They roost at night in groups in large trees adjacent to the river in areas that are protected from the harsh winter elements. They perch in large shoreline trees to rest or feed on fish. There is no critical habitat designated for this species. The listing for the bald eagle has recently been changed from endangered to threatened.

Least Tern (*Sterna antillarum*) Alexander and Jackson Counties in Illinois

It nests on bare alluvial or dredged spoil islands and sand/gravel bars in or adjacent to rivers, lakes, gravel pits and cooling ponds. It nests in colonies with other least terns and sometimes with the piping plover. There is no critical habitat designated for this species.

3.3.6.3 Fish

Topeka shiner (*Notropis topeka*) Clark County in Missouri.

The Topeka shiner is a minnow of small, clear, low order prairie streams. The dominant substrate type of these streams is most often clean gravel, cobble or sand, although stream bottoms of bedrock or clay hardpan are not uncommon. These streams may cease to flow during dry seasons but permanent pools are maintained by percolation of water through the stream bed, spring flow, or groundwater seepage. Topeka shiners most often occur in pool or run areas of streams, seldom being found in riffles.

Pallid sturgeon (*Scaphirynchus albus*): Illinois and Missouri counties below the confluence of the Missouri River.

The endangered pallid sturgeon (*Scaphirhynchus albus*) is found in the Mississippi River downstream of its confluence with the Missouri River. The entire stretch of river is considered potential habitat. Little is known of its habitat preferences, however, telemetry studies and commercial fishing bycatch indicate that adults are associated with main channel borders and scour holes. Juveniles may utilize shallower portions of channel borders and downstream island tips. It is suspected that sand/gravel bars may be utilized for spawning.

3.3.6.4 Mussels

Higgins' eye pearly mussel (*Lampsilis higginsii*): Scott, Louisa, and Muscatine Counties in Iowa. Rock Island, Mercer and Henderson Counties in Illinois; and Marion County Missouri.

This species prefers sand/gravel substrates with a swift current and is most often found in the main channel border or an open, flowing side channel.

Fat pocketbook (*Potamilus capax*): transplanted populations in Hancock and Pike Counties Illinois; and in Lewis, Clark, Pike, and Ralls Counties in Missouri.

The fat pocketbook is a freshwater mussel found in sand, silt and clay bottoms, in flowing water a few inches to more than eight feet in depth. The status of this species is unknown, and may be extirpated.

Pink mucket pearlymussel: St. Louis County in Missouri.

The pink mucket pearlymussel is found in medium to large rivers, in habitats ranging from silt to boulders, rubble, gravel and sand substrates in moderate to fast-flowing water, at depths ranging from 0.5 to 8.0 meters. The pink mucket occurs in the Black River in Wayne and Butler counties; the Little Black River in Ripley County; the Meramec River from the Bourbeuse River confluence downstream to the Highway 231 bridge in Franklin, Jefferson and St. Louis counties; the Big River in Jefferson County; the Gasconade River in Maries, Osage and Gasconade counties; the Osage River downstream of Bagnell Dam to its confluence with the Missouri River; and the Sac River in Cedar County. Increases in turbidity and suspended sediments cause nutritional stress and mortality in the pink mucket pearlymussel.

3.3.6.5 Reptiles

The Mark Twain AEC is within the historical range of the massasauga rattlesnake and copperbelly watersnake (*Nerodia erythrogaster neglecta*). The massasauga is a candidate species for listing. Known populations of this snake are currently limited to small areas outside the Area of Ecological Concern in Illinois, but habitat exists on Complex lands to support this reptile. However, no populations are known to exist.

The copperbelly watersnake is listed as threatened in Michigan, Indiana and Ohio. However, a recently confirmed finding of this species on the Port Louisa NWR and Lake Odessa State Wildlife Area means that the snake may be a candidate for listing in Iowa.

3.3.6.6 Plants

Decurrent false aster (*Boltonia decurrens*): Jersey, Madison, Pike, and St. Clair Counties in Illinois; and St. Charles County, Missouri

The decurrent false aster occupies disturbed alluvial soils in floodplains of the Upper Mississippi and Illinois rivers. There is no critical habitat listed for this species.

Running buffalo clover (*Trifolium stoloniferum*): St. Louis County, Missouri

Running buffalo cover is a stoloniferous, perennial clover with erect flowering stems up to 16 inches tall. Running buffalo clover seems to favor moist, partially shaded woodlands, sometimes along stream or river terraces. It is sometimes found in areas disturbed by grazing or mowing that may suppress competing species. Management activities consistent with the maintenance of open woodland habitat should benefit populations.

3.3.6.7 Invertebrates

Illinois cave amphipod (Gammarus acherondytes): Monroe and St. Clair Counties in Illinois.

The Illinois Cave amphipod is a species that lives in streams primarily in the dark zone of caves in parts of the Salem Plateau of Illinois. Little is known of the biology and habitat requirements of this species although it has been collected in groundwater mainstream gravel riffles, tributaries, rimstone pools, and from streams with silt overlying bedrock. As a group, amphipods require cool water temperatures and are intolerant of wide ranges in temperature. Limiting factors may include increased nutrient load, sedimentation, hydrologic changes, and other changes in water quality. Historically, it was known to occur in six cave systems in Monroe and St. Clair Counties. Additional populations have been found in four groundwater systems in Monroe County. Its presence has not been recently confirmed in one cave system, and is thought to be extirpated from another in St. Clair County.

3.4 Public Use

The 1997 Refuge System Improvement Act gives priority to six wildlife-dependent recreational uses of national wildlife refuges when these uses are compatible with the purposes for which the refuge was established. These uses, known within the Service as the "Big Six," include hunting, fishing, wildlife photography, wildlife observation, environmental education and environmental interpretation.

Not every division within the Complex is open to each of the Big Six uses. Some refuge divisions are open year-round for public use (Big Timber and Long Island); on the other hand, as a condition of its acquisition from the previous owners, the Delair Division is closed year-round to public use except for specific events. Many of the divisions are closed to public access in the fall and early winter to provide sanctuary for migratory birds. Big game hunting is permitted on seven divisions; fishing is permitted on 13 refuge divisions; upland game hunting is allowed on four divisions; and waterfowl hunting is allowed on three divisions. With 40 percent of all waterfowl in North America relying on the Mississippi Flyway, the opportunities for birding are outstanding.

Wildlife and environmental education programming has been limited due to staff availability, but each station has conducted special events or field trips on an opportunistic basis. Designated hiking trails on the Complex are limited, but visitors can walk, bike, or drive cars on service roads within several divisions during open seasons.

While the Complex refuges are located in rural regions of Iowa, Missouri and Illinois, each Refuge is within 50 miles of a metropolitan area. Two Rivers NWR, Great River NWR and Middle Mississippi River NWR are all near St. Louis, Missouri. Port Louisa NWR is near the Quad Cities (Moline and Rock Island, Illinois, and Davenport and Bettendorf, Iowa). Tourism is increasing within the Upper Mississippi River corridor (Black et al., 1999), providing more opportunities for wildlife education and interpretation. The Great River Road, a network of federal, state and county roads covering 3,000 miles and paralleling the Mississippi River, passes near each Refuge. While the potential exists for the refuges to play a greater role as an educational resource and wildlife observation destination, each office has an inadequate visitor contact station. Public use/education activities account for no more than 10 percent to 15 percent of staff members' job duties at 2002 staffing levels.

3.5 Socioeconomics

The National Environmental Policy Act (NEPA) of 1969 requires agencies to disclose to decision makers and the public what society gains or loses with projects that have the potential of altering the environment. In addition, Executive Order 12898 requires agencies within the Department of Interior to evaluate whether any notable impacts to minority and low-income populations and communities will occur with the proposed project action.

Recently, two economic studies were completed that help characterize the economics of the Mississippi River corridor counties, and the importance of refuges to local community economies.
The Upper Mississippi River Coordinating Committee directed the production of the "Economic Profile of the Upper Mississippi River Region" report. This study provides a snapshot of current regional economic activity dependent on the Upper Mississippi River.

The profile by Black, et al., (1999) encompasses economic activity in all 60 counties in five states, bordering the Mississippi River, including 26 that are outside the Mark Twain Complex boundaries. Specific data to the Mark Twain corridor counties cannot be extrapolated from the totals, but generalities can be implied. The Complex does not include any of the 17 Minnesota or Wisconsin counties included in the report, but does consist of 14 (of 18) Illinois counties, 5 (of 10) Iowa counties, and 14 Missouri counties. The report uses available databases and literature to characterize ten key economic sectors including:

- Commercial Navigation
- Harvest of Natural Resources
- Water Supply
- Recreation
- Tourism and Cultural/Historical Resources
- Mineral Resources
- Agriculture
- Energy Production
- Manufacturing Natural Resource Services; this last economic sector involves:

  Wastewater Treatment: Approximately 280 facilities use the UMR as a "sink" for discharging wastewater. Dischargers include manufacturers and municipal sewage treatment plants.

  Wetland Services: Over 40,000 acres of wetlands in the corridor provide benefits associated with flood control, protection of water quality, water supply, and habitat for wildlife.

  Wildlife Species and Habitat: Environmental quality and the health of habitat and species have an intrinsic value, irrespective of human use. This value is reflected in the many past and ongoing efforts to restore and preserve UMR habitat.

Considered together, the 10 economic sectors in the five state area accounts for about $145 billion in revenue to businesses in the corridor. Approximately 870,000 jobs are associated with this economic activity. The revenue generated by the 10 sectors represents about 40 percent of the total output of the corridor, and 18 percent of the economic activity in the five-state region. Manufacturing is by far the largest sector, generating about $126 billion in revenues and 602,000 jobs. By removing manufacturing from the equation, revenue data suggest that tourism, agriculture, energy, and commercial navigation are the dominant sectors. The remaining sectors, however, should not be considered "less important" even though revenue and employment figures are less substantial.

Agricultural land dominates the corridor counties, representing over 70 percent of land in the corridor. Data on average value per acres of agricultural land in different states suggest that the agricultural land in the corridor counties is worth approximately $23 billion. The second most prevalent land use is forested land, relevant to tourism and recreation. Other land uses in the study area are relatively minor wetland and open water areas are the next most notable, representing about 5 percent of the corridor counties. Residential and industrial land represent only small portions of the study area.

The Service produced "Banking on Nature: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation." This 1997 report is the first of a multi-phase study investigating the impact of national wildlife refuges on their local economies. It is a broad spectrum report that discusses the income and employment effects that recreational visitors to refuges have on the economies of local regions. In addition, to the economic effects of refuge hunting and fishing programs in local communities, it measures the economic impact of "eco-tourism," the relatively recent phenomenon of large numbers of people traveling substantial distances to take part in non-consumptive uses of the natural environment. Eco-tourism is one way to derive economic benefits from the conservation of wildlife and habitat.

The study found that:

- Recreational visits to national wildlife refuges generate substantial economic activity. In fiscal year 1995, people visited refuges more than 27.7 million times for recreation and environmental education. Their spending generated $401.1 million of sales in regional economies. As this spending flowed through the economy, more than 10,000 people were employed and $162.9 million in employment income was generated.
- Non-consumptive use of wildlife at refuges generated far more economic activity than hunting and fishing. Although non-consumptive wildlife users usually stay for shorter periods of time and spend less, their numbers at many refuges far exceed those of hunters and anglers and more than compensate for lower spending per person (Laughland 1997). This is a relevant fact to the conditions throughout the Mark Twain Complex. Since much of the Complex is managed as sanctuary surrounded by areas open to hunting, wildlife observation is a secondary use which can occur on river refuges during the fall.

Another study, conducted by Carlson et al., (1995) measured recreational usage originating from developed sites along the Upper Mississippi River and Illinois River. This study produced basin-wide estimates of the total number of recreation visitors, the activities they engaged in, the amount of money they spent on recreation and the patterns evident in their spending. The researchers estimated that over 12 million daily visits by recreationists took place during the study year. Boating was the most popular activity, with more than half of all visitors participating in this activity (6.9 million boaters).

3.6 Cultural Resources

As a part of the CCP process, the Service contracted for an archaeological and cultural values overview study of the refuge. The resulting report, *"An Archaeological and Historical Records Study for the Mark Twain National Wildlife Refuge in Illinois, Iowa and Missouri, by Midwest Archaeological Consulting,"* (Rusch, McKay, Karstens) was submitted to the Service in draft form in July 1999. The authors divided the study by refuge divisions to facilitate understanding and use of the report. It also included an area within a 2-mile radius outside of each division boundary. Information was provided on nearly 750 previously recorded cultural resources that are located within the Complex and the contextual study area surrounding each of the refuge's 15 divisions. Each of the sites, and its associated information, which are located inside, and those closest outside the refuge boundary (approximately one-quarter mile), have been entered into the Complex GIS system so that the information is readily available for management purposes.

The following summary is based on the overview study and other information as interpreted by the Regional Historic Preservation Officer (RHPO). With approximately 0.5 percent of the refuge having been investigated through detailed archeological survey, the current inventory of 176 known or reported cultural resources sites is thought to be a fraction of the potential sites on the refuge. Although erosion occurs at some sites, the overall trend in the river bottom is to aggrade. Thus deeply buried sites can be expected and are likely to be in relatively undisturbed condition. Sites and isolated resources from Archaic, Woodland, Mississippian, and historical are known to exist, and many more sites likely exist. Some Complex divisions are close to the Mississippian cultural center at Cahokia, and known Mississippian sites occupy land forms of the kind found on some Complex divisions. In the historic period, river transportation is the single theme that connects all the Complex divisions. In the earliest historic period, people transported materials down-river on flatboats and keel boats, and returned on keel boats or on trails paralleling the river. Landing sites, often with warehouses or stores or residences, exist throughout the length of the river; Turner Landing is known to be on the refuge. Other sites, probably not likely to be identified, would be associated with firewood stockpiling to feed the wood-burning river boats, which reportedly burned up to 10 cords of firewood a day. Land on some divisions is high enough that farming was practical. Other divisions supported camps, cabins, and resorts for hunters. Old roads, including some of historic importance in Missouri, are on or adjacent to Complex divisions. Other than recent administrative and maintenance buildings, no standing structures remain on the refuge. Objectives of the overview study include identifying Indian tribes and other organizations and public groups that might have an interest in cultural resources and historic preservation on the Complex. The study identified 120 organizations and 19 Indian tribes. It also posed noteworthy research questions to guide future archeological and other cultural resources investigation on the Complex.

Chapter 4: Environmental Consequences

This chapter evaluates the potential environmental and social impacts of implementing each management alternative. Table 3, which is located at the end of this chapter, provides a detailed comparison of the alternatives. However, some potential effects will be the same under each alternative and are summarized in the following section.

4.1 Effects Common to All Alternatives

4.1.1 Environmental Justice

Executive Order 12898 "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations" was signed by President Bill Clinton on February 11, 1994, to focus Federal attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed Federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in Federal programs substantially affecting human health and the environment, and to provide minority and low-income communities access to public information and participation in matters relating to human health or the environment.

None of the proposed management alternatives disproportionately place an adverse environmental, economic, social, or health impacts on minority or low-income populations. Improvements in any refuge facilities or expanded land base near such population centers as St. Louis will likely benefit minority or low income populations in that they will make wildlife dependent recreational opportunities more readily available to them.

4.1.2 Cultural and Archaeological Resources

During the planning process, an archeological resources study was commissioned for existing Mark Twain NWR divisions. None of the proposed management actions will affect known cultural resources. Coordination with the Regional and State Historic Preservation Officers will provide information regarding cultural resources for proposed land acquisition. Archeological studies and surveys will be performed, as necessary, to assure preservation from proposed actions on acquired lands. In the event an unidentified archeological site is discovered, the project by which it was discovered, will be stopped until the resources are adequately protected.

Cultural resources would be protected as mandated by law under all alternatives.

4.1.3 Climate Change Impacts

The U.S. Department of the Interior issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long range planning endeavors.

The increase of carbon within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration constitutes the primary climate-related impact to be considered in planning. The U.S. Department of Energy's "*Carbon Sequestration Research and Development*" (U.S. DOE, 1999) defines carbon sequestration as "...the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

The land is a tremendous force in carbon sequestration. Terrestrial biomes of all sorts – grasslands, forests, wetlands, tundra, perpetual ice and desert – are effective both in preventing carbon emission and acting as a biological "scrubber of atmospheric carbon monoxide. The Department of Energy report's conclusions noted that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

Preserving natural habitat for wildlife is the heart of any long range plan for national wildlife refuges. The actions proposed under any of the alternatives would preserve or restore land and water, and would thus enhance carbon sequestration. This in turn contributes positively to efforts to mitigate human-induced global climate changes.

4.1.4 Prescribed Fire as a Management Tool

4.1.4.1 Social Implications

Prescribed burns will have an effect on the local public. Public concern is noticed every time a fire is set. A prescribed burn will effect and benefit the local community in many ways. These benefits must be explained to the public at every opportunity. The Refuges Fire Management Plan (FMP) provides additional detail beyond what is captured in this section and will be adopted through this EA.

A prescribed burn on the Refuge Complex will be a direct benefit to the public in creating recreational opportunities through increased wildlife populations for hunting and observation. If a wildfire is started on or near the Refuge Complex, the areas that were previously prescribed burned and the firebreaks intended for prescribed burning will be of extreme benefit in controlling the fire.

The aspect of the fire that will solicit the most public concern will be the smoke. Smoke from a Refuge Complex fire could impair visibility on roads and become a hazard. Actions to manage smoke include: use of road guards and pilot car, signing, altering ignition techniques and sequence, halting ignition, suppressing the fire, and use of local law enforcement as traffic control. Burning will be done only on days that the smoke will not be blown across the community or when the wind is sufficient as not to cause heavy concentrations.

If States in which the Refuge Complex institute smoke regulations, the FMP will be amended to ensure consistency with those regulations. Combustion of fuels during prescribed fire operations may temporarily impact air quality, but the impacts are mitigated by small burn unit size, the direction of winds the burns are conducted with, and the distance from population centers. All efforts will be taken to assure that smoke does not impact smoke sensitive areas such as roads and local residences. In the event of wind direction changes, mitigative measures will be taken to assure the public safety and comfort. Complex staff will work with neighboring agencies and in consultation with State air quality personnel to address smoke issues that require additional mitigation.

