U.S. Fish & Wildlife Service

Two Rivers
National Wildlife Refuge

Comprehensive Conservation Plan Summary

The mission of the U.S. Fish & Wildlife Service is working with others to conserve, protect, and enhance fish and wildlife and their habitats for the continuing benefit of the American people.

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.
Mission of the National Wildlife Refuge System

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.

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Disclaimer

In 2004, the U.S. Fish and Wildlife Service completed a Comprehensive Conservation Plan, or CCP, for the Mark Twain NWR Complex. Covering five national wildlife refuges – Port Louisa NWR, Great River NWR, Clarence Cannon NWR, Middle Mississippi River NWR, Two Rivers NWR and Middle Mississippi River NWR – it is a bulky document.

For Refuge Managers who want to consult the CCP for guidance on management issues, it is worse than bulky, it is unwieldy. This document is an attempt to pare down the full CCP into a Two Rivers NWR CCP.

This document is intended to be a handy reference, not an all-inclusive separate CCP for Two Rivers NWR. For complete information, please refer to the Mark Twain NWR Complex CCP either on the Service's planning website (http://www.fws.gov/midwest/planning/marktwain), or by calling the Complex Headquarters at 217/224-8580.

Two Rivers NWR

Spanning 28 miles of the Mississippi River in the states of Illinois and Missouri and 9 miles of the Illinois River, Two Rivers NWR is located near the confluence of the Mississippi and Illinois Rivers. The Refuge includes five divisions – Calhoun, Gilbert Lake, Batchtown, Portage Island, and the Apple Creek Division – totaling 8,500 acres.

Two Rivers NWR functions as an important link for migratory birds that rest, feed, and winter along the Mississippi Flyway. More than 200 different species of birds funnel through this important river juncture on their fall migration, including over 5,000,000 ducks and 50,000 geese. Open water pools, backwater sloughs, small impoundments, wetland management units, and a cooperative farming program all contribute to this objective. The Refuge is one of the four national wildlife refuges that make up the Mark Twain NWR Complex.

As with the other refuges of Mark Twain NWR Complex, Two Rivers NWR is a popular area for the federally listed threatened Bald Eagle, with over 1,000 over-wintering in the area. Two Rivers is also one of the few remaining places where the *Boltonia decurrens* (decurrent false aster), a federally listed threatened plant, can still be found.

Comprehensive Conservation Planning

The National Wildlife Refuge System Improvement Act of 1997 mandated that each national wildlife refuge in the country to develop a Comprehensive Conservation Plan (CCP) to direct its management. Comprehensive conservation plans provide management goals and objectives to guide refuges and strategies to implement those objectives over the course of 15 years.

The CCP is a vital part of the future of Two Rivers NWR. Although prepared by the U.S. Fish and Wildlife Service (Service), the plan incorporates the ideas and concerns expressed by many organizations and local residents during the planning process.

U.S. Fish & Wildlife Service

The U.S. Fish and Wildlife Service is the primary federal agency responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. Our specific responsibilities include enforcing federal wildlife laws, managing migratory bird populations, restoring nationally significant fisheries, administering the Endangered Species Act, and restoring wildlife habitat such as wetlands. The mission of the Service is to work with others to conserve, protect, and enhance fish, wildlife and plants and their habitats for the continuing benefit of the American people.

The Service's role also includes managing the National Wildlife Refuge System, the world's largest collection of lands specifically managed for fish and wildlife. The System is a network of more than 540 national wildlife refuges encompassing more than 93 million acres of public land and water. 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.

Refuges are also unique places for people. When it is compatible with wildlife and habitat needs and the purpose for which the refuge was established, they can be used for wildlife- dependent activities such as hunting, fishing, wildlife observation, photography, environmental education and environmental interpretation.

Vision Statement for the Mark Twain NWR Complex

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. Refuge 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.

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.

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.

Mark Twain NWR Complex Goals

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.

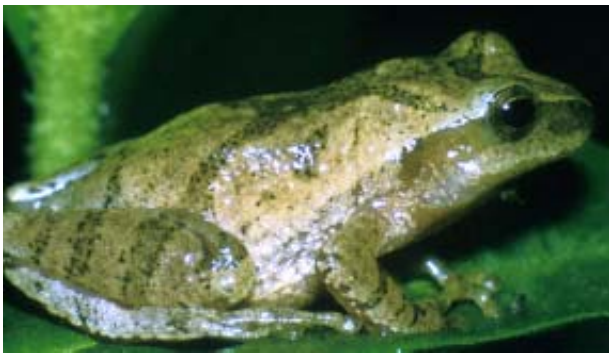
Public Use and Education: Provide wildlife-dependent recreation and education opportunities where appropriate, and improve the quality and safety of the visitor experience.

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.

Area of Ecological Concern

The lands and waters of the Mark Twain NWR 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.

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.

Need for Action/Planning Perspectives

The 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.

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 NWR 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. The 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.

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

Mammals

Indiana bat (*Myotis sodalis*)

Birds

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*)

History and Establishment of Mark Twain NWR Complex

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.

Two Rivers National Wildlife Refuge

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 area of ecological concern for Mark Twain NWR Complex 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 River Mile 246 and River Mile 251.5 in Pool 25. The Division includes about 2,300 acres of forests, backwater sloughs, scrub-shrub, 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 River Mile 5 to River Mile 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 completed in 2003. 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 River Mile 3.8 to 8. Gilbert Lake totals approximately 735 acres, consisting of a 250-acre lake bordered by forest and grassland. 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. 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, River Mile 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.

Management Direction

Refuge Management Considerations

Wetland Management

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 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 smart-

weed, 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 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.

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.

Divisions within the Mark Twain NWR 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.

Even with varying levels of water management control on three divisions of Two Rivers NWR, (Calhoun, Batchtown, Gilbert Lake) 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.

Forest Management

Open water and forest are the largest habitat cover types along the river corridor, both historically and presently. 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 that 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. 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-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 NWR 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.

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 the Refuge, 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

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 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 preapproved 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.

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.

One problem confronting the entire 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.

Table 1: Prescribed Burn Units, Two Rivers NWR

Division	Acres
Calhoun	190
Gilbert Lake	83
Total	273
Refuge Complex Totals	9,573

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.

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 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.

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.

Illinois has 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*). Noxious and exotic weeds are controlled biologically, mechanically, or chemically on Two Rivers NWR. Chemical use has been greatly reduced 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.

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 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.

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 NWR 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 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.

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).

Intermittently during the past several years, commercial fishing has been used as a management tool at Swan Lake in the Calhoun Division. 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.

Trapping

Trapping of furbearers is utilized occasionally as a management tool by the Refuge 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.

Management of Lands Associated with Agriculture Department (USDA)

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.

Refuge staff are responsible for reviewing foreclosed properties in an assigned number of counties. 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.

Two Rivers NWR manages 19 FSA conservation easements totaling 257 acres. 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.

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.

Two Rivers NWR is accountable for private lands activities in 4 west-central Illinois Counties.

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

The goals that follow are general statements of what we want to accomplish within the Mark Twain NWR Complex in the next 15 years.

The objectives are specific statements of what will be accomplished to help achieve a goal. Objectives describe the who, what, when, where and why of what is to be accomplished. Strategies are listed under each objective to specify the activities that will be pursued to realize an objective.

The goals, objectives and strategies were drafted for the Complex as whole. The CCP includes specific strategies for each Refuge within the Complex. This summary includes only the strategies pertaining to Two River NWR. There are instances when objectives did not include specific strategies for the Refuge. Those objectives are included in this summary, and we also note that the strategies did not pertain to Two Rivers NWR.

Habitat Goals

Land and water resources within Two Rivers NWR and the entire Upper Mississippi River 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.

Two Rivers NWR 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 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 Refuge 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 NWR 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. Two Rivers NWR is 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 NWR 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.

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)

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 Refuge. 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. At Two Rivers NWR, a combination of flooding, drying, mowing discing, burning, and agriculture are used to enhance wetland habitat on Calhoun, Gilbert Lake, and Batchtown divisions. 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 Refuge 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.

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, 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.

Strategies Table 1: Wetlands and Aquatic Habitat Strategies (Objective 1.A)

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres				Additional Information
			SFE	SPF	P	OW	*"✓" 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.
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 1.A. Provide a 6-year average 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.

Strategies: Manage the wetland impoundments described in Strategies Table 1: Wetlands and Aquatic Habitat Strategies (Objective 1.A) on page 24 to protect and enhance wetland vegetation.

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 in Strategies Table 2 .

Objective 1.C. 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 in Strategies Table 3.

Strategies Table 2: Wetlands and Aquatic Habitat Strategies (Objective 1.B)

Strategy Number	Units	Total Wetland Acres	Vegetation Type of Optimum Acres			Additional Information
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.

Strategies Table 3: Wetlands and Aquatic Habitat Strategies (Objective 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 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 spe-

cies). 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 topmost 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 cot-

tonwood-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 succes-

Strategies Table 4: Forest Habitat Strategies 2.A.1 (Objective 2.A)

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.

sional 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.

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.) (See Strategies Table 4)

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. (See Strategies Table 5)

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 replant-

Strategies Table 5: Forest Habitat Strategies 2.A.2 (Objective 2.A)

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.

Strategies Table 6: Forest Habitat Strategies 2.B.3 (Objective 2.B)

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.

ing 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.

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 (Strategies Table 6).

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. 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.7. 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.

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 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

Strategies Table 7: Other Terrestrial Habitats Goal, Strategies 3.B (Objective 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.

area are heavily hunted during waterfowl season. Crops on Refuge lands provide feeding and resting areas for waterfowl in unhunted sanctuaries during fall migration. The Refuge 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 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 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 on the Refuge 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 Refuge 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 Table 8: Other Terrestrial Habitats Goal, Strategies 3.C (Objective 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.

Strategies Table 9: Other Terrestrial Habitats Goal, Strategies 3.D (Objective 3.D)

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

Strategies Table 10: Other Terrestrial Habitats Goal, Strategies 3. E (Objective 3.E)

Strategy No.	Units 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.

Strategies: No strategies planned for Two Rivers NWR.

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 divisions described in Strategies Table 7.

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 divisions described in Strategies Table 8.

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 Divisions described in Strategies Table 9.

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 units described in Strategies Table 10.

Strategies Table 11: Other Terrestrial Habitats Goal, Strategies 3.F (Objective 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.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 units described in Strategies Table 11.

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: There are no strategies planned for Two Rivers NWR.

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 crop ground was returned to production.

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.

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.

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. (See Strategies Table 12)

Strategies Table 12: Sedimentation and Water Quality Goal, Strategies 4.A (Objective 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.	

Strategies Table 13: 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.	

Strategies Table 14: 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.
4.B.20	Gilbert Lake	Dredge deep water holes to improve water quality (low dissolved oxygen) for fish.	

Objective 4.B. Reduce sedimentation and improve overall water quality on Refuge System lands by 2010 for the benefit of fish and wildlife populations. (See Strategies Table 14.)

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.

Table 2: Connectivity and Sedimentation, Two Rivers NWR

Division	Acres (From GIS Data)		
	Open to River	Levee with Spillway (Connectivity Every 1 to 5 Years)	Major Levee
Cahoun	0	4,836	0
Gilbert Lake	0	736	0
Batchtown	1,149	995	0
Portage Islands	230	0	0

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.

Two Rivers NWR Floodplain Management

Two Rivers NWR will, like all of the refuges within Mark Twain NWR Complex, continue to be managed using an integrated approach to floodplain management. When making floodplain management decisions within the AEC, Refuge staff 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.
- # 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.

On Two Rivers NWR, Gilbert Lake, Calhoun, and the lower end of Batchtown divisions 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.

