Upper Mississippi River National Wildlife and Fish Refuge

Habitat Management Plan

November 21st, 2019

Bottomland forest and associated lentic backwater lake habitats in the Winona District of the Upper Mississippi River National Wildlife and Fish Refuge. Photo by Stephen Winter/USFWS.

Habitat Management Plans provide long-term guidance for management decisions; they 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 habitat management activities 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.

The National Wildlife Refuge System, managed by the U.S. Fish and Wildlife Service, is the world's premier system of public lands and waters set aside to conserve America's fish, wildlife and plants. Since the designation of the first wildlife refuge in 1903, the System has grown to encompass more than 150 million acres, 556 national wildlife refuges and other units of the Refuge System, plus 38 wetland management districts.

Habitat Management Plan
For
Upper Mississippi River National Wildlife & Fish Refuge

APPROVALS			
Action	***Name***	***Signature***	***Date***
Prepared By	Dan Salas and Mark Pranckus (Cardno); Stephen Winter, Refuge Wildlife Biologist		10/31/2019
Submitted By	Timothy Yager, Deputy Refuge Manager		10/31/2019
Reviewed By	Patricia Heglund, Regional Refuge Biologist		11/11/19
Reviewed By	Sabrina Chandler, Refuge Supervisor		11/12/19
Approved By	Regional Refuge Chief ACTING		11/21/2019

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Executive Summary

The Upper Mississippi River National Wildlife and Fish Refuge (or refuge) was established by an Act of Congress on June 7, 1924, as a refuge and breeding place for migratory birds, fish, other wildlife, and plants. The refuge encompasses slightly more than 244,000 acres of Mississippi River floodplain and non-floodplain habitats along approximately 261 miles of the river from near Wabasha, Minnesota to near Rock Island, Illinois. The refuge is divided administratively into four districts and geographically by navigational pools (navigational pools are impoundments created by the locks and dams constructed on the Upper Mississippi River; pool numbers correspond to the dam number that creates their associated impoundment). District offices are located in Winona, Minnesota (Pools 4-6), La Crosse, Wisconsin (Pools 7-8), Prairie du Chien, Wisconsin (Pools 9-11) and Savanna, Illinois (Pools 12-14; Figure 1-1). The refuge's headquarters office is located in Winona, Minnesota.

The refuge, with substantial assistance from multiple stakeholders and partner agencies, identified 24 Priority Resources of Concern. Some of these Priority Resources of Concern represent individual species, guilds of species, or plant communities that are in need of conservation and can be used as indicators of habitat management by responding to management actions conducted solely or principally by the refuge. In addition to this, the list of Priority Resources of Concern includes some species, guilds and communities that may not be used by the refuge for these purposes. This is justified for three primary reasons:

- Some priority ROCs have been selected because they will represent refuge priorities when the refuge engages in the planning and execution of partnership activities such as UMRR HREP projects. Examples of this are provided by the limnophilic and fluvial-dependent fish and mussel guilds. There are no known habitat management activities the refuge is capable of conducting solely or principally on its own that can address the species in these guilds, a high number of which are considered species of greatest conservation need (as determined by multiple state, regional, and federal plans and lists; see Appendix C). Furthermore, the refuge lacks the resources (staff, technical expertise, equipment) to engage in inventory, monitoring, or research activities associated with these guilds. For this reason, the refuge is reliant on its partners (state DNR agencies, USGS, USFWS Fisheries and Ecological Services offices, USACE) to assist with providing information on the status and trends and the habitat needs of these guilds.

- For some priority ROCs, the refuge may not be capable of conducting habitat management activities solely or principally on its own, outside of greater partnership activities such as the UMRR HREP. However, these species will be addressed in the subsequent Inventory and Monitoring Plan because monitoring will be conducted that seeks to document their presence or activity in relation to human activities such as recreational and commercial use of the river by the public, industry, and agencies. An example of this would be monitoring the disturbance of waterfowl, including canvasbacks, to determine if human activities are disturbing them to a degree that they are unable to effectively feed and rest while they are using the refuge. Another example would be documentation of breeding colonies of waterbirds such as black terns that need to be protected from human disturbance.

- During the ROC selection process, especially the portion employing the ROCSTAR tool, a notable lack of information was apparent concerning the distribution and abundance of a substantial number of species of greatest conservation need. For example, during the ROC selection process, the grassland broad habitat had the highest number of potential ROCs associated with it relative to all other broad habitats (n=57; see Appendix C). Almost half of the potential ROCs for the grassland broad habitat were pollinators, a guild of species that provide critical ecological services and likely represent a substantial contribution to BIDEH. Yet a minimal amount of information exists about whether these invertebrate species occur on the refuge, where they occur, or how abundant they are. For priority ROCs that fall within this category, the refuge's subsequent Inventory and Monitoring Plan may address them through inventories to determine if they are appropriate for further consideration in future planning and execution of refuge habitat management activities.

Chapter 1. Introduction

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1.1 Scope and Rationale

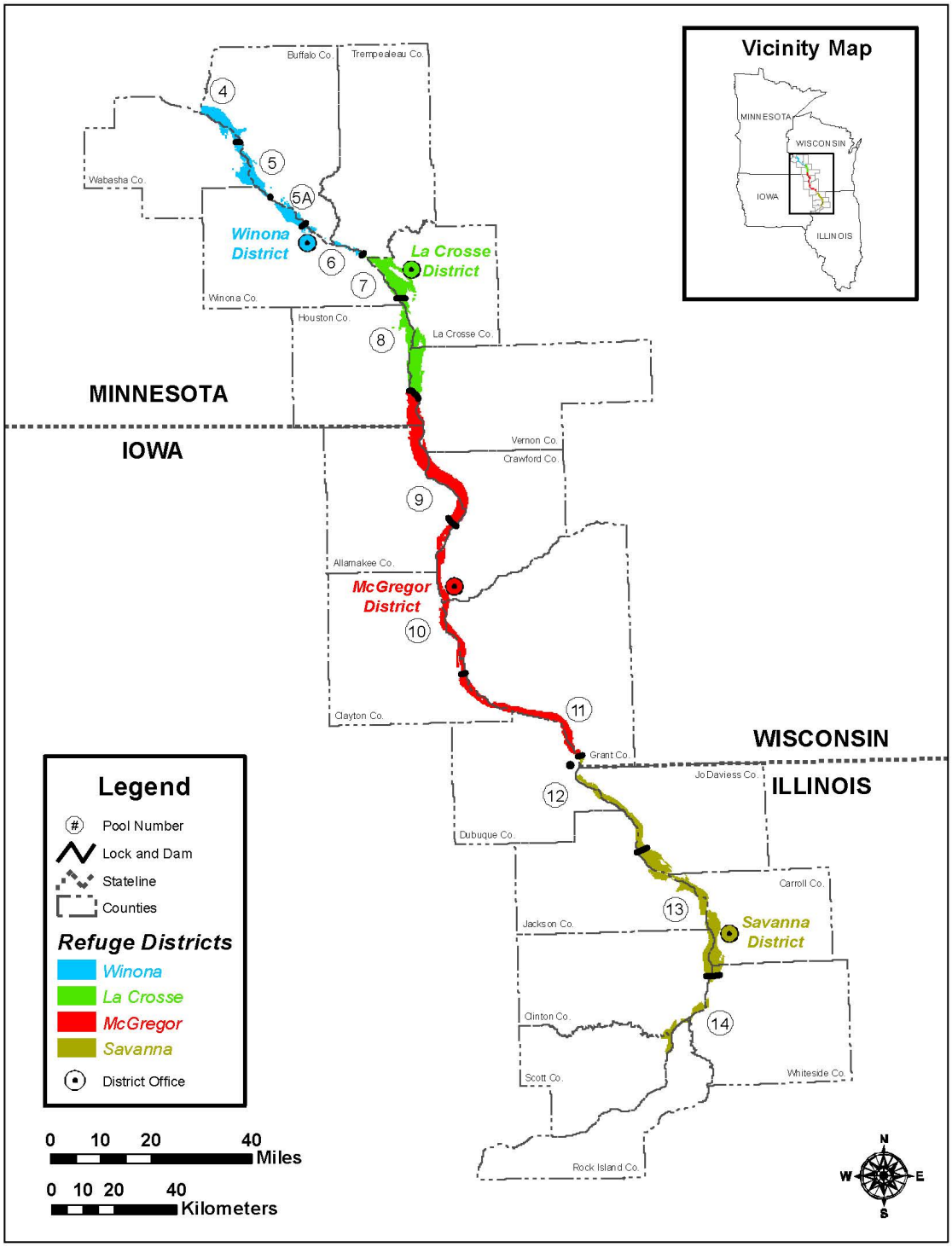
The Upper Mississippi River National Wildlife and Fish Refuge (or refuge) was established by an Act of Congress on June 7, 1924, as a refuge and breeding place for migratory birds, fish, other wildlife, and plants. The refuge encompasses slightly more than 244,000 acres of Mississippi River floodplain and non-floodplain habitats along approximately 261 miles of the river from near Wabasha, Minnesota to near Rock Island, Illinois.

The refuge is managed by the U.S. Fish and Wildlife Service as part of the National Wildlife Refuge System (NWRS or Refuge System). The mission of the NWRS is to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans. The many goals of the Refuge System include:

- The fulfillment of a statutory duty to achieve refuge purposes and further the System mission.
- The conservation, restoration where appropriate, and enhancement of all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- The perpetuation of migratory bird, interjurisdictional fish, and marine mammal populations.
- The conservation of a diversity of fish, wildlife, and plants.
- The conservation, and restoration where appropriate, of representative ecosystems of the United States, including the ecological processes characteristic of those ecosystems.
- The fostering of an understanding and appreciation of native fish, wildlife, and plants, and conservation, by providing the public safe, high quality, and compatible wildlife-dependent public use.
- Ensuring the biological integrity, diversity, and environmental health of the System for the benefit of present and future generations.

The refuge is divided administratively into four districts and geographically by navigational pools (navigational pools are impoundments created by the locks and dams constructed on the Upper Mississippi River; pool numbers correspond to the dam number that creates their associated impoundment). District offices are located in Winona, Minnesota (Pools 4-6), La Crosse, Wisconsin (Pools 7-8), Prairie du Chien, Wisconsin (Pools 9-11) and Savanna, Illinois (Pools 12-14; Figure 1-1). The refuge's headquarters office is located in Winona, Minnesota.

Figure 1-1. Location of the Upper Mississippi River National Wildlife and Fish Refuge.



The refuge's Comprehensive Conservation Plan (CCP; USFWS 2006) identified multiple elements within and associated with the refuge that highlighted its importance. At the time that document was written, in terms of natural resource features and a complex geopolitical landscape (note that quantities identified in the following bullets represent what was provided in the CCP; these numbers may differ from those provided later in this Habitat Management Plan (HMP) document because of updated information that has become available since the CCP was written):

- A national scenic treasure – river, backwaters, islands, and forest framed by 500-foot high bluffs.
- Interface with four states, 70 communities, and two U.S. Army Corps of Engineers districts.
- A series of 11 navigation locks and dams within the overall boundary.
- Representation by eight U.S. Senators and six U.S. Representatives.
- National Scenic Byways on both sides.
- 3.7 million annual visits, among the highest of all national wildlife refuges.
- A diversity of wildlife including 306 species of birds, 119 species of fish, 51 species of mammals, and 42 species of mussels.
- Designation as a Globally Important Bird Area.
- Designation in 2010 as a Ramsar Floodplain Wetland of International Importance.
- Up to 40 percent of the continent's waterfowl use the river flyway during migration.
- Up to 50 percent of the world's canvasback ducks stop during fall migration (see Appendix A for scientific names of organisms mentioned in text).
- Up to 20 percent of the eastern population of tundra swans stop during fall migration.
- Over 300 active bald eagle nests in 2012.
- More than 2,500 bald eagles during spring migration.
- Up to 3,000 heron and egret nests in as many as 19 breeding colonies.

Managing and protecting these resources requires planning, active on-the-ground management, and partnerships with the associated states and communities of the Upper Mississippi River. The refuge's CCP (USFWS 2006) outlined the management direction for the refuge over a 15-year period. A Habitat Management Plan is a step-down plan from the CCP and is essential to the refuge's ability to meet these challenges. This HMP provides a long-term vision and specific guidance on managing habitats for the identified Resources of Concern of the refuge. The HMP will provide direction for habitat management activities for a period of 15 years and management objectives have been established for more than 10,000 acres of habitat. Reviews of the HMP every five years will be based on information derived from adaptive management activities, research, inventory, and monitoring efforts to assess, modify and amend the HMP as needed.

1.2 Legal Mandates

The mission of the U.S. Fish and Wildlife 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 is the primary federal agency tasked with this responsibility. 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 Service also manages the NWRS, the world's largest collection of lands specifically managed for wildlife. The System is a network of more than 560 national wildlife refuges and other units plus 38 wetland management districts encompassing more than 150 million acres of public land and water.

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."

The Upper Mississippi River Wild Life and Fish Refuge[1] Act of 1924
The 1924 act establishing the refuge set forth the purposes of the refuge as follows:

- "...as a refuge and breeding place for migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, and…

- …to such extent as the Secretary of Agriculture[2] may by regulations prescribe, as a refuge and breeding place for other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants, and…

- …to such extent as the Secretary of Commerce[2] may by regulations prescribe as a refuge and breeding place for fish and other aquatic animal life."

The National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Improvement Act of 1997
Legislation that guides management of the Refuge System includes the National Wildlife Refuge System Administration Act of 1966 and the National Wildlife Refuge System Improvement Act of 1997 16 U.S.C. 668dd to 668ee (Refuge Administration Act). This defines the Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established.

The landmark National Wildlife Refuge System Improvement Act, passed by Congress in 1997, prepared the way for a renewed vision for the future of the refuge system where:
- Wildlife comes first
- Refuges are cornerstones for biodiversity and ecosystem-level conservation
- Lands and waters of the System are biologically healthy
- Refuge lands reflect national and international leadership in habitat management and wildlife conservation

Important provisions of this legislation and the subsequent policies to carry out its mandates include:

The Establishment of a Broad National Policy for the Refuge System:
- Each refuge shall be managed to fulfill the mission and its purposes.
- Compatible wildlife-dependent recreation is a legitimate and appropriate use.
- Compatible wildlife-dependent uses are the priority public uses of the System.
- Compatible wildlife-dependent uses should be facilitated, subject to necessary restrictions.

Directing the Secretary of the Interior to:
- Provide for the conservation of fish, wildlife, and plants within the System.
- Ensure biological integrity, diversity, and environmental health of the System for the benefit of present and future generations.
- Plan and direct the continued growth of the System to meet the mission.
- Carry out the mission of the System and purposes of each refuge; if conflict exists between these, refuge purposes take priority.
- Ensure coordination with adjacent landowners and the states.
- Assist in the maintenance of adequate water quantity and quality for refuges; acquire water rights as needed.
- Recognize compatible wildlife-dependent recreational uses as the priority general public uses of the System.

[1] Administratively changed to Upper Mississippi River National Wildlife and Fish Refuge in 1983 and affirmed legislatively in 1998

[2] Changed to Secretary of the Interior in 1939 pursuant to reorganization and transfer of functions

- Ensure that opportunities for compatible wildlife-dependent recreation are provided.
- Ensure that wildlife-dependent recreation receives enhanced consideration over other uses of the System.
- Provide increased opportunities for families to enjoy wildlife-dependent recreation.
- Provide cooperation and collaboration of other federal agencies and states, and honor existing authorized or permitted uses by other federal agencies.
- Monitor the status and trends of fish, wildlife, and plants in each refuge.

Providing Compatibility of Uses Standards and Procedures:
- New or existing uses should not be permitted, renewed, or expanded unless compatible with the mission of the System or the purpose(s) of the refuge, and consistent with public safety.
- Wildlife-dependent uses may be authorized when they are compatible and not inconsistent with public safety.
- The Secretary shall issue regulations for compatibility determinations.

Planning:
- Each unit of the Refuge System shall have a Comprehensive Conservation Plan completed by 2012.
- Planning should involve adjoining landowners, state conservation agencies, and the general public.

The Migratory Bird Treaty Act
The Migratory Bird Treaty Act provides for the protection of more than 800 species of birds through the implementation of four bilateral treaties with Great Britain/Canada, Mexico, Japan, and Russia. The Act prohibits the pursuit, capture, killing, possession, and commerce in of birds, their parts, nests, and eggs unless authorized by permit. In the case of migratory species of game birds that are hunted, the act provides for closed and open seasons during which hunting can occur.

The Endangered Species Act
The Endangered Species Act prohibits the taking, possession, transport and sale of endangered species, provides authority to acquire land for the conservation of listed species, and authorizes the establishment of cooperative agreements and grants-in-aid to States that establish and maintain active and adequate programs for endangered and threatened wildlife and plants.

The Bald and Golden Eagle Protection Act
This law prohibits the taking, possession of, and commerce in bald and golden eagles, their parts, eggs or nests. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

1.3 Relation to Service Policy

Important guidance for habitat management on refuges has already been provided by several key policies outlined by the Service. These policies are included within the Fish and Wildlife Service Manual, which documents re-delegation of the Director's authority, prescribes the policies and procedures for administrative activities and program operations, and steps down our compliance with other requirements, such as statutes, Executive Orders, Departmental directives, and regulations of other agencies. Policies pertinent to the development of HMP's include:

Habitat Management Planning Policy - 620 FW 1 (U.S. Fish and Wildlife Service 2002b)
This chapter of the Service Manual establishes Service policy for planning habitat management within the NWRS. The guidance in this chapter applies to the development of HMPs and Annual Habitat Work Plans (AHWP) and discusses their relationship to refuge CCPs. The policy and guidance in this chapter describe strategies and implementation schedules for meeting CCP goals and objectives. We utilize this policy to direct the content and considerations addressed in this HMP.

Compatibility Policy
No use for which the Service has authority to regulate may be allowed on a unit of Refuge System unless it is determined to be compatible. A compatible use is a use that, in the sound professional judgment of the refuge manager, will not materially interfere with or detract from the fulfillment of the Refuge System mission or the purposes of the national wildlife refuge. Managers must complete a written compatibility determination for each use, or collection of like uses, that is signed by the manager and the Regional Chief of Refuges in the respective Service region.

Biological Integrity, Diversity and Environmental Health Policy - 601 FW 3 (U.S. Fish and Wildlife Service 2001)
The Service is directed in the Refuge Improvement Act to "ensure that the biological integrity, diversity, and environmental health of the Refuge System are maintained for the benefit of present and future generations of Americans…" The biological integrity policy helps define and clarify this directive by providing guidance on what conditions constitute biological integrity, diversity, and environmental health (BIDEH); guidelines for maintaining existing levels; guidelines for determining how and when it is appropriate to restore lost elements; and guidelines in dealing with external threats to BIDEH. The policy also provides guidance for the conservation and management of a broad spectrum of fish, wildlife, and habitat resources found on refuges and associated ecosystems. We consider the role of BIDEH in our habitat management to the extent that it supports the refuge purpose, goals, and objectives.

Inventory and Monitoring Policy - 701 FW 2 (U.S. Fish and Wildlife Service 2014b)
This updated chapter provides guidance for developing an Inventory and Monitoring Plan (IMP) for a station in the NWRS. It describes priorities for natural resource surveys, the selection and design of survey protocols, data storage and analysis, and reporting results. It accommodates all levels of natural resource surveys from the station level to participation in landscape, regional, national and international inventory and monitoring programs, both internal and external to the Service. Overall, this policy promotes consistency in the planning and implementation of inventory and monitoring throughout the Refuge System. We utilize its guidance to direct the development of inventory and monitoring strategies outlined within the Inventory and Monitoring Plan, which will be developed following the completion of the HMP.

1.4 Relation to Other Plans

Guidance for wildlife and wildlife habitat management at the refuge has already been provided by several important refuge, state, regional, and national plans.

Interagency Plans

Upper Mississippi River Land Use Allocation Plan: Master Plan for Public Use Development and Resource Management (U.S. Fish and Wildlife Service 2004, U.S. Fish and Wildlife Service 2006, U.S. Army Corps of Engineers 2011a)
The history and current administration of the Upper Mississippi River National Wildlife and Fish Refuge is closely linked with that of the U.S. Army Corps of Engineers (USACE) and their navigation project on the river. Beginning in 1871, Congress approved funding for the USACE to improve the river for navigation, mainly through the removal of snags and occasional dredging. Further navigation improvements were facilitated with wing dams and backwater closing structures. With growing demands for improved shipping capacity and reliability, in 1930 Congress authorized and funded the current 9-foot navigation channel. The navigation project would eventually include a series of 29 locks and dams between Minneapolis, Minnesota and St. Louis, Missouri; eleven of these locks and dams are within the refuge boundary.

Once the 9-foot navigation project was authorized, acquisition of lands for the refuge by the Bureau of Biological Survey (now the Service) was suspended due to the navigation project's timeline and funding. The USACE was required to acquire lands that would be flooded because of project construction. Additionally, it made sense not to have two federal agencies competing for the same land acquisition. The USACE thus acquired approximately 106,000 acres within the generally accepted boundary of the refuge. The solution for these conflicting Congressional directives was for the USACE to transfer those lands unnecessary for managing the navigation project to the Service. The first formal documentation of an

agreement between the Service and the USACE is provided by three executive orders issued by President Roosevelt between September 1935 and October 1936. The orders reserved USACE lands… "for the use of the Department of Agriculture as a breeding place for migratory birds, other wild birds, game animals, fur-bearing animals, fish and other aquatic animal life and for the conservation of wild flowers and aquatic plants, to be administered as a part of the Upper Mississippi River Wild Life and Fish refuge." The executive orders noted that the lands "are primarily under the jurisdiction of the War Department" and conditioned the reservations with the right of the USACE to pursue its activities without interference.

Early on there were discrepancies on the administration of these USACE transferred lands and each agencies' respective role. Compounding this issue were the different land management priorities of the two agencies. To help clarify their relationship, the USACE and the Service began to plan for cooperative use in late 1941 by classifying the lands and preparing a written agreement. Negotiations were held from 1941 through 1945 and were successfully concluded with the signing of the first cooperative agreement on May 15, 1945. The first conference between the USACE, the Service, and the states (Minnesota, Wisconsin, Iowa, Illinois, and Missouri) to negotiate general plans was held in 1950. By 1954, the new Cooperative Agreement and General Plans were signed and executed in the five states. The 1954 Cooperative Agreement and the 1953 General Plans provided a unified system of administration over USACE lands. Only three major categories of land were to exist: "Green lands" were Upper Miss. Act land as part of the original refuge; "Blue lands" were non-transferred USACE land; and "Red lands" were those transferred by cooperative agreement. Some project lands were further transferred from the Service to the states (Illinois, Iowa, and Missouri) for administration. The General Plans were drawn up in accordance with the Fish and Wildlife Coordination Act of 1946. Since their initial drafting, the Cooperative Agreement was revised in 1963 and amended in 2001 and the General Plan was revised in 1961.

In summary, the 2001 Amended Cooperative Agreement, with some reservations, grants to the Service the rights to manage fish and wildlife and its habitat on those lands acquired by the USACE. These lands are managed by the Service as a part of the refuge. The USACE retained the rights to manage as needed for the navigation project, forestry, and Corps of Engineers-managed recreation areas, and all other rights not specifically granted to the Service. Subsequent cooperative agreements between the Service and the states (Illinois, Iowa, and Missouri) allow for the management of General Plan Lands through the states' respective agencies exercising administration over fish and wildlife resources.

Continuing to recognize the need for fully coordinated work on lands covered under the General Plan, the first Land Use Allocation Plan (LUAP) was completed in collaboration with Minnesota, Wisconsin, and Iowa in 1983 for Pools 1-10 (St. Paul District; U.S. Army Corps of Engineers 2011a). The LUAP includes a Master Plan for Public Use and Development and Resource Management, most recently updated in January 2011. The master plan acts as a zoning plan and allocates lands for wildlife management, navigation project operations, low-density recreation, intensive recreation, and natural areas. This plan is used to help guide future federal land use actions in a clear and balanced process between the Service and USACE. More information about the long history of cooperative management of resources on the Upper Mississippi River by the USACE and the USFWS can be obtained from the refuge's Comprehensive Conservation Plan (U.S. Fish and Wildlife Service 2006) and the Mark Twain National Wildlife Refuge Complex Comprehensive Conservation Plan and Environmental Assessment (U.S. Fish and Wildlife Service 2004).