The fire prescription portion of the Annual Prescribed Fire Plan for each unit proposed to be burned during the burning season will have specific mitigative measures to deal with unexpected smoke management problems. This will included identified problems that unforecasted wind changes may cause and measures to be employed to protect the public.

The emotional impact of a prescribed fire on the local residents must also be considered. A great deal of public concern may arise with any kind of smoke from the Refuge Complex. This concern can be relieved only by a concerted effort by Refuge Complex personnel to carefully inform the local citizens about the prescribed burning program. Emphasis will be placed on the benefits to wildlife as well as the safety precautions in effect. Formal interpretive programs both on and off the Refuge Complex, explaining the prescribed burning program, will be encouraged.

4.1.4.2 Cultural and Archaeological Resources

There may be archaeological sites within prescribed burn units. When these units are burned, it is doubtful that the fire will have any adverse impact on the sites. The fire will be only a temporary disturbance to the vegetation in the area and in no way destroy or reduce the archaeologic value. All artifacts are buried well beneath the surface. No above ground evidence exists. No known sites will be impacted by prescribed burning operations.

4.1.4.3 Flora

The prescribed burning program will have a visible impact on vegetation and the land. Immediately after a fire much of the land will be blackened. There will be no grasses or ground forbs remaining and most of the higher brush such as oak sprouts and willow will be bare of leaves. Trees will be scorched up to 20 feet above the ground. This will be particularly noticeable on the light colored bark of aspen and birch. There may be large areas up to one acre in size interspersed throughout the burn that are untouched by the fire. This may be a result of wet ground conditions or a break in fuel continuity.

Within three days after the burn the grasses and forbs will begin to grow. The enriched soil will promote rapid growth such that after two or three weeks the ground will be completely covered. The willow and oak will, in many cases, re-sprout. The bases of the trees as well as the burned slash and stumps will be partially or completely covered by the new growth. Some of the less fire resistant trees will show signs of wilting and may succumb within a month or two. Generally speaking, after one seasons regrowth, any sign of the prescribed burn will be difficult to detect without close examination. After two or three years it will be virtually impossible to detect the presence of the fire.

Other more long lived signs of the burn will remain for an indefinite period of time. The firebreaks will not be allowed to grow over as their benefit could be realized in a wildfire situation as well as in future prescribed burns. Vehicle tracks through the burn are visible on the freshly burned ash and may be longer lived if the vehicle became stuck or created tire grooves in the ground. Travel across the burn area will be kept to a minimum. Vehicle travel is necessary in some instances, such as lighting the fire lines or quickly getting water to an escape break-over point. A fire plow will be used only in the event that a break-over does occur and cannot be controlled by any other method. The deep trench of the plow would leave a very long lived scar. This trench could be repaired by filling, which would eliminate it from view after five to ten years.

4.1.4.4 Listed Species

The potential impacts of fire on listed species is likely to be neutral to positive if there is any impact. Of the 12 listed species, 5 are aquatic. The pallid sturgeon, Topeka shiner, Higgins' eye pearly mussel, fat pocketbook, and pink mucket pearly mussel are unlikely to be affected by fire management activities. Bald eagles that nest on the refuge are unlikely to be negatively affected, since burning activities would not typically be carried out during the nesting and fledging period. Fire effects in roosting areas and near known nest trees are anticipated to result in reduced fuel loads and beneficial changes to groundcover and the understory. Least terns are associated with bare sand and gravel bars well away from vegetation for nesting and would not be affected by fire management activities. The Indiana and gray bats would be expected to benefit from fire management activities which reduce fuel loads and open up forest understory. However burn units will be thoroughly surveyed for potential Indiana bat maternal colonies or summer roost trees. Burn plans will reflect consideration of the seasonal requirements of forest dependent endangered species. Because running buffalo clover and decurrent false aster are both associated with open conditions and disturbance, it is likely that the effects of burning will be beneficial by setting back competition. The Illinois cave amphipod is located in the blufflands adjacent to the AEC and would be unaffected by refuge fire management.

4.1.4.5 Soils

The disturbances to the soil by fire are similar to those caused by any other manipulative practice applied to the land. A farming, logging, or flooding operation will have no greater or lesser impact. All three are applied on the Refuge Complex at the present time.

The effect of fire to the soil is dependent largely on the fire intensity and duration. On areas with high fuel loads, a slow backing fire is usually required for containment and desirable results. The intense heats generated by this type fire to kill unwanted plant species or remove slash will have a greater effect on the soils than fast, cool head-fires used on farm fields and wildlife openings. The cool, moist soils of wetter areas in the burn units or areas with little fuel will be unaffected by the fire.

The severity of damage to the soil depends also to a great degree on the thickness and composition of the organic mantle. In many cases where only the top layer of the mantle is scorched or burned, no damage will result to the soil below. This is usually experienced in the forested areas of the burn units.

On open areas such as dry grassland or wet meadow sites, the blackening of the relatively thin mantle will cause greater heat absorption and retention from the sun. This will encourage earlier germination during the spring growing season.

Nutrient release occurs as a result of the normal decomposition process. Fire on the soil will greatly speed up the process. The rate and amount of nutrients released will again be dependent on the fire duration and intensity as well as the amount of humus, duff and other organic materials present in the mantle. The increase, immediately after a burn, of calcium, potash, phosphoric acid and other minerals will give the residual and emergent vegetation a short term boost. However, the rapid leaching through the sandy soils will cause rapid runoff of these nutrients and only short term benefits. The increased nutrification of the soil by the emergent vegetation and increased nutrient release result in rapid regrowth of grasses and other succulent vegetation on the sites.

There is no evidence to show that the direct heating of the soil by the burning of material above it with a fire of low intensity has any significant adverse affect. Fire on these types of soil has little total affect on the soils, and in most cases would be beneficial.

4.1.4.6 Escaped Fire

With any prescribed fire there always exists the possibility of its escape into the surrounding area. This can be caused by one or more factors which may be preventable or non-preventable. Inadequate firebreaks, too few personnel, unpredicted changes in weather conditions, peculiar fuel type, being in too big a hurry, and insufficient knowledge of fire behavior are a few factors which could cause loss of control. There is no doubt that an escaped fire could turn into a very serious situation. The damage that could result would be much less severe on the Refuge Complex than if it encroached on private land where buildings, equipment, and land improvements would be involved. Many of the prescribed burn areas are well within the Refuge Complex and of minimal threat to private or other improved lands in the event of an escape breakover. Extreme care, careful planning, and adherence to the unit prescription will be exercised when prescribed burning all units with emphasis employed when burning areas that are near or adjacent to the Refuge Complex boundary.

In the event that a prescribed fire does jump a firebreak and burn into unplanned areas, there is a high probability of rapid control with minimal adverse impact. The network of firebreaks and roads will greatly assist in rapid containment. In most cases all of the Refuge fire fighting equipment will be immediately available at the scene with all nearby water sources previously located. The applicable DNR fire suppression crews and local fire departments will always be notified of a prescribed burn. Thus, maximum numbers of experienced personnel and equipment are immediately available for wildfire suppression activities.

4.1.4.7 Trapping

Trapping is occasionally used as a management tool under permit or by refuge staff. Removing beaver that are plugging water control structures or muskrats, beaver, or woodchucks that are damaging dikes by undermining them with tunnels are examples of management uses for trapping. The direct impact upon the animal trapped is fatal but impacts upon the overall population of the affected species is negligible in the AEC due to the small number of animals taken and the restricted areas trapped.

4.2 Alternative A: (Expanded Boundaries, Increased River Connectivity)

Restore Riverine Habitat for Migratory Birds and Indigenous Fish and Increase Floodplain Functions Such As Connectivity and Flood Water Storage Via Expanded Boundary and Adaptive Management Techniques (Preferred Alternative).

Broaden Refuge Complex opportunities both to expand river/floodplain connectivity and to manage for habitat diversity for fish and wildlife resources on the Upper Mississippi River System through a Refuge boundary expansion (up to 27,659 acres) and use of adaptive management techniques within the 500-year floodplain of the Area of Ecological Concern.

4.2.1 Listed and Other Species of Interest

Increased connectivity with the river could benefit the pallid sturgeon as well as waterfowl and shorebirds. Restored habitats such as floodplain forest, wet meadow, and wetlands will benefit migratory birds associated with those habitats. As the forest ages, Indiana Bats may benefit from increased roost sites. Periodic flooding could help maintain sandbars favored by the Interior Least Tern. Increased connectivity between the floodplain and river could result in slight reductions in the sedimentation of mussel beds by depositing the sediments elsewhere in the floodplain.

4.2.2 Habitat Management

Under Alternative A there would be an increase in the number of wetlands and the amount of seasonal, semi-permanent, and permanent wetland vegetation due to planned improvements on existing refuge lands. The acquisition of additional lands with some level of protection from the river's fluctuations would also increase the acreage and quality of refuge wetlands. The return of wetlands to a more natural hydrologic cycle, would permit the establishment of a more natural diversity of habitats. Backwater and side channel habitats connected to the river also would be enhanced. In addition, some lands within the potential acquisition boundary would be opened to the river, resulting in an increase in overall floodplain connectivity. Because of these increases in wetland and aquatic habitat diversity and floodplain connectivity, migratory bird, mussel, and fishery resources would be enhanced including the endangered pallid sturgeon.

This Alternative would result in an increase in the amount of forest within the Mississippi River floodplain, as well as enhanced tree species diversity and age structure.. Former cropland in flood prone areas would be restored and reconnected to the river, hard mast trees would be planted, additional lands would be acquired, and a detailed plan for enhancement of forest lands would be developed. The result would be improved habitat for migratory songbirds, waterfowl, red-shouldered hawks, nesting colonial waterbirds, the endangered Indiana bat, and many other species of forest-dependent native wildlife.

There would be an increase in native grassland/wet meadow habitat due to land acquisition and restoration on the Refuge Complex, benefitting grassland-dependent songbird species including Henslow's and grasshopper sparrows, as well as shorebirds, waterfowl, and other resident wildlife species.

Grassland edge sensitive species of migratory birds would benefit from the establishment of three large (>150 acres) of contiguous native grassland/wet meadow complexes. In addition the 500 acres of smaller grassland patches and 400 acres of smaller wet meadow areas would benefit grassland and edge tolerant species. Since this alternative has the second largest acreage (exceeding 1350 acres) of grassland and wet meadow, it will likely be very beneficial for grassland dependent species. However, the increased connectivity of the floodplain to the river will likely somewhat reduce productivity of grassland birds on the Complex due to periodic flooding destroying nests or delaying nesting.

The total acreage of cropland on existing and newly acquired lands would be reduced as lands are converted to wetland, forest, scrub/shrub, and grasslands. However, agriculture would be maintained on approximately 500 acres to provide a dependable supplement to natural food sources for waterfowl, to provide open space for resting areas, and to be used as a management tool to maintain high quality wildlife habitat in refuge wetlands by periodically setting back succession or invasion of undesirable species. Farming techniques would also be used to maintain open fields on approximately 675 acres until they can be converted to another planned habitat type, such as on newly acquired lands.

Since this alternative includes the second largest acreage (1175 acres) in agriculture of any alternative, it will provide significant benefits to those species that utilize such habitats. Waterfowl and deer will benefit in particular. An additional 1000 acres o f seed and browse crops planted annually under this alternative will provide a dependable supplement to natural food sources for waterfowl and will provide open space resting areas.

The U.S. Department of Agriculture's definition of prime farmland is cropland, pasture land, range land, forest land or other land, but not urban built-up land, which is capable of being used as prime and unique farmland. This definition excludes lands that are saturated for long periods of time and flood more often than once in two years. But, because of the protection of agricultural land by levees, much of the 500 year floodplain is considered prime farmland. Prior to the 1993 flood, the majority of the floodplain lands had been drained and/or protected by levees. The flood's impact was severe on the drainage and levee system, causing much of the formerly protected lands to lose their prime farmland status. Most of the damaged systems were repaired or replaced after the flood making the protected farmland prime once again. However, lands where protection system have not been repaired do not meet the definition of prime farmland.

Under Alternative A, lands acquired by the Service for the establishment of a refuge in the floodplain may be prime farmland. In considering this impact, the Service has reviewed the Federal Farmland Protection Act, which is administered by the U.S. Department of Agriculture, Natural Resources Conservation Service. In their opinion, the establishment of a refuge would not be an "irreversible change of farmland." On a broad scale, this alternative will have no noticeable effect upon state and nationwide food production over the life of the project.

4.2.3 Sedimentation and Water Quality

Sediment will continue to accrue in areas left open to the river following acquisition. Additional nutrient cycling offered by an "open" system may increase contaminant levels where deposited in floodplain soils. However, areas with some protection by modified levees with spillways will benefit from decreased sedimentation. Private lands work will be expanded to improve water quality entering Complex lands. Working with partners in the watershed and the resulting additional protection within the Complex watershed will decrease sedimentation and should improve dissolved oxygen within refuge impoundments. There could be a slight increase in overall floodplain water quality and nutrient settling and recycling capabilities due to refuge lands being more connected to the river.

4.2.4 Floodplain Management

A mixture of managed and open-to-the-river refuge lands will increase opportunities for floodplain connectivity for spawning fish over current conditions. In addition, areas open to the pulse of the river will provide local flood water storage and nutrient recycling, functioning as natural floodplains. The feasibility of restoring natural functions of the floodplain will be carefully evaluated in all refuge expansion areas.

4.2.5 Public Use and Education

Under Alternative A, Complex expansion would permit additional public access to the floodplain and river. Generally, Complex lands are open to the public during daylight hours. State, county and township roads that traverse any portion of the Complex would remain open to public traffic unless closure was mutually agreed upon by the Service and the appropriate government entity. Access to divisions would be provided from public roads and accommodated at parking lots constructed on Complex lands. Alternative A would permit additional hunting, fishing and non-consumptive public use activities to occur, where compatible with Service and Complex objectives, and the floodplain. Certain areas may be designated closed during migratory periods as a sanctuary for birds and other wildlife.

Within some divisions, hiking trails, observation platforms, information kiosks and auto tour routes would be developed or expanded to provide access for persons with disabilities or an educational experience from a motorized vehicle. Structures will be designed to require minimum maintenance and be minimally at risk during high flow events. Additional environmental education and interpretive activities will be provided, where appropriate. Areas with greater levels of river connectivity will have fewer interpretive opportunities. Law enforcement efforts will be increased.

There may be a slight increase in wildlife disturbance from an increase in recreational users but this will be limited by proper design and location of the recreational facilities. A balance between competing uses and river users should be improved due to the greater area available under refuge expansion and expanded public use areas.

4.2.6 Monitoring

Monitoring of lands acquired under Alternative A will provide a baseline for comparison to follow the biological changes occurring on the land. Monitoring will include vegetative and wildlife responses. Noxious weeds which often invade retired agricultural land will be removed, as necessary, to comply with local regulations. Water quality and sedimentation within newly acquired lands will also be surveyed. Public use surveys as well as habitat and wildlife surveys would also be increased on existing lands. Additional staff will be required for monitoring efforts, to capture the biological changes and maximize opportunities for adaptive management techniques. Existing surveys (vegetative and wildlife) will be expanded.

4.2.7 Coordination and Socioeconomic Impacts

Improved and increased public use access, consumptive and non-consumptive uses, are predicted to promote the Complex and Service mission. Increased visitation to communities will boost local and regional spending; staff additions in local communities will also enhance their economies. Payments in lieu of taxes (revenue sharing) will be made to counties in which refuge divisions are located. By acquiring additional floodplain and leaving it open to the river, there could potentially be a decrease in downstream flood heights, thereby decreasing damage to agricultural and municipal interests.

Acquisition and management of land within the described AEC will have no effect on commercial navigation.

Coordination with other agencies would be improved as the Service sought partnerships to coordinate floodplain management and address sedimentation and water quality issues in the watershed.

The refuge programs and expansion under this alternative would complement the Corps of Engineer's Environmental Management Program (EMP) program and the program would provide opportunities for restoration on the refuge.

Under Alternative A, interpretive and environmental education programs on archeological and cultural resources will be presented to the public.

Additional staff will be required to implement Alternative A. However, any staff increases will be determined by future budget allocations and staff ceilings. Increasing staff levels will not only be needed to adequately manage newly acquired lands, but to cover existing deficits. Maintenance of facilities will improve to 'Service-standard' levels. Proposed enhancements and additional facilities would require a substantial increase to current Operations and Maintenance funding. Extra staff would improve and increase habitat management, law enforcement, public use, and biological monitoring efforts.

4.3 Alternative B: Current Program

Current Management Strategies and Acquisition Within Existing Boundaries (No Action)

Limit the Mark Twain NWR Complex land acquisition to completing acquisition within the currently authorized boundaries; current management strategies would continue.

4.3.1 Listed and Other Species of Interest

Under this alternative, the Refuge Complex will continue to restore and manage habitats to benefit threatened and endangered species as well as migratory birds, mussels, fish, and other species of interest to the Service. Existing limited connectivity on some Refuge Complex units between the river and floodplain will limit habitat diversity and access available to fish and wetland associated birds. Smaller forest block size, less diversity in wetland types, and a more artificial hydrologic system compared to Alternative A will negatively impact some edge-sensitive, forest dwelling migratory birds and wetland dependant species. Acquisition of Refuge Complex lands will not occur beyond that which is currently authorized, limiting additional habitats which could be restored or managed to benefit species of interest. Maintaining current practices will likely have a neutral to slight positive impact on the threatened and endangered species in the AEC as habitat restoration and management continues at the current rate.

4.3.2 Habitat Management

The current distribution and quantity of wetland and aquatic habitats would remain largely unchanged. Fishery resources would increase slightly as lands are acquired within the authorized boundary. The amount of habitat available for waterfowl would stay the same or increase slightly as remaining refuge inholdings are acquired.

The impacts of agriculture under this alternative would be similar to those described for Alternative A. The total of 1075 acres in agriculture under this alternative is similar to the 1175 acres under Alternative A. However, a total of 2,500 acres of seed and browse crops will be planted under this alternative to provide a dependable supplement to natural food sources for waterfowl and to provide open space rest areas.