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 Refuge 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 Refuge 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)

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, the Refuge 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 rec-

Strategies Table 15: Floodplain Management Goal, Strategies 5.A (Objective 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.
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.

ognizes 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 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. (See Strategies Table 15)

Objective 5.B. Manage refuge lands for wildlife first, while considering UMR floodplain functions and contributing to improving those values (see Strategies Table 16).

Strategies Table 16: Floodplain Management Goal, Strategies 5.B (Objective 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.

Although Two Rivers NWR is located in a rural region of Illinois, it is within 50 miles of St. Louis, Missouri. Tourism is increasing within the entire 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 Two Rivers NWR and all of the refuges in the Mark Twain NWR complex. Two Rivers NWR 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 Refuge 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 optimal, higher elevations. The 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, there are great opportunities for the public to visit the Refuge and view waterfowl and other migrating birds. 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 Refuge 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 the Refuge has conducted special events or field trips on an opportunistic basis.

Strategies Table 17: Discussion, Public Use and Education Strategies (Objective 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.	
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.

Hunting and fishing regulations that were in place at Two Rivers for the 2000-2001 season are summarized below. 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.

The Refuge is open to public use during daylight hours only. The Batchtown, Calhoun, Portage Island, and Gilbert Lake Divisions are closed from October 15 through December 15.

Bicycling and hiking are allowed on Refuge roads unless otherwise posted.

Pets must be on a leash, except when used for the purpose of hunting where hunting is allowed.

Berry and mushroom gathering are permitted for personal consumption only. These items shall not be used for any commercial use.

Firearms: Except for authorized hunting on the refuge, firearms are only permitted when being transported on refuge roads or waters and must be unloaded and either dismantled or cased.

Camping is not permitted on the Refuge. Trapping is not permitted on the Refuge.

Hunting of deer, migratory birds, and upland game are allowed only on the Apple Creek Division, and in accordance with Illinois state seasons and regulations. Portable stands may be used, but they must be removed at the end of each day-s hunt. No nails, screws, or other hardware may be used to climb or secure blinds to the trees. Only portable blinds are permitted. Hunters must remove boats, decoys, and portable blinds at the end of each day-s hunt. The Batchtown, Calhoun, Portage Island and Gilbert Lake Divisions are closed to all forms of hunting.

Fishing is allowed year-round at the Apple Creek Division during daylight hours only in accordance with Illinois state seasons and regulations.

Batchtown, Calhoun, Gilbert Lake and Portage Island Divisions – Fishing is allowed during daylight hours only from January 1 through October 14, in accordance with Illinois state seasons and regulations. Boats are allowed in Batchtown and Swan Lake during this period for sport fishing purposes only. Boats are allowed in Gilbert Lake only when flood waters enable access from the river over the levee, and only for sport fishing purposes during the period specified above. Bank launching is not allowed in Gilbert Lake.

The taking of turtles or frogs is prohibited on the entire Refuge.

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. See Strategies Table 17.

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. (See Strategies Table 18.)

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. (See Strategies Table 19.)

Objective 6.D. Increase fishing opportunity by improving access at five Divisions by 2010 (Strategies Table 20).

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. (Strategies Table 21)

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. (Strategies Table 22)

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 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 Refuge 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 Two Rivers NWR 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.

Strategies Table 18: Goal 6: Discussion, Public Use and Education Strategies 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.
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.

Strategies Table 19: Discussion, Public Use and Education Strategies 6.C (Objective 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.	
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.

Strategies Table 20: Discussion, Public Use and Education Strategies 6.D (Objective 6.D)

Strategy No.	Division	Strategies	Comment
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.

Strategies Table 21: Discussion, Public Use and Education Strategies 6.E (Objective 6.E)

Strategy No.	Division	Strategies	Comment
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.	

Strategies Table 22: Discussion, Public Use and Education Strategies 6.F (Objective 6.F)

Strategy No.	Division	Strategies	Comment
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.	

Table 3: 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 burreed, hardstem bulrush
Seasonally Flooded Emergents	Seasonally Flooded Emergent Annual	Wild millet, beggartick, smartweed
	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 cutgrass, prairie cord-grass
Scrub-Shrub	Scrub-Shrub	Buttonbush, false indigo
Grassland	Grassland	Big bluestem, foxtail, roadside/levee grass
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 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 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 River-Watch.

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 refuge divisions within the Mark Twain NWR Complex. 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.

The Refuge 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 Refuge will improve 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.

Two Rivers NWR 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. See Strategies Table 23.

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. See Strategies Table 24.

Objective 7.C. Monitor public use and environmental education programs to ensure compatibility with wildlife purposes, visitor satisfaction/safety and outreach effectiveness. See Strategies Table 25.

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. See Strategies Table 26.

Objective 7.E. Develop and implement an effective record-keeping and data analysis system, compatible with HNA, to facilitate adaptive management decision-making. See Strategies Table 27.

Strategies Table 23: Monitoring Goal, Strategies 7.A (Objective 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.	

Strategies Table 24: Monitoring Goal, Mark Twain NWR Complex Strategies 7.8 (Objective 7.B)

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.	
7.B.5	Develop step-down inventory and monitoring plan with specific survey locations and protocols to cover above effects.	

Strategies Table 25: Monitoring Goal, Mark Twain NWR Complex Strategies 7.C (Objective 7.C)

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.	✓

Strategies Table 26: Monitoring Goal, Mark Twain NWR Complex Strategies 7.D (Objective 7.D)

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.
7.D.4	Work with partners to evaluate floodplain 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.

Strategies Table 27: Monitoring Goal, Mark Twain NWR Complex Strategies 7.E (Objective 7.E)

Strategy No.	Strategies	Comments
		"✓" 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.	