U.S. Department of the Interior Adaptive Management Guide (Williams et al. 2009, Williams and Brown 2012)

The planning team used adaptive management principles in the development of this HMP and the refuge will use adaptive management to respond to changing conditions that impair the ability to measure and achieve habitat objectives. It should be noted that although aspects of the U.S. Department of the Interior's (DOI) adaptive management guide were used throughout the entire process of developing this HMP, it is not a required aspect of completing the HMP. As such, the processes outlined below were strictly used as guidance and Service policy (620 FW 1, 601 FW 3, 701 FW 2) for development of HMPs was the overarching direction used to complete the Refuge HMP. As defined by the DOI (Williams et al. 2009), adaptive management is:

> "…a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."

There are two phases in implementing the DOI's adaptive management procedures (Williams and Brown 2012); the "Set-up Phase" (Steps 1-5 below) where key components of the program are developed, and the "Iterative Phase" (Steps 6-9) where components of the program are put in practice and linked together in a data-driven, results-oriented, sequential decision making process. The DOI suggests these nine steps in establishing an adaptive management program:

Step 1 – Stakeholder Involvement
This step involves gathering stakeholders to assess the problem(s) and reach agreements about its scope, objectives, and potential management actions. Effort should be made to identify and engage all stakeholders and all steps of the adaptive management process should be open and transparent to them.

Step 2 – Objectives
This step involves identifying clear, measureable, and agreed-upon management objectives to guide decision-making and evaluate management effectiveness over time. Objectives should address the resource issue and reflect the social, economic, and/or ecological values of the stakeholders. When drafting objectives, it is important for them to be specific and unambiguous, measureable with the appropriate field data, achievable but challenging, results-oriented, and time fixed.

Step 3 – Management Actions
This step involves identifying potential management actions for decision making. Potential actions should consist of activities that are under management control and alternative actions should be explicit and documented.

Step 4 – Models
This step involves identifying models that characterize different ideas and hypotheses about how the system works. The models should: 1) be understood to change through time, 2) be focused on key components of interest, 3) describe resource changes directly influenced by management, 4) incorporate fluctuating environmental conditions, 5) apply a cost/benefit analysis and, 6) be calibrated with available data and knowledge.

Step 5 – Monitoring Plans
This step involves designing and implementing a monitoring plan to track resource status and other key resource attributes. The monitoring plan should include procedures to: 1) evaluate progress towards achieving objectives, 2) determine resource status in order to identify management actions, 3) increase the understanding of resource dynamics by comparing predictions and results, and 4) enhance and develop models of resource dynamics.

Step 6 – Decision Making
This step involves selecting management actions from a comprehensive list of all possible actions based on management objectives, resource conditions, and enhanced understanding. Actions should be based on objectives and both may need to be adjusted over time to account for the changing of resource conditions or updated understanding of resources and resource dynamics.

Step 7 – Follow-up Monitoring
This step involves using monitoring to track system responses to management actions. Monitoring should occur after management actions have taken place, but in certain situations (e.g. population monitoring) it may be necessary to monitor before the implementation of actions to establish baseline information.

Step 8 – Assessment
This step involves comparing predicted vs. observed change in resource status to improve understanding of resource dynamics. These assessments should include (from monitoring results) parameter estimation, comparative assessments, and prioritization of management alternatives. The results of these comparisons are used to update the understanding of management impacts, inform the selection of management actions, and evaluate the effectiveness of management actions.

Step 9 – Iteration
This step involves returning to Step 6 and amending, if necessary, management actions based upon the results of Steps 7 and 8. Occasionally it may be necessary to return to step 1.

Certain aspects of adaptive management as outlined in steps 1–9 have previously been completed with the refuge's 2006 CCP (U.S. Fish and Wildlife Service 2006), while others were revisited or completed with the development of this HMP. Specifically, Step 1 was utilized in developing the HMP with the research of the refuge history (Chapter 2), the selection of priority resources (Chapter 3), and the development of updated goals, objectives, and strategies (Chapters 4 and 5). In certain cases, outside partners were consulted for their expertise on the wildlife and habitat of the refuge. In other instances, "stakeholder involvement" involved interactions between the planning team and other experts within the Service and both federal and state partner agencies as well as by consulting peer-reviewed and/or published literature (e.g. state, regional, national and international plans listed below). Step 2 was first addressed in the 2006 CCP but was revisited in the HMP with the modification of goals and objectives as outlined in Chapter 4, and these modifications took into account aspects of Steps 3 and 4. Step 5 requires the refuge to establish and maintain a monitoring program to ensure that changing conditions can be detected and responded to adequately and efficiently. The monitoring program will be created in accordance with 701 FW 2 and will be developed as a step down plan that is incorporated into Chapter 6. Step 6 has been achieved with the strategies as outlined in Chapter 5 and these will be revisited every 5 years with the internal review and update of the HMP as mandated in Service policy (620 FW 1). Steps 7–9 will be achieved on an annual basis over the 15-year life of this HMP.

National, Regional, and State Plans

The following plans or lists were used to develop the refuge's HMP. In many of the plans, species of animals and plants are identified as being in need of conservation actions and were considered for inclusion in the HMP as a Refuge Resource of Concern (ROC). These plans were also used to develop habitat management objectives and strategies as well as provide a vision for restoration and management actions in collaboration with the broad partnership of agencies and organizations that manage natural resources on the Upper Mississippi River.

USFWS Region 3 Endangered, Threatened, Proposed, and Candidate Species List (U.S. Fish and Wildlife Service 2015a)
This list identifies all fish, wildlife, and plant species within USFWS Region 3 that are federally listed as threatened or endangered, are proposed for such listing, or are candidates for such listing.

USFWS Migratory Bird Program Strategic Plan (U.S. Fish and Wildlife Service undated)
The U.S. Fish and Wildlife Service Division Migratory Bird Program developed a strategic plan providing direction for the Services' migratory bird management through the period 2004–2014. The plan contains a vision and recommendations for the Refuge System's place in bird conservation. It defines strategies for the Service to actively support bird conservation through monitoring, conservation, consultation, and recreation. This HMP, to the extent it is practical, will utilize standard monitoring protocols, habitat assessment and management, and promote nature-based recreation and education to forward the vision of the Migratory Bird Program Strategic Plan.

USFWS Birds of Conservation Concern List (U.S. Fish and Wildlife Service 2008a)
The Birds of Conservation Concern List identifies the migratory and non-migratory bird species, beyond those already designated as federally threatened or endangered, that represent the U.S. Fish and Wildlife Service's highest conservation priorities.

USFWS Migratory Bird Program Focal Species Strategy: FY2012–FY2016 Focal Species (U.S. Fish and Wildlife Service 2011a)
The USFWS Migratory Bird Program Focal Species Strategy identifies species for which: 1) there is a high level of conservation need; 2) their conservation needs are similar to those of a larger suite of species; 3) conservation actions directed toward them could serve to unify conservation partnerships; and 4) conservation actions may realistically address factors affecting their status.

USFWS Region 3 Fish and Wildlife Resource Priorities (U.S. Fish and Wildlife Service 2002a)
The priorities presented within this report identifies 243 species considered to be in the greatest need of attention within the Midwest under the Service's full span of authorities. The strategies identified in this document will contribute to the conservation, protection, and recovery of migratory birds, threatened and endangered species, and interjurisdictional fish, as well as the habitats on which they depend.

USFWS Midwest Birds of Concern (U.S. Fish and Wildlife Service 2015b)
This list, compiled by the Migratory Bird Program of the USFWS in Region 3, identifies 85 species that are Federally-listed as threatened or endangered, rare or declining, migratory game birds, or superabundant and contributing to human-wildlife conflicts.

Landscape Conservation Cooperative (LCC) Planning Efforts (Landscape Conservation Cooperative Network 2014)
LCC's are public-private partnerships that facilitate collaboration, coordination, and integration of conservation activities at landscape scales among states, tribes, federal agencies, non-governmental organizations, and other conservation entities. The refuge is located primarily within the USFWS's Upper Midwest Great Lakes (UMGL) LCC with a small portion of the refuge located in the Eastern Tallgrass Prairie and Big Rivers (ETPBR) LCC. Both the UMGL LCC and the ETPBR LCC recently issued drafts lists of surrogate species as part of a national effort to develop a surrogate species approach to strategic habitat conservation (Blomquist et al. 2013, Blomquist et al. 2014, U.S. Fish and Wildlife Service 2014d) but final lists were not available at the time this HMP was completed. However, species included in the draft lists were used during assessment of potential ROCs for this HMP.

North American Waterfowl Management Plan (North American Waterfowl Management Plan, Plan Committee 2004a, 2014b, 2012)
The North American Waterfowl Management Plan was originally written in 1986 and envisioned a 15-year effort to achieve landscape conditions that could sustain waterfowl populations. The 2004 revision established a new 15-year timeframe for waterfowl conservation in North America by assessing and defining the needs, priorities, and strategies required to guide waterfowl conservation in the 21st century. The species and habitat priority lists associated with this plan were reviewed during our development of refuge-specific ROC.

Partners in Flight Bird Conservation Plan for the Upper Great Lakes Plain (Knutson et al. 2001)
Partners in Flight (PIF) is a partnership of government agencies, private organizations, academic researchers, and other stakeholders focused on coordinating voluntary bird conservation efforts to benefit species at risk and their habitats. The PIF Bird Conservation plan identifies species and habitats in need of conservation within the Upper Great Lakes Plain (UGLP) geographic area, recommends conservation actions targeting these species, and suggests opportunities for achieving these recommendations. It identifies species of concern based on established assessment criteria. Species identified as priority species in this plan were considered during our development and prioritization of refuge-specific ROC.

Upper Mississippi River and Great Lakes Region Joint Venture (UMRGLR JV) Implementation Plan (Upper Mississippi River and Great Lakes Region Joint Venture 2007)
Joint Ventures are collaborative, regional partnerships among government agencies, non-profit organizations, corporations, tribes, and the public to conserve habitats for priority bird species, other wildlife, and people. A primary goal of the Upper Mississippi River and Great Lakes Region Joint Venture is the integration of continental priorities for the conservation of migratory birds with conservation actions at regional, state, and local scales. This plan was followed by a series of step-down plans with conservation strategies targeting four broad taxa of birds: landbirds (Potter et al. 2007b), shorebirds (Potter et al. 2007a), waterbirds (Soulliere et al. 2007b), and waterfowl (Soulliere et al. 2007a, Soulliere et al 2017). The goal of the strategies is the establishment of efficient habitat conservation to maintain or increase carrying capacity for populations of priority species consistent with continental and Joint Venture regional goals. Species identified in the UMRGLR JV plans were considered during our development and prioritization of refuge-specific ROC.

Upper Mississippi Valley/Great Lakes (UMVGL) Waterbird Conservation Plan (Wires et al. 2010)
The UMVGL plan provides recommendations to maintain and restore waterbird populations and habitats throughout the planning region as part of the continental-scale North American Waterbird Conservation Plan (Kushlan et al. 2002). Species identified in the UMVGL plan were considered during our development and prioritization of refuge-specific ROC.

Environmental Pool Plans: Mississippi River Pools 1-10 (Fish and Wildlife Working Group 2004)
The Environmental Pool Plans were prepared by the Fish and Wildlife Work Group of the River Resources Forum. The River Resources Forum is a partnership between state and federal agencies that addresses resource issues concerning the Upper Mississippi River system. The Pool Plans identify existing and desired habitat conditions and summarize potential actions to achieve desired conditions. The refuge contributed to the development of the Pool Plans and the HMP will contribute to the achievement of desired habitat conditions identified in the Pool Plans.

Upper Mississippi River Systemic Forest Stewardship Plan (Guyon et al. 2012)
Arising from the collaborative efforts of the U.S. Army Corps of Engineers (USACE) with multiple state and federal agencies, including the USFWS, as well as non-governmental organizations and stakeholders, the Systemic Forest Stewardship Plan provides a guide for sustainable management of forests in the Upper Mississippi River system. The refuge's HMP will contribute to the system-wide goals identified in the Systemic Forest Stewardship Plan and the achievement of desired future conditions. The 2012 Forest Stewardship Plan represents the state of knowledge at the time it was written, but the intent of USACE and partner foresters and planners is to update the plan on a recurring basis as new information becomes available. These updates could result in the modification or refinement of desired future conditions, goals, objectives, and/or desired stand conditions currently identified in the plan. The refuge will work cooperatively in cooperation with the USACE and other partner foresters to determine when it would be appropriate to similarly modify or refine the forest management objectives specified in this HMP or to implement actions seeking to achieve conditions, objectives, and conditions identified in the systemic forest plan.

Upper Mississippi River Fisheries Plan 2010: Conservation through Cooperation (Janvrin et al. 2010)
The Upper Mississippi River Fisheries Plan was produced by the Upper Mississippi River Conservation Committee, a collaborative body of partners comprised of state and federal agencies, non-governmental organizations and other stakeholders. The Fisheries Plan identifies the resource needs and makes recommendations to address those needs, with the intent of maintaining a sustainable fisheries resource. The refuge's HMP will contribute to the goals identified in the Fisheries Plan.

Conservation Plan for Freshwater Mussels of the Upper Mississippi River System (Upper Mississippi River Conservation Committee 2004)
This report was released in 2004 by the Upper Mississippi River Conservation Committee, Mussel Ad Hoc Subcommittee. The plan outlines the history of harvest, biology, status, concerns, and numerous strategies for the conservation, including restoration, of the freshwater mussels in the Upper Mississippi River System.

Distribution and Relative Abundance of Upper Mississippi and Illinois River Mussels, 2003 (Kelner 2003)
This resource is a table that provides information on the distribution and abundance of 53 species of freshwater mussel. Geographic areas covered include the Upper Mississippi River from the Upper Saint Anthony Falls Navigation Pool downstream through Navigation Pool 26. Abundance for each species in each pool is characterized as historic, rare, common, or abundant.

Interjurisdictional Fishes of the Mississippi River Basin (Mississippi Interstate Cooperative Resource Association 2009)
This document categorizes an extensive number of fish species as interjurisdictional and provides the following explanation for the classifications:

> "Interjurisdictional fish" are defined as those species that depend on interjurisdictional rivers during some part of their life cycle, and therefore, come under the management of two or more governmental entities. Interjurisdictional fish are not necessarily migratory, but can move either short or long distances between political jurisdictions in the completion of their life cycles. Even species as common as bass and bluegill can come under interjurisdictional management.

Distribution and Relative Abundance of Upper Mississippi River Fishes August 2010 (Steuck et al. 2010)
This resource provides information on the distribution and abundance of 163 species of fish. Geographic areas covered include the Upper Mississippi River from the Pool 1 downstream through Navigation Pool 26. Abundance for each species in each pool is characterized as stray, historic, uncommon, occasional, common, or abundant.

State Wildlife Action Plans (Iowa Department of Natural Resources 2005, Illinois Department of Natural Resources 2005, Minnesota Department of Natural Resources 2006, Wisconsin Department of Natural Resources 2005)
State Wildlife Action Plans represent comprehensive wildlife conservation strategies that are intended to conserve wildlife and their habitats before they become rarer and more expensive to protect. States are required to complete a Wildlife Action Plan to be eligible for funds distributed from the federal government through the Wildlife Conservation and Restoration Program and the State Wildlife Grants Program. Wildlife Action Plans document the distribution and abundance of all species of wildlife within a state and identify those with low and declining populations. All states associated with the refuge (Minnesota, Wisconsin, Iowa, and Illinois) have completed a Wildlife Action Plan.

State lists of Endangered, Threatened, and Species in Need of Conservation (Illinois Endangered Species Protection Board 2015, Iowa Natural Resource Commission 2009, Minnesota Department of Natural Resources 2013, Wisconsin Department of Natural Resources 2014a, 2014b)
These resources document species listed by each state, as codified in legislation, as endangered, threatened, or in need of conservation.

Upper Mississippi River Basin Association (UMRBA) 2013–2017 Strategic Plan (UMRBA 2013)
The UMRBA is an interstate organization that facilitates and maintains communication and cooperation on water planning and management among the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin. The UMRBA 2013-2017 Strategic Plan identifies the state's broadly defined joint priorities and helps to communicate those priorities to partners such as the USFWS.

Upper Mississippi River Restoration Program (UMRR) Strategic Plan (U.S. Army Corps of Engineers 2015)
This plan outlines four goals for UMRR through partnerships between USACE, USFWS, USGS, the five Upper Mississippi River state governments (IL, IA, MN, MO, and WI), other governmental agencies, non-profits, and the public from 2015 through 2025. Ultimately, the UMRR program is the responsibility of USACE; however, with partnerships, the mission is to construct high performing restoration, rehabilitation, and enhancement projects, increase the effectiveness of ecosystem restoration and knowledge through monitoring and research, and keep organizations engaged in the vision for restoration of the Upper Mississippi River. The plan was endorsed by the UMRR Coordinating Committee in November 2014 (http://umrba.org/meetings/empcc-minutes/umrr11-14.pdf).

Habitat Needs Assessment (Theiling et al. 2000)
The Habitat Needs Assessment provides a system-wide analysis of historical and existing habitat conditions, and desired future habitat conditions for the Upper Mississippi River system. It is intended to guide future Habitat Rehabilitation and Enhancement Projects (HREP) associated with the Upper Mississippi River Restoration (UMRR) Program. The UMRR program is a partnership of state, federal, and non-governmental stakeholders who collaboratively monitor the health of the Upper Mississippi River, and restore and enhance habitats with the river.

Upper Mississippi River Ecosystem Restoration Objectives 2009 (U.S. Army Corps of Engineers 2009)
This document identified areas for new restoration projects, knowledge gaps, and objectives at a system scale for the Upper Mississippi River Restoration Program.

Indicators of Ecosystem Structure and Function for the Upper Mississippi River System (De Jager et al. 2018)
This document provides quantified measures of UMR ecosystem structure and function. Each indicator represents one or more management objectives for the UMR (U.S. Army Corps of Engineers 2009), and the objectives represent five essential ecosystem characteristics: hydraulics and hydrology, biogeochemistry, geomorphology, habitat, and biota.

Habitat Needs Assessment-II: Linking Science to Management Perspectives (McCain et al. 2018)
The Habitat Needs Assessment-II identified 12 quantifiable indicators of Upper Mississippi River structure and function developed in De Jager et al. (2018). The quantitative indicators were compared to qualitative assessments of conditions desired by river managers to determine habitat needs.

American Bird Conservancy (ABC) United States Watchlist of Birds of Conservation Concern (American Bird Conservancy undated)
This resource identifies birds in the United States that the American Bird Conservancy categorizes as being of Highest Continental Concern (Red List) or being a Declining or Rare Continental Species (Yellow List).

Blueprint for Minnesota Bird Conservation: Recommendations for Minnesota's Prairie Hardwood Transition Region (Pfanmuller 2014)
This document is focused on a biogeographical area of the Minnesota, the Prairie Hardwood Transition Region, which encompasses the Upper Mississippi River. It identifies bird species that will be the focus of conservation efforts, conservation strategies, and locations where conservation activities will be implemented.

Stewardship Birds of Minnesota (Pfanmuller 2012)
This document identifies 12 Minnesota bird species that have the characteristics of: 1) 5% or more of their breeding population can be found in Minnesota; and 2) 5% or more of their breeding range occurs within Minnesota.

Midwest Partners in Amphibian and Reptile Conservation Midwest PARC Species (Midwest Partners in Reptile and Amphibian Conservation undated)
This resource categorizes 164 species of salamanders, frogs, toads, lizards, snakes, and turtles according to Regional Concern scores (high, medium-high, medium-low, low) and Regional Responsibility scores (high, low).

Xerces Society Red Lists of Bees, Butterflies and Moths, and Aquatic Invertebrates (Xerces Society for Invertebrate Conservation undated)
These are individual red lists for each taxa group (bees, butterflies and moths, and aquatic invertebrates) that identify species and habitats in need of conservation, threats to survival, and information regarding research and conservation needs.

Upper Mississippi River Conservation Opportunity Area Wildlife Action Plan (Moorehouse and Brinkman 2012)
This draft document provides strategies and prescriptions for the implementation of Illinois' State Wildlife Action Plan in the Upper Mississippi River planning area.

Refuge Plans

Comprehensive Conservation Plan (U.S. Fish and Wildlife Service 2006)
The National Wildlife Refuge Improvement Act of 1997 stipulated that all refuges should prepare a CCP by 2012. The CCP is an all-encompassing document that guides all biological and public use actions on the refuge for a 15-year period. The refuge completed its CCP in 2006. The HMP represents a step-down plan that outlines the implementation of many of the wildlife and habitat goals and objectives identified in the CCP.

Chronic Wasting Disease Surveillance and Management Plan (U.S. Fish and Wildlife Service 2005)
Chronic wasting disease, which attacks the brains of infected white-tailed deer and other cervids, has been detected in all four states associated with the refuge. This plan outlines refuge strategies for surveillance and monitoring of chronic wasting disease and the response of the refuge in the event that chronic wasting disease is detected on refuge properties.

Furbearer Management Plan and Environmental Assessment (U.S. Fish and Wildlife Service 2007)
Considered a step-down management plan of the CCP, the Furbearer Management Plan identifies three goals of furbearer management on the refuge:

- Maintenance of healthy furbearer populations and their habitats through a science-based harvest program.
- The protection of refuge infrastructure critical to habitat for fish and wildlife.
- A continuation of traditional recreational use of refuge resources while meeting the purposes of the refuge and mission of the Refuge System.

Fire Management Plan (U.S. Fish and Wildlife Service 2008b)
Each refuge containing "vegetation capable of sustaining fire" is required to prepare a Fire Management Plan as mandated by Service policy. Prescribed fire, which is utilized to mimic natural processes and manage certain habitats, has been incorporated as a management strategy into this HMP.

Annual Habitat Work Plan (AHWP)
Each refuge prepares an Annual Habitat Work Plan that includes a review of the habitat management activities of the previous year, an evaluation of monitoring programs, and updated recommendations for habitat management strategies for the coming year. It is a tool to accomplish the goals and objectives of this HMP.

Inventory and Monitoring Plan (IMP)
An Inventory and Monitoring Plan is a required refuge plan and will be developed following the completion of the HMP. Management objectives and strategies developed in the HMP will provide for the framework for how refuge staff can measure progress or status of stated goals.

Chapter 2. Background

2.1 Refuge Location and Description
2.2 Geographical Setting
2.3 Historical Perspective of Ecological Landscape
2.4 Current Climate Influences
2.5 Current Natural and Anthropogenic Disturbances
2.6 Current Refuge Conditions and Resources

2.1 Refuge Location and Description

The Upper Mississippi River National Wildlife and Fish Refuge (refuge) represents one of the largest blocks of floodplain habitat in the lower 48 states. Bordered by steep wooded bluffs that rise 100 to 600 feet above the river valley, the Mississippi River corridor and refuge offer scenic beauty, a wild character, and productive fish and wildlife habitat unmatched in mid-America. The refuge encompasses more than 244,000 acres and extends 261 river miles from the confluence of the Chippewa River, near Wabasha, Minnesota, in the north to near Rock Island, Illinois in the south. On the Upper Mississippi River, river miles on the Upper Mississippi River are numbered starting from mile 0 near Cairo, Illinois, through mile 866 near Minneapolis, Minnesota; the northern and southern extents of the refuge are associated with river mile 763 in the north and river mile 503 in the south (U.S. Army Corps of Engineers 2011b). While extensive wetland habitat losses have occurred well beyond its boundaries in neighboring states, the refuge remains a stronghold of bottomland forests and wetlands vital to breeding and migrating fish and wildlife.

The refuge is one of several management entities on the Mississippi River. The U.S. Army Corps of Engineers (USACE) operates the 9-foot navigation project within the Upper Mississippi River System (UMRS), and administrative boundaries of the navigation project overlay the entire refuge. The navigation project provides a continuous channel for barge traffic through a series of reservoirs, or pools, created by 29 locks and dams on the Upper and Middle Mississippi River. For management and administrative purposes, the refuge is divided into four districts based on the geographic distribution of pools: Winona District encompasses Pools 4, 5, 5a, and 6; La Crosse District encompasses Pools 7 and 8; McGregor District encompasses Pools 9, 10, and 11; and Savanna District encompasses Pools 12, 13, and 14. In addition to USACE and refuge ownership, the adjoining states of Iowa, Illinois, Minnesota, and Wisconsin own wildlife management areas within the floodplain.