Two large (>150 acres) areas of contiguous native grassland/wet meadow would be provided under this alternative. Therefore, edge-sensitive grassland species would benefit less under this alternative than under Alternative A and D where three large grassland areas are provided. However, those species would benefit more under this alternative than under Alternative C where one large area is provided.

This alternative would benefit grassland associated or edge associated species by providing approximately 550 acres of smaller patches of grassland and wet meadow areas. This is less than Alternatives A and D but more than Alternative C.

The current decline in species diversity and age structure in forest habitats and the minimal regeneration of forest would continue. Habitat available to waterfowl and non-game migratory birds would increase slightly as remaining authorized acquisitions are purchased. The effect on wildlife populations would not change notably from current conditions.

The size and quality of agriculture and other terrestrial habitats would continue.

4.3.3 Sedimentation and Water Quality

Silt and sediment would continue to accumulate at the current rate on Complex lands. Current unacceptable conditions of water quality, nutrient settling, and nutrient recycling in the floodplain would continue.

4.3.4 Floodplain Management

Current levels of water control on refuge wetlands and connectivity to the river would not change.

4.3.5 Public Use and Education

Existing public access and recreational opportunities would increase slightly as additional lands are added to the Complex. Existing recreational facilities would be maintained. Disturbance of wildlife by recreationists would not increase or decrease. Nesting bald eagles and waterfowl would be protected from disturbance by regulations and law enforcement.

4.3.6 Monitoring

The Complex would continue to rely on USGS monitoring data. Sporadic wildlife surveys would be conducted as time permits.

4.3.7 Coordination and Socioeconomic Issues

Planned land acquisition would have no or slightly positive effect on the economy of local communities.

Interagency coordination would continue at the current level or improve slightly due to coordination efforts during the comprehensive conservation planning process. The current participation in the Army Corp of Engineers' Environmental Management Program would continue to be enhanced.

Management of existing facilities would continue at below Service standards.

4.4 Alternative C: Existing Boundaries, Maximum River Connectivity

Increase River Connectivity Via Spillways, Levee Breaches, and Acquisition Within Existing Boundaries

Increase the river/floodplain connectivity by reducing effectiveness of existing protective levees, even at the cost of increased sedimentation and loss of water level management capability.

4.4.1 Listed and Other Species of Interest

Most listed species would benefit under this alternative due to the maximum connectivity between the river and floodplain of any of the alternatives considered in this document. The Decurrent False Aster, Pallid Sturgeon, and Interior Least Tern would likely benefit from increased habitat due to regular flooding of the area. Endangered mussels could benefit from a slight reduction in siltation of the mussel beds as the flood waters spread out and deposited their sediment loads elsewhere in the floodplain. There could be additional feeding areas for such species of interest as waterfowl and fish provided by the back waters and diverse wetlands created by the flooding. However, the Indiana Bat could be negatively impacted if the flooding frequency and duration prevented the regeneration of floodplain forest areas or resulted in a loss of some floodplain forest areas. This could also negatively impact edge-sensitive migratory birds. The successful management of moist soil areas to benefit waterfowl and other migratory birds would be compromised by the inability to control water levels and flooding frequency and duration.

4.4.2 Habitat Management

Under Alternative C, minimal habitat management would occur due to the river's fluctuating water levels and the desired resource goals would be difficult to achieve. Increased sedimentation would cause further deterioration of existing wetland and aquatic habitat. The loss of seasonally and semi-permanently flooded wetland vegetation and loss of bathymetric diversity will negatively affect waterfowl, shorebirds, marsh birds, fish, and other wetland-dependent species.

Approximately 250 acres of smaller patches of grassland and wet meadow are provided under this alternative. This will benefit grassland and wetland species that are not sensitive to disturbance by species that inhabit adjacent habitats or areas where two or more habitats converge. One large (>150 acres) of contiguous grassland habitat is provided to benefit edge-sensitive grassland species under this alternative. This is the least amount of such habitat of any of the alternatives.

Approximately 500 acres of seed and browse crops planted annually will provide a dependable supplement to natural food sources for waterfowl, and to provide needed open space resting areas. Cropland associated species such as deer and waterfowl at certain periods will benefit from the 875 acres of cropland that will be maintained permanently or until converted to another habitat. This is the least amount o f agricultural land of any of the alternatives.

Reduced ability to set back succession on refuge wetlands and grasslands will likely increase the forest component which will benefit forest dependent birds and other wildlife species. Acquired lands will be taken out of agriculture and converted to forest. Early successional forest will increase temporarily. However, the overall diversity of tree species will be minimal with a continued predominance of silver maple. There may be an increase in scrub/shrub habitat under "open" conditions. Lands opened to the rivers fluctuations will be subject to invasive and exotic species including reed canary grass, purple loosestrife and zebra mussels.

Fishery resources may be improved temporarily by greater connectivity of riverine and shallow water habitats, but over time increased sedimentation will cause loss of aquatic vegetation and reduced bathymetric diversity. Invasive non-native fish species will have increased access to Refuge Complex waters. Increased frequency and duration of flooding will reduce cropland production on refuge lands and reduce managed grassland diversity.

4.4.3 Sedimentation and Water Quality

Refuge divisions currently sequestered from high water events will accrue sediment under this alternative. Contaminant levels will increase within refuge boundaries as protected land is exposed to the flow of river water. However, trapping contaminated water and nutrients within refuge lands could fractionally improve water quality downstream (e.g., Gulf hypoxia issues).

The increased floodwater storage capacity will likely benefit overall floodplain water quality by providing nutrient settling and recycling areas and reducing flooding impacts downstream.

4.4.4 Floodplain Management

Under Alternative C, there will be a slight increase in connectivity to the river providing easier fish access to the floodplain. There may be a slight reduction in downstream flood heights and slight increases in nutrient recycling within the floodplain.

4.4.5 Public Use and Education

Alternative C calls for an increased connectivity to the river. Public access to some locations will be precluded during high water events. Existing facilities (roads, parking lots, kiosks) would receive little maintenance or be removed because of fluctuating water levels. Environmental education and interpretive activities would decrease except at the Riverlands office near St. Louis, Missouri. The affected refuge units would provide less habitat diversity and opportunity for environmental interpretation, and fewer facilities for visitors. Disturbance of wildlife due to recreational use would not increase under this alternative. However, hunting, fishing and trapping opportunities would increase as new lands are added to the refuge.

4.4.6 Monitoring

Minimal monitoring will be done with "open to the river" conditions. Additional staff, and/or assistance from the Biological Resource Division of the U.S. Geological Survey, would be needed to monitor increased sedimentation, contaminants, rates of change in vegetative habitat types, or changes in use by wildlife.

4.4.7 Coordination and Socioeconomic Issues

The acquisition and management of additional floodplain lands would lead to a slight decrease in downstream flooding. Fewer visitors could be expected on divisions and facilities that are affected by frequent seasonal flooding. These decreases would be felt by local economies as visitors that currently use Complex divisions for non-consumptive uses (e.g., bird watching, hiking) would have diminished access to open areas.

Interagency coordination would see a slight improvement under this alternative, primarily due to the CCP planning effort and public involvement in it. Under Alternative C, additional staff would not be necessary because minimal management will occur. The initial costs to breach levees would be high, but over the long run, operations and maintenance costs would be lowered. Boundary posting and policing of recreational sites would encompass the majority of staff time. Additional law enforcement efforts would be needed under a "post and patrol" program.
Alternative C would not result in negative impacts to cultural resources. Cultural sites on acquired lands would receive protection under Federal laws.

4.5 Alternative D: Existing Boundaries, Least River Connectivity

Enhance Habitat Protection Via More Flood Protection, Less River Connectivity on Refuge Lands Within Existing Boundaries

Increase flood protection on existing lands and lands acquired within currently approved boundaries in order to increase effectiveness of habitat management practices on wetlands, grasslands, and bottomland forests, even at the cost of reduced river connectivity.

4.5.1 Listed and Other Species of Interest

The loss of connection between the river and its floodplain under this alternative could negatively impact the Pallid Sturgeon, Interior Least Tern, Decurrent False Aster, and the mussel species of interest to the Service. Reduced flooding frequency or access to the floodplain would mean reduced spawning and feeding habitat for fish, reduced natural habitats for wetland dependant birds, greater siltation or scouring of mussel beds, and a more artificial hydrologic cycle. Sandbar formation and maintenance could be negatively impacted by this as well as the periodic inundations that seem to benefit the Decurrent False Aster by inhibiting less flood-tolerant species. The ability to control flooding could aid in the restoration of floodplain forest, benefitting forest associated species. The water control could also facilitate moist soil management, benefitting waterfowl and other wetland dependant migratory birds.

4.5.2 Habitat Management

Under Alternative D, extensive levee protection on Complex lands would permit more reliable and predictable habitat management within current refuge divisions. The amount and diversity of wetland vegetation would increase due to the re-creation of natural water level changes, providing more high quality habitat for waterfowl, shorebirds, marsh birds and other wetland-dependent wildlife species. The levees would permit improved water level management because of protection from flooding and from rapid artificial changes in river level caused by water releases at the dams. High levees would protect wetlands and other habitat types from increased sedimentation. However, backwater and side channel fisheries and mussel habitat would be reduced, as would fisheries access to the floodplain. Even with levee protection, water seepage can limit management timing on some moist soil units and croplands. And levees can occasionally overtop or fail when river levels are high. There would be a considerable expenditure for maintenance, habitat management, and added structures and facilities.

This Alternative would result in enhanced tree species diversity and age structure. Formerly flood prone areas could be restored with hard mast trees. Acquired lands would be taken out of agriculture and converted to forest. The result would be improved habitat for migratory songbirds, waterfowl, red-shouldered hawks, nesting colonial waterbirds, the endangered Indiana bat, and many other species of forest-dependent native wildlife.

Other habitat types could be maintained more easily due to increased water level control, resulting in benefits for grassland birds, waterfowl, and resident wildlife.

Approximately 1060 acres of smaller patches of grassland and wet meadow areas will benefit grassland and wet meadow species not negatively impacted by habitat edge effects. Edge sensitive species will benefit from three large (>150 acres) areas of contiguous native grassland/wet meadow. In both cases, the affected species will benefit from the presence of food and cover.

Similar to Alternative A, approximately 1000 acres of seed and browse crops will be planted annually to supplement natural waterfowl food sources and to provide needed open space resting areas for waterfowl. Agricultural techniques will be utilized on approximately 700 acres to set back succession or the invasion of undesirable species, maintaining high quality habitat in refuge wetlands in the process. Farming will also be used to maintain approximately 675 acres of open fields until they can be converted to other planned habitat types. Species such as deer will benefit directly from the use of the fields and crops as well as waterfowl at certain times of the year. Setting back successional processes through the use of farming techniques will benefit wetland associated species groups such as shorebirds, wading birds, and waterfowl by providing desirable feeding and loafing sites.

4.5.3 Sedimentation and Water Quality

Less sedimentation is likely to occur by sequestering refuge divisions from most flooding and high water events. Upland runoff within the Complex watershed would continue sending sediments and contaminants into the divisions. Vegetative diversity could decrease if Complex wetlands transition to “treatment” wetlands rather than producing optimal vegetative habitat for migratory birds.

4.5.4 Floodplain Management

Under Alternative D, there will be far less connectivity to the river, decreasing spawning habitat for fish. There could be a slight increase in downstream flood levels if the currently-open divisions, which provide floodwater storage, are leveed off from the river. A decrease in the nutrient recycling process will occur without the river’s access to its floodplain.

4.5.5 Public Use and Education

Alternative D could potentially offer increased public use access because of levee protection. Increased staffing on each refuge would be necessary to maintain additional structures, facilities and to provide law enforcement. Levee protection could provide opportunities for added hunting, fishing, bird watching and other consumptive and/or non-consumptive uses. The levees would also provide increased access for walk-in visitors. All facilities would be ○‰11⅜ friendly" due to potential levee failure.

4.5.6 Monitoring

Monitoring of lands and wildlife would be increased under Alternative D. New surveys would observe the biological changes occurring following levee construction. Surveys will also include vegetative, and wildlife responses. Additional staff would be required to acquire biological data.

4.5.7 Coordination and Socioeconomic Issues

Separating each division from the river through levees will permit enhanced opportunities for wetland management (more intensive management), providing avenues to reach habitat management objectives. Maintenance of pumps, structures, ditches, etc., associated with a more intensive wetland management style will be very expensive. However, staffing requirements may not increase above and beyond that suggested under Alternative A, due to a reduced land acquisition component.

Downstream flooding levels may rise slightly due to the decrease in floodplain storage available on refuge lands. Downstream agriculture, municipalities and businesses may be affected by increasing levee heights on the Mark Twain divisions. However, new lands added to the refuge would help to mitigate this impact. Converted croplands on newly-acquired lands would provide floodwater storage capability.

Interagency coordination would see a slight improvement under this alternative, primarily due to the CCP planning effort and public involvement in it. Alternative D would not result in negative impacts to cultural resources. Cultural sites on acquired lands would receive protection under Federal laws. Levees surrounding Complex lands could also provide added protection from flooding and scouring to known historical and cultural sites. However, as in all previous alternatives, any disturbances will be immediately reported to Regional and State Historic Preservation.

4.6 Cumulative Impacts

The floodplain capacity to store flood water will increase under alternatives A and C, remain the same under Alternative B (No Action) and decrease under Alternative D. Increased flood storage capability means reduced flooding downstream and greater sediment retention and nutrient recycling. This in turn could reduce the sediment and nutrient load that eventually reaches the Gulf of Mexico. A reduction in nutrients reaching the Gulf could help moderate the hypoxia situation there that results in depletion of oxygen and the subsequent death of many aquatic species in the broad area that is affected.

While the individual contribution to sediment retention and nutrient recycling is small for any one of the Complex Refuges under any alternative compared to the total sediment and nutrient load reaching the Gulf, the cumulative impact of the Complex Refuges together can be significant. This impact is magnified further if the refuge is expanded and managed to benefit greater floodplain connectivity with the river. Under Alternative A, the maximum expansion of the refuge would occur, bringing the authorized boundaries of the Complex to slightly more than 80,000 acres. River connectivity would be increased on existing Complex lands and much of the expansion area would emphasize connectivity to the river. Under Alternatives B, C, and D, the refuge would not expand beyond the currently authorized boundary of approximately 53,000 acres. Alternative C would seek the maximum river connectivity within the existing authorized boundaries, but would also likely result in lower wildlife and habitat productivity. Alternative B would retain the current level of river connectivity and Alternative D would decrease river connectivity through the use of levees.

The general increase in flood frequency and duration the past few decades appears to be related to the significant drainage of wetlands and channelization of streams that has occurred throughout the Upper Mississippi River watershed. While significant efforts have been made by various states in the watershed and other agencies, including the Service, to restore wetlands and to restore habitats that reduce sediment runoff, much work still needs to be done. Over time, the Service's efforts working through the Mark Twain Complex and other National Wildlife Refuges and Waterfowl Production Areas, the Partners for Fish and Wildlife Program, and through partnerships with the States, the Corps, and other agencies, the cumulative impact of the various programs can provide measurable positive results in improving water quality on the Mississippi River.

The retirement of the relatively small amount of agricultural land under any of the alternatives would have no measurable impact on agricultural production in the region.

The refuge programs compliment other agencies' and partners' habitat and wildlife work in the AEC. For example, many of the Corps' environmental management program projects to mitigate negative impacts of the river navigation system occur on areas administered as part of the Refuge Complex. The Riverlands Project focused upon environmental education and interpretation in the St. Louis area is another example of the Refuge Complex working cooperatively to create the greatest environmental benefits. Both the Corps and the Service are committed to restoring and maintaining a sound and diverse forest resource in support of Refuge Complex goals for wildlife management. Such partnerships ensure that the work being done on the Refuge Complex is coordinated with other state and federal partners. The cumulative effect is greater benefit to habitat and wildlife through a coordinated approach to restoring habitats, monitoring populations, and dealing with threats to wildlife and habitat.

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
1. Listed Species and Other Species of Interest				
Preservation/perpetuation of threatened and endangered species and other species of interest to the Service	Fish benefit from increased connectivity with river; expanded boundaries protect and restore greatest amount of habitat, benefitting listed species and species of interest	No Change	Fish benefit from increased connectivity with river; Decurrent False Aster likely to benefit from flooding	Decurrent False Aster could be negatively impacted by reduced flooding frequency; less habitat for fish species due to limited connectivity of floodplain to river
2. Habitat: Wetland and Aquatic				
Restoration of connected backwaters and side channels. Enhancement of managed wetlands	Increase of vegetation in managed wetlands due to ability to mimic natural hydrologic cycle more closely. Increase in high quality side channels and connected backwaters due to land acquisition and restoration possibilities.	No Change; No enhancements or improvements to existing units, impoundments	Decreased diversity of managed wetlands due to inability to control unnatural water level fluctuations. Increase in number of side channel and connected backwaters, but long term decrease in quality.	Increase in moist soil management, other wetland types due to ability to control water levels. Decrease in side channels and connected backwaters due to levee building.
Enhance Fishery resources	Increase due to increased wetland diversity, river connectivity, water control capability, and more habitat due to boundary expansion	Slight increase due to more habitat available as lands are acquired within the current authorized boundaries	Slight increase due to greater connectivity with the river but decreased habitat diversity due to sedimentation and unnatural water level fluctuations.	Decrease due to less connectivity to the river and more managed moist soil areas
Assure availability of habitat for migratory birds while providing for overall healthy wildlife populations, achieving habitat and species abundance	Increased migratory bird habitat availability and habitat and species abundance due to more natural hydrologic cycle permitting reestablishment of the natural diversity of habitats combined with increased habitat available due to boundary expansion	No Change to slight increase as remaining refuge inholdings are acquired	Decrease due to inability to control sedimentation and unnatural water level fluctuations and the resulting effects on habitat diversity	Increase in habitat for waterfowl, shorebirds, and marsh birds due to ability to more precisely manage wetland habitats. Increase in overall populations of wetland dependent wildlife and habitat and species diversity. No negative effect on non-wetland dependent wildlife.