Appendix A: Two Rivers NWR Maps

Area of Ecological Concern

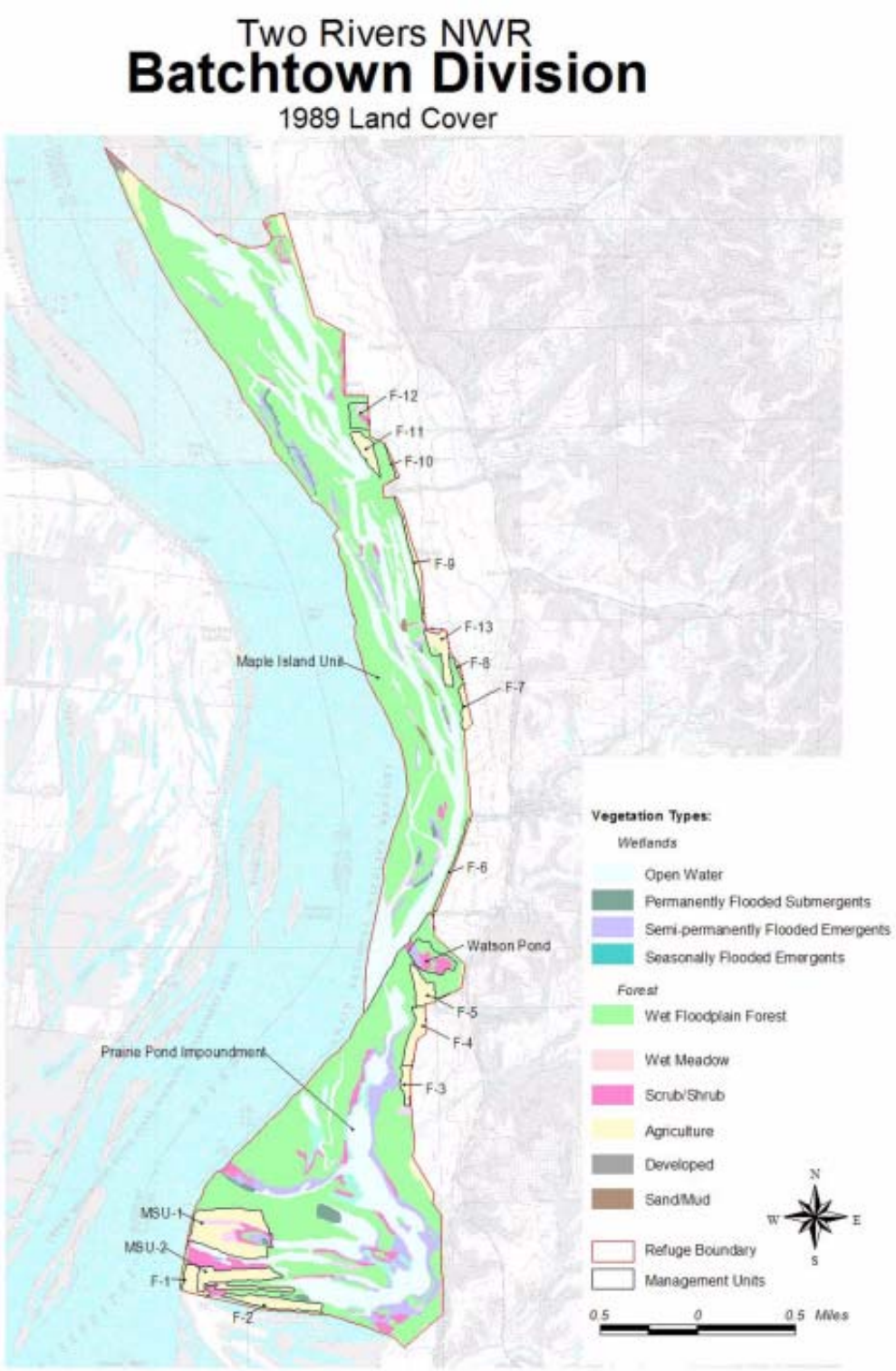
Current Land Cover

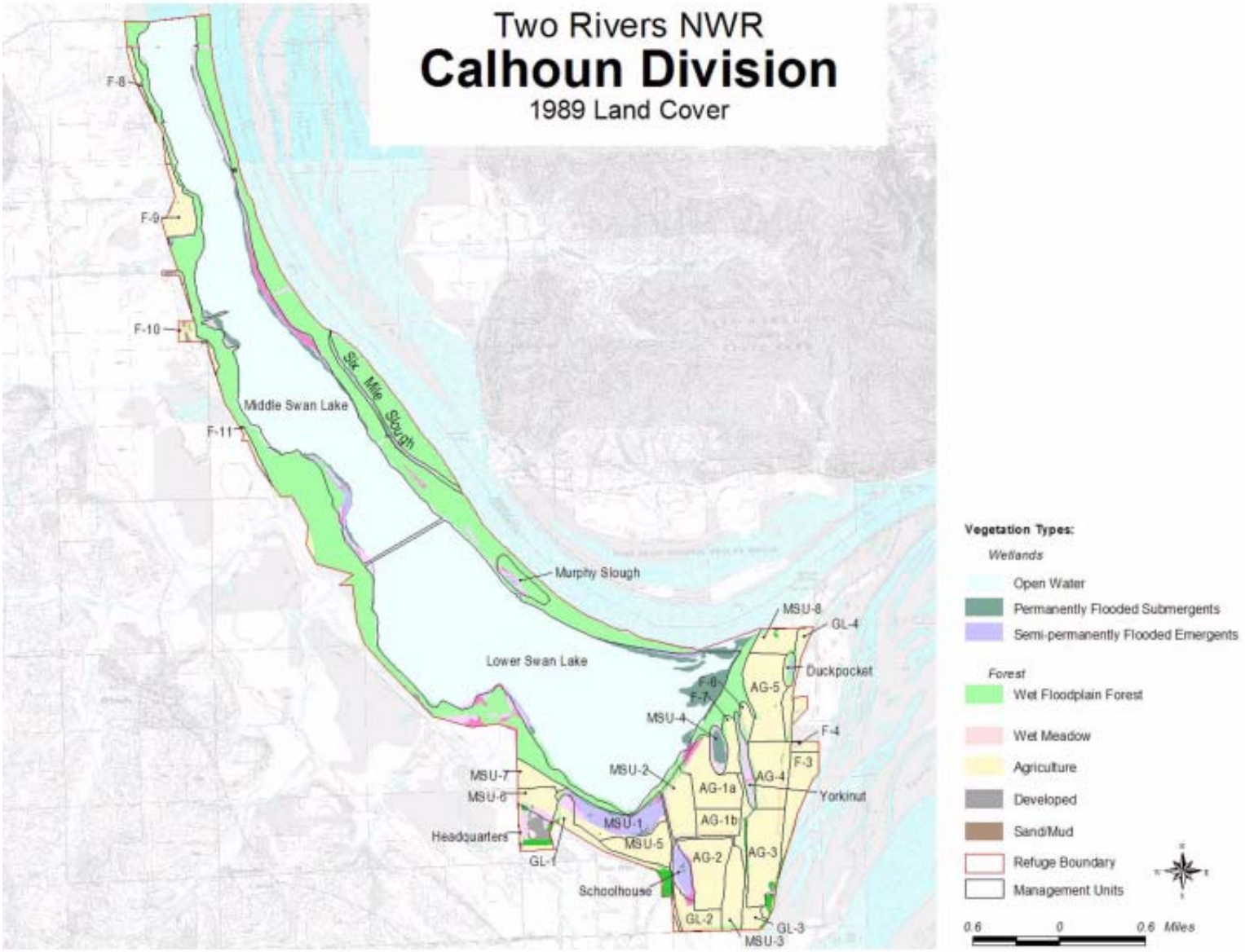
Existing Public Use Facilities

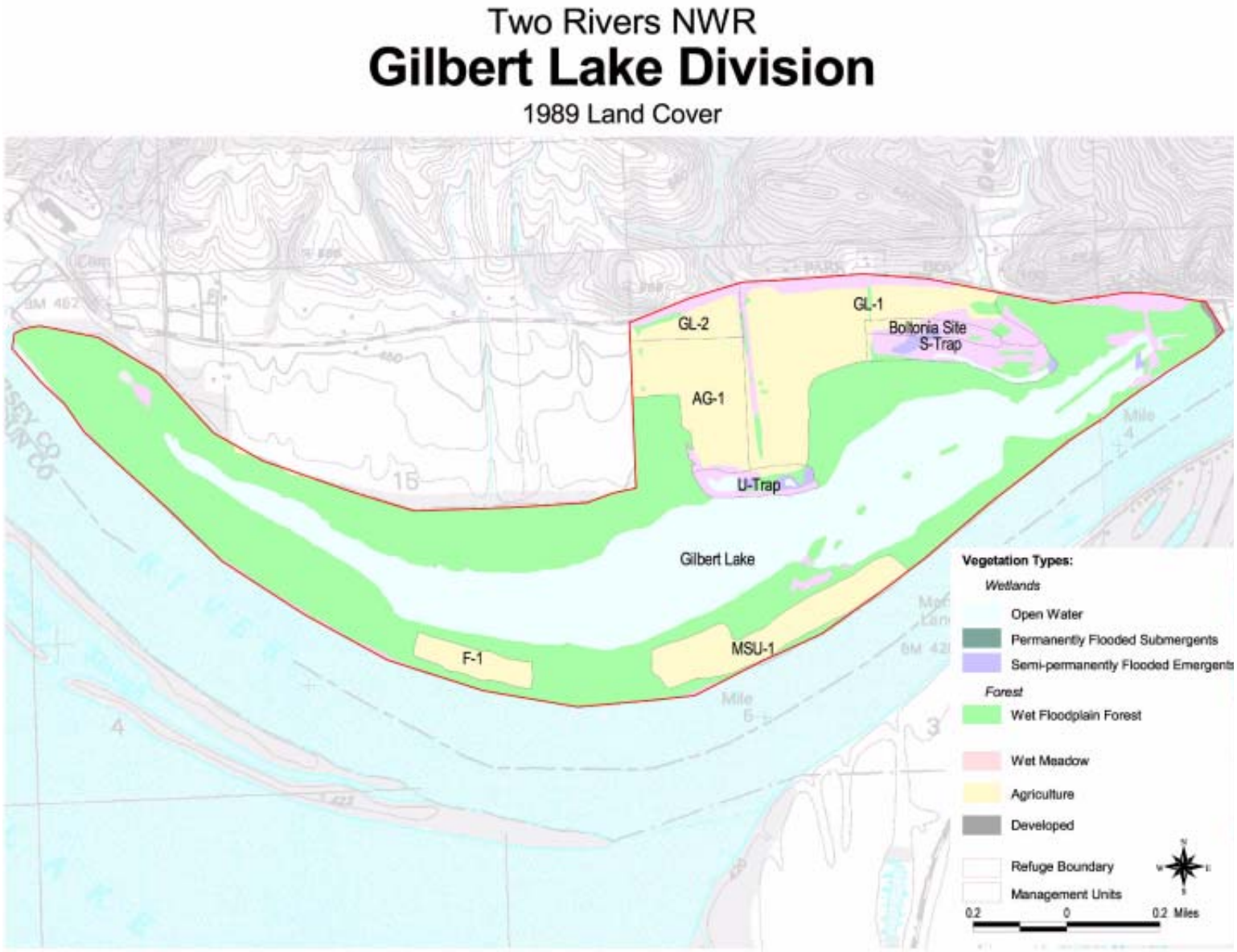
Future Land Cover

Mark Twain Refuge Complex Planning Area
"Area of Ecological Concern"

Current Land Cover


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
Prairie Pond Impoundment
F-3
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

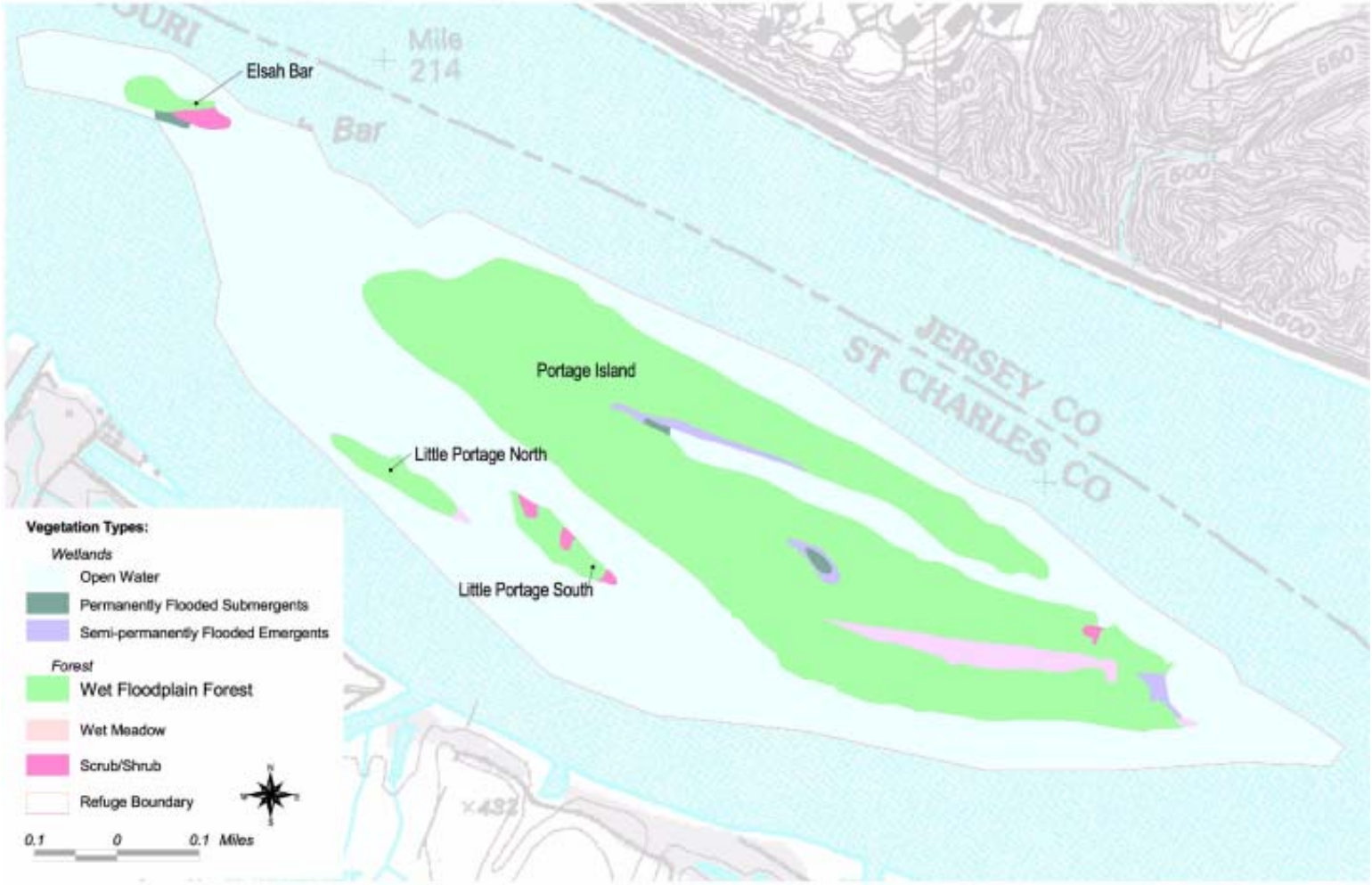

Two Rivers NWR
Calhoun Division
1989 Land Cover
F-8
F-9
F-10
F-11
Middle Swan Lake
Six Mile Slough
Murphy Slough
Lower Swan Lake
MSU-8
GL-4
Duckpocket
F-6
F-7
AG-5
MSU-4
F-4
F-3
MSU-2
AG-4
MSU-7
MSU-6
AG-1a
Yorkinut
MSU-1
AG-1b
Headquarters
MSU-5
AG-2
AG-3
GL-1
Schoolhouse
GL-2
GL-3
MSU-3
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Forest
Wet Floodplain Forest
Wet Meadow
Agriculture
Developed
Sand/Mud
Refuge Boundary
Management Units
0.6 0 0.6 Miles


Two Rivers NWR
Gilbert Lake Division
1989 Land Cover
GL-1
GL-2
Bollonia Site
S-Trap
AG-1
U-Trap
Gilbert Lake
F-1
MSU-1
Vegetation Types:
Wetlands
Open Water
Permanently Flooded Submergents
Semi-permanently Flooded Emergents
Forest
Wet Floodplain Forest
Wet Meadow
Agriculture
Developed
Refuge Boundary
Management Units
0.2
0
0.2 Miles