Winona District
The Winona District is located between River Miles 715 and 764 in Pools 4, 5, 5a, and 6 and is within Geomorphic Reaches 2 and 3 (Table 2-1; Figure 1-1). The district, the smallest of the refuge, encompasses 38,665 acres, primarily composed of open water, submersed aquatic vegetation, marsh, and bottomland forest located in Minnesota and Wisconsin (See Table 2-4 in Section 2.5).

La Crosse District
The La Crosse District is located between River Miles 679 and 715 in Pools 7 and 8 and is within Geomorphic Reach 3 (Table 2-1; Figure 1-1). The district, the second smallest of the refuge, encompasses 47,788 acres, primarily composed of open water, submersed aquatic vegetation, marsh, and bottomland forest located in Minnesota and Wisconsin (See Table 2-4 in Section 2.5).

McGregor District
The McGregor District is located between River Miles 583 and 679 in Pools 9, 10, and 11 and is within Geomorphic Reaches 3 and 4 (Table 2-1; Figure 1-1). The district, the largest of the refuge, encompasses 91,737 acres, primarily composed of open water, submersed aquatic vegetation, marsh, and bottomland forest located in Iowa, Minnesota, and Wisconsin (See Table 2-4 in Section 2.5).

Savanna District

The Savanna District is located between River Miles 503 and 583 in Pools 12, 13, and 14 and is within Geomorphic Reaches 5 and 6 (Table 2-1; Figure 1-1). The district, the second largest of the refuge, encompasses 66,315 acres, primarily composed of open water, submersed aquatic vegetation, marsh, and bottomland forest located in primarily Illinois and Iowa with a small portion in Wisconsin (See Table 2-4 in Section 2.5). The district also contains the most grassland and upland forest habitat within the refuge.

Table 2-1. Location of refuge districts within different geographic or management areas within the Upper Mississippi River System.

District	USACE Lock and Dam Pool	Geomorphic Reach	Floodplain Reach	River Mile
Winona	4, 5, 5a, and 6	2 and 3	Upper impounded	715 - 764
La Crosse	7 and 8	3	Upper impounded	679 - 715
McGregor	9, 10, and 11	3 and 4	Upper impounded	583 - 679
Savanna	12, 13, and 14	5 and 6	Upper impounded	503 - 283

2.2 Geographical Setting

As stated previously, the refuge is located along a portion of the Upper Mississippi River bordered by four states: Minnesota (Wabasha, Winona, and Houston Counties), Wisconsin (Buffalo, Trempealeau, La Crosse, Vernon, Crawford, and Grant Counties), Iowa (Allamakee, Clayton, Dubuque, Jackson, Clinton, and Scott Counties), and Illinois (Jo Daviess, Carroll, Whiteside, and Rock Island Counties). The Upper Mississippi River Basin is a major sub-basin of the entire Mississippi River Basin, representing approximately 15% of that larger basin.

The Upper Mississippi River

The Upper Mississippi River drains 189,000 square miles located in parts of six states and (Figure 2-1). Historically, water, nutrients, and sediment reached the Upper Mississippi River through tributaries bordered by riparian forest and prairie or by forests, wetlands, and prairies that stored water during wet periods and slowly released it during dry ones. This resilient landscape buffered water flows, and delivered nutrients more evenly during the year. With the installation of a lock and dam system and landscape-scale changes in the watershed, mostly from agriculture, these natural processes have been greatly altered. Today, managers attempt to mimic aspects of the historical flow regime by manipulating water levels to benefit waterfowl, aquatic vegetation, and the river as a whole.

See Appendix B, Figure 2-1. The Upper Mississippi River NW&FR boundary and the Upper Mississippi River watershed in Appendix A.

Spring snowmelt in the upper portions of the watershed typically result in seasonal flooding along the river. The size and extent of the spring flood each year depends on the amount of snowpack in the upper watershed at the time of spring thaw and the amount of rain during the spring season. Large-scale precipitation events throughout the year can also have an impact on flooding within the areas adjacent to the Mississippi River. Conversely, periods of low flow during the summer and winter were historically common but construction of the locks and dams, and management of the river for navigation purposes, have largely removed these flow events from annual hydrologic cycles. Management of the navigation system attempts to maintain water levels above a minimum amount necessary to facilitate navigation, which is typically higher than the water levels that would have often occurred during periods of the summer and winter.

The Mississippi River Flyway

The refuge sits in the heart of the Mississippi River flyway, one of four major migration routes on the continent, known for the spectacular numbers of ducks and geese that follow the river and use the wetlands each spring and fall. This great flyway serves a vital corridor for many other kinds of birds as well. Each

spring and fall, the Mississippi River valley serves as one of the most important bird migration corridors in North America. Millions of birds representing over 290 different species rely on the waters, wetlands, forests, and grasslands along the Mississippi River for places to rest and feed during the fall and spring migration.

USACE River Reaches

For planning and habitat management purposes, USACE identifies 12 dominant geomorphic areas, or river reaches. The refuge occurs in Reaches 2–5, or Pools 4–14 (Theiling et al. 2000). The first three reaches (2, 3, 4), Pools 4–13 of the refuge, are characterized by many braided channels and a mix of open water, aquatic vegetation, floodplain forest, some agricultural and urban areas, numerous islands, and a narrow floodplain (about 1 to 3 miles) that terminates at steep bluffs. The fifth Reach (including Pool 14 of the refuge) is dominated by agriculture, with occasional floodplain forest and wetland habitats.

Bird Conservation Region (BCR) 23 – Prairie Hardwood Transition (UMRGLR 2007)

The regional planning efforts completed by the North American Bird Conservation Initiative in 1999 created a series of regional conservation planning units that span international boundaries. The majority of refuge properties are located within BCR 23 (Prairie Hardwood Transition) with a small portion of refuge property located in BCR 22 (Eastern Tallgrass Prairie; Figure 2-2).

See Appendix B, Figure 2-2. Location of the Upper Mississippi River National Wildlife & Fish Refuge in relation to BCR 22 and BCR 23 in Appendix A.

Partners in Flight Physiographic Area 16 – Upper Great Lakes Plain (Knutson et al. 2001)

Partners in Flight (PIF) has created 99 physiographic areas that link conservation areas by natural environmental characteristics. The refuge is located in PIF Physiographic Area 16, the Upper Great Lakes Plain (Figure 2-3).

See Appendix B, Figure 2-3. Location of the Upper Mississippi River National Wildlife & Fish Refuge in relation to PIF 16 in Appendix A.

Landscape Conservation Cooperative (LCC) Geography (LCC 2014)

The refuge is located primarily within the USFWS's Upper Midwest Great Lakes (UMGL) LCC with a small portion of the refuge located in the Eastern Tallgrass Prairie and Big Rivers (ETPBR) LCC (Figure 2-4).

See Appendix B, Figure 2-4. Location of the Upper Mississippi River National Wildlife & Fish Refuge in relation to the UMGL LCC and the ETPBR LCC in Appendix A.

Upper Mississippi River/Great Lakes Region Joint Venture (UMGL JV)

The refuge occurs within the UMGL JV, which includes all of Indiana, Michigan, Wisconsin, plus portions of seven other states including the portions of Iowa and Minnesota within the refuge boundary (Figure 2-5).

See Appendix B, Figure 2-5. Location of the Upper Mississippi River National Wildlife & Fish Refuge in relation to the UMGL JV.

2.3 Historical Perspective of Ecological Landscape

Geology

The refuge lies within the Mississippi River floodplain, an ancient river valley filled with alluvial material (mud, sand, and gravel) carried and deposited by surface water. The river and its tributaries traverse sedimentary rock formations (dolomite, sandstone, and shale) that accumulated under inland seas during the early Paleozoic Era about 400 to 600 million years ago (Fremling and Claflin 1984, Fremling 2004).

In more recent geologic times, the river valley was shaped by the presence (and absence) of glacial action. A warming climate ended the last period of glaciation, about 12,000 years ago, and melted glaciers created huge clearwater lakes. Glacial Lake Agassiz covered much of northern Minnesota, the Dakotas, and central

Canada. Most of that lake emptied to the south via the River Warren through which water ran in torrents for about 3000 years, trenching the Mississippi River valley by as much as 200 feet (Fremling and Claflin 1984). Once the flow from glacial lakes subsided, the river lost much of its velocity and sediment transport capabilities. Sediment deposition ensued, and the valley partially refilled with sand and gravel. Several episodes of flushing and filling of the river valley have followed. Sand terraces that presently flank the river valley are remnants of ancestral floodplains not scoured during the most recent postglacial floods.

Much of the refuge follows the Mississippi River as it flows through the Driftless Area, a non-glaciated "island" within the larger area of central North America shaped by a series of glaciers (Albert 1995). This region has minimal amounts of glacial deposits known as "drift" and is therefore known as the Driftless Area. This landscape features a combination of steep, exposed bluffs and eroded ravines that bound the wide floodplain of the Upper Mississippi River, creating the unmatched wild and scenic character prized by many visitors. The bluff tops mark the edge of a plateau extending many miles from the river. The bluffs are capped with loess soils that range in depth from 2–20 feet, the thinnest occurring along the valley walls. The Driftless Area includes parts of southwest Wisconsin, southeast Minnesota, northeast Iowa, and northwest Illinois. It also is called the Blufflands or Paleozoic Plateau.

Pre-European Settlement Vegetation

Prior to European settlement, the Upper Mississippi River was broad and shallow with an extensive network of braided channels forming thousands of islands (Fremling 2004) resulting in a mosaic of channels, islands, and wetlands. Surveys conducted by the Mississippi River Commission in the 1890's and early 1900's serves as the basis for land cover/use maps for the Upper Mississippi River during 1890 (Upper Midwest Environmental Sciences Center 1999). This was a period when modifications to the river to improve navigation where occurring but construction of the lock and dam system had not yet begun. The amount and distribution of major habitats present in the 1890s, in relation to contemporary refuge boundaries, is provided in table 2-2 and illustrated in Figures 2-6 through 2-17 of Appendix B.

See Appendix B, Figures 2-6 through 2-17. Land cover from the 1890s.

Table 2-2. Summary of 1890s land cover categories by District. "No Data" indicates original data source did not include information that could be designated for this land cover type.

Land Cover Class	Winona	La Crosse	McGregor	Savanna	Refuge Total
Upland Forest	No Data	No Data	No Data	No Data	No Data
Savanna	No Data	No Data	No Data	No Data	No Data
Grassland	No Data	No Data	No Data	No Data	No Data
Bottomland Forest	18,336	20,302	46,400	26,296	111,334
Shrub Scrub	3,093	3,787	11,677	10,151	28,708
Wet Meadow	3,701	9,590	10,076	3,954	27,321
Marsh	2,411	2,365	167	0	4,943
Submersed Aquatic Vegetation	No Data	No Data	No Data	No Data	No Data
Sand and Mud	667	859	2,767	2,926	7,219
Open Water	9,499	7,944	19,453	14,850	51,746
Developed	24	15	9	9	57
Agriculture	170	1,152	989	4,757	7,068
Other	765	1,776	202	3,371	6,114
Total Acres	38,666	47,790	91,740	66,314	244,510

Modification of the Upper Mississippi River System

The Upper Mississippi River system has undergone substantial modifications due to agricultural, navigational, and flood control activities (Carlander 1954, Chen and Simons 1986, Theiling 1995, Sparks

et al. 1998, Kollath 2000, Collins and Knox 2003, Johnson and Hagerty 2008, Sparks 2010, Theiling and Nestler 2010). Extensive modification of the Upper Mississippi River for navigational purposes began in the 1800s and included the removal of fallen trees, the construction of wing dikes and closing dams to direct water flow to the main channel, and dredging of the main channel to permit passage by watercraft. The current navigational system and structures originated in 1930 when Congress authorized the 9-foot navigation channel project for the Upper Mississippi River System to be constructed, operated, and maintained by the U.S. Army Corps of Engineers. This navigation system, including 29 locks and dams on the Mississippi River, has brought the most significant change to the river ecosystem since European settlement.

The lock and dam system was completed by the late 1930s and created a stairway of reservoirs (navigation pools) from Minneapolis, Minnesota, to St. Louis, Missouri, allowing boats and barges to pass obstacles and readily traverse this 400-foot elevation gradient and 670 mile stretch of the Mississippi River. The navigation pools permanently raised water levels and inundated thousands of acres of floodplain habitat. The newly created backwater wetlands and shallow lakes immediately supported an abundance of fish and wildlife adapted to this new water regime.

2.4 Current Natural and Anthropogenic Disturbances

Invasive Species

Invasive Animal Species

Common carp is native to Europe and Asia and has been present in the UMRS since the 1880s (Lubinski et al. 1986). It is classified as abundant to common throughout the UMRS and makes up between 72 to 98% of the total non-native fish biomass at long-term sampling locations (Johnson and Hagerty 2008, Steuck et al. 2010). However, it is possible that common carp have been declining in abundance in portions of the Upper Mississippi River and mechanisms driving population dynamics of common carp are in this region are being investigated (Lubinski et al. 1986, Bajer et al. 2012, Silbernagel and Sorensen 2015).

Other non-native carp species that may affect the fish community of the UMRS include bighead and silver carp. Currently, only scattered accounts of non-native carp occurrence other than the common carp have been reported in the UMRS but their threat is exemplified by their invasion of the Illinois River system where they make up 60% of the biomass (Garvey et al. 2012). Between 2012 and 2014, 33 occurrences of silver carp capture have been reported and their range expanded 118 miles upriver into Minnesota through lock and dam No. 7 (U.S. Fish and Wildlife Service 2014a). Twenty-seven occurrences of bighead carp capture were documented in the UMRS between 2012 and 2014 with the farthest observation coming within seven miles of the Minnesota state border. Both species along with other non-native carp such as grass carp and black carp can outcompete small and large native fish. Although not currently abundant in waters of the refuge, non-native carp represent a significant threat to the native fish community if they were to become established in the UMRS.

Zebra mussels and quagga mussels are native to Eurasia and have been present in the UMRS since the early 1990s (Upper Mississippi River Conservation Committee 2004, Grigorovich et al. 2008). Zebra mussels quickly spread throughout the UMRS and can reach densities of 60,000/m^2. Zebra mussels out-compete native mussels because zebra mussels do not require a fish host, are prodigious reproducers, and can attach and grow on the bottom, hard surface, and native mussels, potentially interfering with native mussel reproduction.

Faucet snails are native to Europe and were introduced to the Great Lakes around 1870 (Sauer et al. 2007). Faucet snails are an intermediate host for two trematode species that are intestinal parasites of waterfowl, coots, and other waterbird species. The first documentation of waterbird mortality due to trematodiasis on the Upper Mississippi River occurred in 2002 (Sauer et al. 2007). Large mortality events potentially involving tens of thousands of waterbirds, primarily lesser scaup and American coots, have occurred since then (Herrmann and Sorensen 2011, Winter et al. 2014, Peirce et al. 2016).

A relatively new forest insect pest in North America first detected in Michigan, the emerald ash borer has killed millions of ash trees as it spreads across U.S. and Canadian forests (Herms and McCollough 2014). Refuge staff and cooperating USACE foresters have documented multiple locations on the refuge where ash mortality is occurring due to this insect pest. Because green ash can be a sizeable component of bottomland forests of the Upper Mississippi River (Yin et al. 2009, Romano 2010, De Jager 2012, De Jager et al. 2012, Guyon et al. 2012, Guyon and Battaglia 2018) the impact of this invasive forest insect pest will likely be substantial.

Invasive Plant Species

Multiple invasive plant species have been documented on the refuge that are either not native to the Upper Mississippi River or have non-native ecotypes considered to be an invasive species threat to the refuge ecological integrity (U.S. Fish and Wildlife Service 2006). In some instances, native species that are relatively benign or even desirable in some habitats are considered invasive or undesirable in other habitats. An example is honey locust, which may be desirable in bottomland forest habitats but is an undesirable species with invasive traits in some upland habitats; an example of where this is the case is at the refuge's Lost Mound Unit in the Savanna District. Species like Eurasian water milfoil, curly-leafed pondweed, reed canarygrass, purple loosestrife, European buckthorn, white mulberry, crown vetch, and garlic mustard are all commonly found on the refuge. Other species such as water hyacinth, water lettuce, parrot feather, spotted knapweed, bush honeysuckle, and leafy spurge currently have localized distributions or have only been documented as isolated occurrences (Table 2-3). It will be important to limit the spread of these and new invasive species throughout the refuge through early detection, rapid response, and continued management actions. Several instances of partnership efforts, often involving a large number of local citizens, exemplify effective responses to early detection of "new" invasive species (e.g., see http://www.lakeonalaska.org/invasive_species.html; https://www.wisconsinrivers.org/ais-success-story-la-crosse/).

Reed canarygrass is a highly invasive grass distributed throughout the United States. It is considered native in North America and Eurasia, but its invasiveness in North America has been attributed to various factors including the introduction of non-native ecotypes (Lavergne and Molofsky 2004). This plant can reach 6 feet in height and out-compete more beneficial wetland plants within the floodplain, quickly developing into a monoculture with relatively little wildlife benefit. Research in Wisconsin has demonstrated a strong negative effect of reed canary grass on occupancy of habitat by secretive marsh birds (Glisson et al. 2015). Reed canarygrass monocultures have also been shown to prevent regeneration of native floodplain forest and other native vegetation (Thomsen et al. 2012), creating the potential for significant habitat change as mature trees die (Upper Mississippi River Conservation Committee 2002). This invasive species is ubiquitous in most wetland habitats throughout the refuge.

Purple loosestrife is a wetland plant native to Europe and Asia and is found along the length of the refuge in suitable wetland habitats. It aggressively reproduces, choking out domestic grasses, sedges, and other flowering plants that provide a higher quality source of nutrition for wildlife. Purple loosestrife adapts readily to natural and disturbed sites, allowing dense, homogenous stands to form. It is capable of invading many wetland types including wet meadows, marshes, river and stream banks, backwater edges, and ditches. Biocontrol with beetles (*Galerucella* sp. and *Hylobius* sp.) has occurred on the refuge for more than 10 years.

European buckthorn is an invasive tree native to Europe. It can become established in a variety of upland and moist habitats and quickly forms dense stands that out-compete native trees and shrubs and reduces or eliminates ground vegetation. Buckthorn spreads by seeds, which can survive for extended periods in the seed bank. Currently, there is no known biological control. Removal or reduction methods involve mechanical, chemical, and hand pulling depending on the size of the tree, size of the stand, and habitat that it has invaded. It is found throughout the upland and bottomland forests of the refuge.

Crown vetch is an invasive legume native to Europe. It prefers sunny, open areas, but it can be found in a variety of environments. Crown vetch spreads through rhizomes, can form dense mats that smother out shrubs and small trees, and can outcompete native vegetation. Seeds can remain viable for more than 15 years. It is difficult to control, but mowing, pulling, prescribed burning and chemical applications can be

used depending on the size of the patch and site conditions. It is found throughout the refuge in upland forest and prairie habitats.

Garlic mustard is a biennial herb of the mustard family. It 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. It is found throughout forest habitats of the refuge.

Table 2-3. Common and localized invasive plants species currently identified on the Upper Mississippi River National Wildlife & Fish Refuge.

Invasive Species	Distribution and Habitats	Known District Locations
Reed canarygrass	Widespread – Wet meadows	Multiple locations in all districts
Purple loosestrife	Widespread – Wet meadows and marshes	Winona District – Polander Lake McGregor District – Cold Spring Landing Savanna District – Spring Lake
Garlic mustard	Widespread – Upland and bottomland forest	Winona District – Garvin Brook McGregor District – Ballard Savanna District – Frog Pond
Crown vetch	Widespread – Grasslands and prairies	Winona District – Weaver Landing Savanna District – Lost Mound
European buckthorn	Widespread – Upland and bottomland forests	Winona District – McNally Landing McGregor District – Ballard Savanna District – Thomson Grassland RNA
Eurasian water milfoil	Widespread – backwaters and other lentic habitats	Multiple locations in all districts
Curly-leafed pondweed	Widespread – backwaters and other lentic habitats	Multiple locations in all districts
Water hyacinth	Limited – backwaters and other lentic habitats	Winona District – Pool 5 La Crosse District – Pool 8
Water lettuce	Limited – backwaters and other lentic habitats	Winona District – Pool 5
Parrot feather	Limited – backwaters and other lentic habitats	Winona District – Pool 5
Spotted knapweed	Limited – Grasslands and sand prairies	Savanna District – Lost Mound
Siberian elm	Limited – Upland and bottomland forests	McGregor District – Guttenberg Islands Savanna District – Thomson Grassland RNA
Honey locust	Limited – Upland and bottomland forests	Savanna – Lost Mound
Leafy spurge	Limited – Grassland and prairies	Winona District – Weaver Landing Savanna District – Lost Mound
Black locust	Limited – Upland and bottomland forests	Winona District – Spring Lake Islands Savanna District – Lost Mound
Japanese knotweed	Limited – Upland and bottomland forests	Winona District – Weaver Landing McGregor District – Bertom Lake Savanna District – Maquoketa Bottoms
Bush honeysuckle	Limited – Upland and bottomland forests	Winona District – McNally Landing Savanna District – Lost Mound

Human Disturbance of Wildlife

Human disturbance of wildlife can be an important consideration in conservation of wildlife populations (Madsen 1994, Korschgen and Dahlgren 1992, Madsen and Fox 1995, Tablado and Jenni 2017, Gaynor et al. 2018). A definition of habitat that includes resources and conditions that produce (or preclude) occupancy by an organism should include human disturbance as a feature of habitat quality because it influences whether the environment provides "conditions appropriate for individual and population persistence" (Hall et al. 1997, p 178). Disturbance of waterfowl has been identified by the refuge's CCP as an important factor in management of the refuge. The CCP identified a critical threshold of one major disturbance per day that will be used to determine whether additional actions will be taken by the refuge to minimize disturbance to migrating/staging waterfowl on refuge lands and waters. The substantial impact of human disturbance on migrating/staging waterfowl, and the great importance of this issue to refuge management, has resulted in substantial effort expended by the refuge in monitoring the amount of disturbance to waterfowl in various areas of the refuge (Korschgen et al. 1985, Kenow et al. 2003b, Rasmussen and Simpson 2010, Kenow et al. 2017). Additional treatment of human disturbance of waterfowl is provided in Section 2.5 Current Refuge Conditions and Resources - Current Wildlife - Birds.

2.5 Current Refuge Conditions and Resources

Climate

The climate of the Upper Mississippi River Basin is subhumid continental with cold dry winters and warm moist summers. Average annual precipitation varies from about 22 inches in the western part of the basin to 34 inches or more in the east. About 75 percent of the total annual precipitation falls between April and September. Basin-wide, the average monthly temperature ranges from about 11 degrees F in January to 74 degrees F in July. Most of the river within the refuge usually freezes solid each winter. The refuge's CCP can be consulted for additional information about climatic conditions.

Climate change is a concern that could have major influences on the refuge. Like the rest of western North America, the Upper Mississippi River watershed is already experiencing changes in temperature and precipitation. Unfortunately, a climate change model specifically for the Upper Mississippi River watershed is not currently available. Most existing climate change models are developed for larger regions such as the Upper Midwest and focus on impacts to the urban areas such as the Minneapolis/St. Paul area. However, impacts to the refuge under different climate change scenarios can be inferred to provide a general understanding. Under current climate change scenarios, annual temperatures will increase, periods of extended cold temperatures (often referred to as cold snaps) will decrease, and heavy precipitation events will increase (Union of Concerned Scientists 2009). For example, the Minneapolis/St. Paul area is expected to see a 66% increase in rain events resulting in 2 inches over a 24-hour period. The Minneapolis/St. Paul area is also expected to see an increase in the number of days greater than 90^{o} F, increasing from an average of 12 days now to over 70 days by the middle of the 21st century. With warmer temperatures, the Upper Midwest is expected to see a 50% increase in precipitation during winter, spring, and fall, resulting in wetter conditions and increased flooding. Precipitation during the summer is expected to decrease by 15% resulting in a higher probability for drought. Downscaling current climate change models to the Upper Mississippi River watershed will provide a better understanding of how climate change will affect the region (Wisconsin's Initiative on Climate Change Impacts 2011) and the refuge.