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
Trapping: occasionally used as a management tool under permit or by refuge staff	No Change	No Change	No Change	No Change
3. Habitat: Forest				
Forest management and restoration	Increased species diversity and age structure	Species diversity and age structure would continue declining; minimal regeneration	Increase in quantity of trees; decrease in species diversity	Increased opportunities for adding species and age structure diversity
Assure availability of habitat for migratory birds, providing for healthy wildlife populations, achieving habitat and species abundance	Notable Increase in forested migratory bird habitat due to improved ability to achieve reforestation with a diverse tree species and age structure and due to expanded area available for restoration	No Change to slight increase as remaining refuge inholdings are acquired	Stable to decreased migratory bird habitat as tree numbers increase but diversity decreases;	Moderate increase in forested migratory bird habitat due to improved ability to achieve reforestation with diverse tree species and age structure but habitat expansion limited to current refuge boundaries
4. Habitat: Other Terrestrial Habitats				
Management of agricultural lands	Reduced cropland on existing and newly acquired lands; some acreage will be maintained to set back succession in managed wetlands, to provide supplemental waterfowl food and in preparation for conversion to other habitat types	Current cropland acres maintained	Decrease in cropland production due to increased frequency and duration of flooding	Current cropland acres maintained; newly acquired lands may be temporarily cropped, in prep. for conversion to other habitat types
Manage grasslands	Increased grasslands as prairies restored on higher elevations and select areas of wet meadow restored	Existing grasslands maintained	Reduced grassland diversity due to increased flooding frequency and duration in excess of historical occurrence	Increased area of grasslands on higher and lower elevations possible due to ability to restrict floods

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
5. Sedimentation and Water Quality				
Reduce siltation and sedimentation and improve water quality	Increased sediment accumulation on areas newly opened to the river; areas with greater protection would receive less sediment; working with partners in the watershed could reduce sediments and pollution slightly; slight increase in overall floodplain water quality and nutrient settling and recycling capabilities due to refuge lands being more connected to the river	Continued accumulation of silt and sediment and stable or decreasing water quality; no change in overall floodplain water quality or nutrient settling or recycling capabilities	Increased sedimentation due to more direct access to refuge lands by flood waters; increased floodplain storage capacity likely to benefit overall floodplain water quality by providing nutrient settling and recycling areas and reducing flooding impacts on other floodplain areas	Less sedimentation, fewer contaminants entering refuge lands; reduction in overall floodplain storage and nutrient filtering capability.
6. Floodplain Management				
Water level management	Increased floodplain connectivity but less control of water levels on some managed areas; slight reduction in downstream flooding; preservation of floodplain functions in some expansion areas	No change in current levels of water control and connectivity to the river	Increase in connectivity; slight decrease in downstream flooding	Decrease in connectivity of refuge lands to the river; downstream flood levels could rise slightly
7. Public Use & Education				
Recreational opportunities (other than hunting and fishing?) or (non-consumptive?)	Increase. Additional access for consumptive & non-consumptive uses on new lands, trails and facilities.	No change. No expansions or enhancements of existing facilities.	Decrease. Some public use opportunities would be lost with added river connectivity.	Slight increase. Additional impoundment structures would provide more access.
Wildlife disturbance from recreational users	Slight increase. New lands, trails and facilities will increase visitation and stretch law enforcement resources.	No change. Current regulations and law enforcement will limit disturbance to nesting bald eagles and other migratory birds.	Same as B.	Same as B.

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
Hunting and fishing, opportunities	Increase for all activities. Up to 27,659 acres added to the Complex and increased diversity of habitats.	Slight Increase. Some new lands added to the Complex as inholdings are acquired.	Same as B.	Slight increase for hunting. More water control ability will increase waterfowl concentrations. No change for fishing.
Balances between competing uses and users of the river	Improved. More riparian acres within the refuge would ease some congestion of uses.	No change.	Same as B.	Same as B.
8. Monitoring				
Refuge ability to monitor fish, wildlife and habitat quality.	Improved (only if staffing and funding are increased). Baseline evaluations will be required for new lands.	No change. Limited staff means limited monitoring.	Improved (only if staffing and funding are increased).	Same as C.
9. Coordination and Socioeconomic Issues				
Effects of land acquisition on the socioeconomics of the region	Authorized Boundaries would be expanded by 27,659 acres; Increased and enhanced public use facilities would promote local economies; added revenues to counties; slight decrease in downstream flooding.	Current authorized boundaries do not change; No change to slight improvement in economic factors.	Current authorized boundaries do not change; Slight decrease in visitation as non-consumptive uses less available; no change or slight decrease in downstream flooding.	Current authorized boundaries do not change; Slight increase in visitation. No change or slight increase in downstream flood levels.
Interagency coordination	Improved. Would require more cooperative work toward land protection.	No change to slight improvement due to CCP planning effort.	Same as B.	Same as B.
Corps' Environmental Management Program	Enhanced. New lands and projects could be added through the program.	No change.	No change to overall program.. Types of projects might change.	Same as C.
Facilities operations and maintenance	Improved. Additional staff would improve facilities to "Service-standard" levels	No change. Management of facilities would continue at below "Service- standards"	Initial high cost to breach levees; minimal operation and maintenance costs in following years.	Expensive to build and maintain levees and facilities

Table 3: Mark Twain NWR Complex, Environmental Effects by Alternative (Continued)

Complex Environmental Issues	Alternative A - Expanded boundaries, increased river connectivity (Preferred Alternative)	Alternative B - Current Program (No Action)	Alternative C - Existing boundaries, maximum river connectivity	Alternative D - Existing boundaries, least river connectivity
10. Effects Common to All Alternatives				
Environmental Justice	Same as B but with slightly expanded recreational opportunities due to expanded boundaries	Wildlife Dependent recreational opportunities provided; no concentration of acquisition areas in poor or minority areas	Same as B.	Same as B.
Protection of cultural resources	Same as B. Could provide additional opportunities for interpretation cultural resources protection due to expanded boundaries	Cultural resources protected as prescribed by Federal law	Same as B.	Same as B.
Global Climate Change	Same as B with slight increase in benefit due to increased area protected & restored due to expanded boundaries	Very slight benefit due to conversion of cropland to permanent cover and reforestation activities	Same as B.	Same as B.
Prescribed Fire Management	Same as B.	Enhances habitat for upland game, waterfowl, and other species of interest. Required procedures ensure safety. Monitoring of results ensures beneficial results.	Same as B.	Same as B.
Trapping:	Same as B.	No Change; occasionally used as a management tool under permit or by refuge staff; lethal for individual animals but no impact on populations	Same as B.	Same as B.

Chapter 5: List of Preparers

Mark Twain Complex staff contributors
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Chapter 6: List of Agencies, Organizations, and Persons Contacted

Elected Federal Officials
U.S. Senator Chuck Grassley (Iowa)
U.S. Senator Tom Harkin (Iowa)
U.S. Senator Richard Durbin (Illinois)
U.S. Senator Peter Fitzgerald (Illinois)
U.S. Senator Christopher Bond (Missouri)
U.S. Senator Jim Talent (Missouri)

U.S. Representative Jerry Costello (Illinois)
U.S. Representative Lane Evans (Illinois)
U.S. Representative Leonard Boswell (Iowa)
U.S. Representative Jim Leach (Iowa)
U.S. Representative Todd Akin (Missouri)
U.S. Representative JoAnn Emerson (Missouri)
U.S. Representative Dick Gephardt (Missouri)
U.S. Representative Kenny Hulshof (Missouri)

Federal Agencies
U.S. Army Corps of Engineers, Vicksburg Division, Rock Island and St. Louis Districts
U.S. Geological Survey, Long Term Monitoring Program; Jackson, MO; Alton, IL
U.S. Department of Agriculture/Natural Resources Conservation Service, Carrolton, IL; Champaign, IL; Hardin, IL; Jerseyville, IL; Carrollton, IL; Columbia, MO; DesMoines, IA; Jackson, MO; Madison, WI; Murphysboro, IL; Quincy, IL; Waterloo, IA; Stronghurst, IL; Aledo, IL; Wapello, IA
Environmental Protection Agency, Chicago, IL; Kansas City, KS
Columbia Environmental Research Center, Columbia, MO
Upper Midwest Science Center, LaCrosse, WI
U.S. Coast Guard, Keokuk, IA
Illinois River National Wildlife Refuge
Shawnee National Forest, Murphysboro, IL
U.S. Fish and Wildlife Service, Ecological Services, Rock Island, IL
Upper Mississippi National Wildlife and Fish Refuge, Winona, MN
Farm Services Administration, Monmouth, IL; Wapello, IA
U.S. Postal Service, Wappello, IA

Tribes
Delaware Nation of Oklahoma
Eastern Delaware Tribe
Iowa Tribe of Kansas
Iowa Tribe of Oklahoma
Kickapoo Traditional Tribe of Texas
Kickapoo Tribe in Kansas
Kickapoo Tribe of Oklahoma
Osage Nation
Otoe-Missouria Tribe
Peoria Indian Tribe of Oklahoma

Prairie Band Potawatomi Nation
Forest County Potawatomi Community
Hannahville Indian Community of Michigan (Potawatomi)
Nottawaseppi Huron Band of Potawatomi
Pokagon Band of Potawatomi Indians of Michigan
Sac and Fox Nation of Oklahoma
Sac and Fox Tribe of Missouri in Kansas and Nebraska
Sac and Fox Tribe of the Mississippi in Iowa
Absentee-Shawnee Tribe of Oklahoma
Eastern Shawnee Tribe of Oklahoma
Loyal Shawnee Tribe of Oklahoma

<u>Elected State Officials</u>
Iowa Governor Thomas Vilsack
Illinois Governor Rod Blagojevich
Missouri Governor Bob Holden

State Senator, Vince Demuzio, (IL)

<u>State Agencies</u>
Iowa Department of Natural Resources
Illinois Department of Natural Resources
Missouri Department of Natural Resources
Missouri Department of Conservation
Southern Illinois University
Iowa State University, Iowa Cooperative Fish and Wildlife Research Unit
University of Missouri, Extension Services
Iowa State University, Extension Services
Illinois State Police
University of Illinois, Extension Services
Mississippi River Parkway Commission
Union County Refuge, IL
Shawnee Resource Conservation and Development Area, IL

<u>City/County/Local Governments</u>
City of Canton, MO
City of LaGrange, MO
Calhoun County Commissioners, Batchtown, IL
Village of Batchtown, IL
Greene County Board, IL
Village of Elsah, IL
City of Grafton, IL
Village of Hamburg, IL
Calhoun County Planning Committee, IL
Calhoun County, IL
Jersey County Board, IL
City of Portage Des Sioux, MO
Cape Girardeau County Emergency Management Agency, MO
Keithsburg City Hall, IL
City of Keithsburg, IL
Muscatine County Conservation Board, IA
City of Muscatine, IA
Louisa County Conservation Board, IA
City of Wapello, IA

Public Libraries

Quincy Public Library, 526 Jersey St., Quincy, IL 62301
Chester Public Library, 733 State St., Chester, IL 62233
Rock Island Public Library, 401 19th St., Rock Island, IL 61201
Louisiana Public Library, 121 N. 3rd St., Louisiana, MO 63353
Cape Girardeau Public Library, 711 N. Clark St., Cape Girardeau, MO 63701
Festus Public Library, 222 N. Mill St., Festus, MO 63028
Keck Memorial Library, 119 N 2nd, Wapello, IA 52653
Fort Madison Public Library, 614 7th Street, Fort Madison, Iowa 52627-2907

Organizations

Pike County Tourism Bureau, Bowling Green, MO
Sny Island Levee Drainage District, New Canton, IL
Greater Alton Twin Rivers Convention & Visitors Bureau, Alton, IL
Migratory Waterfowl Hunters, Inc., Alton, IL
c/o Ducks Unlimited, Batchtown, IL
Treehouse Wildlife Center, Brighton, IL
Golden Eagle Wildlife Preserve, Inc., Chesterfield, MO
St. Louis Audubon Society, Chesterfield, MO
Principia College, Elsah, IL
The Nature Conservancy, Havana, IL
Great Rivers Chapter of Illinois Audubon Society, Jacksonville, IL
St. Louis Audubon Society, Kirkwood, MO
Webster Groves Nature Study Society, St. Louis, MO
Webster Groves Nature Study Society, ST Louis, MO
Nature Institute, Alton, IL
Piasa Palisades Chapter, First Unitarian Church, Alton, IL
Bassmasters, Alton, IL
The Wildlife Society, Iowa Chapter, Iowa State University, Ames, IA
Mississippi Interstate Cooperative Resource Association, Bettendorf, IA
Ducks Unlimited, Canton, IL
Nature Conservancy, Chicago, IL
The Conservation Fund, Chicago, IL
Sierra Club, Kaskaskia Group Conservation Chair, Columbia, IL
The American Fisheries Society, Columbia, MO
The Missouri Prairie Foundation, Columbia, MO
The Wildlife Society, Missouri Chapter, MO Dept. of Conservation, Columbia, MO
The Illinois Audubon Society, Danville, IL
The Nature Conservancy, Des Moines, IA
Iowa Wildlife Federation, Inc., Des Moines, IA
Iowa Bass Chapter Federation, Des Moines, IA
The Iowa Environmental Council, Des Moines, IA
Izaak Walton League of America, Inc., Iowa Division, Des Moines, IA
Illinois Wildlife Foundation, Edwardsville, IL
Illinois Rivers Project, Edwardsville, IL
St. Louis Area Chairman, Ducks Unlimited, Florissant, MO
The Audubon Council of Illinois, Forreston, IL
The Izaak Walton League of America, Gaithersburg, MD
The Illinois Chapter Federation, Glen Ellyn, IL
Partners for Wetlands, Godfrey, IL
Illinois Federation of Outdoor Resources, Godfrey, IL
Illinois EcoWatch, Godfrey, IL
The Iowa Audubon Council, Grinnell, IA

Missouri Wildlife Society, Hannibal, MO
Missouri Conservation Foundation, Jefferson, MO
Missouri Chapter American Fisheries Society, Missouri Department of Conservation, Jefferson City, MO
The Conservation Federation of Missouri, Jefferson City, MO
The Missouri Audubon Council, Jefferson City, MO
The Missouri Bass Chapter Federation, Lake St. Louis, MO
Sierra Club, Madison, WI
Sierra Club, Madison, WI
The American Fisheries Society, Illinois Chapter, Manito, IL
Southwestern Illinois Resource Conservation and Development, Mascoutah, IL
Mississippi River Basin Alliance, Minneapolis, MN
Muscatine County Ducks Unlimited, Muscatine, IA
Iowa Raptor Foundation, Pella, IA
The Two Rivers RC&D, Pittsfield, Il
Upper Mississippi River Conservation Committee, Rock Island, IL
The Illinois Natural Heritage Foundation, Rockford, IL
The Illinois Bass Chapter Federation, Springfield, IL
The Illinois Environmental Council, Springfield, IL
Green Strategies, Springfield, IL
Missouri State Chapter, Soil and Water Conservation Society, Springfield, MO
Center for Plant Conservation, Missouri Botanical Garden, St. Louis, MO
MARC 2000, St. Louis, MO
The Audubon Society of Missouri, St. Louis, MO
Upper Mississippi River Campaign, National Audubon Society, St. Paul, MN
Illinois-Indiana Sea Grant College Program, University of Illinois, Urbana, IL 61801, IL
Wildlife Management Institute, Washington, DC
National Wildlife Foundation, Office of Federal and International Affairs, Washington, DC
American Rivers, Washington, DC
The Clean Water Fund, National Office, Washington, DC
Defenders of Wildlife, Washington, DC
The National Waterways Conference, Inc., Washington, DC
The National Wildlife Refuge Association, Washington, DC
The Natural Resources Council of America, Washington, DC
The Sierra Club, Washington, DC
National Audubon Society, Washington, DC
Northeast Midwest Institute, Washington, DC
Friends of the Upper Mississippi River Refuges, Winona, MN
Resource Studies Center c/o St. Mary's University of MN #7, Winona, MN
Izaak Walton League, Davenport Chapter, Davenport, IA
The Quad Cities Audubon Society, Davenport, IA
Iowa Natural Heritage Foundation, Des Moines, IA
The Upper Mississippi, Illinois, and Missouri Rivers Association, Jacksonville, IL
Louisa County Pheasants Forever, Oakville, IA
Louisa County Izaak Walton League, Wapello, IA
Ducks Unlimited, Williamsburg, IA

Individuals

Individuals who participated in open house sessions or who requested to be on the Comprehensive Conservation Plan mailing list.

Chapter 7: Appendices

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7.2 Appendix 2, Acronyms and Abbreviations Used in the EA

AEC - Area of Ecological Concern
CCP - Comprehensive Conservation Plan
COE - Corps of Engineers
CRP - Conservation Reserve Program
DNR - Department of Natural Resources
EA - Environmental Assessment
EMP - Environmental Management Program
EWRP - Emergency Wetland Reserve Program
FONSI - Finding Of No Significant Impact
FmHA - Farmer's Home Administration (now FSA)
FSA - Farm Service Agency
GIS - Geographic Information System
HNA - Habitat Needs Assessment
HREP - Habitat Rehabilitation and Enhancement Project
IADNR - Iowa Department of Natural Resources
ILDNR - Illinois Department of Natural Resources
LTRMP - Long Term Resource Monitoring Program
MODOC - Missouri Department of Conservation
NEPA - National Environmental Policy Act
NRCS - Natural Resources Conservation Service
NWR - National Wildlife Refuge
PFW - Partners for Fish and Wildlife
RM - River Mile
ROS - Refuge Operations Specialist
UMR - Upper Mississippi River (confluence with Ohio River at Cairo, IL, to St. Paul, MN)
UMRCC - Upper Mississippi River Conservation Committee
UMRS - Upper Mississippi River System (UMR and navigable tributaries, e.g., Illinois River)
USDA - United States Department of Agriculture
USEPA - United States Environmental Protection Agency
USFWS - United States Fish and Wildlife Service
USGS - United States Geological Survey
WRP - Wetland Reserve Program

Appendix I: Guiding Laws and Orders

Appendix I: Guiding Laws and Orders

Rivers and Harbor Act (1899) (33 U.S.C. 403): Section 10 of this Act requires the authorization by the U.S. Army Corps of Engineers prior to any work in, on, over, or under a navigable water of the United States.