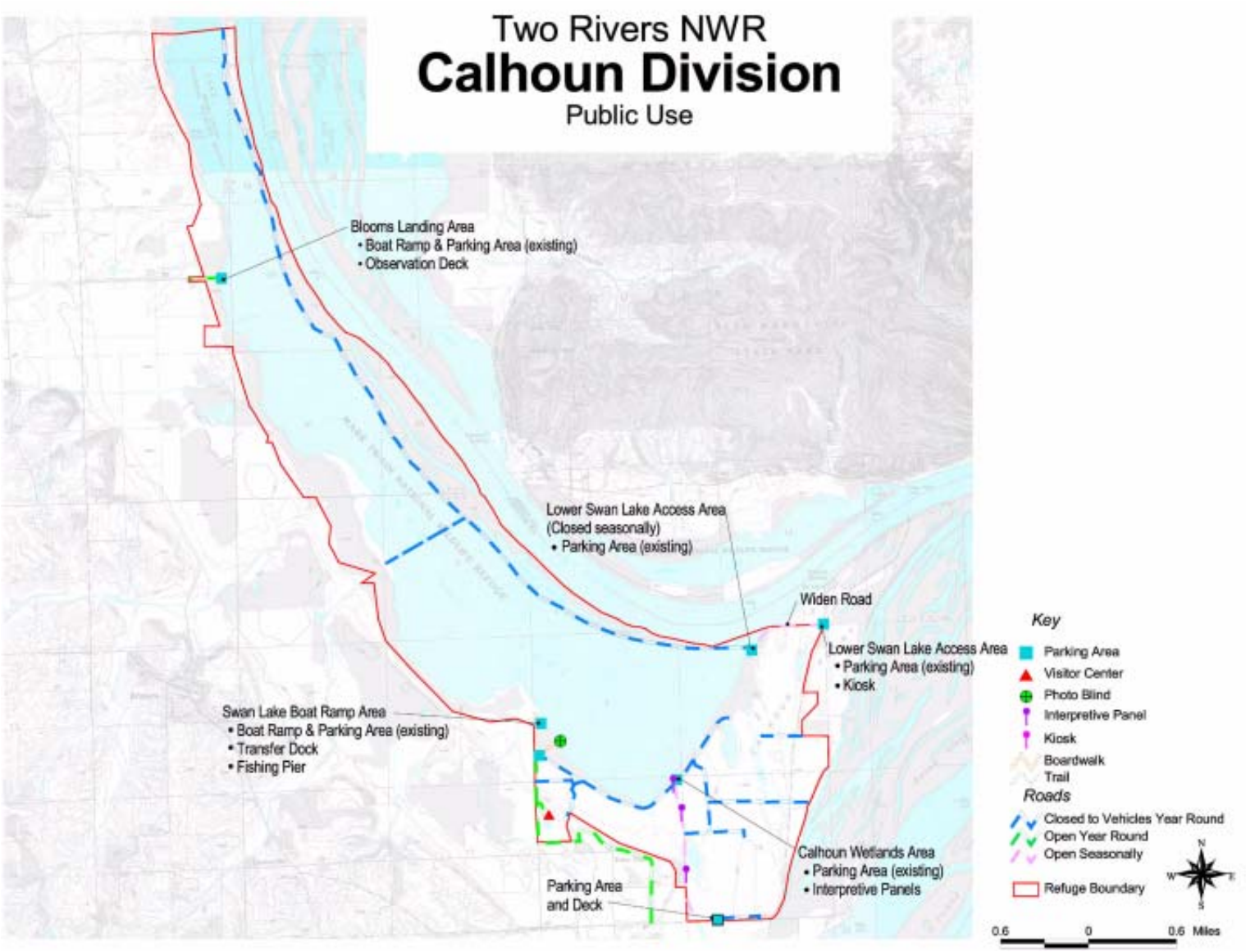
Two Rivers NWR

Portage Island Division

1989 Land Cover



Existing Public Use Facilities

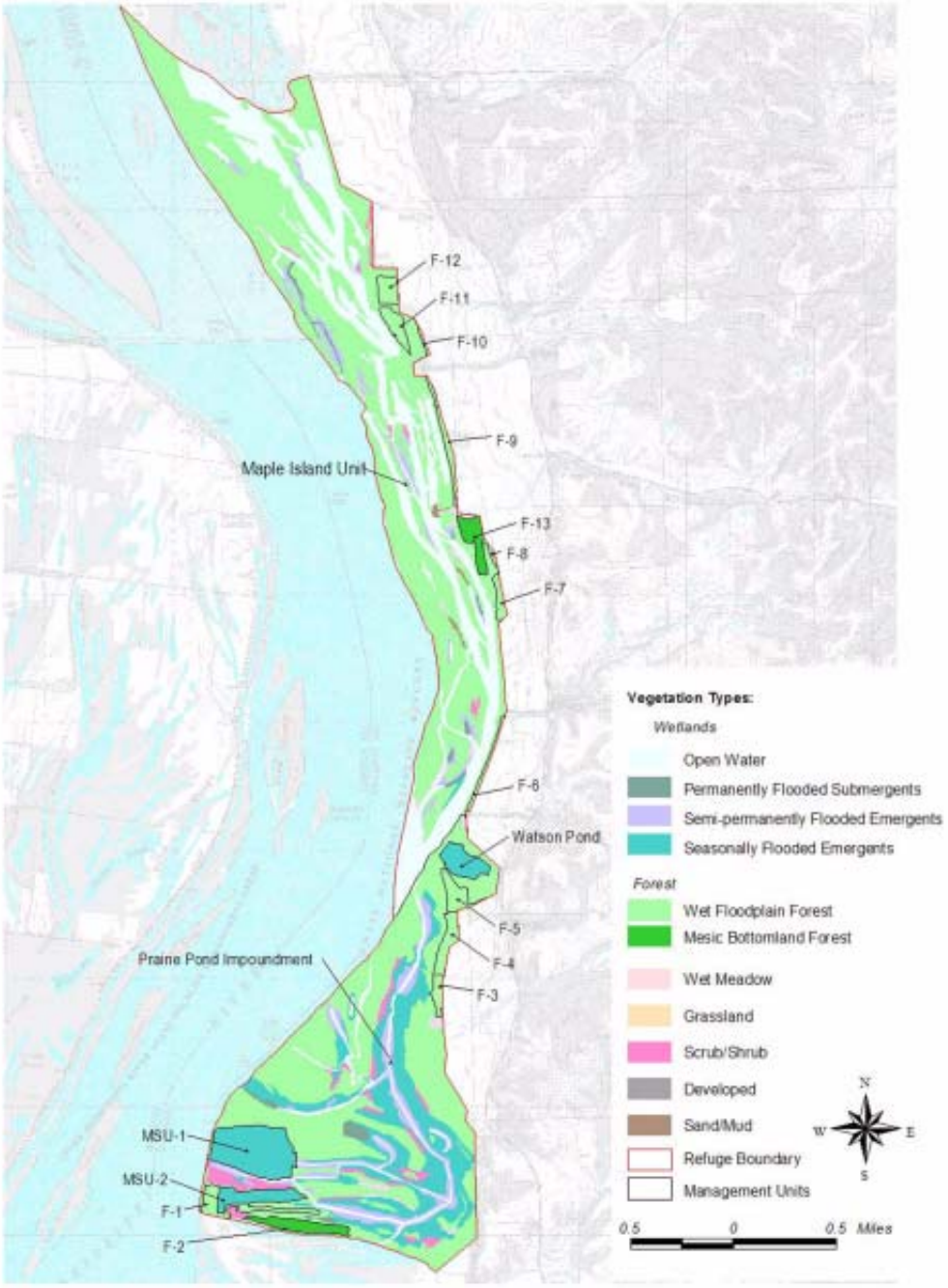

Two Rivers NWR
Calhoun Division
Public Use
Blooms Landing Area
• Boat Ramp & Parking Area (existing)
• Observation Deck
Lower Swan Lake Access Area
(Closed seasonally)
• Parking Area (existing)
Widen Road
Lower Swan Lake Access Area
• Parking Area (existing)
• Kiosk
Swan Lake Boat Ramp Area
• Boat Ramp & 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
N
W
E
S
0.6
0
0.6 Miles