Topography

A typical cross section of the refuge is bounded by bluffs on each side. Steep slopes coming off the bluffs represent the effects of erosional processes that carved the river valley and resulting wide floodplain. At the base of the bluffs, more gradual slopes toward the river resulted from historic floodplain deposition and sloughing of the bluffs. Topography generally becomes flat at the high river stage elevation. Subtle differences in elevation are due to a combination of historic flood events scouring and depositing sediments. Topography is a major driving factor in the plant communities and habitats found on the refuge. See Vegetation and Land Use Classification subsection below for additional information about how topography influences the habitats on the refuge.

Soils

Much of the Upper Mississippi River Basin is covered by loess, a silty soil deposited by postglacial winds. These soils form a mantle over half the Upper Mississippi and Illinois subbasins and serve as a major source of silt to the Upper Mississippi River System (Nielsen et al., 1984). Alluvial soils (clay, silt, sand and gravel) are up to 150 feet deep (Pool 10). Soils within the pools vary from silty clay to sand. Sand terraces occur at slightly higher elevations on the edge of the floodplain of the River and consist of glacial outwash deposited during periods of higher average flow. More information about characteristic soils within the navigation pools can be found in the refuge's CCP (USFWS 2006).

Hydrology and Water Quality

Hydrology and water quality play a vital role in maintaining the ecological integrity of the refuge. A rich assemblage of species requires an appropriate mix of physical, chemical and biological features, such as water flow and depth, adequate but not excessive nutrients in the substrate, appropriate temperature, oxygen and light levels, food sources and escape cover.

Water quantity and quality within the Upper Mississippi River Basin and the floodplain go to the very heart of the conservation conundrum of the refuge. Besides trying to deal with an increasing array of environmental degradation symptoms, it is important to trace the problems to their sources for long-term solutions. Monitoring on the river has demonstrated that some forms of pollution have actually declined since the federal Water Pollution Control Act was passed in 1972, mandating the secondary treatment of sewage effluents.

However, the river and the refuge are still being exposed to biotic risks and threats from a growing array of agricultural chemicals and their degradation products, excess nutrients from both point and non-point sources, dissolved heavy metals in water and sediment, and other toxic compounds or invasive organisms.

Water flow within the entire basin is influenced by agriculture, urban development and the thousands of reservoirs installed throughout the basin. USACE has 76 reservoirs, holding 40 million-acre feet of water; this volume would take three months to flow past St. Louis at average discharges (Wlosinski 1999). An estimated 3,000 more reservoirs with unknown capacity also occur in the basin.

Wetland drainage has affected 26 million acres in the Mississippi River Basin. An estimated 34 to 85 percent of wetlands have been lost in Wisconsin and Minnesota and 85 to 95 percent in Iowa and Illinois (Dahl 1990). These losses are critical because wetlands help decrease runoff from uplands, they capture sediments and nutrients that would otherwise enter tributary streams, and they sustain highly diverse plant and animal populations.

River flow on the Upper Mississippi has been altered by installation of more than 25 dams as well thousands of wing dams and other river training structures. Since 1933, the long-term average hydrologic pattern on the Upper Mississippi River System shows an approximate 11-year cycle of low and high flow, an apparent long-term increase in flow, and an increase in the frequency and amplitude of multiyear fluctuations in flow. Flood heights have increased and the number of days water elevations are above flood stage is increasing; present day floods on the Mississippi River at St. Louis tend to be 9 feet higher than historic floods at the same discharge (780,000 cfs). As of 1999, major floods at St. Louis were occurring once every six years (Wlosinski 1999).

The lock and dam system has permanently inundated lands previously rejuvenated through annual drying and "flood pulse" cycles. For a period immediately after the navigation pools were created they supported extensive wetlands (Green 1954) but within a few decades these habitats declined in coverage; turbidity caused by the foraging activities of common carp, island erosion, and wave action that re-suspends bottom sediments have all contributed to the decline of aquatic plants. To compensate for degradation of marsh habitats, attempts are being made to simulate historic hydrologic cycles with periodic drawdowns and to restore island backwater habitats with projects in cooperation with the USACE and the states.

Land Use Characteristics of the Upper Mississippi River Basin

The Upper Mississippi River Basin is a major sub-basin of the entire Mississippi River Basin. It includes approximately 800 miles of river and covers 189,189 square miles, about 15 percent of the entire Mississippi River Basin. The majority of the land area in the Upper Mississippi River Basin is devoted to cropland or pasture. Sediments, nutrients, pesticides and other contaminants enter the Mississippi River via its many tributaries, many of which receive runoff from urban and rural drainage networks consisting of tiles and ditches.

With the installation of a lock and dam system and landscape-scale changes in the watershed, mostly from agriculture, natural processes within the basin have been greatly altered, especially in terms of hydrological regimes - water levels have been stabilized relative to historical conditions, runoff has increased and water quality has declined. As a result, floodplain productivity has declined because sediments from the uplands have filled backwaters, floods and river currents have eroded away plant beds and islands. Stabilized water levels have eliminated natural processes of drying and flooding, which are essential to maintaining highly productive wetlands.

Vegetation and Land Classification

Various categorization schemes have been utilized to identify and describe the ecological communities present in and along the Upper Mississippi River (Sternberg 1971, Wilcox 1993, Theiling et al. 2000, Koel 2001, Dieck and Robinson 2004, Dieck et al. 2015, Federal Geographic Data Committee Vegetation Subcommittee 2008). The General Wetland Vegetation Classification System (GWVCS) is based on mapping of aerial photos and categorizes wetland and terrestrial vegetation within the river floodplain into 31 land cover/use (LCU) classes (Dieck and Robinson 2004, Dieck et al. 2015). An Aquatic Habitat Classification System (AHCS) based on the geomorphic and constructed features of the Upper Mississippi River has also been developed (Wilcox 1993). Habitat categories identified and described in the refuge's CCP primarily reflect those captured by GWVCS (Dieck and Robinson 2004), while habitat categories identified and described in Theiling et al. (2000) utilize both the GWVCS and the AHCS. The classification resulting from Theiling et al. (2000) is commonly referred to as the Habitat Needs Assessment (HNA) classification. The Upper Mississippi River Systemic Forest Stewardship Plan (Guyon et al. 2012) utilized both the GWVCS and a Hydrogeomorphic (HGM) classification system (Heitmeyer 2008) to identify and describe forest communities of the Upper Mississippi River System. However, the HGM was developed for a segment of the Mississippi River that is south of the refuge (Heitmeyer 2008) and its ultimate applicability in the Upper Mississippi River system has not been determined.

A coarse-scale inventory of GWVCS categories represented on refuge properties is possible using LCU georeferenced maps derived from 2010 aerial imagery (Dieck and Robinson 2004, Dieck et al. 2015). Appendix B, Figures 2-18 through 2-29 provide maps of the 2010 land cover for each pool. Table 2-4 provides a summary of different habitats among the Districts and the totals for the refuge. Note that 2010 land cover data for Pool 11 in the McGregor District was not available at the time this mapping work was conducted so 2000 land cover was used for Pool 11.

See Appendix B, Figures 2-18 through 2-29. Land cover from 2010.

Table 2-4. Summary of 2010 land cover categories by District. Note that 2010 land cover data for Pool 11 in the McGregor District was not available at the time this mapping work was conducted so 2000 land cover was used for Pool 11.

Broad Habitat[1]	Winona District	La Crosse District	McGregor District	Savanna District	Refuge Total
	Acres				
Upland Forest[2]	41	16	112	698	867
Savanna	0	31	12	450	493
Grassland	274	378	178	3,236	4,066
Bottomland Forest	11,247	9,759	24,691	19,471	65,168
Shrub/scrub	227	157	224	306	914
Wet Meadow	1,087	3,550	2,742	1,702	9,081
Marsh	7,237	9,587	13,381	7,693	37,898
Sand and Mud	158	30	196	21	405
Submersed Aquatic Vegetation	7,671	8,803	15,328	9,771	41,573
Open Water	10,654	15,369	34,774	22,520	83,317
Developed	36	59	33	122	250
Agriculture	0	14	0	142	156
Other[3]	33	35	60	183	311
Total Acres	38,665	47,788	91,737	66,315	244,505

[1]See Table 2-5 for how broad habitats correspond to the GWVCS and other classification schemes.
[2]Upland Forest is under-estimated because the LCU maps and GWVCS do not provide coverage outside the floodplain, while refuge properties include bluffs adjacent to the floodplain, the majority of which likely represent upland forest habitat.
[3]Comprised of agriculture, conifer, levee, and plantation land use classifications.

The GWVCS and AHCS classification schemes provide a great deal of information that is useful to describe the habitat within the refuge and help inform habitat management objectives. However, using these classification schemes to organize and communicate habitat management objectives is difficult because of the fine scale these schemes use. For example, the GWVS lists 31 different habitats. Broad habitats were developed for this HMP by combining similar habitats and will be used to develop habitat management objectives. Information from the GWVCS, AHCS, and HNA schemes were used to identify and describe terrestrial, wetland, and aquatic ecological communities encompassed by refuge boundaries. Additionally, federal agencies engaged in vegetation classification are required to use or crosswalk their classifications to the National Vegetation Classification System (Federal Geographic Data Committee Vegetation Subcommittee 2008). Table 2-5 provides a crosswalk between broad habitats and HNA, GWVCS, and NVCS schemes. For any habitat classification scheme, including the broad habitats developed for this HMP, the overall classification does not preclude the presence of other, different habitats within the area classified. The Upper Mississippi River floodplain and associated habitats represent a mosaic of habitats that may not be evident in mapping exercises, depending on the scale of the map or area of interest.

Table 2-5. Crosswalk between broad habitats of the Refuge and GWVC, AHCS, and NVCS classification schemes.

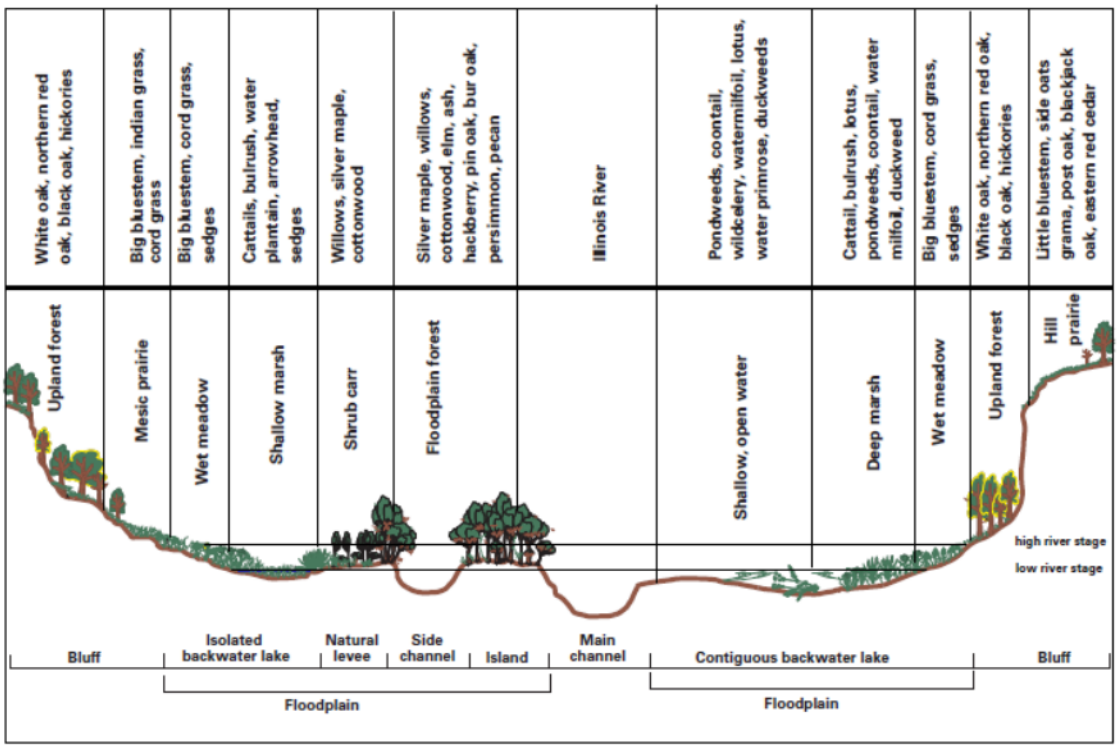
Broad Habitat	HNA Geomorphic Area(s)	HNA Classification	GWVCS Classification (also referred to as UMR class 31)	NVCS Classification
Upland Forest	Terrestrial island and contiguous terrestrial floodplain	Mesic bottomland hardwood forest	Upland Forest	Midwestern Dry and Dry-mesic Oak Forests
				Midwestern Mesic Oak and Oak-maple Forest
Savanna	Terrestrial island and contiguous terrestrial floodplain	Not available	Not available	North-central Bur Oak Openings
Grassland	Not available	Grassland	Grassland (including Pasture and Roadside Grass/Forbs)	Midwestern Deep Soil Tallgrass Prairie
				Midwestern Thin-soil Tallgrass Prairie
				Midwestern Sand and Gravel Tallgrass Prairie
Bottomland Forest	Terrestrial island and contiguous terrestrial floodplain	Populus community	Populus Community	Midwestern Riverfront Floodplain Forest
		Salix community	Salix Community	
		Wet floodplain forest	Floodplain Forest	
			Lowland Forest	Midwestern Bottomland Hardwood Forest
			Wet Meadow Shrub	Dogwood - Mixed Willow Shrub Meadow
Wet meadow	Not available	Wet meadow	Sedge Meadow	Midwestern Wet Prairie and Meadow
			Wet Meadow	
			Wet Meadow Shrub	Dogwood - Mixed Willow Shrub Meadow

Broad Habitat	HNA Geomorphic Area(s)	HNA Classification	GWVCS Classification (also referred to as UMR class 31)	NVCS Classification
Marsh	Main channel border, contiguous floodplain lake, contiguous impounded area, and contiguous floodplain shallow aquatic area	Scrub/shrub	Deep Marsh Shrub	Dogwood - Willow Swamp
			Shallow Marsh Shrub	
		Semi-permanently flooded emergent annual	Deep Marsh Annual	Wild Rice Marsh
		Semi-permanently flooded emergent perennial	Deep Marsh Perennial	Midwest Mixed Emergent Deep Marsh
		Floating-leaved aquatic bed	Rooted Floating Aquatics	
		Seasonally flooded emergent annual	Shallow Marsh Annual	Bulrush - Cattail - Bur-reed Shallow Marsh
		Seasonally flooded emergent perennial	Shallow Marsh Perennial	
Sand and mud on islands, bars, and flats	Main channel border	Sand/mud	Mud	Not applicable
	Not available		Sand	
	Not available		Sand Bar	
Lentic backwater lakes and impounded areas	Contiguous backwater floodplain lake	Open water	Open Water	Not applicable.

Broad Habitat	HNA Geomorphic Area(s)	HNA Classification	GWVCS Classification (also referred to as UMR class 31)	NVCS Classification
	Contiguous floodplain shallow aquatic area			
	Contiguous impounded area			
	Not available	Submersed aquatic bed	Submersed Aquatic Vegetation	Not applicable.
Lotic main channel border, secondary channel, tertiary channel	Main channel border	Open water	Open water	Not applicable.
	Tailwater			
	Secondary channel			
	Tertiary channel			
	Tributary channel			
	Excavated channel			
Lotic main channel	Main navigation channel	Open water	Open water	Not applicable.

The plant communities and habitats present on the refuge are greatly influenced by the Mississippi River's hydrology and the topography of the adjacent terrestrial landscapes. Figure 2-8 provides a generalized representation of the habitats associated with the floodplain and adjacent uplands in the Upper Mississippi River. The original source of the figure (U.S. Geological Survey 1999) used it to illustrate habitats in the Illinois River Valley but there is great similarity in how natural communities characteristic of these two river ecosystems vary based on the morphology of the river and its surrounding upland areas. In general, the refuge can be broken down into ten broad habitats briefly described below. Tables in Chapter 3 also include detail of these habitats.

Figure 2-8. Conceptual cross section of habitats along the Illinois River, which are very similar to those of the Upper Mississippi River (from U.S. Geological Survey 1999).



Terrestrial and Wetland Habitats

Upland Forests

The GWVCS describes upland forests as growing on hills near the edge or outside of the river floodplain and characterized by oaks, hickories, and elms (Dieck and Robinson 2004, Dieck et al. 2015). Tree species composition of upland forests in this region can shift abruptly based on combinations of slope, aspect and soil type (Curtis 1959, Peet and Loucks 1977). South- and southwest-facing slopes, with exposure to solar radiation and summer winds, are typically characterized by species adapted to xeric conditions. Conversely, north- and northeast-facing slopes can be characterized by tree species adapted to more mesic conditions. Upland habitats of the Driftless Region, a region that encompasses nearly the entire refuge, were historically subjected to frequent fires resulting in woody plant and herbaceous communities characterized by fire-tolerant species (Shea et al. 2014, Knoot et al. 2015). Historically, these frequent fires often resulted in upland forests of this region being characterized by a relatively open canopy composed of oaks and other fire-tolerant species (Iowa Department of Natural Resources 2005, Minnesota Department of Natural Resources 2006). Dey and Kabrick (2015) describe a continuum of tree density and crown canopy closure that differentiates between savanna, open oak woodland, and closed oak woodland.

Extensive areas of upland forest are present along the bluffs that demarcate the edge of the river floodplain. However, decades of fire exclusion has likely resulted in most of these forests being characterized by a greater degree of canopy closure and a shift in species composition in both the overstory and understory vegetation (Nowacki and Abrams 2008). Upland forests of the region provide important habitat for transient Neotropical migrant landbirds (Knutson et al. 2006). However, continued shifts in tree species composition of Midwestern forests from xeric-adapted species to mesic-adapted species may diminish the value of this habitat to migrant landbirds (Wood et al. 2012).

Savanna
GWVCS does not include a savanna classification. However, savannas can generally be described as sparsely treed areas dominated by native warm season grasses with a minor native forb component (Minnesota Department of Natural Resources 2005). Dey and Kabrick (2015) describe a continuum of tree density and crown canopy closure that differentiates between savanna, open oak woodland, and closed oak woodland. Savannas resulted from the interplay between fire frequency and local soil, topography, and moisture conditions and were likely the most extensive vegetation structure type in the Driftless Region (Shea et al. 2014). Savannas developed where fires were frequent enough to prevent fire-intolerant trees and shrubs from dominating (Curtis 1959). Mapping of the refuge indicates there are 493 acres of savanna on the refuge, of which 450 acres are located in the Savanna District (Table 2-4).

Grasslands
The CCP identifies 41 grassland units managed by the refuge. Two of these, Lost Mound and the Thomson Prairie in the Savanna District are relatively large, representing in excess of 3,000 acres. The remainder of the grassland units range in size from approximately 2 to 125 acres. Vegetation mapping using 2010 data identified 4,072 acres of grassland contained within refuge boundaries (Table 2-4). This is an underestimation because there are refuge grasslands that lie outside the boundaries of areas that were mapped. Refuge grasslands occur on both sandy and finer soils, with soil type playing a large role in determining plant species composition. Additionally, refuge grasslands represent both remnant (presumably never plowed) and restored or reconstructed prairies.

Bottomland Forests
Bottomland forest can be found in areas adjacent to the river where inundation length and frequency are short enough to allow for the establishment of trees. The amount of canopy openings and the position of the trees in relation to the floodplain elevation determine tree species composition.

Several GWVCS vegetation classes comprise the bottomland forest habitat including floodplain forest, lowland forest, *Populus* communities, and *Salix* communities. The total of all bottomland forest on the refuge is 65,168 acres (Table 2-4). The floodplain forest class is characterized by silver maple, elm, cottonwood, black willow and river birch. The *Populus* community is characterized by cottonwood comprising greater than 50% of the overstory canopy while the *Salix* community is characterized by willow comprising greater than 50% of the overstory. The lowland forest class is found on elevations slightly higher than the floodplain forest class and is flooded less frequently. Species that characterize the lowland forest class include oak, hickory, and river birch.

Shrub/Scrub
The GWVCS defines this vegetation class as occurring on drier soils and consisting of greater than 25% infrequently flooded shrubby vegetation growing with grasses. Only 914 acres of shrub/scrub habitat were mapped within refuge boundaries. However, it is likely that some areas of this habitat that are within refuge boundaries lie outside of the areas that were mapped. For habitat management planning purposes, shrub/scrub habitat was not included as a separate broad habitat and a specific habitat management objective for shrub/scrub will not be developed in Chapter 4. Refuge shrub/scrub habitat management activities will be incorporated into actions for either bottomland forest or wet meadow, depending on the location of the shrub/scrub habitat.

Wet Meadow
This habitat is found on low-lying areas and can be characterized by a high water table, saturated soils, and frequent flooding. The GWVCS includes three vegetation categories that fall within this broad habitat: wet meadow, wet meadow shrub, and sedge meadow. Within refuge boundaries, 9,081 acres of wet meadow habitat was mapped in 2010 (Table 2-4). The GWVCS characterizes this vegetation class as being greater than 10% perennial grasses and forbs with reed canarygrass, rice cutgrass, and goldenrod being typical species. Wet meadow shrub vegetation is described as temporarily flooded with greater than 25% vegetation composed of alder, elderberry, false indigo, dogwood, and willow. Sedge meadow is described as having greater than 10% of the vegetation consisting of sedges.

There has been limited research on the suitability of reed canarygrass as habitat for breeding birds and results suggest some bird species are not negatively influenced by the cover or dominance of this species in wetlands and wet meadows (Kirsch et al. 2007, Spyreas et al. 2010). Arthropods are a primary food source for many breeding grassland birds, and one study failed to find a relationship between percent cover of reed canarygrass and arthropod biomass, abundance, or arthropod family richness (Meier 2004).

Marsh
Marsh habitat combines the GWVCS classes of deep marsh annual, deep marsh perennial, deep marsh shrub, rooted floating aquatics, shallow marsh annual, shallow marsh perennial, and shallow marsh shrub, totaling 37,898 acres on the refuge. In the GWVCS classification scheme, the characteristic aquatic vegetation species in the deep marsh annual class is wild rice, while the deep marsh perennial class is characterized by pickerelweed, arrowhead, cattail, and bur-reed. Characteristic species in the shallow marsh annual class are barnyard grass, smartweed, spike-rush, flatsedge, and beggarstick; the shallow marsh perennial class is characterized by bulrush, purple loosestrife, and giant reed. The GWVCS rooted floating aquatic class is characterized by white waterlily and American lotus. Buttonbush is a characteristic species of both the deep marsh shrub and shallow marsh shrub classes. The shallow marsh shrub class is also characterized by sandbar willow, dogwood, and false indigo.

Marsh habitats on the Upper Mississippi River are important for a variety of species and guilds, including muskrats (Clark and Clay 1985, Clay and Clark 1985, Wlosinski and Wlosinski 1998), secretive marsh birds (Graetz et al. 1997, Darrah and Krementz 2009, Darrah and Krementz 2010, Bolenbaugh et al. 2011, Schlect undated), and tundra swans (Thorson et al. 2002).

Aquatic Habitats

Sand and Mud on Islands, Bars, and Flats
Sand and mud on islands, bars, and flats habitat, for the purpose of the HMP, is considered to be unvegetated to sparsely vegetated areas associated with shallow areas near islands, bars, and flats. For at least a portion of the year, the area is inundated preventing the establishment of perennial vegetation. As water levels recede, bare substrate of deposited sand and mud remains.

Lentic Backwater Lakes and Impounded Areas
This habitat includes three HNA classifications: contiguous impounded area, contiguous floodplain shallow aquatic area, and contiguous backwater floodplain lake (Theiling et al. 2000). Contiguous impounded areas are located at the lower ends of pools and are bounded by navigational dams and connecting dikes. This habitat is variable in each pool based on pool size and its orientation to prevailing winds. The upstream end of contiguous impounded areas are typically bound by islands or contiguous floodplain shallow areas. Contiguous backwater floodplain lakes are areas that are connected year-round hydrologically to the river channel and provide low water current velocity. In these areas, substrate is mixed between silt, clay, and mixed sand, silt, and clay. Aquatic plant and animal species are adapted to the low velocity conditions. Water depth, velocity, dissolved oxygen levels, and nutrient levels are all important factors determining habitat quality.