Antiquities Act (1906): Authorizes the scientific investigation of antiquities on Federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Migratory Bird Treaty Act (1918): Designates the protection of migratory birds as a Federal responsibility. This Act enables the setting of seasons, and other regulations including the closing of areas, Federal or non-Federal, to the hunting of migratory birds.

Migratory Bird Conservation Act (1929): Establishes procedures for acquisition by purchase, rental, or gift of areas approved by the Migratory Bird Conservation Commission.

Fish and Wildlife Coordination Act (1934) as amended: Requires that the Fish and Wildlife Service and State fish and wildlife agencies be consulted whenever water is to be impounded, diverted or modified under a Federal permit or license. The Service and State agency recommend measures to prevent the loss of biological resources, or to mitigate or compensate for the damage. The project proponent must take biological resource values into account and adopt justifiable protection measures to obtain maximum overall project benefits. A 1958 amendment added provisions to recognize the vital contribution of wildlife resources to the Nation and to require equal consideration and coordination of wildlife conservation with other water resources development programs. It also authorized the Secretary of Interior to provide public fishing areas and accept donations of lands and funds.

Migratory Bird Hunting and Conservation Stamp Act (1934): Authorized the opening of part of a refuge to waterfowl hunting.

Historic Sites, Buildings and Antiquities Act (1935) as amended: Declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges. Provides procedures for designation, acquisition, administration, and protection of such sites.

Refuge Revenue Sharing Act (1935) as amended: Requires revenue sharing provisions to all fee-title ownerships that are administered solely or primarily by the Secretary through the Service.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act (1948): Provides that upon a determination by the Administrator of the General Services Administration, real property no longer needed by a Federal agency can be transferred without reimbursement to the Secretary of Interior if the land has particular value for migratory birds, or to a State agency for other wildlife conservation purposes.

Federal Records Act (1950): Directs preservation of evidence of the government's organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

Fish and Wildlife Act (1956): Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Refuge Recreation Act (1962): Allows the use of refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

Wilderness Act (1964) as amended: Directed the Secretary of Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife

Refuge and National Park Systems and to recommend to the President the suitability of each such area or island for inclusion in the National Wilderness Preservation System, with final decisions made by Congress. The Secretary of Agriculture was directed to study and recommend suitable areas in the National Forest System.

Land and Water Conservation Fund Act (1965): Uses the receipts from the sale of surplus Federal land, outer continental shelf oil and gas sales, and other sources for land acquisition under several authorities.

National Wildlife Refuge System Administration Act (1966) as amended by the National Wildlife Refuge System Improvement Act (1997)16 U.S.C. 668dd668ee. (Refuge Administration Act): Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, or environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

National Historic Preservation Act (1966) as amended: Establishes as policy that the Federal Government is to provide leadership in the preservation of the nation's prehistoric and historic resources.

Architectural Barriers Act (1968): Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

National Environmental Policy Act (1969): Requires the disclosure of the environmental impacts of any major Federal action significantly affecting the quality of the human environment.

Uniform Relocation and Assistance and Real Property Acquisition Policies Act (1970) as amended: Provides for uniform and equitable treatment of persons who sell their homes, businesses, or farms to the Service. The Act requires that any purchase offer be no less than the fair market value of the property.
Endangered Species Act (1973): Requires all Federal agencies to carry out programs for the conservation of endangered and threatened species.

Rehabilitation Act (1973): Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the Federal government to ensure that anybody can participate in any program.

Archaeological and Historic Preservation Act (1974): Directs the preservation of historic and archaeological data in Federal construction projects.

Clean Water Act (1977): Requires authorization from the Corps of Engineers (404 permits) for the discharge of dredged material and fill material into waters of the United States.

Surface Mining Control and Reclamation Act (1977) as amended (Public Law 95-87) (SMCRA): Regulates surface mining activities and reclamation of coal-mined lands. Further regulates the coal industry by designating certain areas as unsuitable for coal mining operations.

Executive Order 11988 (1977): Each Federal agency shall provide leadership and take action to reduce the risk of flood loss and minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

Executive Order 11990. E.O. 11990 directs Federal agencies to (1) minimize destruction, loss, or degradation of wetlands and (2) preserve and enhance the natural and beneficial values of wetlands when a practical alternative exists.

Executive Order 12372 (Intergovernmental Review of Federal Programs): Directs the Service to send copies of the Environmental Assessment to State Planning Agencies for review.

American Indian Religious Freedom Act (1978): Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

Fish and Wildlife Improvement Act (1978): Improves the administration of fish and wildlife programs and amends several earlier laws including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. It authorizes the Secretary to accept gifts and bequests of real and personal property on behalf of the United States. It also authorizes the use of volunteers on Service projects and appropriations to carry out a volunteer program.

Archaeological Resources Protection Act (1979) as amended: Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

Federal Farmland Protection Policy Act (1981) as amended: Minimizes the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses.

Emergency Wetlands Resources Act (1986): Promotes the conservation of migratory waterfowl and offsets or prevents the serious loss of wetlands by the acquisition of wetlands and other essential habitats.

Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species, and an interdisciplinary approach with the cooperation of other Federal and State agencies.

Native American Graves Protection and Repatriation Act (1990): Requires Federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

Americans With Disabilities Act (1992): Prohibits discrimination in public accommodations and services.

Executive Order 12898 (1994): Establishes environmental justice as a Federal government priority and directs all Federal agencies to make environmental justice part of their mission. Environmental justice calls for fair distribution of environmental hazards.

Executive Order 12996 Management and General Public Use of the National Wildlife Refuge System (1996): Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the System.

Executive Order 13006 Use of Urban Historic Properties(1996):

Executive Order 13007 Indian Sacred Sites (1996): Directs Federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

National Wildlife Refuge System Improvement Act (1997): Considered the "Organic Act of the National Wildlife Refuge System. Defines the mission of the System, designates priority wildlife-dependent public uses, and calls for comprehensive refuge planning.

National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act (1998): Amends the Fish and Wildlife Act of 1956 to promote volunteer programs and community partnerships for the benefit of national wildlife refuges, and for other purposes.

National Trails System Act: Assigns responsibility to the Secretary of Interior and thus the Service to protect the historic and recreational values of congressionally designated National Historic Trail sites.

Appendix J: Soil Associations

Appendix J: Soils Associations

Port Louisa NWR

Big Timber Division

Fruitfield - Elrick - Toolesboro - nearly level and very gently sloping, excessively drained, well drained and poorly drained, loamy and sandy soils that formed in alluvium on bottomland.

Ambraw - Shaffton - Nodaway - nearly level, poorly drained to moderately well drained, silty and loamy soils that formed in alluvium on bottom land.

Louisa Division

Fruitfield - Elrick - Toolesboro - see Big Timber Division
Ambraw - Shaffton - Nodaway - see Big Timber Division
In minor amounts: Atterberry - Muscatine - Stronghurst - nearly level, somewhat poorly drained, silty soils that formed in loess on uplands.

Horseshoe Bend Division

Fruitfield - Elrick - Toolesboro - see Big Timber Division
In minor amounts: Rowley - Tuskeego - Titus - nearly level, somewhat poorly drained and poorly drained, silty soils that formed in alluvium on bottom land and low stream terraces.
Downs - Fayette - Gently sloping to steep, well drained, silty soils that formed in loess on uplands.
Atterberry - Muscatine - Stronghurst - see Louisa Division

Keithsburg Division

Sawmill - Orion - Radford - poorly drained and somewhat poorly drained, occasionally flooded and frequently flooded, moderately permeable, silty soils; formed in alluvium. Minor in this association are the poorly drained Brooklyn and moderately well drained Raddle soils on nearly level stream terraces. Most areas of this association are used for cultivated crops. Some areas close to the streams support native timber. Well suited to cultivated crops. Flooding and seasonal high water table are main management concerns.

Great River NWR

Fox Island Division

Soils found within the Fox Island Division are comprised primarily of silt loams and silty clay loams, with some fine sandy loam, sandy loam and loamy sand also mapped.

Klum fine sandy loam is frequently flooded and is subject to flooding of long duration; it is moderately well drained; found on floodplains. The soil is suited to trees. Hydric inclusions.

Huntsville silt loam is occasionally flooded, well drained, and is found on broad raised areas of the floodplain. It is generally protected by levees but is subject to flooding because of levee breaks. Seepage through the levees also may cause partial flooding during extended periods of high water. This soils is well suited to trees.

Colo silty clay loam is occasionally flooded, poorly drained soil found on floodplains. It is protected by levees but is subject to flooding for brief periods due to levee breaks. Seepage through the levees also causes partial flooding during extended periods of high water. Hydric soil.

Zook silty clay loam is occasionally flooded, poorly drained soil in low areas of broad floodplains. It is subject to flooding for brief periods. Hydric soil.
Gilford loam is occasionally flooded, poorly drained soil found in low areas of broad floodplains. It is subject to flooding and ponding for brief periods. This soil is suited to trees. Equipment limitations, seedling mortality and the windthrow hazard are the main management concerns.

Beaucoup silt loam is occasionally flooded, poorly drained soil on flood plains. It is protected by levees but is subject to flooding and ponding for brief to long periods. Seepage through the levees causes partial flooding in some areas during extended periods of high water.

Perks loamy sand is occasionally flooded, excessively drained soil on slightly raised areas of the flood plains. It is protected by levees but is subject to flooding for brief periods. Seepage through the levees causes partial flooding in some areas during extended periods of high water. This soil is well suited to trees. Seedling mortality is a problem in woodland management. Reinforcement planting or planting container-grown stock will help improve seedling survival.
Fatima silt loam is frequently flooded, moderately well drained soil on broad natural levees of the flood plains. It is protected by levees but is subject to flooding for brief periods. Seepage through the levees causes partial flooding in some area during extended periods of high water. This soil is suited to trees.

Long Island Division

Soils on the Long Island Division are composed primarily of silty loam and silty clay loam types. These include Beaucoup silty clay loam, Huntsville silt loam, Tice silty clay loam and Lawson silty loam (hydric inclusions). A small area of Riverwash (sand and gravel) has also been delineated.

Delair Division

Soils on the Delair Division are composed primarily of silt loams and silty clay loams. These include Beaucoup silty clay loam, Shaffton silty clay loam, Petrolia silt loam, Ambraw loam, Haymond silt loam, Wakeland silt loam, Ambraw silt loam, Ceresco loam and Titus silty clay. Also mapped are areas including Sparta loamy fine sand, and Sarpy loamy fine sand. (Cannot find names for soils mapped 4070 and 8071).

Clarence Cannon NWR

Chequest - Dockery - Carlow - very deep, nearly level, somewhat poorly drained and poorly drained soils formed in alluvium; on flood plains. Of minor extent in this association are the Blackoar, Dupo, Haymond and Moniteau soils. This association is used mainly for cultivated crops (corn, soybeans and small grain). Some small areas are used for timber.

Two Rivers NWR

Batchtown Division

Beaucoup-Tice - poorly drained and somewhat poorly drained, nearly level, silty soils formed in alluvium on floodplains. Depressions and former stream channels are widely scattered throughout the bottom land. Minor soils in this association are Orion, Raddle and Wakeland soils. The major soils are used for cropland or as habitat for wetland wildlife. They are well suited to use as habitat for wetland wildlife. They are moderately suited to cultivated crops.

Calhoun Division

Beaucoup-Tice (see Batchtown Division).
Booker - Okaw - Very poorly drained and poorly drained, nearly level, clayey and silty soils formed in lacustrine sediments or in loess and lacustrine sediments; on terraces. Minor soils in this association are Hurst and Oakville soils. The major soils are used mainly as cropland or woodland. These soils are moderately suited to cultivated crops and to use as woodland. They are well suited to use as habitat for wetland wildlife.

Gilbert Lake Division

Bottomland and Terrace soil Association - nearly level to gently sloping, poorly drained to well-drained bottomland soils and nearly level to steep, imperfectly drained to well-drained terrace soils. The most common soils are Beaucoup, Darwin, Wabash, Rice, McFain, Lawson, Dupo, Jules and Huntsville.

Portage Islands Division

Portage Islands is comprised of the Carlow silty clay loam soil type. This nearly level, poorly drained soil is on the Mississippi River flood plain. Subject to occasional flooding. The soil is suited to trees. Seedling mortality may be a problem because of the wetness of the soil.

Apple Creek WMA

Lawson - Wakeland - Beaucoup : nearly level, somewhat poorly drained and poorly drained soils that formed in water-deposited sediment; on flood plains. This is the primary association on Apple Creek Division.

Fayette - Sylvan - Bold: gently sloping to very steep, well-drained soils that formed in loess; on uplands. Minor amount of soil association on Apple Creek WMA.

Middle Miss NWR

Harlow Island Division

Soils composing Harlow Island include Blake silty clay loam and Blake series, both consisting of somewhat poorly drained soils formed in alluvium on bottom lands. Also Haynie silt loam and Haynie series which are well and moderately well drained soils. Haynie series soils were formed in calcareous silty alluvium on bottom lands. Haynie silt loam is frequently flooded with a high availability for water capacity. It is well-suited for growing cultivated crops. Waldron silty clay and Waldron silty clay loam is somewhat poorly drained. Waldron silty clay loam is occasionally flooded and is usually protected by levees.

Wilkinson Island Division

Darwin - Medway - Cairo - very poorly drained to somewhat poorly drained soils that formed in water-laid clayey or loamy sediment in the flood plain of the Mississippi River. This association consists mainly of nearly level to sloping soils on broad flats, ridges and knolls of the Mississippi River bottom land. Minor soils include Ware, Karnak, Gorham, and Bowdre. Most areas of this association are used for growing corn, soybeans, grain sorghum and wheat. Soils that are not protected by the levee are subject to flooding and to cutting and deposition.

Meissner Island Division

Ambraw-Haynie - Nearly level and gently sloping, poorly drained and moderately well drained, moderately permeable, silty soils; formed in loamy alluvium. The Ambraw soils are poorly drained and found in swales and depressions, while the Haynie soils are on undulating ridges and wide floodplain terraces. There are 5 soils types found on Meissner Island including Riverwash, Aquents, loamy, Sarpy fine sand, Ambraw silty clay loam and Haynie silt loam. They all are frequently flooded and poorly suited to cultivated crops. Shallow water areas for waterfowl can be easily developed on Ambraw silty clay loam and Aquents soils.

Appendix K: Bibliography

Appendix K: Bibliography

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Additional Water Quality References

The Environmental Protection Agency (EPA) has a great deal of detailed information available through their Internet web sites regarding monitoring data, outfall locations, and wastewater permit limitations. Queries can be made regarding any and all wastewater discharges into the Mississippi River by entering their EnviroFacts database found at: www.epa.gov/enviro/index.html. In addition to wastewater permit information (PCS), the EnviroFacts database includes information on toxic release inventory (TRI), hazardous waste sites (CERCLIS) and air emissions (AIRS).

A search of the EnviroFacts databases has been used to gather information on all contaminant sources as part of the refuge Biomonitoring of Environmental Status and Trends Program (BEST), CIMAS (Contaminant Information Management and Analysis System), and Contaminant Assessment Process (CAP) projects. The BEST program was originally designed to meet the needs of the FWS to monitor contaminants that could affect Service trust resources. This program has since been expanded to encompass all Department of Interior lands. CAPs provide an inventory of contaminant sources around and within a specific refuge unit. They also identify areas on the refuge unit or along its boundary that have the potential to be contaminated because the subject area is connected somehow via air, groundwater, surface water or biologically to a known contaminant source. The U.S. FWS's

Environmental Conservation Online System (http://ecos.fws.gov) provides detailed information on Mark Twain NWR contaminant studies, and is recommended as further reference. Seven (Gilbert Lake, Calhoun, Keithsburg, Wilkinson Island, Harlow Island, Fox Island and Horseshoe Bend) of the 15 Mark Twain divisions have had CAPs performed.

In addition, the USGS has a new online Contaminants database which provides information to assess the River's contaminants and how resource managers are responding to this issue. The web site address is: www.umesc.usgs.gov/data_library/sediment_contaminants/sediment_contaminant_page.html. The reader is directed to more detailed contaminant information pertinent to the Mississippi River by reading USGS Circular 1133 "Contaminants in the Mississippi River, 1987-92" and "We All Live Downstream: The Mississippi River and the National Toxics Crisis" compiled by Greenpeace (1989).

Appendix L: List of Preparers

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Appendix M: Land Protection Plan

Appendix M: Land Protection Plan

Situated along the Mississippi River corridor, the Mark Twain National Wildlife Refuge Complex is a mosaic of river, wetland, forest and grassland. The Complex, which is located along the Mississippi Flyway and includes five national wildlife refuges, provides habitat for a wide range of resident and migratory species, particularly migratory waterfowl.

The Complex began with establishment in 1958 of a single Refuge (acres) with three primary divisions. Land for the Refuge was originally purchased from the U.S. Army Corps of Engineers, and the Refuge's headquarters were located in Quincy, Illinois. District offices were located in Annada, Missouri; Brussels, Illinois; and Wapello, Iowa. In 1964, the Clarence Cannon National Wildlife Refuge was made part of the Mark Twain Refuge. Over time, additional lands were purchased and Refuge operations expanded. At the same time, the use of the name "Mark Twain" burgeoned in the area, resulting in serious confusion about what the Refuge is and where it is located. In 2000, the Director of the U.S. Fish & Wildlife Service approved a change in the Refuge's organizational structure. This structure created the Mark Twain NWR Complex, which has headquarters in Quincy, Illinois, and is comprised of five national wildlife refuges: Port Louisa NWR, Middle Mississippi NWR; Great River NWR; Two Rivers NWR; and Clarence Cannon NWR. The names of the refuges and the divisions within each Refuge are more recognizable to local residents and better differentiate the refuges from state wildlife areas and other facilities.