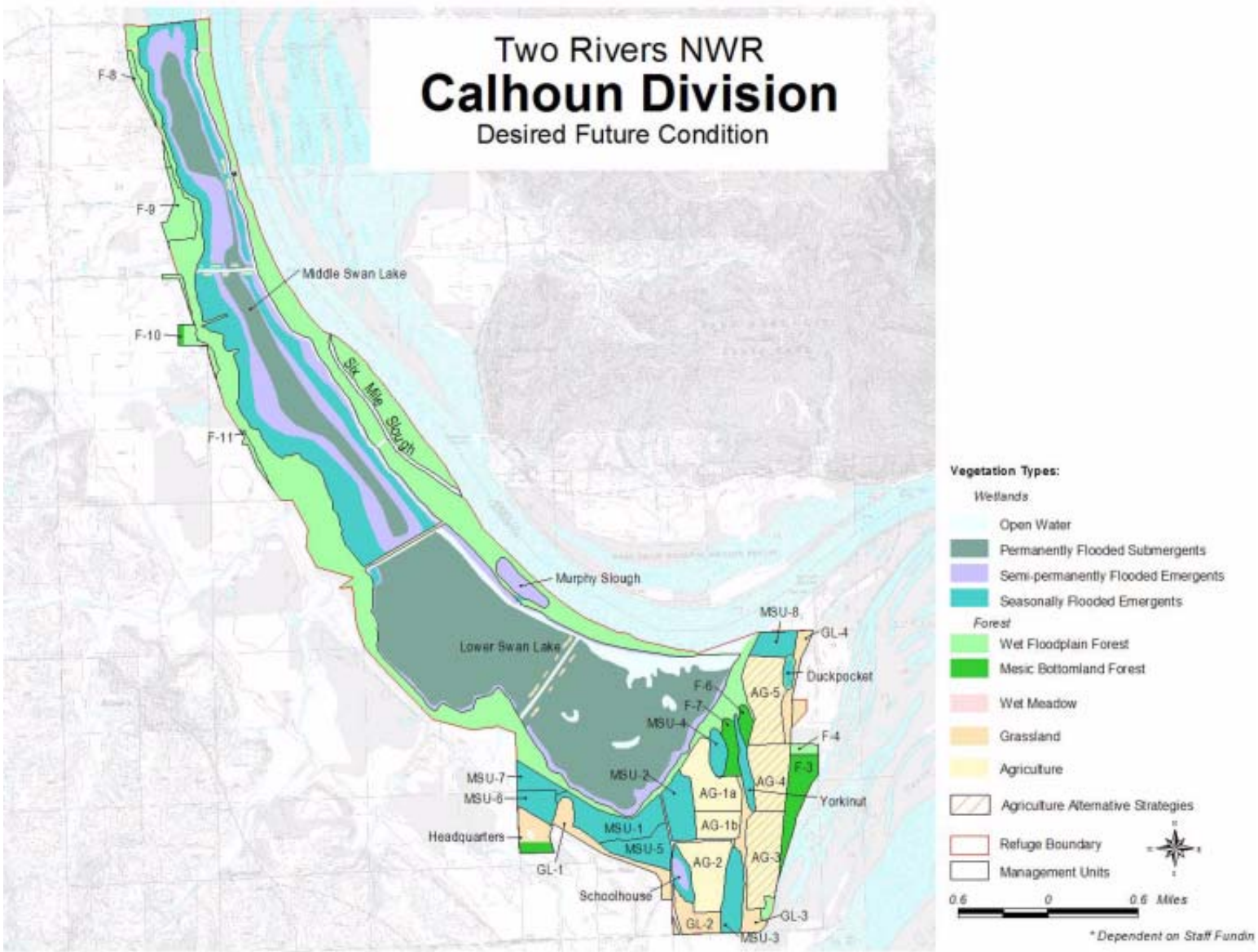
Future Land Cover

Two Rivers NWR

Batchtown Division

Desired Future Conditions

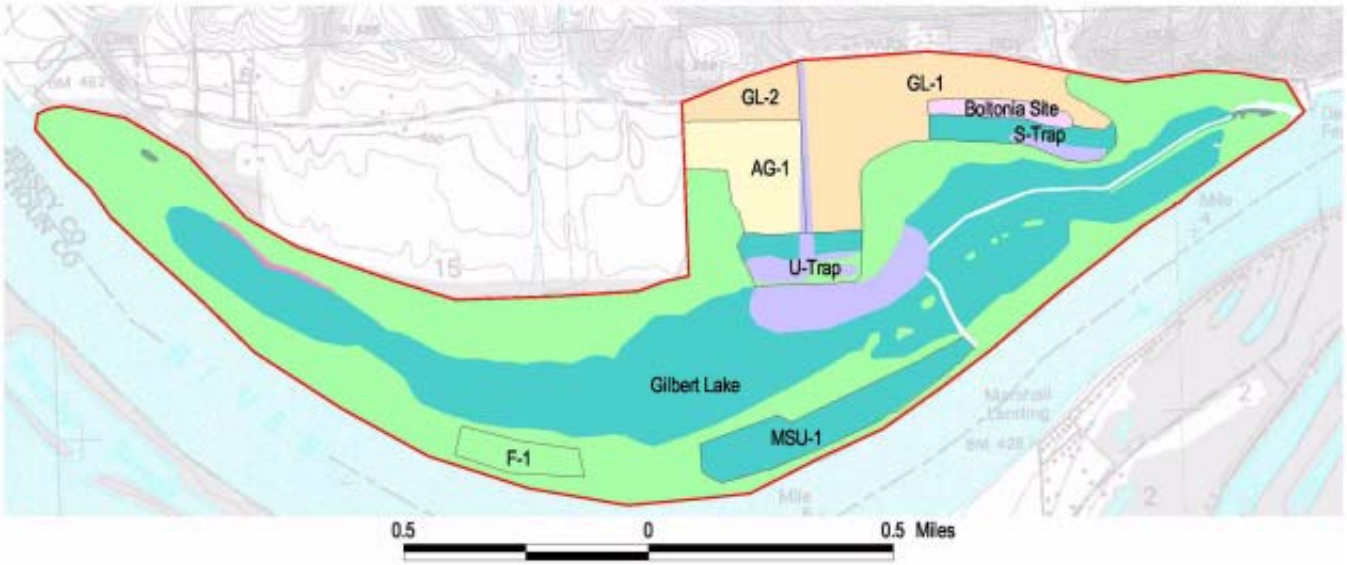



Two Rivers NWR
Calhoun Division
Desired Future Condition
F-8
F-9
F-10
F-11
Middle Swan Lake
Six Mile Slough
Murphy Slough
Lower Swan Lake
MSU-8
GL-4
Duckpocket
F-6
F-7
AG-5
MSU-4
F-4
F-3
MSU-2
AG-4
MSU-7
MSU-6
AG-1a
Yorkinut
MSU-1
AG-1b
Headquarters
MSU-5
AG-2
AG-3
GL-1
Schoolhouse
GL-2
GL-3
MSU-3
Vegetation 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

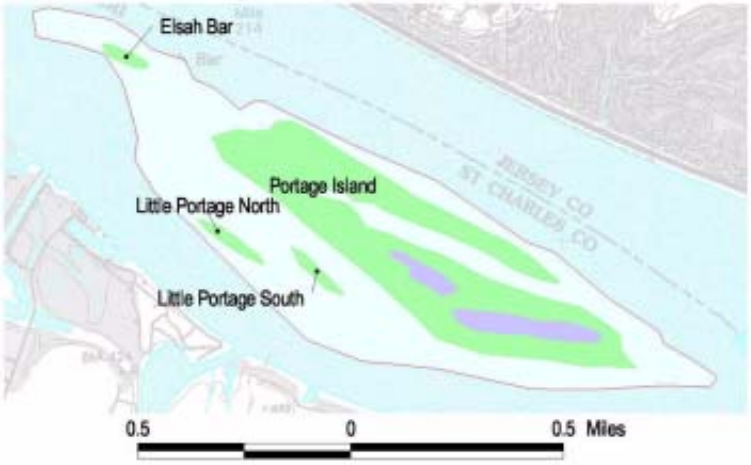
Two Rivers NWR

Gilbert Lake Division

Desired Future Condition



Portage Island Division



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

Appendix B: Land Protection Plan

Land Protection Plan

(*A Land Protection Plan was approved for the Mark Twain National Wildlife Refuge Complex in 2004 as part of the comprehensive conservation planning process. The following document is excerpted from the 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 4: 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
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

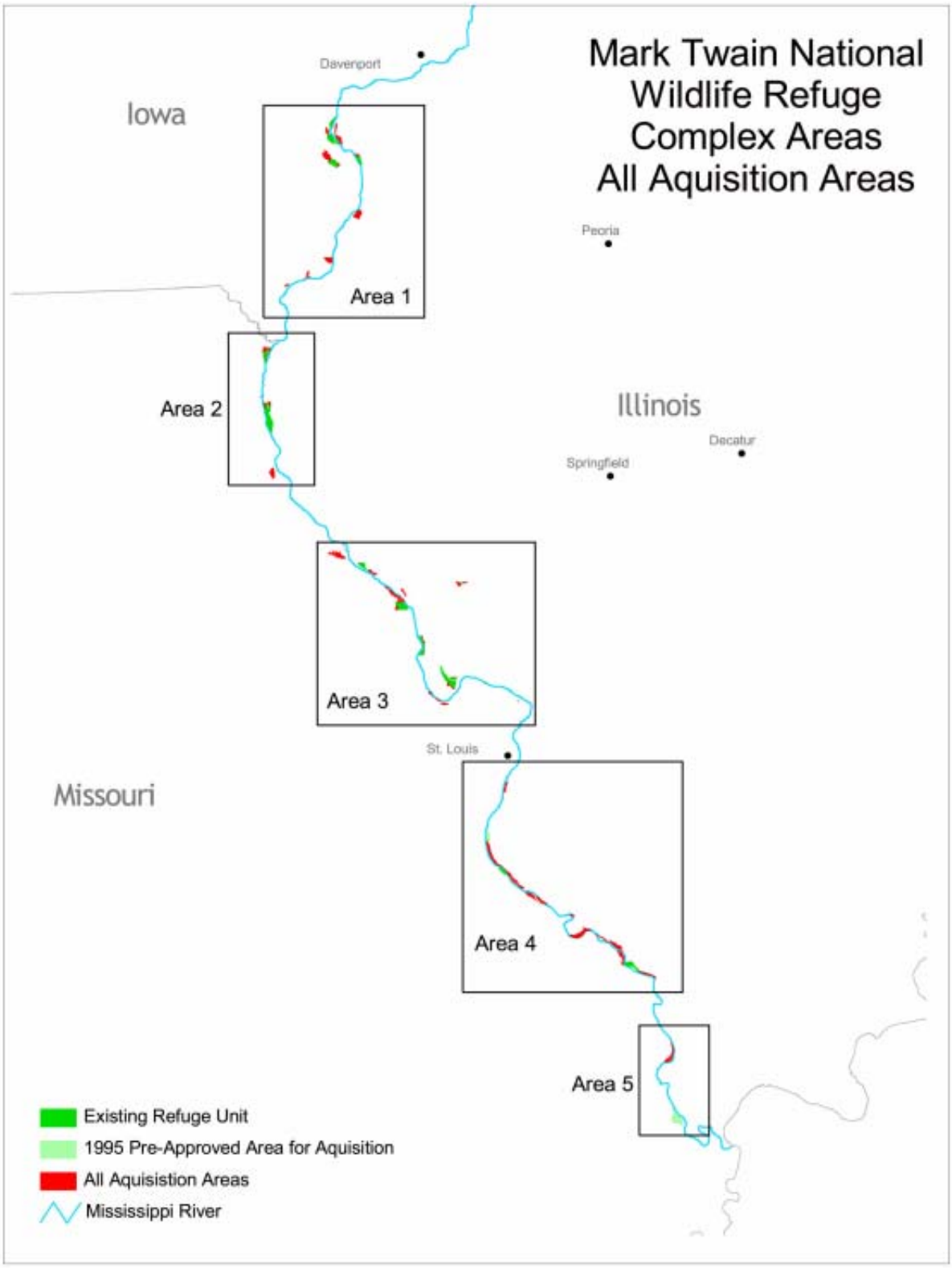
Table 4: Tracts Considered for Boundary Expansion, Acreages, and Priorities[1] (Continued)

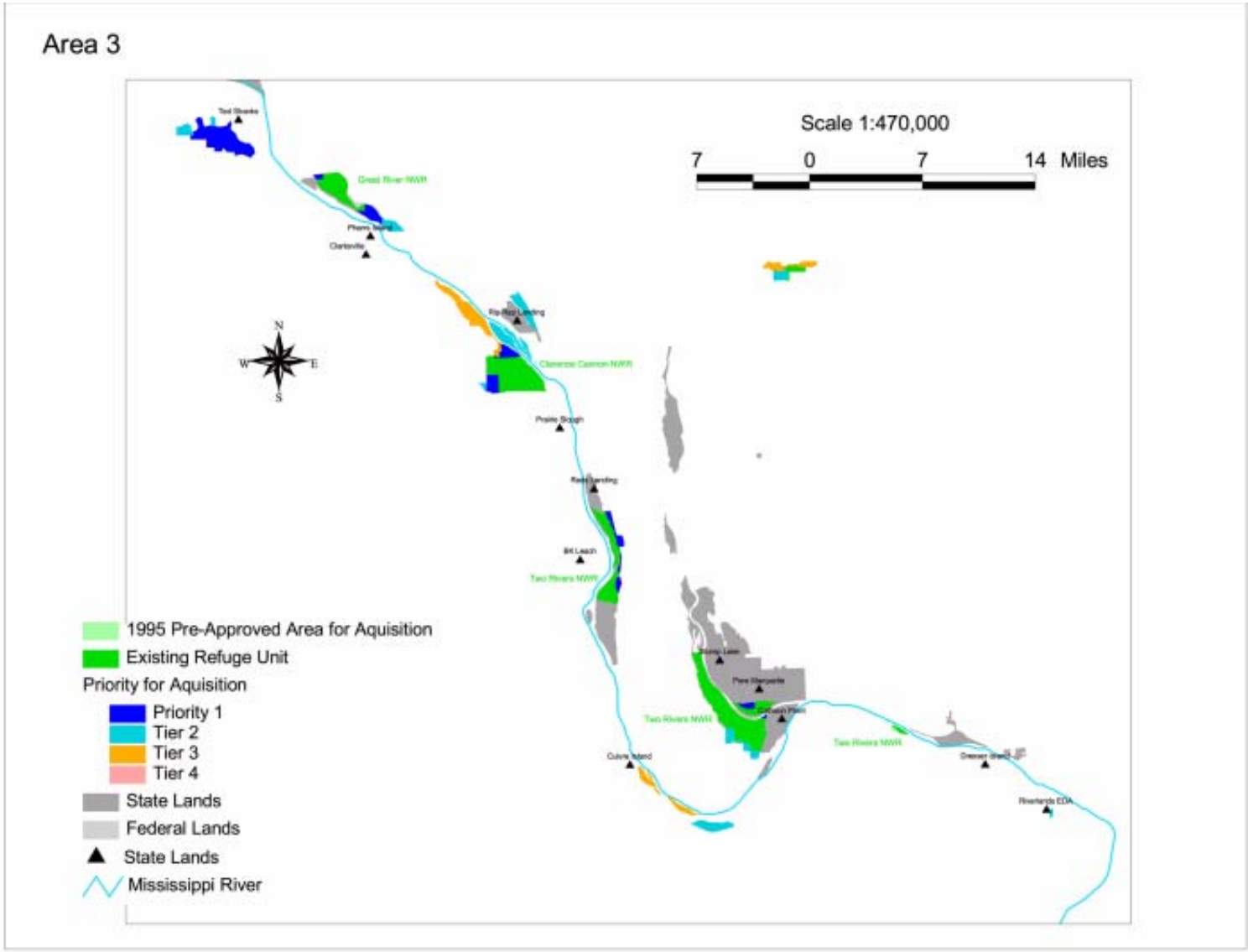
ID #	Tract Name	Acres	Owners	State	County	River Mile	Refuge	Type Action	Priority
38	Gilbert Lake DNR Agreement	92	0	Illinois	Jersey	218	TWR	Trade From State	1
39	Calhoun North	27	1	Illinois	Calhoun	218	TWR	Acq or other protect	1
41	Calhoun Division within DNR	-9	0	Illinois	Calhoun	218	TWR	Trade To State	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
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

Table 4: Tracts Considered for Boundary Expansion, Acreages, and Priorities[1] (Continued)

ID #	Tract Name	Acres	Owners	State	County	River Mile	Refuge	Type Action	Priority
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		
	Middle Miss River (MMR)	24258		14758	5215	4213	71		
	Adjusted Complex Totals	55673		27659	14084	8537	5393		

1. Only Priority 1 tracts are proposed for the boundary expansion.


Mark Twain National
Wildlife Refuge
Complex Areas
All Aquisition Areas
Davenport
Iowa
Area 1
Peoria
Area 2
Illinois
Decatur
Springfield
Area 3
St. Louis
Missouri
Area 4
Area 5
Existing Refuge Unit
1995 Pre-Approved Area for Aquisition
All Aquisistion Areas
Mississippi River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Priority for Aquisition
Priority 1
Tier 2
Tier 3
Tier 4
State Lands
Federal Lands
State Lands
Mississippi River

Appendix C: Compatibility Determinations

COMPATIBILITY DETERMINATION

Use: **Commercial Fishing**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To permit the harvest of fish, on a commercial basis, for species listed on state (either Illinois or Missouri depending on location of activity), game and fish codes as being legal for commercial take, except that some species, such as paddlefish, may not be taken or possessed on refuge units. Permits would be required on refuge units which include isolated wetlands or other controlled aquatic units. Refuge areas which are open to river navigation may not require SUP where adequate state regulations protect compatibility.