Lotic Main Channel Border, Secondary Channel, Tertiary Channel
This habitat includes six HNA classifications: main channel border, secondary channel, tertiary channel, tributary channel, tailwater, and excavated channel (Theiling et al. 2000). Main channel border is the area between the main navigational channel and the apparent shoreline. In the upper portion of pools, this area is a narrow band, but becomes wider towards the lower end of the pools as more floodplain has been inundated. Substrates are typically a mix of sand, silt, and clay, but areas of gravel and rock also occur. Submerged plants, logs, and wing dams provide habitat for many aquatic organisms. Secondary channels are large channels similar to the main river channel, but they carry less flow. The navigational channel may be located in a secondary channel. Habitat in secondary channels is variable and is a function of connectivity to the main channel, secondary channel age, size, and substrate. When a secondary channel is large or has a strong connection to the main channel, habitat and water quality characteristics are similar to the main channel. Lower current velocity, finer sediments, and more logjams and aquatic plants are typically present in secondary channels that are either smaller or have less connection to the main channel.

Tertiary channels are smaller channels that branch off secondary channels. Tertiary channel habitat and water quality is dependent on their connectivity with other aquatic areas and tree cover. Some tertiary channels can have high current velocity with sand and gravel substrates and few plants. Other tertiary channels can have low current velocity and are similar to backwater areas with silt-clay substrates and submersed aquatic plants. Tributary channels are the small feeder streams and channels that flow into the main, secondary and tertiary channels. Tributary channel habitat can be variable, but is important to provide fish refuge during high flows.

Tailwater habitat is located directly downstream from the navigational dams. Water velocity is fast and turbulent with deep scour holes (Theiling et al. 2000). Substrates consist of boulders, cobble, gravel, and shifting sand. Excavated channels are channels created to provide either flow or navigational access. They range in size from small channels created to provide access for marinas to large channels that provide access for commercial shipping. Habitat quality in excavated channels is typically variable and poor for aquatic organisms.

Lotic Main Channel
The lotic main channel is the designated main navigation channel (Theiling et al. 2000). In straight reaches, the designated channel is 300 feet wide, while through bends in the river, it can be 500 feet wide. The channel depth is at least 9 feet deep, which is maintained by navigation dams, channel training structures and dredging. In the main channel, current velocity is high with shifting sand substrates. Similar to tailwater, water quality is adequate, but winter water temperatures may be too extreme for some fish species.

Current Wildlife

Birds
The American Bird Conservancy designated the refuge a Globally-Important Bird Area in 1997 because it had, at that time, over 70 breeding pairs of bald eagles, which represented more than 1 percent of the United States breeding population. Additional justification for the designation was a peak fall population of more than 16,900 tundra swans, which represented more than 20 percent of the eastern population, and a peak fall population of more than 136,000 canvasbacks, which also represented more than 20 percent of the world's population. Since 1997, the numbers of eagle pairs, tundra swans and canvasbacks have increased. At the time of designation as a Globally-Important Bird Area, the refuge had over 5,700 pairs of great blue herons.

The refuge lies within the Mississippi Flyway and hosts what is likely a large proportion of the continent's waterfowl during annual migrations (Serie et al. 1983, Korschgen et al. 1988, Weiner et al. 1998, Korschgen et al. 1999, Thorson et al. 2002, USFWS 2006). Waterfowl abundance has changed over time as conditions on the refuge have changed in response to the construction of the lock and dam system (Fremling 2005). Following the installation of the locks and dams, productive shallow marshes and extensive beds of submersed aquatic vegetation were created, resulting in high use during fall and spring migrations by tundra swans as well as puddle and diving ducks.

The refuge has conducted ground and aerial surveys of waterfowl during the fall migration since the 1920s. During the period 1997–2013, aerial surveys were conducted approximately weekly during the fall along a set of transects (flight lines) that stayed relatively consistent through that period (data housed at the refuge HQ office). The refuge's aerial survey data should be interpreted with caution, however, because it is known that some aerial survey observers deviated from protocol when conducting surveys. This results in an unknown level of uncertainty, variability, and reliability being associated with the aerial waterfowl survey data because little information exists with regards to what extent deviations from protocol occurred (how often, in what locations, what species were involved). However, it may be useful to present the data in some instances, along with appropriate qualifiers regarding its reliability, to provide insight on the approximate and relative levels of waterfowl abundance and distribution. This approach conforms to USFWS policy (U.S. Fish and Wildlife Service 2011b) which states that Service employees must:

"…communicate the results of scientific and scholarly activities clearly, honestly, objectively, thoroughly, accurately, and in a timely manner"

"…clearly differentiate among facts, personal opinions, assumptions, hypotheses, and professional judgment in reporting the results of scientific and scholarly activities and characterizing associated uncertainties in using those results for decision making, and in representing those results to other scientists, decision makers, and the public."

"…be responsible for the quality of the data I use or create and the integrity of the conclusions, interpretations, and applications I make. I will adhere to appropriate quality assurance and quality control standards, and not withhold information that might not support the conclusions, interpretations, and applications I make."

Tundra swan use of the Upper Mississippi River and the refuge during fall migration has increased through time (Kenow et al. 2004) from approximately 90 in 1946 (Thorson et al. 2002) to an average annual peak number of 29,897 during 1997–2013. During 1997–2013, the highest peak number of tundra swans recorded in the fall during a one-week survey period was 78,065 in 2011. The importance of the Upper Mississippi River to tundra swans is illustrated by an assessment that approximately 25 percent of the Eastern Population of tundra swans, and approximately 50 percent of all Eastern Population tundra swan cygnets have been recorded on the refuge (Thorson et al. 2002). Additional evidence for the importance of the Upper Mississippi River to Eastern Population tundra swans was provided by satellite-telemetry research of Wilkens et al. (2010). Compared to all other areas used by satellite-tracked swans during fall migration, the highest average number of days spent at one location, the second-highest proportion of all satellite-tracked swans, and the third-highest maximum number of days spent at one location was recorded for tundra swans using Pools 4–8 of the Upper Mississippi River.

High numbers of canvasback ducks stage in the fall on open water habitats of the Upper Mississippi River where they feed on submersed aquatic vegetation and benthic invertebrates (Thompson 1973, Serie et al. 1983, Korschgen et al. 1988). Relative to portions of the Upper Mississippi River upstream and downstream of the refuge, the stretch of river between lower Pool 4 and Pool 13 have been characterized in recent years by an abundance of submersed aquatic vegetation (Johnson and Hagerty 2008, Moore et al. 2010) which provides important food resources for canvasback and other waterfowl. During 1997–2012, the average annual peak number of canvasbacks counted during weekly aerial surveys in the fall was 340,284. This canvasback data should be interpreted with great caution, however, because it is known that some aerial survey observers deviated from protocol substantially when counting canvasbacks specifically. Using surgically implanted transmitters, Takekawa (1987) determined that canvasbacks staged on Lake Onalaska in Pool 7 for an average of 17.5 days. The length of stay for canvasbacks staging on the Upper Mississippi River in the fall has been shown to be inversely related to the fat reserves of individual birds (Serie and Sharp 1989). Canvasbacks with higher fat reserves left the Upper Mississippi River for their wintering grounds earlier than birds with lower fat reserves, suggesting that body condition was an important factor in migration chronology and survivorship (Serie and Sharp 1989). The importance of body condition is illustrated by research from wintering canvasbacks on the Chesapeake Bay where adult males with relatively high early-winter body mass had higher winter and annual survival probabilities than adult males with relatively lower early-winter body mass (Haramis et al 1986)

Both greater and lesser scaup occur on the Upper Mississippi River but lesser scaup are thought to be more abundant than greater scaup. During aerial surveys, the two species cannot be distinguished from one another so data only exists for scaup as a whole. During 1997–2012, the average annual peak number of scaup counted during weekly aerial surveys in the fall was 111,256. The highest number of scaup counted during a one-week survey period during 1997–2013 was 174,980 in 2011.

Eight species of dabbling duck are regularly encountered during fall aerial surveys of the refuge (mallard, northern pintail, gadwall, American wigeon. northern shoveler, blue-winged teal, green-winged teal, and wood duck). Of these, mallards have been the most abundant dabbling duck encountered during 1997–2013. During 1997–2012, the average annual peak number of mallards counted during weekly aerial surveys in the fall was 62,278. The highest number of mallards counted during a 1-week survey period during 1997–2013 was 150,554 in 1998. The refuge's fall aerial database is currently structured such that similar metrics are not readily available for all dabbling ducks combined because each species of dabbling

duck often exhibits a peak abundance during a different week within the fall aerial survey season than other species.

An important component of waterfowl habitat is the amount of disturbance that may or may not occur to waterfowl using the habitat. Habitat, as defined by Hall et al. (1997) includes resources and conditions that produce (or preclude) occupancy by an organism and it is related to an area's physical and biological characteristics. Disturbance of waterfowl by human activities has been quantified on the Upper Mississippi River by Korschgen et al. 1985, Havera et al. 1992, Kenow et al. 2003b, Rasmussen and Simpson 2010, and Kenow et al. 2017. Disturbance of waterfowl can have a negative impact on energetic cost/benefit ratios for individual birds; time spent by a bird reacting to disturbance is time that is not spent feeding (gaining energy) or resting (conserving energy). Takekawa (1987) demonstrated that canvasbacks on Lake Onalaska in Pool 7 spent 17.5% of their time feeding (gaining energy) and 50% of their time resting and sleeping (conserving energy). Similarly, Korschgen et al. (1985) reported that when disturbances were infrequent, canvasbacks spent most of each day in activities related to feeding (diving, swimming) or resting and sleeping. Flight, which is a common behavioral response to human disturbance, exacts a substantial energetic cost on waterfowl (Fredrickson and Reid 1988). Flights of canvasbacks associated with disturbance were described by Korschgen et al. (1985) as being longer in duration and at higher altitudes than flights not associated with disturbance. The energetic costs of canvasback flights associated with disturbance can be substantial and, in order for an individual bird to maintain body condition, would require additional time spent feeding and the consumption of additional calories (Korschgen et al. 1985, Kahl 1991). The most recent assessment of waterfowl disturbance on the refuge (Kenow et al. 2017) indicated that disturbance rates at Lake Onalaska in Pool 7 exceeded the critical threshold specified in the refuge's CCC (one major disturbance per day) during each of the last three years that disturbance monitoring was conducted there (2010, 2011, and 2016).

The refuge provides a vital migration corridor for millions of songbirds and other landbirds, many species of which fly thousands of miles each year between Central and South America and the United States and Canada. Various survey methods have been used to document songbird and landbird abundance on the refuge. Volunteer birders and researchers have documented over 160 species of songbirds, including 32 species of warblers, on the refuge. During the period 1994-2003, an average of about 120 species were observed during spring migration (the first two weeks of May are the refuge's peak spring migration dates), and about 80 species were observed as summer nesting residents. Songbirds nesting on the refuge include the American robin, downy woodpecker, great-crested flycatcher, prothonotary warbler, tree swallow, yellow-headed blackbird, belted kingfisher, northern cardinal, brown creeper, and cerulean warbler.

Colonial nesting birds on the refuge include species that nest on floating mats of aquatic vegetation, such as black tern, and tree-nesting species, including great blue heron, double-crested cormorants, great egrets, and green herons. Herons, egrets and cormorants use floodplain forest trees (usually silver maple, cottonwood, or swamp white oak), while cormorants will also nest on the ground. During the period 1994–2011, the number of colonies on the refuge in a given year varied from 12–19 (mean = 14.5) and the mean number of nests per colony varied from 199–507 (Winter and Nelson 2012).

The American white pelican is a relatively new, but common, visitor to the refuge in spring, summer and fall. Small numbers (less than 100) of non-breeding pelicans first showed up on the refuge in the early 1990's, with more recent counts of more than 1,000 by the mid-2000's. The first record of nesting occurred on the refuge in 2007 in Pool 13. In 2015, there were five pelican nesting colonies in Pool 13 and 1,385 nests were counted on those colonies during a one-day monitoring event in June of that year. The nearest other nesting colonies are in western Minnesota (Marsh Lake) and east-central Wisconsin (Horicon National Wildlife Refuge).

Fish

One hundred and sixty three fish species, including sport fish, commercial fish, forage fish, ancient fish, and many other unique species can be found within the UMRS (Steuck et al. 2010). Fifty-five species are considered abundant or common in the river system and 37 species are classified as occasional with scattered, local populations that can be considered large. The remaining 71 species are found in the UMRS with populations that are limited in distribution and/or abundance. States within the UMRS list 90 fish

species populations that are listed as endangered, threatened or in need of conservation. Threats to refuge fish populations include loss of habitat, the operation and maintenance of the navigation system, over-exploitation, and exotic species.

Popular sport fish on the refuge include walleye, sauger, white bass, largemouth bass, smallmouth bass, channel catfish, northern pike, bluegill, and crappie. Bluegills are the most harvested fish in the UMRS, based on creel data (U.S. Fish and Wildlife Service 2006). Pitlo et al. (1995) considered bluegill to be abundant in the pooled portions of the UMRS; however a recent review of the fishery survey data indicates that bluegill are now less common in several pools (Steuck et al. 2010). Loss of suitable spawning and over-wintering backwaters due to sedimentation may be affecting bluegill survival. Low dissolved oxygen levels and water depth that allows ingress and egress under thick ice and snow cover conditions in backwater habitats may be limiting over-wintering survival (Knight et al. 1995, U.S. Fish and Wildlife Service 2006). Besides being an important sport fish, bluegills are an important prey species for flathead catfish, largemouth bass, and bowfin and they are host to 14 species of mussels found in the Upper Mississippi River.

Three species of sturgeon are found within the UMRS (pallid, lake, and shovelnose). The pallid sturgeon is listed as an endangered species by the U.S. Fish and Wildlife Service (U.S. Fish and Wildlife Service 2014c) but is typically found well south of the refuge boundary (U.S. Fish and Wildlife Service 2006). Lake and shovelnose sturgeons are considered rare to uncommon on the refuge. Shovelnose sturgeon are also a host to at least three mussel species, including the hickorynut mussel.

The lock and dam system impedes fish passage in the UMRS by restricting upstream and downstream movement of fish, altering migration behavior, and impeding access to foraging habitat and wintering areas (Garvey et al 2010, Tripp et al 2014). There are at multiple species of fish that migrate on the UMRS, or cross jurisdictional boundaries, and the include: paddlefish, sturgeon, gar, skipjack herring, suckers, redhorse, channel catfish, flathead catfish, northern pike, white bass, largemouth bass, smallmouth bass, walleye, sauger and freshwater drum (Welsh 2004, Mississippi Interstate Cooperative Resource Association 2009, Hupfeld et al 2016). Installation of fish passage structures, modifications to the operation of dam gates, water level management plans, and the lock filling and emptying system are all measures that may influence fish passage through the UMRS. However, implementation of any of these strategies may need to take into account their potential influence on passage of invasive carp in the UMRS (Garvey et al 2010).

Reptiles and Amphibians

There are 22 species of reptiles and 13 species of amphibians that occur on the refuge (U.S. Fish and Wildlife Service 2006). The refuge provides good turtle habitat with sandy shorelines for nesting habitat and backwater marshes for hatchling nurseries. Eleven species of turtles are found on the UMRS including Blanding's, painted, snapping and common map turtles, species that prefer quiet backwater habitats. Species such as smooth and spiny softshell, and Ouachita and false map turtles prefer the more riverine or faster flowing waters associated with the main channel borders as well as secondary and tertiary channels. Stockpiling channel maintenance dredge material, campers and picnickers, and egg-eating predators all may be threats to nesting turtles but another factor that may greatly influence turtle populations is commercial harvest. Blanding's turtle is threatened in states bordering the Upper Mississippi River, but a relatively large population is located on the Minnesota side of Pool 5 and is found on refuge, state and private lands.

Ornate box turtle is another state-listed species and some of the largest populations in Illinois are found on the refuge and associated non-refuge conservation properties in the Savanna District. At the Lost Mound Unit of the Savanna District, a 19-acre turtle enclosure was constructed in 2008 to protect a population of this species from predators until the population within the enclosure reaches a sufficient size to justify release into the surrounding habitat (Strickland et al. 2017, E. Britton pers. comm.). The population of ornate box turtles within the turtle enclosure consists of all individuals that were known to remain at the Lost Mound Unit, some individuals translocated from other nearby areas, and additional individuals that have been added to this population after being "head-started" (grown in captivity to an advanced size for their age) by the Niabi Zoo (Coal Valley, IL), Lincoln Park Zoo (Chicago, IL), and Brookfield Zoo (Chicago, IL).

Field work during the summer of 2019 indicated there were 85 ornate box turtles within the enclosure (N. Richards, pers. comm.).

Several snakes found on the refuge are identified as deserving conservation attention, including the plains hog-nosed snake, timber rattlesnake, and eastern massasauga (Illinois Department of Natural Resources 2005, Iowa Department of Natural Resources 2005, Minnesota Department of Natural Resources 2006, Wisconsin Department of Natural Resources 2005, Szymanski et al. 2016). Plains hog-nosed snakes are known to occur at the Lost Mound Unit in the refuge's Savanna District, where extensive areas of sandy soils provide an important habitat component for this species. Timber rattlesnakes are extremely limited on the refuge because bluff-side habitats with upland forests, bluff-side prairies, rocky outcrops, and subterranean denning areas, are rare within the refuge's boundaries. An exception to this, however, is a small parcel in Crawford County, WI, where the refuge property abuts the Rush Creek State Natural Area and is managed by the WI Department of Natural Resources under a cooperative agreement with the refuge. The eastern massasauga was listed as a federally threatened species in 2015 and populations are known to occur on lands directly adjacent to the refuge in Wisconsin.

Nine species of frogs and one toad are known to occur on the UMRS. Blanchard's cricket frog and eastern cricket frog are identified in several State Wildlife Action Plans as deserving conservation attention (Illinois Department of Natural Resources 2005, Iowa Department of Natural Resources 2005, Minnesota Department of Natural Resources 2006, Wisconsin Department of Natural Resources 2005). The mudpuppy is an aquatic salamander that occurs in the Upper Mississippi River and associated tributaries, is identified in several State Wildlife Action Plans (Illinois Department of Natural Resources 2005, Iowa Department of Natural Resources 2005, Minnesota Department of Natural Resources 2006, Wisconsin Department of Natural Resources 2005) and is unique for its role as the only known host for the salamander mussel (Patterson et al 2018), a mussel species of conservation concern (Illinois Department of Natural Resources 2005, Minnesota Department of Natural Resources 2006, Wisconsin Department of Natural Resources 2005).

Mammals

Fifty-one species of mammals are found on the refuge (U.S. Fish and Wildlife Service 2006). The refuge has abundant habitat for aquatic furbearers such as muskrat, beaver, mink and otter. Muskrat populations probably peaked during the decades immediately following completion of the lock and dam system when extensive marsh habitat characterized by emergent aquatic vegetation was present. Since then, the gradual decline in amount of emergent marsh habitat and the gradual filling in of shallow water habitats through sedimentation have likely contributed to a decline in abundance of this species. Regulated trapping of furbearers has occurred on the refuge since 1929 (U.S. Fish and Wildlife Service 2007, U.S. Fish and Wildlife Service 2016b) and current refuge regulations require fur harvesters to obtain a Special Use Permit to conduct their activities. While actual furbearer population data is lacking, harvest data submitted by fur harvesters indicates that muskrat harvest has declined during the period 1996–2016 (U.S. Fish and Wildlife Service 2016b).

Mussels

Prior to the creation of the lock and dam system, 44 species of mussels existed within the river section now occupied by the refuge but recent records indicate there are now only 39 species present (U.S. Fish and Wildlife Service 2006). The main mussel beds found on the refuge occur in main channel areas and main channel borders, but mussels are also found in secondary and tertiary channels as well as backwater habitats. The East Channel at Prairie du Chien Wisconsin in Pool 10 was historically the premier mussel bed on the refuge. A zebra mussel infestation in the late 1990s and early 2000s nearly caused a catastrophic loss of this bed. By 2017, however, zebra mussel densities at this site had decreased greatly while densities of native mussels had increased (D. Kelner, USACE personal communication).

A large proportion of the high quality mussel assemblages in the Upper Mississippi River occur on refuge lands (T. Newton, USGS personal communication, Newton et al. 2011). Five of the 10 essential habitat areas (EHA) for the federally endangered Higgins eye pearlymussel are found on the refuge (Whiskey Rock in Pool 9; Harper's Slough in Pool 10; McMillan Island in Pool 10; Prairie du Chien in Pool 10; and Cordova in Pool 14; (Anonymous undated available at

https://www.fws.gov/midwest/endangered/clams/pdf/hepmEHA.pdf). Additionally, three of four new EHA's are also on refuge lands (Lansing in Pool 9; Cassville in Pool 11; and Hanson's Slough in Pool 14). Finally, five additional potential EHA's also occur on refuge lands (Winter's Landing in Pool 7; RM 659.4 in Pool 9; RM 589 in Pool 11; Bellevue in Pool 13, and RM 518.8 in Pool 14).

The life cycle of freshwater mussels includes a period where mussel larvae are parasitic on a host species, usually a fish host but sometimes an amphibian host (Woody and Holland-Bartels 1993, Barnhart et al. 2008, Freshwater Mussel Host Database 2017, Patterson et al. 2018). For some mussel species, considered generalists, there is a wide variety of suitable host species while for other mussel species, known as specialists, there is only one or a very limited number of known host species (Patterson et al. 2018). For example, the salamander mussel has one known host species, the mudpuppy (an aquatic salamander; Patterson et al. 2018). This relationship between mussels and their hosts highlights the necessity of considering host populations when addressing the conservation and restoration of mussel populations (Watters 1992, Vaughn 1997, Haag and Warren 1998, Kelner and Sietman 2000, Vaughn and Taylor 2000, Schwalb et al. 2011).

Other Invertebrates

Terrestrial and aquatic invertebrates play important roles in food webs of refuge habitats. A limited amount of inventory work has been done on the refuge for terrestrial invertebrates, with the majority of it occurring at the Lost Mound Unit in the Savanna District. Recently, native bee surveys have been conducted at various locations within the refuge and the federally endangered rusty patched bumble bee has been found at locations in the Winona and McGregor Districts. The refuge may provide habitat for a substantial number of butterflies and moths identified by the states of Illinois, Iowa, Minnesota, and Wisconsin as being threatened, endangered, or in need of conservation, particularly in grassland habitats (see Appendices C and D). Additionally, the USFWS, particularly in Region 3, has prioritized the conservation of monarch butterflies as exemplified by its contribution to the Monarch Joint Venture (https://monarchjointventure.org/) and agency partners are currently engaged in habitat restoration and management activities to address monarch butterflies along the UMR (National Fish and Wildlife Foundation. Undated). Future inventory work is needed to provide additional information on the distribution and abundance of terrestrial invertebrates on the refuge, particularly pollinators such as butterflies, moths, and bees. In aquatic habitats, burrowing mayflies and fingernail clams are an important food source for migrating waterfowl and fish. Monitoring of Pools 4, 8, and 13 during 1992–2002 found that mayfly densities were typically highest in backwater contiguous, impounded, and side channel habitats (Sauer 2004). Fingernail clams were abundant in these habitats and main channel border habitats as well (Sauer 2004) but population declines of fingernail clams have been documented in the Upper Mississippi River (Wilson et al. 1995).

Chapter 3. Resources of Concern

3.1 Introduction

Defining Resources of Concern

Resources of Concern (ROC) are the focal point of an HMP. The HMP policy (620 FW 1) defines "resources of concern" as

> "All plant and/or animal species, species groups, or communities specifically identified in refuge purpose(s), System mission, or international, national, regional, state, or ecosystem conservation plans or acts. For example, waterfowl and shorebirds are a resource of concern on a refuge whose purpose is to protect "migrating waterfowl and shorebirds." Federal or State threatened and endangered species on that same refuge are also a resource of concern under terms of the respective endangered species acts."