The most significant land acquisition effort to date stems from the Great Flood of 1993, which cost local landowners millions of dollars in levee damage and lost crops. In response, Congress funded the Complex for acquisition within four areas in the lower 200 miles of the Upper Mississippi River as part of a broader federal strategy to assist landowners of the historic floodplain and to restore some floodplain function. Public Law 103-75 (Emergency Supplemental Appropriations for Relief from Major, Widespread Flooding in the Midwest of 1993) provided funds for the Complex to purchase a portion of the 11,400 acres identified as part of a refuge boundary expansion approved following the 1993 flood.

Project Description

During the process of developing the Comprehensive Conservation Plan for the Complex, an addition to the Complex of approximately 60,000 acres was evaluated. This area was later reduced to 55,673 acres due to the change in status of some of the lands making them no longer appropriate for additions. The remaining potential additions were ranked in priority order. Due to the realities of funding in the current economy and due to concerns regarding the growing operations and maintenance funding deficits, the decision was made to focus the boundary expansion only on those tracts listed under Priority 1(Table 1). The comprehensive conservation plan proposes a total boundary expansion of 27,659 acres encompassing four of the five refuges that comprise the Mark Twain NWR Complex. There are approximately 10,724 acres (18% of the authorized boundaries) remaining to be acquired within the currently approved Complex boundaries.

Over 53% of the 27,659-acre expansion area includes land located in the Middle Mississippi River reach of the Upper Mississippi River. Very little public ownership exists there and floods have been particularly hard on floodplain farmers in that portion of the river.

Threat to or Status of Resource to be Protected

The lands and waters of the Mark Twain NWR Complex provide many of the core wildlife habitat areas along the lower half of the Upper Mississippi River System (UMRS). The UMRS includes the Upper Mississippi River and navigable tributaries, including the Illinois River but excluding the Missouri River. While the entire river corridor is important, particularly to the health and recruitment of aquatic species, habitat values change along each river mile. Development, agriculture, navigation and flood control measures have all negatively impacted Upper Mississippi River water quality. Sedimentation is the primary concern because it degrades wetlands throughout the System, diminishes the diversity of water depths, and over time can convert wetlands to terrestrial habitat. Suspended sediments also increase turbidity, resulting in a reduction of light penetration that may limit or eliminate aquatic plant growth and reduce primary production by phytoplankton. Nutrients, heavy metals and pesticides also degrade the quality of wetland habitats throughout the River.

This boundary expansion is proposed on a willing-seller-only basis, which means that acquisition would occur when landowners chose to sell. It would most likely take two or three decades for the Service to acquire all of the land it was authorized to purchase. It is important that the Complex be authorized to purchase land now so that the slow process of acquisition and restoration can begin before habitat degradation is irreversible.

Proposed Action and Objective

Over the course of the 15-year planning horizon, and in reality a good deal longer, the Service proposes to buy land within the 27,659-acre expansion boundary from willing sellers. The expansion boundary encompasses approximately 134 landowners on 31 separate areas.

Most of the lands would be managed for forest and aquatic habitats. The forests will provide a contiguous corridor for nesting and migrating birds and aquatic habitats will be managed for the benefit of big river fish. Expansions of the flood zone will contribute to the floodplain management and water quality goals. An exact prediction of the habitat types that will result in any area can not be made until the areas have been acquired and options can be explored on-site. However, it is estimated that locations of the expansion above St. Louis will result in habitat types that are proportioned close to the distribution that now occurs in those refuges. In general, this would break down to: forest types, 50 percent; wetland and aquatic types, 30 percent; and other terrestrial types, 20 percent. Since there will be an increased emphasis on connectivity rather than isolated wetlands in the Middle Mississippi River section, the proportions there are estimated to be 65 percent forest, 20 percent wetland, and 15 percent other terrestrial habitats.

Protection Alternatives

Land protection options vary from written agreements on land management to outright purchase of the land. Land may be acquired in fee title by several methods including exchange, purchase or donation. Conservation or non-development easements can also be purchased by the Service or donated by a landowner. Each parcel of land has unique resource values and circumstances that determine the desired level of protection.

Alternatives considered as part of this planning process include not pursuing a boundary expansion (no action), fee-title acquisition, acquisition of easements, and acquisition/management by others.

No Action: In the absence of the proposed acquisition, agricultural and flood control practices will continue to have a negative impact on the Upper Mississippi River. Agricultural land will continue to require significant investment in flood control.

Acquisition and/or Management by Others: There is little public ownership of land in the area of the proposed boundary expansion, including land owned by Departments of Natural Resources or Conservation in affected states. The Service is already a presence in the communities of the individual Refuges and therefore is the most logical agency to acquire land.

Fee Title or Less Than Fee Title: Flood control is essential for landowners to have any benefit from the land, however the Service's intent is to create better connectivity with the River. These two needs are mutually exclusive, thus landowners would probably benefit more from outright sale of their land rather than retaining fee-title to land that would probably be more subject to flooding than it is right now.

After considering these alternatives, the Service is proposing to acquire land only in those areas identified as Priority 1 tracts within the proposed boundary expansion on a fee-title basis. The Upper Mississippi River System is a vast watershed. Indeed, the area of ecological concern for the Mark Twain NWR Complex is 1.3 million acres in size. Conservation and habitat protection efforts within an area that big demand partnerships with individual land owners, non-governmental organizations, and state and federal agencies. We believe in the power of partnerships and we will seek opportunities to form partnerships within the area of ecological concern. The lands included in Priorities 2, 3, and 4 as well as other lands within the broader area of ecological concern will be protected through partnerships with other agencies, with the States, private organizations, and with private landowners, working through the Service's Partners for Fish and Wildlife Program and other existing programs. Those areas will not be acquired by the Service.

At the same time, we believe that expanding the Complex boundary through fee-title acquisition will benefit both the Service and private landowners. Very little public ownership exists throughout much of the area, and floods have been particularly hard on floodplain farmers in the portion of the River. The purchase of easements would have limited benefit for the landowner because flooding has severely limited the practical use of the land for farming. Purchase and management of land by the state or other government agencies is unlikely since there are few areas of public ownership now, and the Service is the logical agency to manage habitat as part of existing national wildlife refuges. The no action alternative has been considered, but increasing sedimentation and the resulting habitat degradation certainly affect the existing refuges and have the potential for more serious effects. It is incumbent on the Service to pursue management strategies that will protect critical habitat for wildlife species.

Acquisition Alternatives

The Service is proposing to use Land and Water Conservation Fund dollars for this boundary expansion project. In a few limited cases, land exchanges may also be used to facilitate the boundary expansion. Long term leases, donations, and easements may also be used to achieve the boundary expansion. It is also likely that the Service may be able to partner with the U.S. Department of Agriculture in joint acquisition of lands eligible for the Wetland Reserve Program. This could significantly lower acquisition costs for the Service. It is also possible, as was the case following the flood of 1993, that emergency flood funding may be available to assist landowners who wish to relocate from the floodplain. It is estimated that the 27,659 acres would cost between $20 million and $27 million.

Coordination

Mark Twain NWR Complex has a long tradition of coordinating management activities with a variety of entities, particularly the U.S. Army Corps of Engineers. The COE has been briefed on the expansion proposal and has had input into the Service's planning process. The Service has also been coordinating this issue with the Ameren/Union Electric Power Corporation. The company has expressed an interest in working with the Complex after it completes research to identify and clear titles in their possession. Long-term leases to the Complex, or the sale of small, key parcels that enable an open water restoration project anchor point have been discussed as a possibility.

Sociocultural Impacts

Acquisition is proposed on a willing-seller-only basis. This means that the Service is proposing to purchase land only from individuals who are selling land of their own volition. Eminent domain is not being proposed.

Given the increased occurrence of flooding, sale of land to the U.S. Fish and Wildlife Service would benefit local communities. The Service would be interested in purchasing land that has diminished value for agricultural purposes and, therefore, is less desirable to other buyers. The land is not being proposed as development, thus no change in life style or activities is likely.

Table 23: Tracts Considered for Boundary Expansion, Acreages, and Priorities[1]

ID #	Tract Name	Acres	Owners	State	County	River Mile	Refuge	Type Action	Priority
14	Fox Island East	108	2	Missouri	Clark	358	GRR	Acq or other protect	1
16 B	Fox Island Central	31	1	Missouri	Clark	358	GRR	Acq or other protect	1
16	Fox Island South	110	1	Missouri	Clark	357	GRR	Acq or other protect	1
21	Dillon Island	530	1	Illinois	Adams	342	GRR	Acq or other protect	1
24	Salt River	2863	5	Missouri	Pike	285	GRR	Acq or other protect	1
25	Delair North	98	1	Illinois	Pike	281	GRR	Acq or other protect	1
26	Delair Center	564	1	Illinois	Pike	278	GRR	Acq or other protect	1
27	Goose Pasture	392	1	Missouri	Pike	263	GRR	Acq or other protect	1
31	Annada East	540	2	Missouri	Pike	261	GRR	Acq or other protect	1
32	Annada Corner	2	1	Missouri	Pike	261	GRR	Acq or other protect	1
48	Calico Island	3316	22	Illinois	Monroe	153	MMR	Acq or other protect	1
52	Schmidts Island	1615	1	Illinois	Randolph	132	MMR	Acq or other protect	1
53	Turkey Island	1403	5	Missouri	Ste Genevieve	130	MMR	Acq or other protect	1
54	Beaver Island	397	1	Illinois	Randolph	118	MMR	Acq or other protect	1
55	Horse Island	3361	9	Illinois	Randolph	112	MMR	Acq or other protect	1
57	Rockwood Island	2319	18	Illinois	Randolph	104	MMR	Acq or other protect	1
58	Jones Towhead	1878	11	Missouri	Perry	100	MMR	Acq or other protect	1
60	Hat Island	470	3	Illinois	Jackson	89	MMR	Acq or other protect	1
2	Louisa North	840	6	Iowa	Louisa	441	PTL	Acq or other protect	1
4	Levee District 11	3016	16	Iowa	Louisa	434	PTL	Acq or other protect	1
5	Horseshoe North I	38	2	Iowa	Louisa	434	PTL	Acq or other protect	1
6	Horseshoe North II	9	1	Iowa	Louisa	434	PTL	Acq or other protect	1
9	Railroad Levee	27	2	Illinois	Mercer	428	PTL	Acq or other protect	1
10	White House Lake	2591	5	Illinois	Hender-son	414	PTL	Acq or other protect	1
13 A	Pool 19 submerged lands	80	1	Iowa	Lee	377	PTL	Acq or lease	1

Table 23: Tracts Considered for Boundary Expansion, Acreages, and Priorities[1] (Continued)

ID #	Tract Name	Acres	Owners	State	County	River Mile	Refuge	Type Action	Priority
13 B	Pool 19 submerged lands	80	1	Illinois	Hancock	374	PTL	Acq or lease	1
33	Batchtown North	498	8	Illinois	Calhoun	252	TWR	Acq or other protect	1
34	Batchtown South	173	5	Illinois	Calhoun	248	TWR	Acq or other protect	1
37	Gilbert Lake Addition	203	1	Illinois	Jersey	218	TWR	Acq or other protect	1
38	Gilbert Lake DNR Agreement	92	0	Illinois	Jersey	218	TWR	Trade From State	1
39	Calhoun North	27	1	Illinois	Calhoun	218	TWR	Acq or other protect	1
41	Calhoun Division within DNR	-9	0	Illinois	Calhoun	218	TWR	Trade To State	1
16 A	Fox Island North	755	8	Missouri	Clark	358	GRR	Acq or other protect	2
17	Fox River North	19	1	Missouri	Clark	355	GRR	Acq or other protect	2
22	Long Island Addition	527	13	Illinois	Adams	342	GRR	Acq or other protect	2
24 A	Salt River North	503	4	Missouri	Pike	285	GRR	Acq or other protect	2
26 A	Delair South	440	2	Illinois	Pike	276	GRR	Acq or other protect	2
28	Slim Island	970	3	Missouri	Pike	267	GRR	Acq or other protect	2
31 A	Annada West	83	1	Missouri	Pike	261	GRR	Acq or other protect	2
45	Jefferson Barracks North	1006	5	Illinois	Monroe	172	MMR	Acq or other protect	2
55 A	Horse Island West	649	3	Illinois	Randolph	112	MMR	Acq or other protect	2
56	Crains Island	958	7	Illinois	Randolph	108	MMR	Acq or other protect	2
61	Schenimann	2602	9	Missouri	Cape Girardeau	64	MMR	Acq or other protect	2
1	Bay Island	2514	7	Illinois	Mercer	444	PTL	Acq or other protect	2
8	Edwards River	463	3	Illinois	Mercer	431	PTL	Acq or other protect	2
29	Pool 25 - I	721	6	Illinois	Calhoun	266	TWR	Acq or other protect	2
42 A	Golden Eagle	750	15	Missouri	St. Charles	229	TWR	Acq or other protect	2
40	Calhoun South	710	6	Illinois	Calhoun	218	TWR	Acq or other protect	2
36	Apple Creek South	350	2	Illinois	Greene	218	TWR	Acq or other protect	2
43	Riverlands	62	1	Missouri	St. Charles	202	TWR	Acq or other protect	2

Table 23: Tracts Considered for Boundary Expansion, Acreages, and Priorities[1] (Continued)

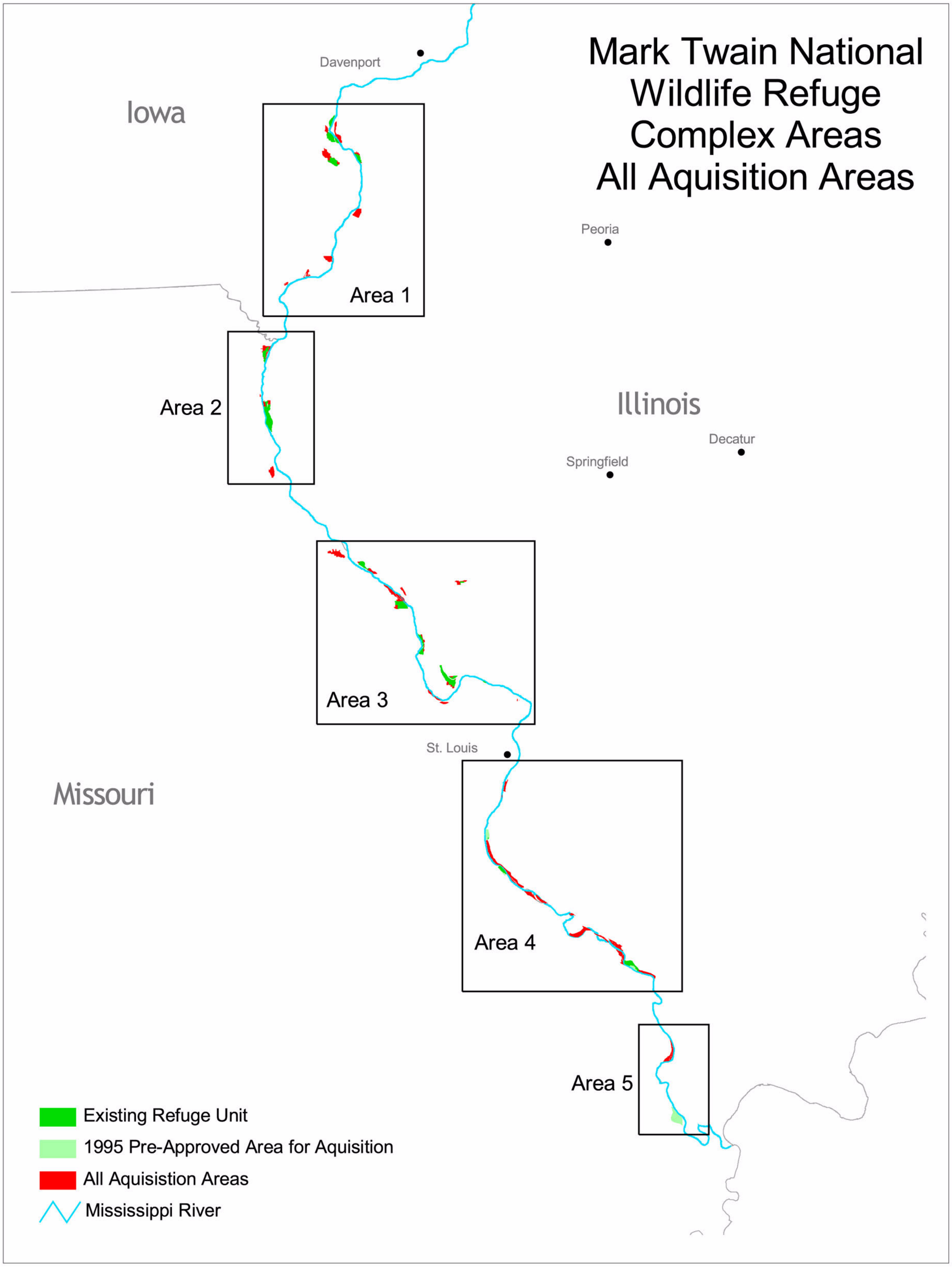
ID #	Tract Name	Acres	Owners	State	County	River Mile	Refuge	Type Action	Priority
44	Riverlands II	2	1	Missouri	St. Charles	202	TWR	Acq or other protect	2
16 C	Fox Island NW/NE	408	4	Missouri	Clark	358	GRR	Acq or other protect	3
15	Grey's Island	265	2	Missouri	Clark	358	GRR	Acq or other protect	3
19	Fox River South	21	1	Missouri	Clark	355	GRR	Acq or other protect	3
18	Fox River South (LD inhold)	-7	0	Missouri	Clark	355	GRR	Trade to Farmer (19)	3
20	Canton	103	2	Missouri	Lewis	343	GRR	Acq or other protect	3
27 A	Fox Creek	1780	7	Missouri	Pike	271	GRR	Acq or other protect	3
48 A	Calico Island South	177	3	Illinois	Monroe	144	MMR	Acq or other protect	3
49	Beagles Island	2562	25	Illinois	Monroe	143	MMR	Acq or other protect	3
50	Fort Chartres Island	396	2	Illinois	Randolph	136	MMR	Acq or other protect	3
60 A	Hat Island East	1078	9	Illinois	Jackson	88	MMR	Acq or other protect	3
3	Louisa South	15	2	Iowa	Louisa	440	PTL	Acq or other protect	3
7	Horseshoe East	333	3	Iowa	Louisa	434	PTL	Acq or other protect	3
42	Peruque & Two Branch Islands	748	3	Missouri	St. Charles	232	TWR	Acq or other protect	3
35	Apple Creek North	658	3	Illinois	Greene	218	TWR	Acq or other protect	3
23	West Quincy	2168	8	Missouri	Marion	320	GRR	Acq or other protect	4
46	Jefferson Barracks South	71	1	Illinois	Monroe	167	MMR	Acq or other protect	4
11	Skunk River	1985	4	Iowa	Des Moines	397	PTL	Acq or other protect	4
12	Ameren East Ft. Madison	837	1	Iowa	Lee	386	PTL	Acq or other protect	4
13	Ameren West Ft. Madison	332	1	Iowa	Lee	380	PTL	Acq or other protect	4
	TOTALS	55673	313						
Revised Total by Refuge				Top Pri	Level 2	Level 3	Level 4		
	Port Louisa (PTL)	13159		6681	2977	348	3154		
	Great River (GRR)	13272		5237	3297	2570	2168		
	Two Rivers (TWR)	4985		983	2595	1406	0		