Availability of Resources: Funds have been available to maintain existing program level, which has been periodic and low impact on staff or station fiscal resources. It is not anticipated that funds would be inadequate to manage this use in the future as it is outlined in the CCP.

Anticipated Impacts of the Use: No negative environmental impacts are expected to occur with current and projected use levels, and any impacts realized will be managed to result in positive benefits to the refuge resources. The permitted activities covered by this determination and managed through Special Use Permits are supportive of CCP Goals for habitat management and water quality.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

Determination:

____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Specific dates of use will be included in SUP to ensure compatibility with migratory bird use periods.

2. Original SUP, not photocopy, must be in the possession of anyone engaged in commercial fishing (only one assistant can be listed) to help control use.

3. Specific equipment permitted to be listed on SUP if different than state regulation.

4. Commercial fishing operations will be conducted during daylight hours only.

5. Nets may not be set in such a manner as to obstruct recreational fishing boat access.

6. Restrictions may apply to some species which are considered commercial by state regulations, such as paddlefish. The presence of any species of concern may also require that nets are attended to at all times while on the refuge (immediate presence on the unit waters while nets are set).

7. All permittees will be required to report total harvest immediately after the permit period.

Justification: Utilizing commercial fishing as a management tool will contribute to achieving the National Wildlife Refuge System mission, and Mark Twain NWR Complex purposes. Commercial fishing is permitted within controlled or isolated 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. Re-establishment and growth of submersed aquatic vegetation may be inhibited by grazing fish such as carp, (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. Harvest of these species reduces renewable resource waste when conducted before a water level drawdown for habitat vegetation management purposes. These activities are seasonally regulated to prevent disturbance to wildlife populations.

Signature:

Refuge Manager: John McAbory 7/22/04
(Signature and Date)

Concurrence:

Regional Chief: Jon Kauffeld 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Environmental Education and Interpretation**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To provide environmental education and interpretation aspects of Two Rivers NWR, the National Wildlife Refuge System and the Mississippi River corridor to the visiting public.

Environmental education and interpretation have been legislated as priority public uses for national wildlife refuges, where compatible with the refuge purpose. These uses are legitimate and appropriate public uses, and are dependent upon healthy wildlife populations. Two Rivers NWR offers opportunities to educate visitors by providing interpretive materials associated with kiosks and observation platforms, brochures, programs, and hiking trails.

Availability of Resources: Funds have been available to maintain existing program level, and periodic funds have been available to adequately maintain existing facilities. Additional funds and/or staff would be required to cover expanded program opportunities or facilities outlined in the CCP.

Anticipated Impacts of the Use: No environmental impacts are expected to occur with current and projected educational and interpretive opportunities. Information kiosks will be erected, where appropriate, to acquaint visitors with Two Rivers NWR, the Mark Twain NWR Complex, the Mississippi River, and the National Wildlife Refuge System.

Individuals and groups who may use the refuge for educational purposes are not expected to significantly disturb wildlife or vegetation. Little or no erosion is predicted through use of hiking trails and refuge roads for permitted tours.

Controlled access and seasonal restrictions will further inhibit any predicted human disturbance to wildlife populations or threatened or endangered species. If, in the sound professional judgment of the refuge manager, an unacceptable level of wildlife disturbance is occurring during critical migratory periods, these activities will be temporarily curtailed. Human wildlife disturbances do not serve to fulfill the mission of the System, or the purposes of the refuge.

Litter resulting from auto tours, hiking trails or access points is expected to be minimal and will be periodically collected by refuge staff and/or volunteers.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

(Minimum 2-week notice in newspaper(s) unless use is very minor with no impacts on Refuge purpose)

Determination:

____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Controlled access with signs and notices will be posted providing seasonal uses and stipulations.

2. Litter control and pick up will be maintained.

3. Trail and road maintenance, as necessary, to provide a safe and enjoyable experience.

4. Educational opportunities will be provided with kiosks and information signs.

Justification: Environmental education and interpretation are in compliance with the refuge's purpose. Additionally, these two uses are considered priority public uses, as legislated by the National Wildlife Refuge System Act of 1997. It serves to further the goals of the National Wildlife Refuge System and the approved Mark Twain Complex Comprehensive Conservation Plan.

No consumptive use of refuge resources occurs with environmental education and interpretation activities. Minimal disturbance to wildlife, vegetation and the refuge infrastructure will occur. These activities are seasonally regulated on many divisions to prevent disturbance to wildlife populations.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING
Regional Chief: Jon Kaufeld 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Farming & Haying**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460K-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To plan and implement farming activities on portions of Two Rivers NWR. Conventional agricultural activities (i.e. row cropping and haying) will be used as a habitat management tool to assist in meeting Refuge purposes. Primarily through the use of cooperative farming agreements and special use permits, grain and green browse will be provided for migratory birds and other wildlife

Availability of Resources: Funds have been available to maintain existing program level. Since the program is being greatly reduced additional funds or staff are not necessary to conduct farm program activities. However, the managed habitats that replace coop farming will require a greater degree of staff and fiscal resources to replace the values associated with the farm program.

Anticipated Impacts of the Use: Little or no erosion or degradation of the environment is expected to take place; the areas available for farming are flat fields and moist soil units with little gradient. Vegetative growth will be enhanced by farming operations and provide quality feed/cover for a variety of wildlife. All farming field operations will be timed so as to minimize disturbance to wildlife species, especially the nesting bald eagles, and to other forms of public use, such as wildlife viewing/photography, tours, etc.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

Determination:

____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Controlled access with signs, notices, and seasonal uses/stipulations.

2. Litter control/pickup, which is expected to be minimal.

3. Trail maintenance by either refuge staff or cooperative farmers to insure access over the least disruptive routes and minimize erosion or encroachment of adjoining use areas.

4. Restrictions/limitations on pesticide use in accordance with federal, state, and Service guidelines.

Justification: Use is in compliance with the Mark Twain NWR Complex Comprehensive Conservation Plan and furthers the goals and mission of the National Wildlife Refuge System. Conventional agricultural crops will augment natural foods which can be depleted at critical times in the life cycles of wildlife and provide habitat diversity for a variety of species. Farming practices are also used periodically to set back undesirable habitat succession, particularly in moist soil habitats. Managed haying can be a beneficial wildlife management tool if conducted outside the primary nesting and brood rearing season for grassland-dependent wildlife species, and implemented in a manner that considers the need for disturbance based on climate, growing season length, and other environmental variables.

The activity of farming on portions of the refuge has resulted in no adverse effects to other refuge programs of wildlife populations. Farming makes some consumptive use of refuge resources but does not degrade the refuge environment; the low use level does no damage to the habitat base, creates little or no potential for erosion (e.g. deep trails cut into hillsides or over levees) and has little disturbance impact on wildlife populations because the use is zoned as to area and time.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING Regional Chief: [signature] 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Fishing**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To provide public sport fishing opportunities on Two Rivers NWR.

All sport fishing activities, including permitted methods of taking, limits, species and open/closed seasons will be consistent with applicable state regulations. Enforcement efforts will be jointly conducted by the state conservation department officers and U.S. Fish and Wildlife Service officers.

Boat and bank fishing is permitted, as provided by refuge special regulations and published in 50 CFR. Some areas may be closed during the fall and winter migratory bird seasons to provide disturbance-free resting and feeding areas for ducks and geese.

Sport fishing on Two Rivers NWR is an integral part of the overall public use program along this major river and navigation corridor and serves the needs of several hundred thousand visitors each year. Public use, and specifically sport fishing activities, will be improved with boat ramp construction, parking areas, information kiosks, and accessible fishing piers, where appropriate within the floodplain. As with many of our projects and uses, this activity should serve to inform the public of the need for stewardship of public lands and waters and increase the awareness of our natural resources.

Fishing has been legislated as a priority public use on national wildlife refuges, where compatible with the refuge purpose. This use is legitimate and

appropriate, and is dependent upon healthy fish populations. Mark Twain NWR Complex offers many opportunities for sport fishing.

Refuge signs will be posted to ensure that refuge visitors are aware of refuge regulations, closed areas and boundaries. Roadways and levee tops are open, except as designated by posted Area Closed signs, for walk-in fishermen.

Fishing is generally low impact recreational activity, is spread over a wide area which prevents overuse or crowding, and is regulated closely by both state and federal statutes.

Availability of Resources: Funds have been available to maintain existing program level, and periodic funds have been available to adequately maintain existing facilities. Additional funds and/or staff would be required to cover expanded program opportunities or facilities outlined in the CCP.

Anticipated Impacts of the Use: No threatened or endangered species will be impacted by this use. The awareness gained by the visiting public of the national wildlife refuge and its programs should help develop an informed user group that will support our programs and long-range goals.

Litter and incidental vandalism resulting from sport fishing use is expected to be minimal and will be handled by refuge officers and volunteers. Minor repair or rehabilitation of facilities will be attended to, as needed.

No degradation of the environment is expected to occur. Bank fishing will take place on areas with shallow slopes, mostly on existing foot paths or access trails. Erosion and damage to vegetation will be minimal. No wake zones will be established where necessary, to protect vulnerable shorelines from erosion by passing boats.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

Determination:

____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Controlled access points with appropriate signs and notices will limit environmental disturbance;

2. Litter control will be part of routine maintenance by refuge staff or volunteers;

3. Cooperation with state fisheries biologists in creel surveys or sampling will provide data to the refuge for management purposes.

Justification: This use is in compliance with the Refuge Recreation Act. It furthers the goals of the National Wildlife Refuge System and Two Rivers NWR, and serves to provide educational opportunities to the visiting public. This

use is planned and approved in the Refuge Comprehensive Conservation Plan. Coordination with the Service and State fisheries offices for monitoring fish populations and habitat conditions is the responsibility of each individual Complex Refuge Manager. All fishing programs will be subject to yearly review and approval.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

Regional Chief: Jon Kauffeld 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Hiking**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To provide for hiking opportunities on portions of Two Rivers NWR.

Except as prohibited by appropriate "closed area" signs or notification, areas on Two Rivers NWR are open to hiking, with some exceptions to provide for undisturbed sanctuary for nesting American bald eagles, and migrating waterfowl.

Refuge roadways, access trails, dike tops and levees are open to hiking as well as "cross-country" areas with no defined trail systems. Insect populations in the summer months and terrain are limiting physical factors.

Some limited interpretive signing, information kiosk and leaflets will enhance the use on certain areas. This activity, together with appropriate interpretation, will promote community stewardship of our public lands, increase public support and awareness of our rich wildlife/wildlands heritage, and provide for increased public use opportunities in the immediate area.

Hiking activities, when properly regulated by refuge signs and notices, will NOT conflict with other Refuge goals. It is expected to enhance overall Service image in the communities and enhance other FWS initiatives.