The USFWS is entrusted by Congress to conserve and protect migratory birds, federally listed threatened and endangered species, inter-jurisdictional fish, and certain marine mammals (trust species) for the benefit of the American people. Each refuge also has its own specified purpose(s) for which it was created that guides its management goals and objectives. Within these purposes, refuges support other elements of biological diversity such as locally rare plant, invertebrate, and vertebrate species, natural communities, and the ecological processes that contribute to the biological integrity and environmental health at the refuge, ecosystem, and broader scales (601 FW 3).

Importance of Resources of Concern to Refuge Activities

Identifying ROC allows us to identify refuge-scale management objectives aimed at maintaining, increasing, and/or improving the habitats required by trust resources and populations identified in the refuge purpose. The ROC process facilitates a targeted approach to identifying priority areas and/or gaps in management that may require additional resources such as information (data collection and monitoring) or staff and equipment. Species respond to habitat management variably and therefore identifying ROC allows us to focus management activities at an appropriate level that yields the greatest benefit to trust resources, complimenting biological integrity, diversity, and environmental health (BIDEH) and the refuge purpose.

The first step in developing a focused habitat management strategy is to define a refuge's comprehensive list of ROC in light of the multiple mandates, purposes, policies, and regional/national plans applicable to that refuge. The following text details the development of the refuge's priority ROC.

3.2 Identification of Refuge Resources of Concern

Initial consideration of potential ROC for the refuge identified at least 3,289 species that were documented to occur on the refuge or were thought to potentially occur on the refuge. This number included 305 birds, 55 mammals, 184 reptiles and amphibians, 203 fish, 174 mollusks, 156 butterflies, 711 other insects, and 1,501 vascular plants.

International, national, and regional conservation plans relevant to the refuge were identified and used in ROC selection. Each species' conservation significance was quantified as the number of currently existing conservation plans that included that species. The comprehensive list of ROCs was narrowed down by selecting species, habitats, or communities most likely to represent a suite of habitat needs for other species (i.e., surrogate species) using a process described more fully in section 3.4.1. We refer to this subset of ROC as priority species, guilds, and plant communities.

Refuge Purposes and Resources of Concern

As discussed in Chapter 2, the refuge was established in 1924 in part because of its regional importance for migratory birds and other fish, wildlife and plants. The refuge currently encompasses more than 240,000 acres distributed across numerous habitats, including upland forests and grasslands, savanna, bottomland forests, wet meadows, marshes, backwater or impoundment areas, side channels off the main navigational channel, and the main channel of the Mississippi River.

The purposes for the refuge are:

- "...as a refuge and breeding place for migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, and

- to such extent as the Secretary of Agriculture may by regulations prescribe, as a refuge and breeding place for other wild birds, game animals, fur-bearing animals, and for the conservation of wild flowers and aquatic plants, and

- To such extent as the Secretary of Commerce may by regulations prescribe as a refuge and breeding place for fish and other aquatic animal life."

Refuge System and USFWS Resources of Concern

USFWS Trust Resources
While the designated purpose is the foremost determinant of a particular refuge's management, managing trust resources also is a priority for all Service lands. Trust resources relevant to the refuge include:

Migratory Birds
A list of all species of migratory birds protected by the Migratory Bird Treaty Act (16 U.S.C. 703–711) and subject to the regulations on migratory birds is contained in subchapter B of title 50 CFR §10.13. The USFWS Division of Migratory Bird Management also maintains lists of priority bird species of concern at national, regional, and ecoregional (Bird Conservation Region) scales (www.fws.gov/migratorybirds). Sources of information used by the refuge to identify potential migratory bird species of concern included:

- State and Federal Listed Species
- USFWS Migratory Bird Program Strategic Plan
- USFWS North American Waterfowl Management Plan
- State of Illinois, Iowa, Minnesota, and Wisconsin's Wildlife Action Plans
- Partners in Flight Bird Conservation Plan for the Upper Great Lakes Plain
- Upper Mississippi River and Great Lakes Region Joint Venture Conservation Plans
- Upper Mississippi Valley/Great Lakes Waterbird Conservation Plan
- American Bird Conservancy Watchlist of Birds of Conservation Concern
- Audubon Minnesota Stewardship Birds of Minnesota
- Status and trend information from refuge bird surveys and regional assessments

Interjurisdictional Fish

The primary sources of information the refuge used to identify potential fish species of concern included:

- State and Federal Listed Species
- Illinois, Iowa, Minnesota, and Wisconsin Wildlife Action Plans
- Upper Mississippi River Fisheries Plan (Janvrin et al. 2010)
- Interjurisdictional Fishes of the Mississippi River Basin (Mississippi Interstate Cooperative Resource Association 2009)

Threatened and Endangered Species

The Endangered Species Act (16 U.S.C. 1531–1544, December 28, 1973, as amended 1976-1982, 1984 and 1988) states in Sec. 8A.(a) that:

> "The Secretary of the Interior… is designated as the Management Authority and the Scientific Authority for purposes of the Convention and the respective functions of each such Authority shall be carried out through the United States Fish and Wildlife Service."

The act also requires all Federal departments and agencies to conserve threatened and endangered species and to utilize their authorities in furtherance of the purposes of this Act.

Federal threatened or endangered species were identified for inclusion in this HMP by reviewing the Federal threatened and endangered species list and relevant recovery plans for listed species (see http://ecos.fws.gov/ecos/indexPublic.do).

3.3 Biological Integrity, Diversity, and Environmental Health

Defining Biological Integrity, Diversity, and Environmental Health

The National Wildlife Refuge System Improvement Act of 1997 states that, in administering the System, the Service shall "ensure that the biological integrity, diversity, and environmental health of the System are maintained…" (U.S. Fish and Wildlife Service 2001). The Service's policy discusses the role of biological integrity, diversity, and environmental health (commonly referred to by its acronym BIDEH). It also provides managers with an evaluation process to analyze their refuge and recommend the best management direction to prevent further degradation of environmental conditions; and where appropriate and in concert with refuge purposes and System mission, restore lost or severely degraded components. The Service defines BIDEH as follows:

- **Biological Integrity** - Biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities.

- **Biological Diversity** - The variety of life and its processes, including the variety of living organisms, the genetic differences between them, and the communities and ecosystems in which they occur.

- **Environmental Health** - Composition, structure, and functioning of soil, water, air, and other abiotic features comparable with historic conditions, including the natural abiotic processes that shape the environment.

Identifying BIDEH within the Refuge

The Service will manage for priority species with habitat needs that exist along a continuum of vegetation structure and hydrologic regimes within habitats present on the refuge. The Service has reviewed historic information regarding habitats, management changes, and species use within the refuge's authorized boundary. The planning team also reviewed relevant literature describing requirements of selected priority

species and ecosystem processes that regulate natural communities to assess historic, current, and future potential conservation status for the refuge. The following resources were used to describe baseline environmental, abiotic, and biotic conditions within the refuge:

- Reports and associated data on site history and capabilities
- Maps of existing landscape conditions displaying watershed boundaries, habitat connectivity (or isolation), as well as land use conditions and ownership surrounding the refuge
- Maps of historic and contemporary vegetation types
- State-level information on threatened, endangered, and special concern species
- State-level native or natural plant community information and National Vegetation Classification System (NVCS) natural community descriptions
- State of Illinois, Iowa, Minnesota, and Wisconsin's Wildlife Action Plans
- Status and trend information for potential species of concern as documented in regional/state assessments and reports
- Previous habitat classifications and designations developed for the Upper Mississippi River by others including USGS, USACE, and UMESC and the CCP

Based on a review of the existing and historical data listed above, Table 3-1 was developed to describe the attributes and processes that define the ecological and biological integrity of broad habitats within the refuge.

Table 3-1. Summary of Habitats that Represent Existing BIDEH for the Upper Mississippi River National Wildlife & Fish Refuge.

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
Upland Forest	Midwestern Dry and Dry-mesic Oak Forests	The canopy is interrupted to continuous with oak species, especially bur and white oak but with varying amounts of hickory, elm and American basswood. More mesic conditions resulting from topographic position, as well as a lack of fire, can result in greater representation by maples and other shade-tolerant species. Midstory and shrub layers are sparse to interrupted and consist of saplings of the previously mentioned species as well as cherries, dogwoods and American hazelnut.	Frequent to moderately frequent fires of low to moderate intensity. Topographical slope and aspect play an important role in determining species composition through their influence on degree of exposure to wind and solar radiation.	Lack of fire and subsequent mesophication; invasive species; lack of recruitment of desired tree species.
	Midwestern Mesic Oak and Oak-maple Forest	Canopy and midstory layers are interrupted to continuous (50 to 100%). Shrub and ground layers are sparse to interrupted (25 to 75%). The most	Moderately frequent to infrequent fires of low to moderate intensity. Topographical slope and aspect	Invasive species; lack of fire and subsequent mesophication; lack of recruitment of desired tree species.

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
		common canopy trees are basswood, northern red oak and sugar maple. Midstory trees include hophornbeam, sugar maple, and basswood. Shrub layer includes sugar maple, hophornbeam, prickly gooseberry, and chokecherry. Ground layer is primarily shade-tolerant forb species.	play an important role in determining species composition through their influence on degree of exposure to wind and solar radiation.	
Savanna	North-central Bur Oak Openings	Scattered to clumped tree cover usually between 25 to 75%. The tree layer is composed of bur oak, white oak, and black oak with some shagbark hickory. Shrub layer is patchy to interrupted and composed of low (< 50cm) semi-shrubs, taller (up to 2m) shrubs, and oak seedlings and saplings (< 2m). The low shrubs leadplant, prairie rose, and poison ivy can be common. Common taller shrubs are chokecherry, American hazelnut, smooth sumac, gray dogwood, western wolfberry, low juneberry, and wild plum. The ground layer is continuous and is dominated by grasses, especially big bluestem and little bluestem, accompanied by a high diversity of forbs.	Frequent fires of low to high intensity that prevented establishment of shade-intolerant trees and shrubs from becoming established, and prevented fire-tolerant trees and shrubs from recruiting into larger size classes to the point of canopy closure or extensive areas of coverage. Occasional grazing by large herbivores such as bison and elk.	Lack of fire and subsequent mesophication; establishment of fire-intolerant woody species; invasive plant species.
Grassland	Midwestern Deep Soil Tallgrass Prairie	Grass-dominated (50-100%) vegetation with forbs (5-50%) and scattered shrubs (<5%). Trees are nearly absent. In drier sites, the dominant grasses are mid-height grasses such as little bluestem, side-oats grama, prairie dropseed, and porcupine grass. In more mesic areas, tallgrasses dominate such as big bluestem and Indian grass. Forb species show more variation across sites and moisture gradients. Common forb species	Frequent fires of low to high intensity that prevented establishment of trees and extensive coverage of shrubs. Periodic drought that impedes or halts plant growth. Occasional grazing by large herbivores such as bison and elk.	Lack of fire; establishment and invasion of fire-intolerant woody species; invasive plant species.

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
		include goldenrod, silky aster, aromatic aster, dotted blazing star, hairy false goldenaster, pasqueflower, harebell, western ragweed, false boneset, and flowering spurge. On more mesic sites, heart-leaf alexanders, heath aster, goldenrod, purple and white prairie clovers, silverleaf scurfpea, stiff sunflower, white sage, northern bedstraw, and smooth blue aster.		
	Midwestern Thin-soil Tallgrass Prairie	Similar to deep soil tallgrass prairie. Grass-dominated (50-100%) vegetation with forbs (5-50%) and scattered shrubs (<5%). Trees nearly absent. Occurs on thin soils over dolomite and sandstone bedrock on steep, usually south- or west-facing slopes. Bedrock outcrops are common. Big bluestem and Indian grass are important components to the grass community. Common mid-height grasses include side-oats grama, plains muhly, and Kalm's brome. Common forbs include flowering spurge, sky blue aster, prairie coreopsis, and prairie violet, false boneset, birdfoot violet, cylindric blazing star, gray-headed coneflower, and compass plant.	Frequent fires of low to high intensity that prevented establishment of trees and extensive coverage of shrubs. Periodic drought that impedes or halts plant growth. Occasional grazing by large herbivores such as bison and elk.	Absence of periodic fire; establishment and invasion of fire-intolerant woody species; invasive plant species.
	Midwestern Sand and Gravel Tallgrass Prairie	Similar to deep soil tallgrass prairie. Grass-dominated (50-100%) vegetation with forbs (5-50%) and scattered shrubs (<5%). Trees nearly absent. Vegetative cover is usually less than 100%, with bare sand exposed among plants in sand areas. Forb species common to both sand and gravel prairies include prairie sandreed, sand dropseed, western	Frequent fires of low to high intensity that prevented establishment of trees and extensive coverage of shrubs. Periodic drought that impedes or halts plant growth. Occasional grazing by large herbivores such as bison and elk.	Absence of periodic fire; establishment and invasion of fire-intolerant woody species; invasive plant species.

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
		ragweed, and large-flowered beard tongue.		
Bottomland Forest	Midwestern Riverfront Floodplain Forest	Present at lower elevations than bottomland hardwood forests. Tree canopy is often continuous and composed primarily of silver maple with lesser amounts of American elm, box elder, green ash, cottonwood, and hackberry. Most of these species are also important in the understory. Shrub layer is sparse to patchy. Ground layer can be sparse to continuous.	Flooding during wet years and after heavy precipitation events. Soil moisture varies based on height of terrace. Scouring and deposition of sediments during flood events.	Colonization of canopy gaps and open areas by reed canarygrass; altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season.
	Midwestern Bottomland Hardwood Forest	Present on terraces at an elevation slightly higher than riverfront floodplain forest. Tree canopy is continuous and composed of a mixture of swamp white oak, bur oak, green ash, hackberry, silver maple, bitternut hickory, American elm, and basswood, with occasional cottonwood and river birch. Shrub layer is sparse to patchy. Ground layer can be sparse to continuous.	Flooding during wet years and after heavy precipitation events. Soil moisture varies based on height of terrace. Minor flood damage and light surface fires.	Colonization of canopy gaps and open areas by reed canarygrass; altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season.
Wet meadow	Midwestern Wet Prairie and Meadow	Dominated by a mixture of sedges but may also include perennial emergents such as purple loosestrife and grasses such a reed canarygrass and rice cutgrass and forbs such as Joe pye weed, marsh muhly, and smartweeds.	Seasonal flooding in the spring. Occasional fire.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season.; absence of fire; invasive plant species including reed canarygrass, purple loosestrife, and common reed.
	Dogwood - Mixed Willow Shrub Meadow	Mixed shrubby vegetation > 25% cover, typically alder, elderberry, false indigo, dogwood and willow with a sedge, grass, forb understory.	Standing water during spring period and after large precipitation events. Dry by mid-summer. Occasional fire that prevents succession to dogwood-willow swamp.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season...

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
Marsh	Dogwood - Willow Swamp	The vegetation is dominated by tall shrubs between 1 and 3 m tall with at least 25% cover, and often very dense (>60% cover). Vegetation dominated by buttonbush and water willow, frequently growing in standing water. May also include rooted floating aquatic vegetation, submersed aquatic vegetation, and deep marsh perennials. May also be composed of sandbar willow growing near the main channel and in backwaters along with mixed emergents, grasses such as blue-joint grass lake sedge and uptight sedge, and forbs such as swamp milkweed and Joe pye weed.	Variable hydrology, but typically seasonal flooding. May naturally succeed from wet meadow state in the absence of fire. May be created by floodplain forest clearing or draining of wet meadows.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season.
	Wild Rice Marsh	Occurs in deeper, sheltered bays with slow-moving water. Dominated by the annual grass wild rice but may include floating-leaved and submersed species such as white waterlily, American lotus, coontail, sago pondweed, Canadian waterweed, water milfoil, water stargrass, and pondweeds.	Standing, stable water levels during the growing season and protection from wave energy. Periodic changes in water levels to act as a disturbance that prevents dominance by perennial species and favors annual species such as wild rice.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season; excessive suspended sediments and nutrients; sedimentation/siltation.
	Midwest Mixed Emergent Deep Marsh	Surface water is permanently present. Mix of emergent, floating and submersed aquatic vegetation along with pockets of open water. Plant community zones usually correspond to water depth. The emergent community commonly includes arrowhead, bur reed, pickerelweed, common reed, and bulrush. Floating-leaved and submersed vegetation includes white waterlily, American lotus, coontail, pondweeds, Canadian	Standing, stable water levels for most of the year. Protection from wave energy.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season; excessive suspended sediments and nutrients; sedimentation/siltation.

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
		waterweed, water milfoil and water stargrass.		
	Bulrush - Cattail - Bur-reed Shallow Marsh	Surface water present throughout most of the growing season (semi-permanent wetland). Mix of emergent aquatic vegetation can include soft-stem bulrush, river bulrush, giant bur-reed, cattail, arrowheads water plantain, pickerel weed, and smartweeds	Standing, stable water levels for most of the year. Protection from wave energy.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season; excessive suspended sediments and nutrients; sedimentation/siltation. Invasive plant species.
Sand and mud on islands, bars, and flats	Not applicable.	Exposed, un-vegetated areas composed of either sand or mud near the main channel, islands, wing dams, or dredge disposal sites.	Large flood events that scour vegetation and/or deposit sediment. Extended periods of inundation that reduces vegetation followed by a low water period.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season.
Lentic backwater lakes and impounded areas	Not applicable.	Areas with low flow and velocity. Ranges from areas that are primarily open water with limited submersed aquatic vegetation to shallow areas with a mix of open water and emergent vegetation. Substrates are a mixture of silt, clay, and sand. Connectivity to main river varies with river level. Some areas are inundated only due to lock and dam system.	Large flood events to exchange materials and nutrients with the main river.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season; excessive suspended sediments and nutrients; sedimentation/siltation.
Lotic main channel border, secondary channel, tertiary channel	Not applicable.	Aquatic areas with noticeable water velocity and flow (i.e. not backwater or lentic) including the area between the navigation channel and the riverbank, large and small side channels with variable velocity, depth, and substrates, and areas directly downstream from navigation dams with deep scour holes and high velocity.	Large flood events scouring and depositing sediment and woody debris to create habitat variability.	Altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season; excessive suspended sediments and nutrients; sedimentation/siltation.

Broad habitat (Representation of existing BIDEH)	NVCS Classification	Populations and Habitat Attributes	Natural Processes	Limiting Factors/Stressors
Lotic main channel	Not applicable.	Main navigation channel with a minimum prescribed depth of 9 ft. High water velocity with shifting sand substrates and abundant dissolved oxygen. Extreme winter water temperatures.		Navigation channel maintenance activities; altered hydrology including an increase in the frequency and duration of flooding, as wells as a lack of water level reductions during the growing season; excessive suspended sediments and nutrients; sedimentation/siltation.

Maintaining and Restoring BIDEH

Starting in the 1800s, the habitats within the modern day refuge were altered to improve river navigation. In the 1930s, the authorization of the 9-foot navigational channel and the creation of the lock and dam system had a significant impact on the ecological integrity of the refuge. The lock and dam system inundated thousands of acres of habitats that historically went through wet/dry periods and altered the nature and character of the riverine habitats. Although ultimate operation of the lock and dam system is within the jurisdiction of the USACE, the refuge, state partners, and USACE have worked together to improve the ecological integrity of the Upper Mississippi River system and habitats within the refuge. Drawing down pools and creating islands through large-scale construction projects are two examples of activities targeted at increasing the ecological integrity of the Upper Mississippi River system while maintaining navigational use of the river. Additional details of historic habitat alteration within the refuge are provided in Chapter 2.

3.4 Refuge Priority Resources of Concern

Priority Resources of Concern Selection

Using guidance provided by Paveglio and Taylor (2010), the refuge narrowed the list of 3,289 species potentially or actually occurring on the refuge to a subset of species that were candidates for further consideration as priority ROCs. In an effort to ensure this subset of candidate ROCs was sufficient, the refuge conducted an extensive outreach effort that engaged partners, stakeholders, and technical experts who manage, conduct research, or otherwise are knowledgeable about natural resources on the Upper Mississippi River. More than 150 individuals were contacted, representing state and federal agencies, tribes, academic institutions, NGOs, and private individuals from five states (IA, IL, MI, MN, and WI). Individuals contacted were asked to review the list of candidate ROCs and/or provide a list of species based on either their professional experience or their agency's priorities. Additions and deletions of species from the candidate list, based on feedback and input from this outreach effort, resulted in a list of species that is provided in Appendix C.

Multiple partner workshops were held with representatives from four state agencies (IA DNR, IL DNR, MN DNR, and WI DNR) and two federal agencies (USACE, USGS) to refine further the list of candidate ROCs and to identify priority habitats. Guidance for workshop activities was provided by Paveglio and Taylor (2010), as well as aspects of Strategic Habitat Conservation (SHC; U.S. Fish and Wildlife Service 2014d), which is an iterative process developed by the Service to support strategic decisions on habitat conservation for species on landscape-level scales. The selection process outlined within Paveglio and Taylor (2010) and the SHC guidance document uses a focal resource concept (i.e., surrogate species approaches).

To assist the refuge and partner agencies in identifying refuge-specific ROC, staff from Cardno JFNew developed the Resources of Concern Selection Tool for America's Refuges (ROCSTAR). The ROCSTAR

tool was developed to assist managers of national wildlife refuges, waterfowl production areas, wetland management districts, and other conservation lands in identifying priority resources for management and monitoring as outlined in Paveglio and Taylor (2010). The ROCSTAR tool allows the planning team to filter the resource list based on refuge objectives when selecting priority ROCs. It also provides a decision support framework that allows users to compare various resources and their ability to address the selection considerations outlined in Paveglio and Taylor (2010), and incorporates aspects of the surrogate species concept as described in Caro (2010) and U.S. Fish and Wildlife Service (2014d). The tool results in a series of resource scorings sorted by habitat (see Appendix D). Based on the scoring results, the planning team was able to make an informed decision on the number and type of priority ROC to select for each habitat managed on the refuge. Within the HMP planning process executed by the Upper Mississippi River National Wildlife and Fish Refuge, ROCSTAR scores did not represent ultimate declarations of which Resources of Concern would be selected as Priority Resources of Concern, but were instead used to inform ultimate decisions regarding Priority Resources of Concern.

A goal of this is to select priority refuge-specific ROC that can be used as indicators of overall habitat management and benefits to other species using the same habitats. Paveglio and Taylor (2010) guides the selection of priority refuge ROC by considering which resources best address the following considerations, including the resources:

1. Relevance to Legal Mandates
2. Management Significance
3. Ecological Significance

Relevant Legal Mandates

Candidate priority resources were evaluated for their ability to be managed in order to fulfill the refuge purpose and associated Service policies and mandates. Specifically,

- Contribution to refuge purpose – Achieving refuge purposes and managing for trust resources as well as BIDEH can be addressed through habitat requirements of focal species, i.e., species that may represent guilds that are associated with important attributes or conditions within habitats. The use of focal species is particularly valuable in addressing Service trust resources such as migratory birds. By selecting focal species, we can document our refuge-specific contribution to migratory bird conservation.

- Contribution to listed species – Several species listed at the state or federal level, including the Higgins eye pearlymussel, Henslow's sparrow, red-shouldered hawk, and western sand darter have historically occupied habitats found on or associated with the Upper Mississippi River. Based on our review of previous restoration efforts and habitat conditions necessary for these and other rare or imperiled species, the Service believes that continued repatriation of listed species is worthwhile. Addressing listed species in this plan is a way that we can address this important Service mandate. It should be noted, however, that the refuge is not able to conduct habitat management activities that benefit all listed species that are or potentially are within its boundaries.

- Contribution to Refuge System – The conservation of priority species within the refuge has an important role in supporting the mission of the NWRS. By selecting priority species that can be used as a measure of our management success, we can use these species in developing our inventory and monitoring program in order to evaluate management and communicate the success and challenges of management with others. In doing so, we will aid in providing long-term support for the NWRS.

Management Significance

A species was considered significant to management on the refuge if it had the following characteristics: 1) species have a direct application to key management decisions or effectiveness of past management activities, 2) species are reliant on habitat management to provide suitable or improved conditions, 3)

management and protection of the species or its habitat is recognized as important (i.e. presence in regional conservation plans and lists noted previously) by managers, researchers, policy makers and the public. Evaluating the management significance is important to the refuge because data on the species and its habitats can help inform management decisions and progress toward refuge goals. Specifically,

- Habitat requirements of priority species – Habitat suitability and availability may limit the refuge's capability to support or manage for a priority species of concern. The following species-specific factors were evaluated:

    - Historic habitat use and abundance on the refuge
    - Connectedness and species utilization of habitats
    - Environmental conditions including soils, hydrology, disturbance patterns, contaminants, predation, and invasive species
    - Specific life history needs – particularly needs for breeding, migrating, and overwintering stages.