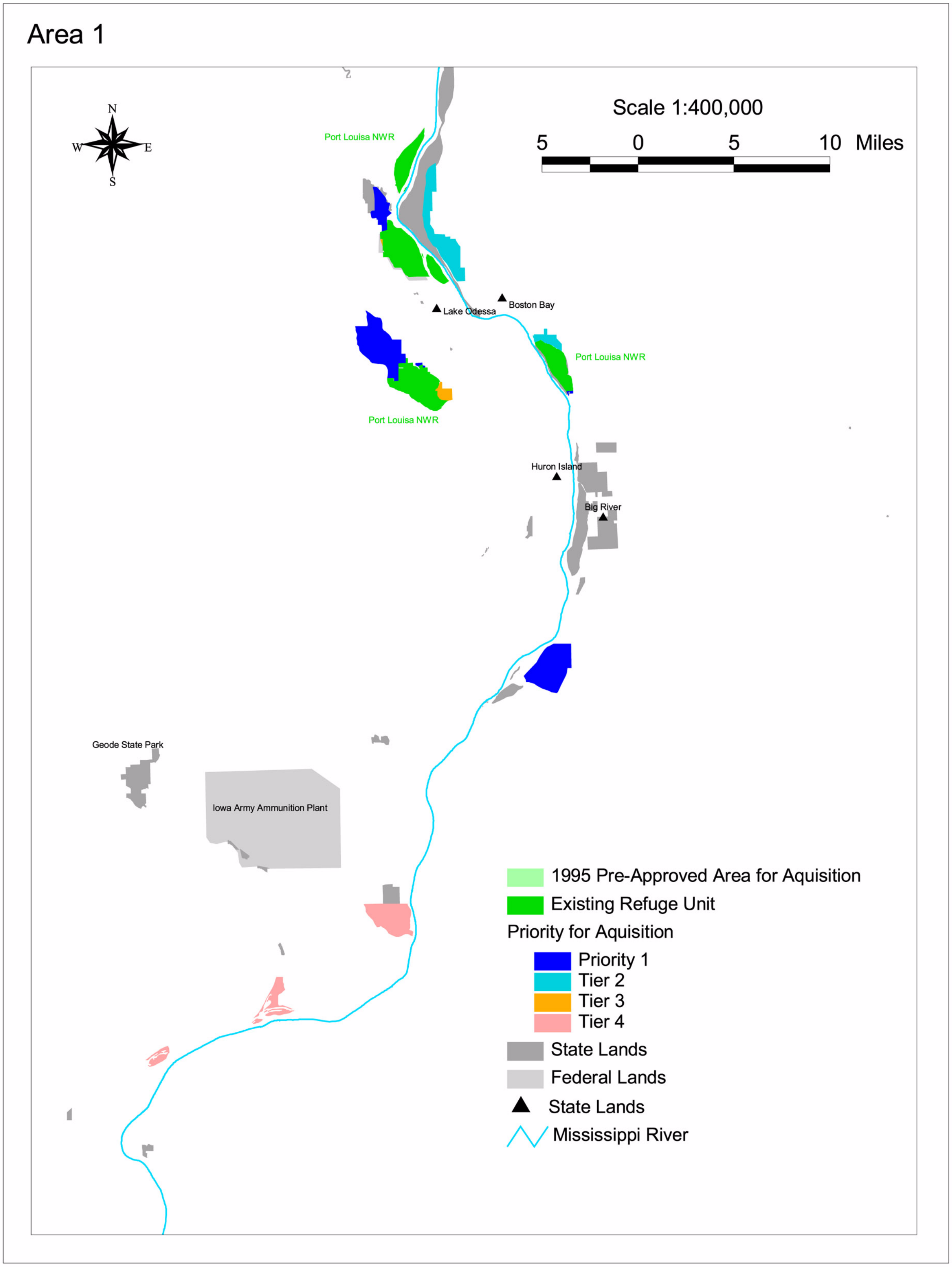
Table 23: Tracts Considered for Boundary Expansion, Acreages, and Priorities[1] (Continued)

ID #	Tract Name	Acres	Owners	State	County	River Mile	Refuge	Type Action	Priority
	Middle Miss River (MMR)	24258		14758	5215	4213	71		
	Adjusted Complex Totals	55673		27659	14084	8537	5393		
			Owners	135	97	66	15		
Lands not yet acquired or protected from 93' Flood expansion project (Middle Miss Refuge)									
47	Meissner Island Addition	1581		Illinois	Monroe	156	MMR	Acq or other protect	
51	Harlow Island Addition	243		Missouri	Jefferson	144	MMR	Acq or other protect	
59	Wilkinson Island Addition	756		Missouri	Perry	92	MMR	Acq or other protect	
63	Powers Island	5740		Missouri	Scott	39	MMR	Acq or other protect	
	Total	8320							
Lands remaining to be acquired at Clarence Cannon NWR:					2,404 acres				

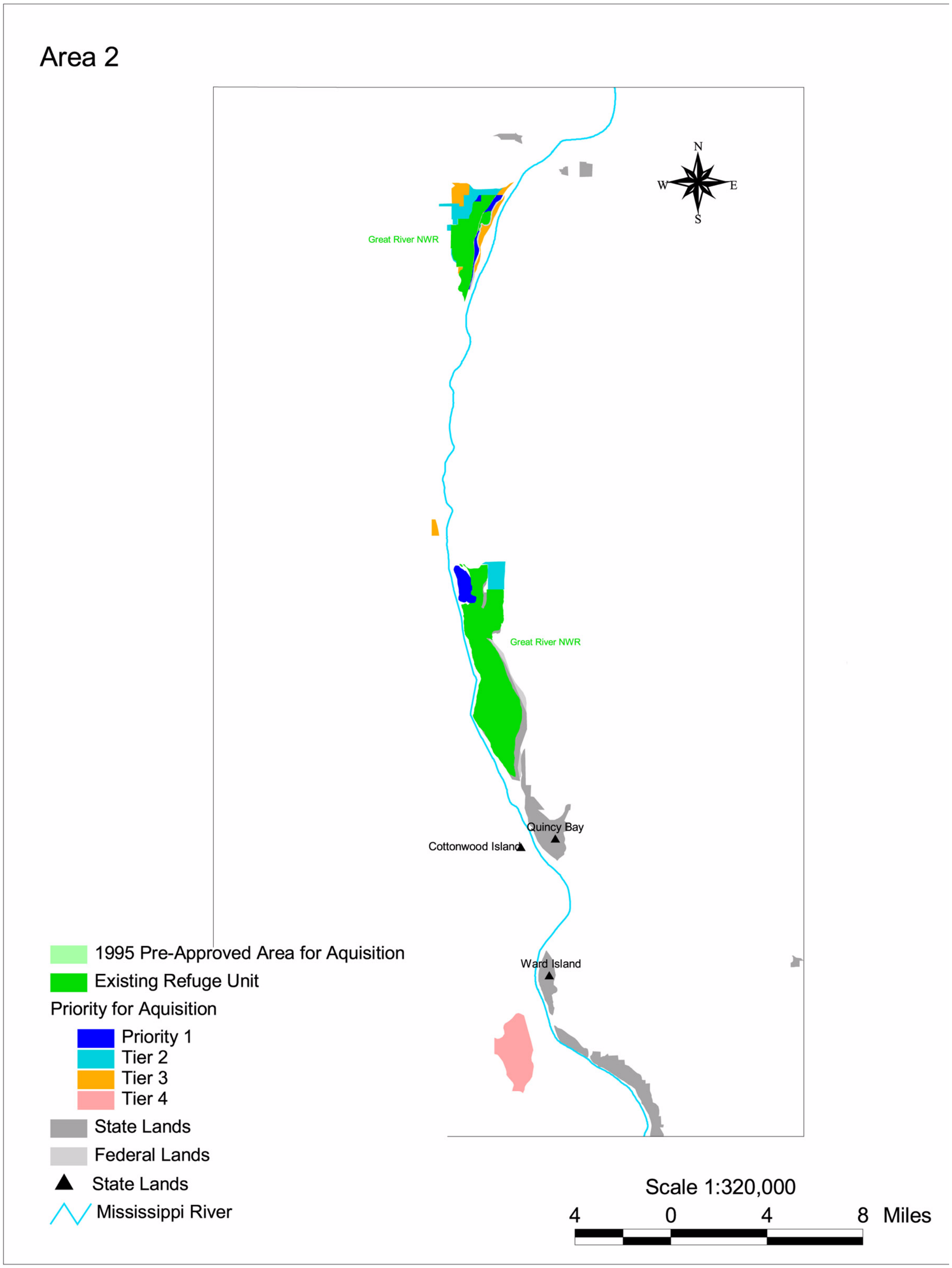
1. Only Priority 1 tracts are proposed for the boundary expansion.

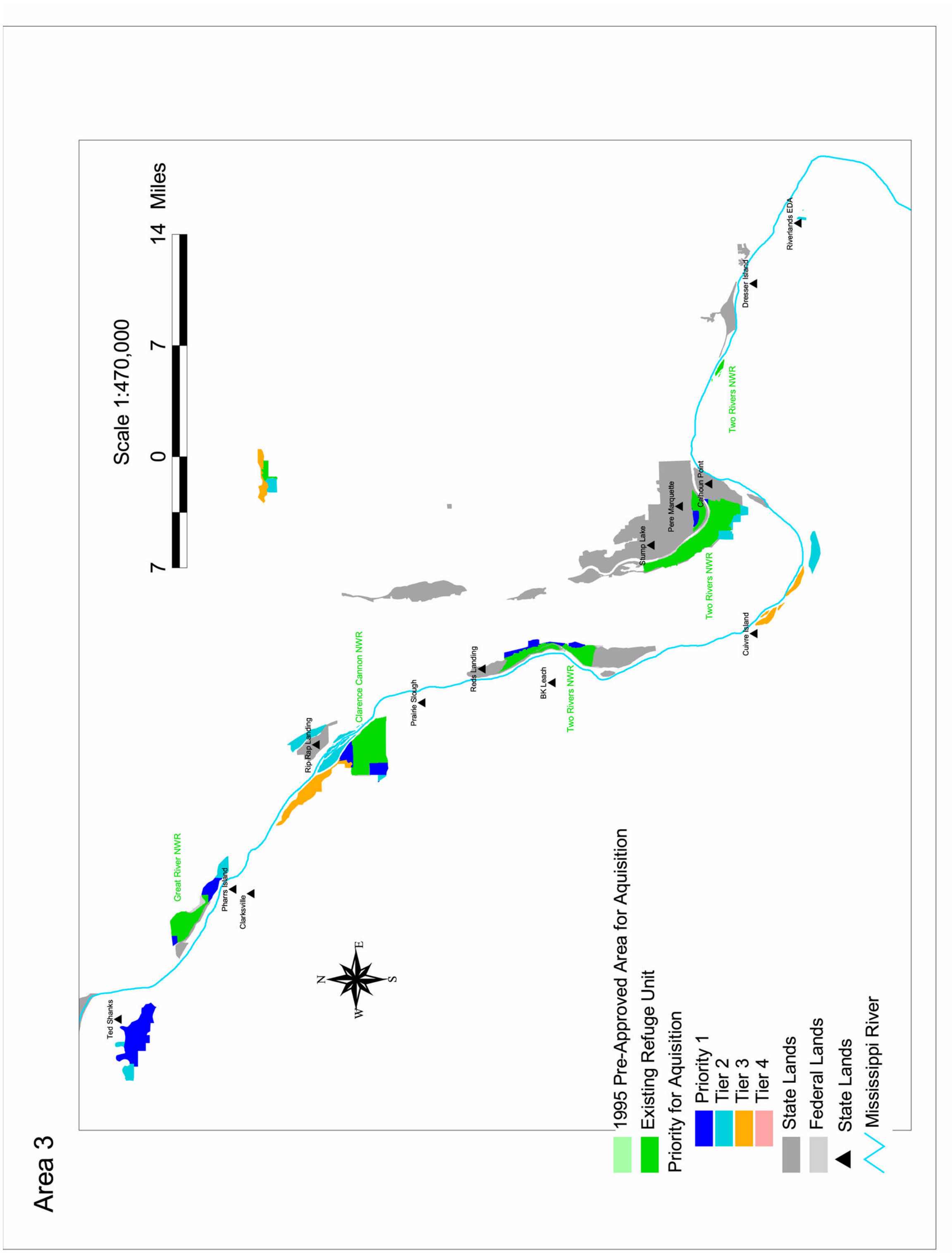
Attachment 1. Maps of the Proposed Boundary Expansion Depicting Unit Numbers
Attachment 2: Maps Depicting Proposed additions (Priority 1 areas), Other Areas Considered for Additions (Tier 2,3,4), and Relationship to Other Conservation Lands

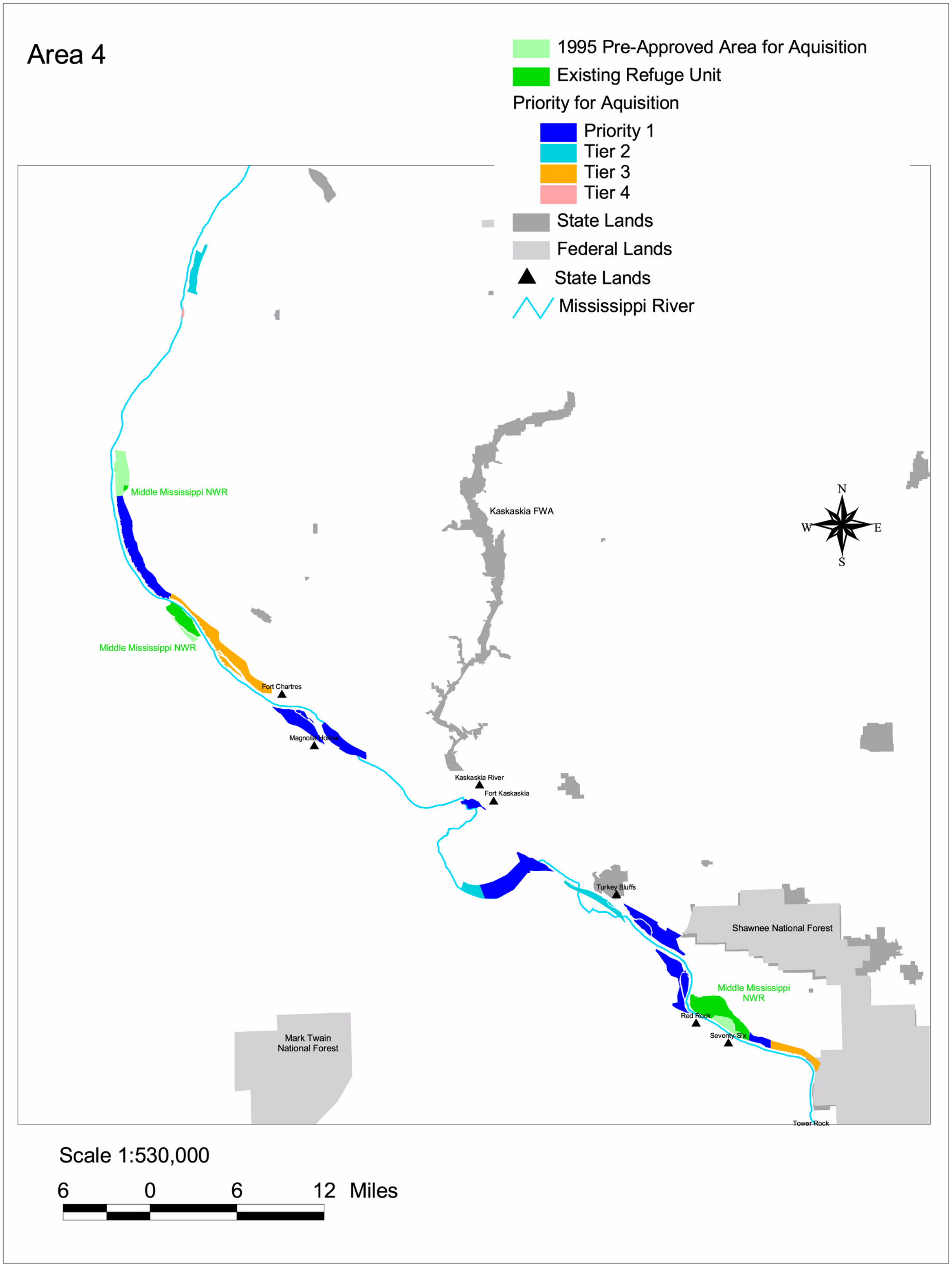

Mark Twain National Wildlife Refuge Complex Areas All Aquisition Areas
Davenport
Iowa
Peoria
Area 1
Area 2
Illinois
Decatur
Springfield
Area 3
St. Louis
Missouri
Area 4
Area 5
Existing Refuge Unit
1995 Pre-Approved Area for Aquisition
All Aquisition Areas
Mississippi River