Availability of Resources: Funds have been available to maintain existing program level, and periodic funds have been available to adequately maintain existing facilities. Additional funds and/or staff would be required to cover expanded program opportunities or facilities outlined in the CCP.

Anticipated Impacts of the Use: Hiking throughout the refuge units will provide the public with an opportunity to view wildlife refuge programs, serve to educate and inform our visitors, and create an advocacy group supportive of our goals and purposes. Through appropriate demonstration and interpretation of programs the "hiking" public will be able to gain an understanding of the interrelationships that link wildlife/wildlands with their habitats. Hiking, when properly regulated in time and space, is an environmentally friendly activity that does not detract from the area.

Controlled access and seasonal restrictions will limit any human disturbance to wildlife populations or threatened or endangered plant species.

Litter, resulting from this hiking use, is expected to be minimal and will be periodically collected by refuge staff and volunteers. Trash receptacles and information signing will be placed at strategic locations.

Little or no erosion or degradation of the environment is expected to take place; the areas open to hiking are flat fields and timbered areas with little gradient. Vegetation should not suffer any great degree of disturbance or is expected to rebound quickly. Heavy fescue sod on the levee and dike tops can withstand moderate to heavy use during the growing season with no ill effect.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

(Minimum 2-week notice in newspaper(s) unless use is very minor with no impacts on Refuge purpose)

Determination:

____ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Controlled access with signs and notices and seasonal uses/stipulations.

2. Littler control/pickup, education of the using public.

3. Trail maintenance/monitoring.

Justification: Use is in the compliance with the Refuge Recreation Act and furthers the goals and objectives of the Mark Twain Complex Comprehensive Conservation Plan.

The activity of hiking across portions of the refuge, in the very low numbers experienced over the past years (less than ten "hikers" per year on any given division of the refuge) has resulted in no adverse effects to other refuge programs of wildlife populations. Appropriate signing and, at times, the complete closure of the refuge unit to all entry will eliminate any disturbance to or disruption of other activities/programs/populations.

Hiking makes no consumptive use of any resources and does not degrade the refuge environment; the almost non-existent use level does no damage to the ground cover, creates no potential for erosion (e.g. deep trails cut into hillsides or over levees) and has little disturbance impact on wildlife populations because the use is zoned as to area and time.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING

Regional Chief: Jon Kauffeld 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: Hunting

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To allow big game, upland game and migratory bird hunting on selected divisions of the Two Rivers NWR in Illinois and Missouri.

All hunting programs conducted on refuge lands and waters are in compliance with applicable state and special refuge regulations.

Hunting has been legislated as a priority public use on national wildlife refuges, where compatible with the refuge purpose. This use is legitimate and appropriate, and is dependent upon healthy wildlife populations. Two divisions of Two Rivers NWR offer opportunities for hunting.

Hunter safety is of paramount concern to refuge staff, hunters a field, and refuge neighbors. Hunting seasons are further regulated on refuge lands by time and space so as to reduce or eliminate any conflicts with other public uses or wildlife species.

Big game hunting for whitetail deer is permitted on two divisions of Two Rivers NWR. Initiation of additional refuge deer hunting programs may be employed after it has been biologically determined that habitat management objectives cannot be achieved due to an excessive population level. Hunting for deer will be primarily a herd reduction tool to decrease damage to habitat and reduce potential for vehicle/deer collisions.

Small upland game hunting is permitted in accordance with state seasons and regulations. The refuge is closed to all nighttime hunting of furbearers and frogs.

Migratory bird hunting is permitted on one division of Two Rivers NWR. Applicable state and refuge regulations are enforced. Only temporary or portable blinds may be constructed.

Upland bird hunting for wild turkeys, ring-necked pheasant and bobwhite quail is permitted on two refuge divisions, under applicable state regulations. Where bird hunting is permitted, the use of steel or other approved non-toxic shot is required, except for turkeys.

Properly administered hunting programs can instill a healthy regard and view of the wildlife resource and assist in helping us meet refuge and Service management goals. These user groups can become a vocal advocacy for management when they understand their role in the larger picture.

Availability of Resources: Funds have been available to maintain existing program level, and periodic funds have been available to adequately maintain existing facilities. Additional opportunity outlined in the CCP is not a significant change from past management and will not require additional funds, per say. Law enforcement coverage remains a concern on the refuge, and will be monitored to ensure that adequate enforcement is available to maintain compatibility of the program.

Anticipated Impacts of the Use: No negative physical impacts on refuge lands or interests are expected to occur. FWS officers will monitor and regulate numbers of participants to levels consistent with safe use of a specific area and motorized equipment will be strictly limited to surfaced roads or prepared parking areas. All travel throughout the refuge divisions will be by foot, only. Boat access sites will be limited to those in existing public use areas or those developed by the refuge. Litter and other trash will be disposed of, as necessary.

Properly regulated hunting programs will provide a positive benefit by, in some cases, reducing population levels to the carrying capacity of the land, or division, where they are found.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

(Minimum 2-week notice in newspaper(s) unless use is very minor with no impacts on Refuge purpose.)

Determination:

____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Population data will be obtained prior to initiating hunting programs to ensure a healthy population exists, which may be removed without depleting the resource below a point of normal recruitment/recovery.

2. Law enforcement patrols will be conducted by state and federal officers to ensure compliance with hunting regulations and refuge special use regulations.

3. Any hunting program may be immediately canceled if, in the judgment of the refuge manager, it causes disturbance to wildlife populations, or harm to other resources beyond that associated with normal entry/access to the area.

4. Litter will be collected, as necessary, by refuge staff and/or volunteers. Special signs will be erected where necessary, to provide information to hunters regarding regulations, boundaries and closed areas.

Justification: Public hunting on selected areas of Two Rivers NWR is an acceptable form of wildlife-oriented recreation which has been found compatible with the purpose for which the refuge was established. Hunting of big game animals is a viable management tool in reducing the numbers of whitetail deer to levels consistent with achieving habitat management objectives and with social and safety factors (deer/vehicle collisions in the vicinity of the refuge divisions). When the stipulations listed above are fulfilled, little or no adverse effects to other refuge programs or wildlife species will occur.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING
Regional Chief: Jon Kaufhold 7/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Mushroom and berry picking**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: Two Rivers NWR will provide opportunities for gathering mushrooms and wild berries on designated lands each year during periods that do not interfere with other uses, or detract from wildlife values. Collection of these plant products is not a wildlife-dependent recreational use. However for some people these activities are traditional family oriented outings which provide an opportunity for the refuge to offer wildlife observation and interpretive services to those who enjoy the hunt in undeveloped areas.

Availability of Resources: There are no staff or budget constraints to implement mushroom and berry picking opportunities on designated Refuge lands. Use has been low and will be monitored for change in that level.

Anticipated Impacts of the Use: No threatened or endangered species will be impacted by this use. Mushroom hunting is usually directed to open under story areas that cause very little disturbance, while late season berry hunting is generally after bird all nesting activity. The awareness gained by the visiting public of the national wildlife refuge and its programs should help develop an informed user group that will support our programs and long-range goals.

Habitat damage, wildlife disturbance, litter and incidental vandalism resulting from these picking uses is expected to be minimal and will be handled by refuge officers and volunteers. Picking activities have not resulted in any problems such as these in the past.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

Determination:

____ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Controlled access points with appropriate signs and notices will limit environmental disturbance;

2. Litter control will be part of routine maintenance by refuge staff or volunteers;

3. Mushrooms and berries must be collected for personal consumption and may not be sold commercially.

Justification: This use is in compliance with the Refuge Recreation Act. It furthers the goals of the National Wildlife Refuge System and the Mark Twain Complex, and serves to provide wildlife observation and educational opportunities to the visiting public. This use is planned and approved in the Refuge Comprehensive Conservation Plan. All picking programs will be subject to yearly review and approval.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING

Regional Chief: Jon Kaufield 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Pre-acquisition Compatibility of Wildlife-dependent Recreational Uses (Hunting, Fishing, Wildlife Observation and Photography, Environmental Education and Interpretation)**

Refuge Name: Two Rivers NWR, a refuge of the Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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.

DESCRIPTION OF USE: For public recreational purposes Wildlife observation, photography, environmental education/interpretation, fishing and hunting opportunities are currently available and occur on Two Rivers NWR in designated areas with seasonal restrictions. The same wildlife-dependent uses are being considered for lands acquired for the Refuge. Hunting will be conducted within the framework of applicable state and Federal regulations. As with each of the above uses, hunting will only be permitted if it does not interfere with migratory bird sanctuary values of the Refuge, which are needed in association with nearby managed hunting programs.

Existing wildlife-dependent uses will generally be continued and promoted to help realize the Refuge goal of increasing opportunities for outdoor recreation and education. The primary areas in which restrictions may be applied are safety issues, such as user conflicts or other dangerous conditions, and conflicts with migratory bird sanctuary values. Wildlife recreational use will help promote understanding, appreciation and support for wetland and prairie restoration and other conservation efforts.

WHEN ARE THE USES CONDUCTED?: The uses occur at various times throughout the year in accordance with State and Refuge System regulations.

ESTIMATE DEMAND FOR PRE-EXISTING WILDLIFE-DEPENDENT RECREATIONAL USE PLUS OTHER WILDLIFE-DEPENDENT RECREATIONAL USES CONSIDERED IF LANDS BECOME REFUGE DOMAIN: Demand for the existing wildlife-dependent recreational uses described above should increase significantly if subject lands are acquired for a refuge. The availability and increased accessibility of refuge lands is likely to be attractive to local users as well as those in the St Louis area. Waterfowl and deer hunting opportunities and demand should increase as wetlands and grasslands are restored. There also should be a significant increase in the number of non-consumptive users for such activities as wildlife photography and wildlife viewing. Preserving and restoring a more pristine riverine/wetland environment will increase native habitats and associated wildlife, which will increase related visitor recreational opportunities.

POTENTIAL IMPACTS OF PROPOSED USE/EXISTING USE ON REFUGE PURPOSE: The continuation of existing wildlife-dependent recreational use is consistent with fish and wildlife management principals in that it recognizes, in the case of hunting, the concepts of harvestable surplus and carrying capacity. White-tailed deer numbers can increase to levels causing increased cropland damage without the control provided by hunting. The potential of floral and faunal degradation reduces biodiversity and negatively impacts other wildlife using the same habitat, including threatened and endangered species. The refuge goal to maintain diversity and increase abundance of waterfowl and other migratory bird species could be impaired without an active hunting program to manage big game populations.

STIPULATIONS THAT WOULD MAKE PROPOSED USE/EXISTING USE COMPATIBLE WITH REFUGE PURPOSE:

1. All activities will be in conformance with applicable local, state and Federal regulations and only permitted where deemed safe, such as conflicting uses, and where the use does not interfere with migratory bird objectives detailed in the Mark Twain Complex Comprehensive Conservation Plan (CCP).

2. Sensitive or rare plant communities may be excluded from consideration of public recreational use on limited acreage if that use would severely damage or extirpate the natural community type, or habitat restoration efforts on newly acquired lands.

3. Wildlife-dependent recreational uses will be subject to modification if on-site monitoring uncovers unanticipated negative impacts to natural communities, wildlife species or their habitats.

JUSTIFICATION: Recreation, including hunting and fishing, wildlife observation, photography, environmental education and interpretation when managed properly has minimal impact on refuge purposes and mission. These proposed wildlife-dependent recreational opportunities

would generate increased public support for the Service's biological and public use programs. When the primary purposes of the refuge are not being negatively affected, citizen tax payers should be permitted to experience the wildlife benefits of these public lands, and in turn, become more understanding and appreciative of habitat protection and restoration needs of the Mississippi River ecosystem.