- Habitat management for selected priority species – Observations and institutional knowledge of the refuge and other Service staff were used to determine the feasibility for the refuge to support a particular species throughout specific seasons (e.g., breeding, migration, overwintering).

- The need for management and protection of the priority species is recognized – Chapter 1 highlighted numerous national, regional, and state conservation plans used to identify conservation priorities for the refuge. Information about the number of conservation plans each species was listed in can be found in the comprehensive ROC list. During the ROCSTAR scoring process, the number of plans for candidate priority resource was considered when making final selections among resources. During the partner outreach effort, relative seasonal (breeding, migrating, wintering) abundances on the refuge of each candidate priority resource was also considered. In doing so, some species that ranked high on conservation plans but were only incidental on the refuge were not selected as a priority resource since because the refuge would have limited ability to effectively manage their habitats in a way that would have a meaningful impact.

- Contribution to inventory and monitoring –Priority species must be able to provide indicators of habitat management by responding to management actions through increased use, improved breeding, presence/absence, or by another measure. We reviewed each candidate for its ability to be monitored, amount of existing data specific to the station, and the likelihood of it being affected through management.

Ecological Significance

Candidate priority resources were evaluated through a series of planning team meetings, literature reviews, and an interagency partner review for their ecological significance to the refuge. Ecological significance was defined as a species 1) having a strong, defensible link to overall ecological function of the landscape or strongly associated with a critical resource of the refuge, 2) sensitive to larger landscape or habitat changes so that it can act as an indicator of potential change, and 3) status of the species or its habitat is representative of other priority species or ecological processes. Evaluating the ecological significance of candidate priority species helps ensure that management and monitoring activities associated with priority species and their habitats contribute to the BIDEH of the refuge. Priority resources can be used as an indicator of BIDEH based on their presence, absence, abundance, or relative well-being in a given habitat niche. In doing so, it serves as a marker of overall health of its required habitat.

Using these criteria, the planning team refined the list of candidate ROCs during the development of the HMP based on continued review of the criteria previously described. Twenty-four Priority Resources of Concern, including 11 bird species or groups, one terrestrial invertebrate group, two reptiles, one mammal group, two fish groups, two mussel groups, and five native plant communities for the refuge were ultimately selected (Table 3-2). During this iterative process, we did not include some candidate priority species that effectively duplicate the habitat requirements and/or potential management response of other species. In

most cases, these “redundant” species were removed because the selected priority species were preferred for management and/or monitoring purposes, according to available datasets, literature review, and/or professional judgment by the planning team. A list of these species, general habitat requirements, and special considerations for management can be found in Table 3-3. Discussion of the selection considerations for each priority ROC can be found following Table 3-3.

Table 3-2. Priority ROCs and Their Habitat Associations for the Upper Mississippi River National Wildlife & Fish Refuge.

Priority Resource of Concern	Broad habitats	Taxa Group or Example Species
Midwestern Forests and Woodlands	Upland forest	Native plant community
North-central Bur Oak Openings	Savanna	Native plant community
Grassland birds	Grassland	Bird
Ornate box turtle		Reptile
Native invertebrate pollinators		Invertebrate – including native butterflies, moths, bees, and flies
Midwestern Tallgrass Prairie		Native plant community
Red-shouldered hawk	Bottomland forest	Bird
Cerulean warbler		Bird
Prothonotary warbler		Bird
Transient Neotropical migrant passerines		Bird – including chestnut-sided warbler, northern waterthrush, and Nashville warbler
Tree-roosting bats		Mammal – including northern long-eared bat and Indiana bat
Midwestern Wooded Swamps and Floodplains		Native plant community
Eastern massasauga	Wet meadow	Reptile
Midwestern Wet Prairie and Meadow		Native plant community
Dabbling duck guild	Wet meadow and marsh	Bird - including mallard, gadwall, American wigeon, northern pintail, green-winged teal, blue-winged teal
Black tern	Marsh	Bird
Tundra swan		Bird
Secretive marsh birds		Bird –including pied-billed grebe, American bittern, least bittern, sora, king rail, Virginia rail, common gallinule
Canvasback	Lentic backwater lakes and impounded areas	Bird
Lesser scaup		Bird
Limnophilic native mussels		Mussel –including paper pondshell and giant floater
Limnophilic native fish		Fish – including mud darter, weed shiner, pugnose minnow, central mudminnow, and pirate perch
Fluvial-dependent native mussels	Lotic main channel border, secondary channel, tertiary channel	Mussel – including Higgins eye pearlymussel
Migratory fluvial-dependent native fish		Fish – including paddlefish and sturgeon spp.

Table 3-3. Priority ROCs and Key Habitat Features and Considerations for the Upper Mississippi River National Wildlife & Fish Refuge.

Priority Resource	Broad habitat	Key Habitat Features and Considerations
Midwestern forests and woodlands	Upland forest	Trees include white oak, red oak, shagbark hickory, hackberry, elm spp., and red maple on lower elevations. Midstory layer includes red maple, black cherry, and other shade tolerant central hardwood species. Shrub layer includes dogwood, serviceberry and maple leaf viburnum. 75-100% canopy closure. Occasional remnant large diameter dominant "wolf trees" present and representative of an older cohort (e.g. old pasture trees, residual trees left over from past logging practices and high grading). Ground layer is patchy to continuous. Lack of fire results in regeneration being dominated by fire-intolerant tree species.
North-central bur oak openings	Savanna	The tree layer is composed of bur oak, white oak, and black oak with some shagbark hickory. The ground layer is dominated by graminoids, especially big bluestem and little bluestem and a high diversity of forbs. Scattered or clumped open-grown trees with 50% or less canopy closure. Periodic fires minimized midstory and shrub layer. Ground layer is dense. Rare community on the refuge. Lack of fire results in regeneration being dominated by fire-intolerant tree species.
Grassland birds	Grassland	Tall and mid-height prairie and grasslands. Depending on the species, open grassland with patchy bare ground to tall, dense vegetation with accumulated litter; minimal to moderate levels of shrub cover and height. Trees are sparse to absent. In addition to the importance of grassland patch size, amount of grassland in the surrounding landscape may be important as well.
Ornate box turtle	Grassland	Sand and dry prairies; oak savanna; Sandy, open habitat during nesting and overwintering. Sandy soils on south-facing slopes. Shifting, unstable sand dunes or blowouts for nesting and overwintering. Small populations may be vulnerable to prescribed fires conducted across the entirety of a management unit during periods when turtles are active.
Native invertebrate pollinators	Grassland	Prairies and grasslands dominated by native grass and forb species. Individual forb requirements vary by pollinator's life history. Diverse prairies with a forb component that flowers throughout the early, mid, and late growing season. Small populations may be vulnerable to prescribed fires conducted across the entirety of a management unit during periods when the entire population is represented by egg and larval life stages residing in litter and/or vegetation.
Midwestern tallgrass prairie	Grassland	Grasses include big bluestem, little bluestem, Indian grass, and porcupine grass. Forb species vary by site but include species in Asteraceae, Fabaceae, and Asclepiadaceae. Dominated by grasses up to 2 m tall. Mid-level and shorter grasses more dominant on drier sites, sandy soils, or with shallow soils.

Priority Resource	Broad habitat	Key Habitat Features and Considerations
		Greatest contribution to total species richness should be from native forbs. Trees and shrubs either sparse of absent. Forb abundance and diversity may be inversely related to the abundance of dominant grasses.
Red-shouldered hawk	Bottomland forest	Mature bottomland forests. Closed canopy forests near water with open, park-like midstory. Human disturbance may influence habitat use.
Cerulean warbler	Bottomland forest	Mature bottomland forests with a preference for oaks. Large tracts of forest with horizontal heterogeneity (canopy gaps) with midstory and shrub layer cover. Area-sensitive. Responds negatively to forest fragmentation.
Prothonotary warbler	Bottomland forest	Bottomland forest consisting of willows, maples, ashes, elms, and river birch. Shrubs include buttonbush. Canopy height 12 to 40 m (usually 16 to 20), canopy cover usually 50–75%, ground vegetation usually very sparse and of low stature (<0.5 m). Nests are often over or near standing or slowing moving water.
Transient Neotropical migrant passerines	Bottomland forest	Mature bottomland forests. Well-defined canopy layers to provide resting and foraging opportunities for a diverse community of birds.
Tree-roosting bats	Bottomland forest	Live trees greater > 9 inches DBH with bark characteristics that provide roosting habitat such as shagbark hickory, dead trees with exfoliating bark > 9 inches DBH; and trees > 26 inches DBH with cavities.
Midwestern wooded swamps and floodplains	Bottomland forest	At lower elevations, tree species are willow, cottonwood, silver maple, American elm, river birch, box elder, green ash, and hackberry. At higher elevations, tree species are swamp white oak, bur oak, green ash, hackberry, silver maple, bitternut hickory, American elm, and basswood, with occasional cottonwood and river birch. Shrub species include prickly-ash, winterberry, nannyberry, high-bush cranberry, and buttonbush. Nearly closed canopy with an open shrub layer and a sparse to continuous herbaceous ground layer. Occurs on temporary flooded soils that range from well drained and sandy to more silty where inundation period is longer. Active management may be necessary to prevent conversion to non-forested habitats such as patches of reed canarygrass.
Eastern massasauga	Wet meadow	Wet prairie and marsh. A mixture of open grass and sedge areas and short, closed canopy. Small populations may be vulnerable to prescribed fires conducted across the entirety of a management unit during periods when snakes are active.
Dabbling duck guild	Wet meadow	Sheetwater habitats where herbaceous vegetation structure has been reduced or eliminated by haying, burning, discing, or grazing. Human disturbance may influence habitat use.
Midwestern wet prairie and meadow	Wet meadow	Plant species include lake sedge, upright sedge, bluejoint grass, spiked muhly, Joe pye weed, and flat-topped white aster. Dominated by tall sedges. Shrubs can be up to 25% cover. Temporary flooding.

Priority Resource	Broad habitat	Key Habitat Features and Considerations
Black tern	Marsh	Shallow freshwater marshes with emergent vegetation, (sloughs, margins of lakes, and river or island edges). High-density emergent vegetation, in landscapes of <50% tilled or wooded upland habitat. Suitable local conditions must be present concurrently with favorable landscape-scale habitat requirements. Human disturbance may influence habitat use.
Tundra swan	Marsh	Arrowhead, sago pondweed, wild celery. Shallow ponds, lakes, and riverine marshes. Large wetlands and open water. Human disturbance may influence habitat use.
Dabbling duck guild	Marsh	Shallowly flooded moist-soil vegetation and sheetwater habitats; annual plants producing abundant seeds; abundant aquatic invertebrates. Human disturbance may influence habitat use.
Secretive marsh birds	Marsh	Wide variety of emergent vegetation including cattail, sedges, burreeds, and bulrushes. Tall, dense stands of vegetation associated with open or standing water; riparian areas, backwater, sloughs, or other bodies of nonmoving water >25 cm deep.
Canvasback	Lentic backwater lakes and impounded areas	Wild celery, pondweeds, and arrowheads. Extensive open-water. Prefers larger water bodies that provide ample food. Human disturbance may influence habitat use.
Lesser scaup	Lentic backwater lakes and impounded areas	Invertebrate prey populations, including amphipods, gastropods, and bivalves. During migration, larger semi-permanent and permanent wetlands and lakes, and impounded portions of rivers. Emergent and submersed species of vegetation. Human disturbance may influence habitat use.
Limnophilic native fish	Lentic backwater lakes and impounded areas	Slow moving or still water. Areas off the main channel that provide well-oxygenated, deep, slowing water.
Limnophilic native mussels	Lentic backwater lakes and impounded areas	Variable depth in areas of slow moving water. Silt and clay (soft) substrates. Many species require a specific fish host to complete their life cycle.
Fluvial-dependent native mussels	Main channel border, secondary, tertiary channels	Variable depth in areas of low to high velocity. Primarily gravel or sandy/gravelly substrates. Some species can tolerate more silt influence. Many species require a specific fish host to complete their life cycle.
Migratory fluvial-dependent native fish	Main channel border, secondary, tertiary channels	Variable depths in areas of low to moderate velocity. Snags, dike structures, and other locations that provide lower flow conditions for resting during migration.
Migratory fluvial-dependent native fish	Lotic main channel	Variable depths in areas of moderate to high velocity. Snags, dike structures, and other locations that provide lower flow conditions for resting during migration.

Priority Refuge Resources and Relation to Refuge BIDEH

Upland Forest

Native Plant Community
Midwestern Forests and Woodlands represent the upland forest of the refuge. Oaks are the dominant or characteristic tree species. Tree communities vary based on location along slope, aspect, and moisture. This group is comprised of at least three other finer-scaled community types with a global conservation status ranging from unknown to G3/G4.

Savanna

Native Plant Community
North-central Bur Oak Openings represent savanna habitat on the refuge. Savanna habitat is both locally and regionally rare and is globally one of the most threatened habitats. It is given the conservation ranking of G1, indicating the importance of conserving and restoring this habitat.

Grassland

Birds
Grassland birds include grasshopper sparrow, Henslow's sparrow, dickcissel, and eastern meadowlark. Grasshopper sparrow is considered a focal species by the Upper Mississippi River and Great Lakes Joint Venture (UMRGL JV) in the Prairie Hardwood Transition Bird Conservation Region (BCR 23). It is also a priority species in the Partners in Flight Bird (PIF) Conservation Plan for the Upper Great Lakes Plain (UGLP). Henslow's sparrow is considered a "Species of Concern" by the USFWS Ecological Services, indicating it is one step removed from being considered a candidate for listing as either federally threatened or endangered. Henslow's sparrow is considered a focal species by the UMRGL JV in BCR 23 and a priority species by PIF in in the UGLP. Dickcissel are considered a priority species by the PIF in the UGLP. Both eastern meadowlark and western meadowlark are found on the refuge. Within the regional conservation planning landscape of the refuge, eastern meadowlark is considered a USFWS Region 3 priority species and a focal species in the UMRGLR JV plan for BCR 23. Each of these four species is considered a species in need of conservation in the State Wildlife Action Plan of at least one of the four states associated with the refuge.

Reptiles
Ornate box turtle is considered a medium high priority species by the Midwest Partners for Amphibian and Reptile Conservation. It is listed as a SGCN, threatened, and endangered in the Illinois, Iowa, and Wisconsin SWAPs, respectively. Ornate box turtle prefers dry sand prairies and will often overwinter in sandy areas with sparse vegetation. It represents species that use sparsely vegetated sand prairies on the refuge.

Invertebrates
The *native invertebrate pollinator* group is represented by native bees, butterflies, moths, and other native invertebrates that provide pollination services to flowering plants. Awareness of the decrease in populations of pollinators has increased over the past several years. This group was selected as a ROC because they represent grassland communities that are high in native plant diversity, specifically forb diversity. Individual species may have broad or very specific plant species preferences. Providing a high number of plant species that flower throughout the growing season will help to support this ROC group, but will also be managing grassland for ecological integrity.

Native Plant Community
Midwestern Tallgrass Prairie on the refuge includes at least seven different finer scale community types varying on slope, aspect, soil depth, and soil moisture. Although characterized by the abundance of native grasses, especially warm-season grasses such as big bluestem, a diverse mixture of forbs is important to providing ecological integrity for multiple species. These communities have been altered through

conversion to agricultural or urban development within the refuge and now range from G1 to G3 on the global conservation ranking.

Bottomland Forest

Birds

Cerulean warbler is listed in the SWAP for Illinois, Iowa, Minnesota and Wisconsin and is a priority species in the Eastern Tallgrass Prairie BCR and the Upper Great Lakes Plain Partners in Flight (PIF) plans. It is representative of species that require mature, floodplain or bottomland forest with a dense canopy or overstory.

Prothonotary warbler is listed in the SWAP for Illinois, Iowa, Minnesota and Wisconsin and is a priority species in the Eastern Tallgrass Prairie BCR and the Upper Great Lakes Plain PIF plans. It is representative of species that require trees capable of producing nest cavities near or over standing water in dense understory.

Red-shouldered hawk is listed in the SWAP for Illinois, Iowa, Minnesota and Wisconsin and is a USFWS Region 3 priority species. It is representative of species that require large tracts of mature forest with a generally closed canopy, near water, and with an open, park-like midstory.

Transient Neotropical migrant passerines is represented by a large group of forest birds that use the forested habitat on the refuge during the spring and fall migration period. Examples of species included in this group are northern waterthrush, chestnut-sided warbler, Nashville warbler, and Tennessee warbler.

Mammal

Tree-roosting bats such as Indiana bat, northern long-eared bat, and little brown myotis, are important conservation species. Indiana bat is a federally endangered species while the northern long-eared bat is federally threatened. Many species including little brown myotis and northern long-eared bat are currently or potentially impacted by white-nose syndrome outbreaks in their overwintering habitat of caves. Tree-roosting bats are representative of mature, floodplain or bottomland forests with large trees that are alive, dead, or dying and provide loose peeling, or sloughing bark. With threats to overwintering habitat, providing forests for breeding and roosting will be critical to help conserve these bat populations.

Native Plant Community

Midwestern Wooded Swamps and Floodplains include at least two different finer scale community types of floodplain and bottomland forests. Globally, both communities are ranked as G4. Tree community composition varies based on position or elevation within the floodplain, with the most flood-tolerant species found at the lowest elevations (De Jager et al. 2012). Species able to tolerate the greatest amount of inundation at the lowest elevations include silver maple, green ash, box elder, cottonwood, and willow. Higher elevations are characterized by species such as American elm, river birch, oaks, black locust, and hackberry.

Wet Meadow

Birds

The *dabbling duck guild* includes species such as mallard, gadwall, northern pintail, American wigeon, green-winged teal, and blue-winged teal. They will use shallowly flooded wet meadows especially when the vegetation has been mowed, burned or grazed. Use is primarily during spring and fall migration but nesting will also occur in higher-elevation meadows that stay dry during the nesting season. This guild was selected as a ROC because they are relatively abundant, relatively easy to survey and they represent other species that use similar habitats such as waterbirds and shorebirds. Several dabbling duck species are common and abundant species and are not considered species in need of conservation. However, some of them are considered focal species by the UMRGL JV and species of concern for the USFWS Region 3, in part because of their recreational and economic importance.

Reptile

Eastern massasauga is a federally listed threatened species, is listed as endangered by the states of Illinois, Iowa, Minnesota, and Wisconsin. It is also considered a high conservation priority by the Midwest Partnership for Amphibian and Reptile Conservation. It represents species that use wet meadows where woody vegetation is a minor to moderate component.

Native Plant Community

Midwestern Wet Prairie and Meadow are typically dominated by grasses and sedges with a small percent of shrubs. As a habitat, it can succeed to being more shrub-dominated in the absence of fire or under drier hydrology conditions. Globally, it is ranked as a G4 community. Common species include various sedges, rice cutgrass, and the exotic reed canarygrass. Shrubs can include alder, elderberry, false indigo, dogwood, and willow.

Marsh

Birds

Black tern is a priority species on both the Eastern Tallgrass Prairie BCR and Prairie Hardwood Transition BCR list and on the Upper Great Lakes Plain PIF list. It is representative of species that prefer marsh habitat with moderate to sparse vegetation and a mixture of patches of vegetation and open water.

Tundra swans are relatively abundant in nearshore open water areas of the refuge during winter and migration periods. They are identified as a priority on other regional bird plans, and are an indicator of high-quality open water/submersed wetland habitat.

Dabbling duck guild species such as mallard, gadwall, northern pintail, American wigeon, green-winged teal, and blue-winged teal use shallow emergent wetland and vegetated mud flats on the refuge, primarily during spring and fall migration. This guild was selected as a ROC because they are relatively abundant, relatively easy to survey and they represent other species that use similar habitats such as waterbirds and shorebirds. Several dabbling duck species are common and abundant species and are not considered species in need of conservation. However, some of them are considered focal species by the UMRGL JV and species of concern for the USFWS Region 3, in part because of their recreational and economic importance.

Secretive marsh birds include sora, pied-billed grebe, American bittern, and king rail. Species in this group are typically considered to be high priority species within USFWS Region 3 and the Eastern Tallgrass Prairie and Prairie Hardwood Transition BCRs. Members of this group have habitat requirements that vary from dense stands of vegetation without open water to emergent wetlands that are in proximity to deeper submersed marshes, or wetlands that have a mix of both emergent and submersed vegetation. Secretive marsh birds are important indicators of diverse marsh conditions on the refuge that provide habitat variability within emergent marshes benefitting a wide range of species that depend on open water, standing vegetation, or a mix of both.

Lentic Backwater Lakes and Impounded Areas

Birds

Canvasback are found on open impounded areas with extensive beds of submersed vegetation. The refuge is a continentally important location for this species during migration periods. Canvasbacks are particularly reliant on wild celery, a submersed aquatic plant species, for feeding in the fall and the spring. Thus, the abundance of canvasback may indicate the relative abundance of wild celery beds and the condition of submersed vegetation on the refuge.

Lesser scaup gather in large numbers on open impounded areas of the refuge and large open marshes during spring and fall migration. A large proportion of their diet during these periods is composed of aquatic invertebrates but they also consume submersed aquatic vegetation. Lesser scaup are a USFWS Region 3 conservation priority. Similar to canvasback, they are representative of habitat requirements for other diving ducks.

Fish
Limnophilic native fish include species such mud darter, weed shiner, pugnose minnow, central mudminnow, and pirate perch; also bullheads, yellow perch, bluegill, northern pike, largemouth bass. These species prefer slow to still waters, areas that provide critical off-channel habitat for feeding, resting, and overwintering. Some members of this group of fish are an important recreational resource to refuge visitors.

Mussels
Limnophilic native mussels such as the giant floater are mussel species that prefer standing or slow moving water, unlike mussels that require faster moving water (fluvial-dependent). Mussels are an important food source for other species within the refuge. Additionally, monitoring for them will help to provide information on the ecological integrity of the backwater and impounded areas.

Lotic main channel border, secondary channel, tertiary channel

Mussels
Fluvial-dependent native mussels such as the Higgin's eye require fast moving water for feeding. They can be impacted by poor water quality and altered hydrology. Additionally, several of these species require a host fish species to complete their life cycle. Operation of the lock and dam system or impediments to fish passage can have a negative impact on this mussel group's populations.

Lotic Main Channel

Fish
Migratory fluvial-dependent native fish include shovelnose sturgeon and paddlefish. They primarily feed in the deep, fast-moving water of the main channel; however, they need access to off-channel habitats for rest and overwintering. Members of this group typically move great distances up and down the river and associated tributaries to complete their life cycle. Operation of the lock and dam system and other impediments to fish passage has had a negative impact on their populations.

Priority Refuge Resources and Relation to Other Benefitting Resources

Table 3-4 summarizes how priority species likely use habitats within the refuge and the surrounding landscape based on a literature review, professional judgment, and management experience. Several priority species use more than one habitat at one or more times of the year, thus emphasizing the importance of integrated habitat management. Selected priority species primarily use the refuge for breeding and/or foraging purposes. Bird abundance significantly drops during the winter as many of the priority species have migrated south.

Management activities associated with a priority species has direct and indirect benefits for other species that have similar habitat requirements. Table 3-4 lists the group or guild of species each priority species represents. In many cases, activities to benefit the priority species will likely result in benefits for other species that are conservation priorities. The species listed in the "Other Benefitting Resources" in Table 3-4 is not an all-inclusive list. The species listed were derived from reviewing the previously mentioned regional plans, refuge staff and researcher observations, and selecting species of conservation concern that are rated as relatively high priority species across the region.

Table 3-4. Priority ROCs and Other Benefiting Resources on the Upper Mississippi River National Wildlife & Fish Refuge.