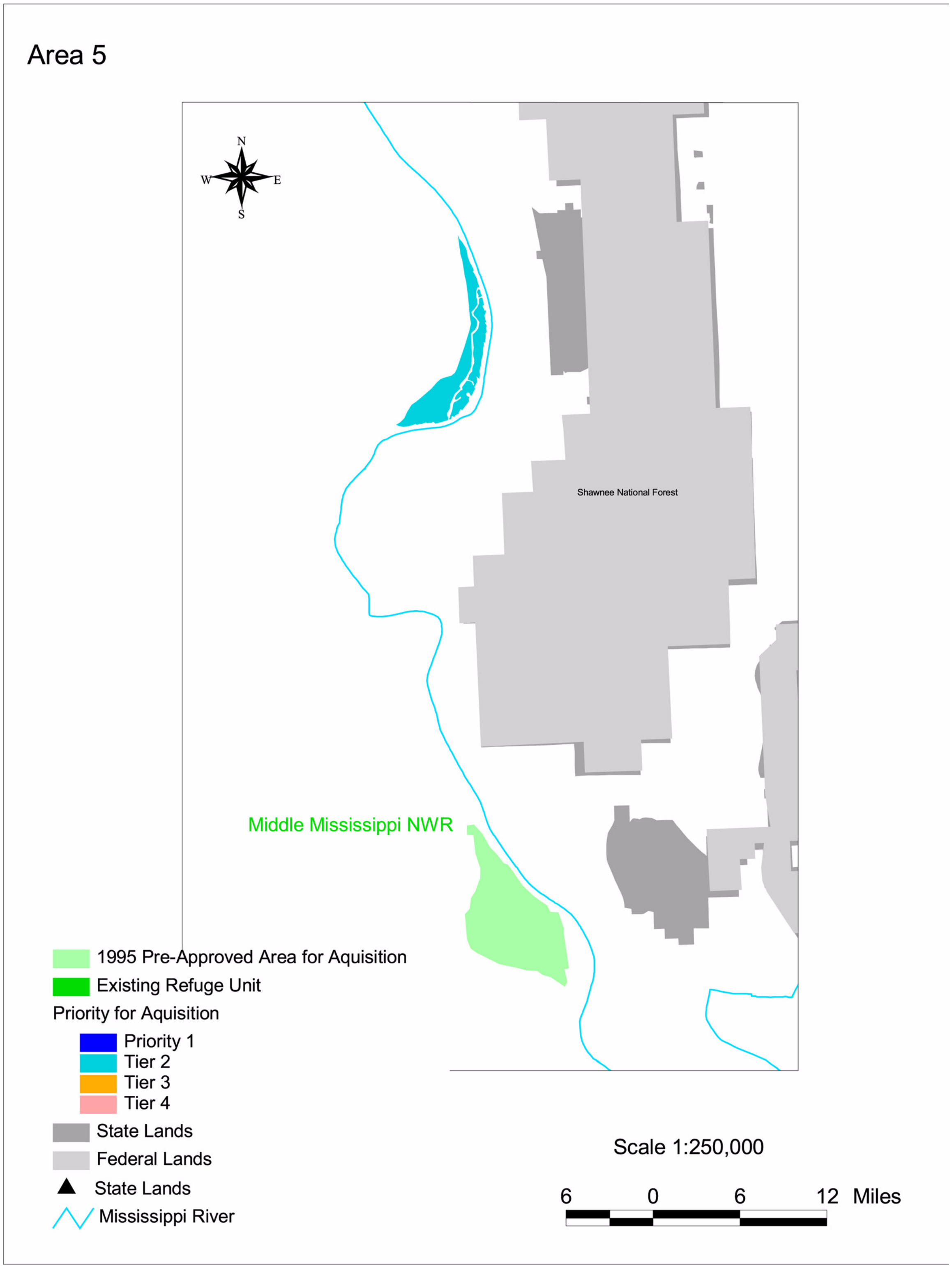
Area 1
Scale 1:400,000
5 0 5 10 Miles
N
W
E
S
Port Louisa NWR
Lake Odessa
Boston Bay
Port Louisa NWR
Port Louisa NWR
Huron Island
Big River
Geode State Park
Iowa Army Ammunition Plant
1995 Pre-Approved Area for Aquisition
Existing Refuge Unit
Priority for Aquisition
Priority 1
Tier 2
Tier 3
Tier 4
State Lands
Federal Lands
State Lands
Mississippi River


Area 2
Great River NWR
Great River NWR
Quincy Bay
Cottonwood Island
Ward Island
N
W
E
S
1995 Pre-Approved Area for Aquisition
Existing Refuge Unit
Priority for Aquisition
Priority 1
Tier 2
Tier 3
Tier 4
State Lands
Federal Lands
State Lands
Mississippi River
Scale 1:320,000
4
0
4
8
Miles


Area 3
Scale 1:470,000
7 0 7 14 Miles
N
E
S
W
Ted Shanks
Great River NWR
Pharrs Island
Clarksville
Rip Rap Landing
Clarence Cannon NWR
Prairie Slough
Reds Landing
BK Leach
Two Rivers NWR
Stump Lake
Pere Marquette
Calhoun Point
Two Rivers NWR
Cuivre Island
Two Rivers NWR
Dresser Island
Riverlands EDA
1995 Pre-Approved Area for Aquisition
Existing Refuge Unit
Priority for Aquisition
Priority 1
Tier 2
Tier 3
Tier 4
State Lands
Federal Lands
State Lands
Mississippi River



Area 4
1995 Pre-Approved Area for Aquisition
Existing Refuge Unit
Priority for Aquisition
Priority 1
Tier 2
Tier 3
Tier 4
State Lands
Federal Lands
State Lands
Mississippi River
Middle Mississippi NWR
Kaskaskia FWA
N
W
E
S
Middle Mississippi NWR
Fort Chartres
Magnolia Hollow
Kaskaskia River
Fort Kaskaskia
Turkey Bluffs
Shawnee National Forest
Middle Mississippi NWR
Red Rock
Seventy-Six
Mark Twain National Forest
Tower Rock
Scale 1:530,000
6 0 6 12 Miles


Area 5
N
W
E
S
Shawnee National Forest
Middle Mississippi NWR
1995 Pre-Approved Area for Aquisition
Existing Refuge Unit
Priority for Aquisition
Priority 1
Tier 2
Tier 3
Tier 4
State Lands
Federal Lands
State Lands
Mississippi River
Scale 1:250,000
6 0 6 12 Miles

Appendix N: Summary and Disposition of Comments on Draft Comprehensive Conservation Plan

Appendix N: Summary and Disposition of Comments on Draft Comprehensive Cconservation Plan

Comments were received on the Draft Comprehensive Conservation Plan from the Illinois Department of Natural Resources, the Missouri Department of Conservation, the Iowa Department of Natural Resources, and two U.S. Army Corps of Engineers Districts (St. Louis and Rock Island). In addition, the Illinois Branch of The Nature Conservancy submitted comments on the Plan. A total of 28 individuals submitted comments on the draft plan, 18 of which were sent as email and 10 through the mail.

We considered the comments as we prepared the final Comprehensive Conservation Plan. The following paragraphs summarize the comments and our response. In addition to the comments, some reviewers noted typographical errors and minor editing needs. We thank the reviewers for catching these errors and we have corrected them.

U.S. Army Corps of Engineers:

The U.S. Army Corps of Engineers (COE) served as a Cooperative Agency according to National Environmental Policy Act (NEPA) guidelines during the entire Mark Twain CCP process. This involved additional interactions directly with the COE at each stage of the process in which draft content or program direction could possibly affect COE interests. The COE does not have "approval" privileges on this plan, however their input is given particular evaluation due to the other Federal authority the agency represents.

St. Louis District:

- Requested that the Service indicate that the Rivers Project Master Plan has been approved (as of July 2001) and that mutually agreed upon administrative boundary adjustments on General Plan/ Cooperative Agreement lands have been accomplished through this plan.

  Response: These revisions have been made.
- In regard to Clarence Cannon NWR, commented that it should be understood that any reduction to downstream flooding would be minimal due to installation of flood damage reduction spillway, which also permits flood water storage at a lower river level.

  Response: This revision has been made.
- Suggested clarifying the statement concerning river structures: Since the early 1970s, structures in the Middle Mississippi River have been coordinated and designed with environmental considerations and have been providing aquatic habitat benefits. As the St. Louis District has developed and experimented with designs and brought partners into the process, they have been continuing to achieve even more positive results.

  Response: Paragraph was reworded
- Iindicated that while water levels at the upper ends of navigation pools were slightly modified, they do most closely resemble the river's natural condition.

  Response: Reference statement reworded
- Commented that our statement regarding decreased sediment transport within the pools is questionable concerning pools 24, 25 and 26. The Combination of regulating structures and operations based on hinge point control results in adequate sediment transport. This may be a valid statement for pools managed with few regulating structures and operated on dam point control.

  Response: Reference statement reworded

- Regarding Goal 4 Discussion – The discussion of the training structures is a fair accurate portrayal of the recent conditions of the lower Missouri River. It could also be construed as a fairly accurate portrayal of the future conditions if a river were managed solely for the purpose of navigation, with no other considerations or objectives taken into account. However, it is not a fair representation of the Middle Mississippi River, where a large number of islands and side channels exist primarily as a direct result of either the original design or modifications (notching) of existing training structures. Recent innovations (bend way weirs, off bank revetments, chevrons, etc.) have resulted in additional tools to yield environmental benefits while maintaining a safe dependable navigation channel.

  Response: Reference statement reworded to acknowledge all these efforts.

Rock Island District:

- The statement which reads "A significant feature of the Land Use Allocation Plan (LUAP) is the Shoreline Management Plan (SMP)….", requires revision. The SMP establishes the District's administrative policy concerning private exclusive use of recreational structures such as boat docks. The SMP does not set policy for the cottage site lease program which is also considered private exclusive use.

  Response: Reference statement reworded to add this land use guidance detail.

- Need citation to support the statement "Consequently, both commercial fish and mussel harvesting were dramatically decreased." Fish and mussel populations fluctuated greatly prior to the construction of dams on the Upper Mississippi River. Recommend authors consider Townsend (1901) and Carlander (1954). The decline in fish and mussel populations has a stronger correlation with pollution and over harvest than it does with dams.

  Response: CCP statement is in relation to the early dams built in Hastings, Minnesota and Keokuk, Iowa. We don't know which of these is more causal, however over-harvests and pollution conditions have improved over the years while many more dams are now in place since the this statement was made about the Hastings and Keokuk pools. The 1931 Hastings citation, which was mistakenly omitted from the draft, has been added to the CCP.

  Rock Island District also provided numerous comments on the CCP Environmental Assessment (EA) relating to content questions, document organization and typographic errors. These changes were made as necessary.

Other Comments Received by Subject Area

Shorebirds

- Fifteen comments were received recommending that the Refuge Complex create wetland habitat for shorebirds where water levels are managed and controlled to coincide with early spring and fall migration, particularly at Two Rivers NWR.

  Response: Within the Wetlands and Aquatic habitats section, we have focused on the habitats themselves more than the long list of species that utilize each type. However we also recognize that all other things being equal, a few inches of water can change habitat utilization, species by species. In the Wetlands and Aquatic Habitat Goal section, 15 strategies indicate that our water levels can be managed to provide habitat for migrating shorebirds. We share the intended outcome expressed by these citizens. The best opportunity to address the level of detail that these comments speak to will be in the "step-down" water level management plans prepared at each individual station during the next couple years after the completion of the CCP.

We will also review the public use sections of the plan to see if there may be additional ways to make these prime shorebird habitats more available for viewing.

Land Acquisition:

The Illinois Department of Natural Resources, the Missouri Department of Conservation, and the Iowa Department of Natural Resources offered support in favor of the land acquisition proposal outlined in the Draft Plan. Specifically, representatives of these agencies said:

- "Illinois has limited public land available to citizens and any effort to provide land for outdoor recreation and natural resource conservation is desperately needed. Efforts targeting the Middle Mississippi between its confluence with the Missouri and Ohio rivers are necessary due to limited public land and resource management opportunities." *Illinois DNR.*
- "Purchasing land from willing sellers within the proposed purchase boundary will improve and enhance opportunity to increase floodplain connectivity and flood water storage capabilities, restore and create wetlands and other floodplain habitats, reduce he impacts to sedimentation and provide benefits to resources and recreationists in the Upper Mississippi River." *Missouri DOC*
- "The goals, objectives and implementation outlined in the document are consistent with the DNR goals along the Mississippi River. We would like to emphasize our desire to expand refuge lands through additional acquisition as stated in Alternative A. As you are aware, Iowa has one of the lowest percentages of public lands. We support the acquisition of additional lands, from willing sellers, to add to Iowa's limited public lands base……The Levee District 11 area would be an important addition that would tie the Horseshoe Bend Division to our Millrace Flats Wildlife Area and the Louisa County Conservation Board's Indian Slough Wildlife Area. The addition would create a continuous 8,000-acre corridor on the lower Iowa River." *Iowa DNR*
- One citizen commenter stated support for land acquisition and suggested that the Service consider acquiring Priority 2-4 lands when they are adjacent to existing refuges and have the potential to contribute to restoring river connectivity.
- Another commenter expressed opposition to land acquisition at Two Rivers NWR, saying that the Refuge should instead "manage what we already have." The individual also stated that the Refuge should work with private land owners along Swan Lake who have major tributaries (ditches) that lead into the lake.
- The Nature Conservancy indicated full support for the implementation of the Preferred Alternative.

  Response: The acquisition of key land would make existing Refuge lands as well as adjoining state wildlife areas better for wildlife, public use and water quality. Priority land for the Refuge Complex is land that has proven to be too flood-prone for good and consistent agricultural practices and highly restorable; both natural resources and willing sellers would benefit from the planned boundary expansion. Working with private landowners, as suggested by the landowner adjacent to Two Rivers NWR, is vital to habitat restoration throughout the watershed and the CCP reflects our desire to work with private landowners on conservation projects they may wish to undertake.

Wildlife-dependent Recreation

- One commenter suggested that more effort should go toward fish and aquatic species for sport fishing instead of the waterfowl focus.

Response: In compiling the final CCP, Refuge staff felt that the Refuge's authorized purpose mandates a migratory bird focus, however every effort has been made to evaluate the whole system and to plan a balanced approach for all native species based on habitat health and diversity, along with compatible public uses.

- The Iowa DNR expressed support for a proposed "no wake zone" but noted that some boaters and anglers may object.

  Response: No change to the CCP was necessary.

- The Iowa DNR recommended continued use of permanent hunting blinds if there is hunter support for them and if blinds are not resulting in an adverse effect.

  Response: Due to the potential to expand public hunting opportunity and to reduce the amount of debris in the river from this activity, Refuge staff maintained the existing strategy, which proposes to restrict permanent blind construction on the Big Timber Division of Port Louisa NWR in Iowa, in favor of open hunting with portable blinds.

- An individual commenter encouraged the Refuge Complex to increase public use opportunities on the refuges when it is compatible with fish and wildlife species. Specifically, the commenter wants the Complex to build trails and boardwalks, develop information kiosks and interpretive displays, and build wildlife observation platforms. The commenter said that emphasis should be placed on facilities that are designed to be inundated and not on structural facilities that would be damaged by flooding.

  Response: No editing necessary; the CCP includes strategies for new facilities, improvements to existing facilities, and improved educational material.

Wildlife and Habitat

- While the Iowa DNR supports management as it is outlined in Alternative A, the agency expressed strong interest in maintaining at least partial isolation from the river in some places to reduce sedimentation and allow water level manipulation. The Iowa DNR stated that Alternative A (the preferred alternative) maintains the flexibility to make area-by-area decisions on management.

  Response: We believe that Alternative A offers the flexibility to provide various levels of connectivity or isolation from the river depending on evaluation of the specific conditions site by site. No change was made to the CCP.

- An individual commenter in interested Port Louisa NWR said that the Complex should: buy additional land to the south and north; modify refuge close dates from September 16 to December 15; add interpretive panels and kiosk at boat ramp; make a no wake zone; dredge for fish habitat; work with adjoining landowners to provide a buffer to stop nutrient invasion; add restroom facilities at boat ramp; remove volunteer trees from boat ramp; improve sand prairie at boat ramp parking area and add more forbs; move boat ramp entrance to improve sight at a distance; improve parking facilities; add fish cribbing to dredged area; add clam colonies to preserve water; improve trail along levee for hiking and biking; purchase old train bridge for future bike trail to Iowa; relocate snags from dredging for fish habitat; provide a GPS/GIS depth chart and map for fishermen; enhance shallow wetlands; provide a fish hatchery for the park.

  Response: Land Acquisition, closed area dates, kiosk, map improvements, no wake zone, limited dredging, adjacent private lands work, and enhancement of wetland values recommendations are each addressed in CCP as prepared. Specific suggestions relating to facility design are noted and will be addressed location by location as site plans are prepared. There are no plans to buy the "old railroad bridge" as the Service would assume a huge liability with no attendant wildlife or habitat value. There are not plans for a fish hatchery within the Complex, however, the refuge would be glad to work with volunteer groups on issues such a fish cribbing where and when appropriate opportunities exists.

- An individual offered comments pertaining to the Wilkinson Island section and the Illinois additions: Improve wetland habitat as needed; a small water control dam could hold back water throughout low lying areas at the Bower's woods; better access needed on the old township road to the back part of the area near the river; The Wagner Landing boat ramp needs to be replaced with a better ramp; fee hunters should not be allowed to drive to the adjoining Vasquez property and hunt on refuge land.

  Response: Evaluations for wetland restoration opportunity will generally occur after legal access has been gained to properties, and assuming that any such plans would not negatively affect any private lands, such as may be the case at the old Bower property at this time. Unimproved road maintence in the flood plain is problematic and thus most of the river "bottom" areas will be managed with very little infrastructure. Private permit hunters using "easement" access across the refuge is not a CCP issue and will be taken up as a coordination issue with the inholding owner.

- One individual encouraged the Complex to plant corn and beans on refuges to benefit bird populations.

  Response: The Service is focusing on providing native habitat that provides necessary nourishment for waterfowl species rather than relying on agricultural crops. This focus reflects a shift in management approach based on waterfowl nutritional needs research.

- The COE, Rock Island District, suggested mentioning a significant new threat to wetland vegetation in the form of invading common reed (*Phagmites australis*).

  Response: This plant has been added to the list of plants threatening Complex habitats.