FUNDING OR STAFFING CONSTRAINTS TO IMPLEMENTATION: The Two Rivers National Wildlife Refuge is within the Mark Twain NWR Complex, which is spread over nearly 400 miles of the Upper Mississippi River. The Refuge boundary expansion is detailed in the station CCP, which also includes information on the resources needed to conduct existing program and implementation of future growth. Additions to the existing Refuge would occur gradually on a willing seller basis only, allowing incorporation of any additional costs in the normal refuge budgeting process.

The identified lands are located in the Mississippi River floodplain and will not be developed with high maintenance facilities. Generally only flood-friendly development will occur. Public use facilities will be minimal and the visitor experiences will be more of a "wilderness" nature. Partners are available for meeting some of these minimal needs. Additional law enforcement coverage will be the primary refuge program area which will need to expand with acquisitions in order for all the desired use to remain safe and compatible.

Are resources available from the Service? Yes

DETERMINATION IF USE IS OR IS NOT COMPATIBLE WITH THE PURPOSE(S) FOR WHICH THE REFUGE WAS ESTABLISHED: THEY ARE

WILL THE USES BE ALLOWED AFTER ACQUISITION: YES (with any additional restrictions that may be required to ensure safety and Compatibility, as stated above)

Public Review and Comment: The draft Land Protection, Mark Twain Refuge Complex Comprehensive Conservation Plan and associated Environmental Assessment detailed the resources and considerations included in the Compatibility Determination. That process included a public scoping period and a 60 day public comment period while in draft stage. These documents have been posted in each refuge office for 30 days. Prior to any acquisition actions a local news release will be distributed to introduce another round of public involvement related to specific areas.

Signature:

Refuge Manager: John W Jabery 7/22/04
(Signature and Date)

Concurrence:

ACTING Regional Chief: Jon Kaufield 2/4/05
(Signature and Date)

COMPATIBILITY DETERMINATION

Use: **Research**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To provide for legitimate RESEARCH needs and studies on lands and waters of Two Rivers NWR.

Research proposals are, typically, developed by area universities and colleges in support of refuge special needs or with refuge staff input into larger scale proposals that may utilize refuge lands and waters as a base of study. Other than staff review time, these research proposals and resultant studies are the responsibility and expense of the sponsoring school or group.

Studies vary from a few weeks to several months in duration (limited ones may develop over two or three years but these are exceptions), are quite labor intensive with several months after the field seasons devoted to refining data and publishing results. All of this accomplished with little or not direct involvement of refuge staff, or at most, modest staff times to review a manuscript.

Research studies, to be conducted on the refuge, must meet the criteria found in the refuge manual and the research outline/proposal must conform to FWS guidelines. Only those studies that provide practical management data or can be used to further the science of wildlife management are screened and approved.

Availability of Resources: Funds have been available to maintain existing program level, which has been periodic and low impact. It is not anticipated

that resources will be inadequate to address the future research program level outlined in the CCP.

Anticipated Impacts of the Use: Impacts on refuge purposes are all determined to be positive. Through properly applied research our "on the ground" management programs can benefit the resource with a minimum of wasted or misdirected effort. As we move into a more holistic, ecosystem-based management paradigm, the baseline date utilized in decision making must be sound and defensible; the research work will provide this key tool.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

(Minimum 2-week notice in newspaper(s) unless use is very minor with no impacts on Refuge purpose)

Determination:

____ Use is Not Compatible

__X__ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Studies proposed by outside agencies/institutions will be reviewed and approved by the Refuge Manager.

2. All proposals must conform to FWS guidelines and be applicable to Two Rivers NWR management needs and of the needs of the larger scientific community.

3. No or very limited funding will be required of the refuge.

4. Special Use Permits (SUP) will be issued for each non-Service conducted project to control of timing for least disturbance to wildlife or other refuge use.

Justification: This use is in compliance with the Refuge Administration Act. It furthers the goals of the National Wildlife Refuge System and the Mark Twain Complex Comprehensive Conservation Plan. It will add to the base of knowledge in the field of wildlife management and will create no adverse affects on other refuge programs or wildlife populations. Research activities are noted in the Mark Twain National Wildlife Refuge Complex Comprehensive Conservation Plan as being needed to develop and refine management strategies.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING

Regional Chief: Jon Kauffeld 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Trapping**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To conduct trapping solely for wildlife management objectives on selected divisions of Two Rivers NWR in Illinois and Missouri.

Trapping will be used on the refuge as a management tool to address muskrat and beaver created problems within the Refuge infrastructure. Muskrats often burrow into roads, ditches, and dikes. The resulting holes and cave-ins along refuge roadways increase maintenance, create safety hazards to visitors and staff, and restrict the refuge's ability to regulate water levels. Plugging of water control regulatory devices including water control structures and damage to our delivery ditches often occurs by beaver and muskrat. Without the water regulatory ability, the refuge cannot meet our primary goal to provide migratory bird habitat. The altered impoundments also create drainage restrictions and can potentially cause problems to neighboring private landowners. Such restriction of drainage on private property can be a violation of state law.

Trapping is not anticipated to occur on an annual basis. The infrequent need to trap will be assessed individually through a case by case determination by the refuge manager or is or her representative. When instituted, trapping will be very restrictive and only authorized by refuge personnel or through the issuance of a Special Use Permit (SUP). The permit offers the refuge manager the opportunity to specifically target offensive individuals and regulate trapping techniques and methods more restrictively than state regulations.

Availability of Resources: Funds have been available to conduct the limited program on Refuge divisions. The CCP does not propose an expansion of this activity.

Anticipated Impacts of the Use: Disturbance of resting waterfowl is a factor to be considered. The activity of a trapper on the refuge will result in disturbance of waterfowl; however, the disturbance is temporary in nature and confined to a matter of minutes. Waterfowl populations become accustomed to limited activity and simply change resting areas when disturbed, but they generally do not leave the refuge during these periods. The birds quickly return to their original resting areas soon after the disturbance has ended.

The capture of non-targeted animals such as bald eagles can potentially exist. Through proper education and training, this threat can be nearly eliminated by addressing the proper location of traps, and prohibiting such techniques as exposed baits, the use of fish for bait, and multiple sets.

No negative physical impacts on refuge lands or interest are expected to occur. In fact, the ability to effectively manage for migratory birds will be enhanced. Specifically, water management will be enhanced as water delivery improves and mast trees and bottomland hardwood forest will be protected.

Potentially most importantly, visitor and staff safety will be significantly improved by the minimization of damage to refuge roadways. The refuge's relationship with neighboring landowners will improve as we respond to their legally binding needs.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

(Minimum 2-week notice in newspaper(s) unless use is very minor with no impacts on Refuge purpose)

Determination:

____ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Trapping will only be conducted following the thorough inspection by the refuge manager or his or her designated representative.

2. Trapping will only occur by refuge personnel or conducted by an outside individual through the use of a SUP.

3. Compliance of the conditions of the SUP will be closely monitored by refuge staff.

4. Trapping will not occur if the population is at such low numbers that trapping may jeopardize the ability of the local population to sustain itself.

5. Trapping shall be targeted only to the species of concern.

6. A Weekly Fur Catch Report will be completed and submitted to the refuge manager by the following Wednesday of each week.

Justification: Trapping on selected areas of the Mark Twain Complex in the states of Iowa, Illinois and Missouri, has been found compatible with the purpose for which the refuge was established. Trapping is a viable management tool in reducing damage to refuge infrastructure, increasing visitor and staff safety, and ensuring compliance with private landowner drainage concerns. When the stipulations listed above are fulfilled, little or no adverse effects to other refuge programs or wildlife species will occur.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING

Regional Chief: John Kaufield 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)

COMPATIBILITY DETERMINATION

Use: **Wildlife Observation, Photography and Auto Tours**

Refuge Name: Two Rivers NWR of Mark Twain National Wildlife Refuge Complex

Establishing and Acquisition Authority (ies): 16 U.S.C. 715d; 16 U.S.C. 644; and 16 U.S.C. 460k-1

Refuge Purpose(s): "...for uses 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 him (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 "...the Secretary...may accept and use...property. Such acceptance may be accomplished under the terms and conditions of restrictive covenants imposed by donors..." 16 U.S.C. 460k-2 (Refuge Recreation Act (16 U.S.C. 460k-460k-4), as amended).

National Wildlife 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."

Description of Use: To provide a variety of wildlife observation options on the Two Rivers NWR by offering observation platforms with viewing scopes, photo opportunities and auto tours.

Wildlife observation and photography have been legislated as priority public uses for national wildlife refuges, where compatible with the refuge purpose. These uses are legitimate and appropriate public uses, and are dependent upon healthy wildlife populations. Two Rivers NWR offers many opportunities for enhance observations of wildlife and photography within some divisions.

Refuge signs will be posted to ensure that refuge visitors are aware of refuge regulations, closed areas and boundaries. Auto tour routes will be clearly posted to maintain a safe environment for visitors, staff and wildlife.

Roadway, levee tops and hiking trails are open year-round, except as designated by posted Area Closed signs, for wildlife observation.

Availability of Resources: Funds have been available to maintain existing program level, and periodic funds have been available to adequately maintain existing facilities. Additional funds and/or staff would be required to cover expanded program opportunities or facilities outlined in the CCP.

Anticipated Impacts of the Use: No negative physical impacts are expected to occur from the allowance of wildlife observation and photography opportunities on refuge lands. Providing enhanced wildlife observation and photography

opportunities will present the public with educational and informative encounters with our refuges. It will further serve to create an advocacy group supportive of our goals and purposes.

Controlled access and seasonal restrictions will limit any human disturbance to wildlife populations or threatened or endangered species. If, in the sound professional judgment of the refuge manager, an unacceptable level of wildlife disturbance is occurring during critical migratory periods, these activities will be temporarily curtailed. Human wildlife disturbances do not serve to fulfill the mission of the System, or the purposes of the refuge.

Litter resulting from auto tours, hiking trails or access points, is expected to be minimal and will be periodically collected by refuge staff and/or volunteers.

Little or no erosion or degradation of the environment is expected to occur with enhanced wildlife observation, photography or auto tour route uses.

Public Review and Comment: Determination prepared and reviewed in conjunction with Refuge Complex Comprehensive Conservation Plan (CCP) and Environmental Assessment.

(Minimum 2-week notice in newspaper(s) unless use is very minor with no impacts on Refuge purpose)

Determination:

____ Use is Not Compatible

_X_ Use is Compatible with Following Stipulations

Stipulations Necessary to Ensure Compatibility: The following stipulations are required to ensure compatibility:

1. Controlled access with signs and notices will be posted providing seasonal uses and stipulations.

2. Litter control and pick up will be maintained.

3. Trail and road maintenance, as necessary, to provide a safe and enjoyable experience.

4. Educational opportunities will be provided with kiosks and information signs.

Justification: Wildlife observation, photography and auto tour routes are in compliance with the Refuge Recreation Act. In addition, wildlife observation and photography are considered priority public uses, as legislated by the National Wildlife Refuge System Act of 1997, and serves to further the goals and objectives of the approved Mark Twain Complex Comprehensive Conservation Plan.

Use of refuge divisions for wildlife observation, photography and auto tours requires no consumptive use of any resource and does not degrade the refuge environment. Little or no erosion occurs on hiking trails, levees or roads within the divisions. There is minimal disturbance impact on wildlife populations during these activities because the use is restricted by seasonal factors.

Signature:

Refuge Manager: John Mabery 7/22/04
(Signature and Date)

Concurrence:

ACTING

Regional Chief: Jon Kaufield 2/4/05
(Signature and Date)

Mandatory 10- or 15-year Re-evaluation Date: 2018

(This determination was prepared as a programmatic review of the use outlined in the Refuge Complex 2003 Comprehensive Conservation Plan. Future Compatibility Determinations prepared to address new or different site specific uses will be prepared at the individual refuge and signed by the Refuge Manager, Complex Manager and Regional Chief.)