Priority Resource of Concern	Habitat Type	Habitat Structure	Life History	Other Benefiting Resources
Midwestern forests and woodlands	Upland forests	Distinct canopy, midstory, shrub, and ground layers dominated by native species and multiple age classes.	Not applicable	Northern flicker Brown thrasher Wood thrush Eastern whip-poor-will Least shrew Woodland vole Southern flying squirrel Eastern hognose snake Timber rattlesnake
North-central bur oak openings	Savanna	Open-grown oak trees with diverse, native ground vegetation.	Not applicable	Red-headed woodpecker Loggerhead shrike American kestrel Orchard oriole
Grassland birds	Grassland	Varies with species from short and sparse with patchy bare ground to tall and dense with accumulated litter.	Migration, nesting, brood rearing, foraging	Golden eagle Prairie vole American badger Plains hognose snake Six-lined racerunner Smooth green snake Prairie ring-necked snake Numerous invertebrates
Ornate box turtle	Grassland	Dry, sandy soils.	Entire life cycle	See previous list for grassland birds
Native invertebrate pollinators	Grassland	Native grasslands with diverse plant species.	Entire life cycle	See previous list for grassland birds
Midwestern tallgrass prairie	Grassland	Relatively treeless areas dominated by native grasses and forbs.	Not Applicable	See previous list for grassland birds
Red-shouldered hawk	Bottomland forest	Large canopy trees with limited shrub and midstory development.	Nesting, brood rearing, foraging	Bald eagle Wood duck Hooded merganser Yellow-billed cuckoo Acadian flycatcher Rusty blackbird Belted kingfisher Green heron Louisiana waterthrush Baltimore oriole Beaver Wood turtle
Cerulean warbler	Bottomland forest	Large trees near canopy gaps	Migration, nesting, brood rearing, foraging	See previous list for red-shouldered hawk
Prothonotary warbler	Bottomland forest	Large trees over standing or slow-moving water.	Migration, nesting, brood rearing, foraging	See previous list for red-shouldered hawk
Transient Neotropical migrant passerines	Bottomland forest	Layered tree canopy and habitat edges and gaps.	Migration, foraging	See previous list for red-shouldered hawk

Priority Resource of Concern	Habitat Type	Habitat Structure	Life History	Other Benefiting Resources
Tree-roosting bats	Bottomland forest	Large, live trees or dead trees with exfoliating bark.	Brood rearing, roosting, foraging	See previous list for red-shouldered hawk
Midwestern wooded Swamps and floodplains	Bottomland forest	Closed canopy with open to sparse shrub layer.	Not applicable	See previous list for red-shouldered hawk
Eastern massasauga	Wet meadow	Mixture of grasses, sedges, and shrubs.	Entire life cycle	Sedge wren Southern bog lemming Native invertebrate pollinators
Dabbling duck guild	Wet meadow	Shallowly flooded, short-statured vegetation.	Migration, foraging, loafing	See previous list for eastern massasauga
Midwestern Wet Prairie and Meadow	Wet meadow	Relatively treeless area dominated by grasses, sedges, and forbs with seasonal water table or flooding influences.	Not applicable	See previous list for eastern massasauga
Black tern	Marsh	Large marsh within undeveloped, open landscape.	Migration, nesting, brood rearing, foraging	Dabbling ducks Yellow-headed blackbird Mink Pickerel frog Northern leopard frog Eastern cricket frog Blanchard's cricket frog Eastern musk turtle
Tundra swan	Marsh	Emergent and submersed vegetation in open marshes, lakes, rivers or flooded fields.	Migration, foraging	See previous list for black tern
Dabbling duck guild	Marsh	Mixture of emergent and submersed vegetation with areas of open water.	Migration, brood rearing, foraging	See previous list for black tern
Secretive marsh birds	Marsh	Dense emergent vegetation with pockets of deep open water and shallow water or bare ground.	Migration, nesting, brood rearing, foraging	See previous list for black tern
Canvasback	Lentic backwater lakes and impounded areas	Emergent and submersed vegetation in open marshes, lakes, rivers or flooded fields.	Migration, foraging, loafing	Bufflehead Common merganser Common tern Forster's tern
Lesser scaup	Lentic backwater lakes and impounded areas	Emergent and submersed vegetation in open marshes, lakes, rivers or flooded fields.	Migration, foraging, loafing	See previous list canvasback
Limnophilic native mussels	Lentic backwater lakes and impounded areas	Soft substrates in slow- moving water.	Entire life cycle	Limnophilic Native Fish
Fluvial-dependent native mussels	Lotic main channel border, secondary channel, tertiary channel	Hard, gravelly substrate in moderate flows.	Entire life cycle	Migratory Fluvial-dependent Native Fish
Limnophilic native fish	Lotic main channel border, secondary channel, tertiary channel	Snags, submersed vegetation, off channel deep water.	Entire life cycle	Limnophilic Native Mussels
Migratory fluvial-dependent native fish	Lotic main channel, main channel border, secondary channel, tertiary channel,	Snags, structures, and off channel deep water that provide flow refugia. Substrate suitable for spawning.	Entire life cycle	Fluvial-dependent Native Mussels

3.5 Priority Habitats and Associated Priority Species

Refuge personnel focus on managing habitats to benefit a suite of priority species, plants, or animals. The priority habitats of the refuge were identified based on information compiled including historic conditions, current vegetation, site capability, and conservation needs of other benefitting species (Table 3-5). Guidance for prioritizing habitats is provided by Paveglio and Taylor (2010) and stipulates that habitats should be categorized as Priority I or Priority II.

> "…these two habitat categories are defined as "Priority I" and "Priority II." By focusing on the former, refuge funding and personnel will be used to manage habitats for the highest priority Refuge Resources of Concern. Those in the latter category are still important, providing value to a range of species and contributing to the overall biodiversity of the refuge. They may also be important communities that do not require active management or that FWS lacks authority to manage. These habitats will be managed, if necessary, when refuge resources allow."
>
> "Priority I and II management categories are most useful for long-term planning. On a year-to-year basis, the actual habitats chosen to work on will vary, depending on resource conditions, needs, management cycles, and available staff and time. These are decisions made when preparing annual habitat work plans. Also, changes on the landscape may push Priority II habitats into the higher category."

In Table 3-5, these categorizations are provided under the headers "USFWS Guidance Priority I Habitats" and "USFWS Guidance Priority II Habitats".

As defined by Paveglio and Taylor (2010), Priority I habitats are those that can be actively managed, maintained, or restored using existing refuge resources. Priority II habitats are those that do not require active management, or the USFWS may lack authority to manage them, or the refuge may not have sufficient resources to manage them. In instances where the refuge wishes to contribute to the management of Priority II habitats, it will likely need to be done within the framework of partnership efforts, such as the Habitat Restoration and Enhancement Project Element of the Upper Mississippi River Restoration Program (UMRR HREP), whereby greater levels of resources are amassed through the collective efforts of multiple conservation players. Habitat management on the river is complex and requires multiple partners to complete large-scale projects such as those through the UMRR HREP. Refuge staff envision continued partnerships and participation in these large-scale projects.

Within each category of USFWS Guidance Priority, individual habitats are ranked to reflect their importance based on multiple factors such as:

- Where management actions would provide the greatest conservation benefit to identified priority species,
- Current habitat conditions and the urgency of needs for active management, and
- The ability of a habitat to be positively affected through management.

Although some habitats may be ranked as Priority II, this should not be interpreted as meaning they do not provide valuable habitat to a variety of species or contribute to refuge BIDEH. These habitats may not require active management, they may represent areas where there is limited management capability under current conditions, or they may exhibit a limited response to habitat management.

Table 3-5. Priority Habitats on the Upper Mississippi River National Wildlife & Fish Refuge.

Habitat	Refuge Priority Rank	Reasons for Priority Ranking	Limiting Factors/Stressors
USFWS Guidance Priority I Habitats Priority I habitats are those that can be actively managed, maintained, or restored using existing refuge resources. Priority II habitats are those that do not require active management, or the USFWS may lack authority to manage them, or the refuge may not have sufficient resources to manage them. In instances where the refuge wishes to contribute to the management of Priority II habitats, it will need to be done within the framework of partnership efforts, such as the UMRR HREP, whereby greater levels of resources are amassed through the collective efforts of multiple conservation players. Habitat management on the river is complex and requires multiple partners to complete large-scale projects such as those through the UMRR HREP. Refuge staff envision continued partnerships and participation in these large-scale projects.			
Bottomland forest	**1**	This is the most extensive terrestrial habitat occurring on the refuge and a high number of ROC species are associated with this habitat. This habitat is of high importance to continental populations of Neotropical migratory birds. The refuge is capable of conducting management actions such as planting/reforestation and targeted timber harvest/timber stand improvement to provide habitat for ROC and other benefitting species.	Elevated and stabilized water levels have resulted in tree species composition being characterized by a few species that are highly-tolerant of wet soils. Elevated water levels and invasive grass species hinder tree regeneration; lack of regeneration and replacement by invasive grass contributes to the fragmentation of large blocks of forest through the eventual conversion to non-forested habitats. Elevated and stabilized water levels lead to erosion and eventual elimination of islands. Increased deer browse interacts with hydrology and invasive grass to prevent seedling establishment and canopy recruitment.
Grassland	**2**	Grassland habitat is minimally represented in surrounding landscapes and, when present, is typically in a degraded condition. The refuge is capable of conducting management actions such as selective tree removal, prescribed burning, haying, grazing, and replanting/restoration to provide habitat for ROC and other benefitting species. A limited amount of this habitat occurs on the refuge. A relatively low number of ROC species are associated with this habitat.	The small size and isolated nature of remnants and restored areas likely impedes population persistence of many species. Woody plant invasion results in early-successional forest communities. Exotic plant invasion alters species composition and perhaps richness and diversity, as well. Insufficient replication of historic disturbance regimes such as fire and grazing can lead to altered plant community composition. Restored areas can be characterized by low plant species diversity.
Savanna	**3**	This habitat is minimally represented in surrounding landscapes and, when present, is typically in a degraded condition. The refuge is capable of conducting management actions such as selective tree removal, prescribed burning, haying, grazing, replanting/restoration to provide habitat for ROC and other benefitting species. A limited amount of this habitat occurs on the refuge. A relatively low number of ROC species are associated with this habitat.	The small size and isolated nature of remnants and restored areas likely impedes population persistence of many species. Woody plant invasion results in early-successional forest communities. Exotic plant invasion alters species composition and perhaps richness and diversity. Insufficient replication of historic disturbance regimes such as fire and grazing can lead to altered plant community composition. Restored areas can be characterized by low plant species diversity.
Marsh	**4**	Extensive areas of this habitat occur on the refuge and a high number of ROC species are associated with this habitat including a high number of migratory birds. A habitat of high importance for continental and regional populations of some species. In some management units, the refuge is capable of conducting management actions such as periodic drawdowns to provide habitat for ROC and other benefitting species.	Stabilized water levels; without management, successional trends tend to convert this habitat to either monoculture emergent marsh (i.e., cattails), submersed aquatic vegetation communities with little or no emergent vegetation, or to open water.

Habitat	Refuge Priority Rank	Reasons for Priority Ranking	Limiting Factors/Stressors
Upland forest	**5**	A moderate number of ROC species are associated with this habitat. This habitat is well represented in the surrounding landscape but in most of those instances it has been highly modified by decades of fire exclusion. Historically, extensive areas of this habitat would have been characterized by an open canopy with some areas being more appropriately classified as savanna. While a limited amount of this habitat occurs on the refuge the feasibility of managing this habitat is high with use of selective tree harvest/thinning and prescribed burning.	Without management, forest succession results in closed canopy conditions that reflect a shift in plant species composition from xeric, light adapted, and fire tolerant species to mesic, shade adapted, and fire intolerant species.
Wet meadow	**6**	A relatively low number of ROC species are associated with this habitat; while extensive areas of this habitat occur on the refuge, management options are limited except on a relatively small scale.	Native herbaceous communities are replaced by near monocultures of invasive exotic reed canarygrass.
USFWS Guidance Priority II Habitats Priority I habitats are those that can be actively managed, maintained, or restored using existing refuge resources. Priority II habitats are those that do not require active management, or the USFWS may lack authority to manage them, or the refuge may not have sufficient resources to manage them. In instances where the refuge wishes to contribute to the management of Priority II habitats, it will need to be done within the framework of partnership efforts, such as the UMRR HREP, whereby greater levels of resources are amassed through the collective efforts of multiple conservation players. Habitat management on the river is complex and requires multiple partners to complete large-scale projects such as those through the UMRR HREP. Refuge staff envision continued partnerships and participation in these large-scale projects.			
Lotic main channel border, secondary channel, tertiary channel	**1**	A high number of ROC species are associated with this habitat. The refuge is capable of conducting management actions to provide habitat for ROC and other benefitting species only through coordination and cooperation with other partners including USACE.	Impoundment and flow modification structures have disrupted hydrologic regimes and hydraulic patterns reduce the diversity of water velocities, depths, and bottom substrates. Channel control structures such as wing dikes and closing dams impair the connectivity of the main channel with secondary and tertiary channels with concomitant impact on habitat for fluvial specialist fishes and unionid mussels.
Lentic backwater lakes and impounded areas	**2**	Extensive areas of this habitat occur on the refuge and a moderate number of ROC species are associated with this habitat. Submersed aquatic vegetation communities in impounded areas provide critical food resources of high importance to continental and regional populations of waterfowl. The refuge is capable of conducting management actions such as periodic pool drawdowns to provide habitat for ROC and other benefitting species only through coordination and cooperation with other partners including USACE.	Sedimentation; excessive wave action; loss of depth, structural and velocity diversity. Altered hydrology and nutrient inputs alter primary production and food quality for aquatic primary consumers.
Sand and mud on islands, bars, and flats	**3**	Important habitat used by multiple ROC species for loafing, feeding, and nesting. The refuge is capable of conducting management actions such as habitat creation and periodic pool drawdowns to provide habitat for ROC and other benefitting species only through coordination and cooperation with other partners including USACE.	Impaired hydrologic function (stable water levels and currents constrained to the main channel) limits the creation of this ephemeral habitat in the river ecosystem. Recreational activities on exposed beaches may prevent use by nesting turtles.

Habitat	Refuge Priority Rank	Reasons for Priority Ranking	Limiting Factors/Stressors
Lotic main channel	**4**	A relatively low number of ROC species are associated with this habitat. Management is primarily the responsibility of the USACE and outside of Service jurisdiction.	Impoundment and flow modification structures have disrupted hydrologic regimes and hydraulic patterns. Channel training structures and channel maintenance activities, including dredging, reduce the diversity of water velocities, depths, and bottom substrates in the main channel. Channel maintenance control structures such as wing dikes and closing dams impair the connectivity of the main channel with secondary and tertiary channels with concomitant impact on habitat for fluvial specialist fishes and unionid mussels.

3.6 Conflicting Habitat Needs

Given the diversity of goals, purposes, mandates, and conservation priorities for the NWRS, it is not uncommon to have conflicting management priorities at a refuge. Balancing the types and proportion of habitats (and their management) requires special consideration and a process for determining the best course of action. The refuge contains habitat and management decisions that require such consideration.

3.7 Adaptive Management

Priority species and their respective habitat attributes were used to develop habitat objectives. Refuge habitat management objectives must be achievable, and several factors may reduce or eliminate the ability of the refuge to achieve objectives. Although these factors were considered during the development of management objectives, conditions may change over the next 15 years and beyond, requiring the use of adaptive management principles as outlined in Chapter 1.

The planning team identified specific areas where we anticipate ongoing need for adaptive management to maximize the refuge's biological benefits. These considerations may require an accelerated iteration and alteration of management actions (Steps 9 and 6 respectively of the adaptive management guidance, Chapter 1) outside of the anticipated 5-year HMP review. These include, but are not limited to the following: seasonal water levels of the Mississippi River; significant changes in the abundance of existing and new invasive species, both plant and animal; response of refuge grassland habitats to restoration activities; and response of vegetation in lentic backwater habitats and the benefit to waterfowl due to pool drawdowns.

3.8 Priority Resources of Concern, Partnership Activities, and Inventory and Monitoring Efforts

In addition to species, guilds and plant communities that can serve as indicators of habitat management by responding to management actions conducted solely or principally by the refuge, the list of Priority Resources of Concern includes some species, guilds and communities that may not be used by the refuge for these purposes. This is justified for three primary reasons:

- Some priority ROCs have been selected because they will represent refuge priorities when the refuge engages in the planning and execution of partnership activities such as UMRR HREP projects. Examples of this are provided by the limnophilic and fluvial-dependent fish and mussel guilds. There are no known habitat management activities the refuge is capable of conducting solely or principally on its own that can address the species in these guilds, a high number of which are considered species of greatest conservation need (as determined by multiple state, regional, and federal plans and lists; see Appendix C). Furthermore, the refuge lacks the resources (staff, technical expertise, equipment) to engage in inventory, monitoring, or research activities associated with these guilds. For this reason, the refuge is reliant on its partners (state DNR

agencies, USGS, USFWS Fisheries and Ecological Services offices, USACE) to assist with providing information on the status and trends and the habitat needs of these guilds.

- For some priority ROCs, the refuge may not be capable of conducting habitat management activities solely or principally on its own, outside of greater partnership activities such as the UMRR HREP. However, these species will be addressed in the subsequent Inventory and Monitoring Plan because monitoring will be conducted that seeks to document their presence or activity in relation to human activities such as recreational and commercial use of the river by the public, industry, and agencies. An example of this would be monitoring the disturbance of waterfowl, including canvasbacks, to determine if human activities are disturbing them to a degree that they are unable to effectively feed and rest while they are using the refuge. Another example would be documentation of breeding colonies of waterbirds such as black terns that need to be protected from human disturbance.

- During the ROC selection process, especially the portion employing the ROCSTAR tool, a notable lack of information was apparent concerning the distribution and abundance of a substantial number of species of greatest conservation need. For example, during the ROC selection process, the grassland broad habitat had the highest number of potential ROCs associated with it relative to all other broad habitats (n=57; see Appendix C). Almost half of the potential ROCs for the grassland broad habitat were pollinators, a guild of species that provide critical ecological services and likely represent a substantial contribution to BIDEH. Yet a minimal amount of information exists about whether these invertebrate species occur on the refuge, where they occur, or how abundant they are. For priority ROCs that fall within this category, the refuge's subsequent Inventory and Monitoring Plan may address them through inventories to determine if they are appropriate for further consideration in future planning and execution of refuge habitat management activities.

Chapter 4. Habitat Goals and Objectives

4.1 Background

The goals of a CCP are to represent broad statements of the desired future conditions of the refuge. The CCP objectives are to be developed as concise ideas that specify what needs to be achieved, how much needs to be achieved, when and where it needs to be achieved, and who is responsible for the work (602 FW 1.6). Goals and objectives provide a framework for refuge management over a 15-year timeframe (602 FW 1.4A). The CCP goals and objectives for the refuge were developed in 2006. Strategies, which are specific actions, tools, or techniques required to achieve objectives, are discussed in Chapter 5 (602 FW 1.6).

During initial development of the HMP, the planning team reviewed the CCP goals and objectives to determine if they were still representative of existing refuge conditions, current Service policies, and desired future management. After detailed review and discussion, the planning team determined existing objectives could be retained but refined and revised, resulting in habitat objectives that reflect the current capabilities of the refuge. HMP policy allows for revision of CCP objectives and strategies (620 FW 1.8), and the planning team believes that by updating these objectives, management of the refuge's natural resources will be clear and concise.

The USFWS requires habitat objectives be developed using the SMART criteria, specifically that objectives be Specific, Measurable, Achievable, Result-oriented, and Time-fixed. In preparation of this HMP, the planning team identified objectives needing refinement in order to meet the requirements of SMART criteria. Rationale are provided for each habitat objective in order to summarize the scientific information, expert opinion, and professional judgment used to formulate each objective.

The planning team reviewed the Service's Writing Goals and Objectives Handbook (USFWS 2004c) and its guidance on hierarchical relationships of refuge goals and objectives to other aspects of the planning process. In doing so, we found that some of the original objectives were either outdated, or did not apply directly to habitat management, lacked a defined timeframe, or lacked an explicit result-orientation related to priority refuge resources. The revised objectives provide refined specificity and are compliant with policy.

4.2 CCP and HMP Visions for Habitat Management on the Refuge

The 2006 CCP provided a long-term vision for refuge management. It reads as follows (USFWS 2006):

> The Upper Mississippi River National Wildlife and Fish Refuge is beautiful, healthy, and supports abundant and diverse native fish, wildlife, and plants for the enjoyment and thoughtful use of current and future generations.

A refuge's CCP vision statement provides a description of the desired state of the refuge in the future. It is a broad statement that helps to guide refuge management through the development of management goals and objectives. Relative to the CCP, it is an all-encompassing statement that includes aspects of habitat management, as well as, other refuge management responsibilities such as public use, cultural resources, and partnerships.

Vision Statement for Habitat Management

We are a refuge where our mission and purpose, as well as the mission and purpose of the USFWS and the national wildlife refuge system, are realized to the greatest extent possible to achieve conservation benefits for the American public. This will be done while working with the public and our partners in a highly-altered, constantly changing river ecosystem with internationally-recognized importance for biodiversity.

Rationale
Following construction of the system of locks and dams on the Upper Mississippi River, there has been a continual decline in the extent of terrestrial habitats and deep water aquatic habitats and a continual increase in the extent of shallow aquatic habitats represented by impounded areas. Attempting to restore wildlife habitat in the Upper Mississippi River to conditions approximating the period before locks and dams is neither legally possible nor logistically feasible. Attempting to fight many of the processes that drive the changes that are occurring to the ecosystem can be equally challenging. Effective conservation will require an accurate assessment of which system components are in greatest need of attention, how refuge resources can be most effectively mobilized, and which activities generated the most desirable results.

The ability of the refuge to accomplish habitat management, enhancement, and restoration goals is constrained by limitations to the human and financial resources available for these activities. In addition to funding the management, enhancement, and restoration of habitats, the annual refuge budget is used to pay employee salaries, maintain facilities and equipment, support visitor centers and visitor services programming, and enforce refuge regulations. Over the previous six years (2011 to 2016), the proportion of funds available for habitat projects has been approximately 15 percent of the total refuge budget, or approximately $705,000 to $750,000, annually. In light of these facts, there is a realization that substantial progress in maintaining and restoring habitat on the Upper Mississippi River cannot be accomplished by the refuge acting alone. Significant progress in these efforts will require the cooperation of multiple state, federal, tribal, and non-governmental partners. The refuge has a long history of working within a large, vibrant, and effective partnership consisting of these groups and is committed to doing so into the future.

This HMP will provide objectives, and strategies for habitat management, enhancement, and restoration activities that the refuge is capable of conducting largely or solely on its own, without the assistance of partners. As previously noted, the ability of the refuge to accomplish habitat goals outside of a larger partnership is severely limited due to budgetary constraints. As such, there is a limit to the amount of habitat management, enhancement, and restoration activities that can be addressed though the current HMP.

On areas of the refuge where restoration and management activities will be conducted solely by the refuge, without the assistance of state, federal, tribal, and non-governmental partners, the refuge will strive to *maintain* the current acreage of most habitats currently found on the refuge. Exceptions to this will occur in some areas where one habitat category may be converted to another through restoration activities (e.g., grasslands comprising monotypic stands of reed canarygrass may be selected as sites for bottomland forest restoration/establishment). Acres that will count towards maintenance are those where the refuge, acting alone without substantial partnership assistance, will conduct management, enhancement, or restoration activities. In other words, maintenance as used here includes activities that result in improved habitat conditions. These acres do not include areas that will be passively managed (no actions taken by the refuge or partners) or areas that will be managed, enhanced, or restored by the refuge in cooperation with the greater Upper Mississippi River partnership.

4.3 CCP and HMP Goals and Objectives

The 2006 CCP listed six goals to guide refuge management for a 15-year period (USFWS 2006). Two of the goals are pertinent to habitat management on the refuge and were used as a starting point when developing habitat management objectives.

- Environmental Health Goal (CCP Goal 2; with four objectives relevant to the HMP)
- Wildlife and Habitat Goal (CCP Goal 3; with 10 objectives relevant to the HMP)

Greater detail of these two CCP goals and their associated objectives is provided in Appendix E.

4.4 HMP Objectives

As detailed in Chapter 3, the refuge was divided into ten habitats that combined the attributes of several other existing classification schemes used within the UMRS. In keeping in line with the 15-year habitat management vision for the refuge, objectives were developed for six of the habitats where the refuge has the ability to complete management activities without a significant contribution from partners. In the following text, these activities are referred to as refuge-specific activities. The scope and scale of these objectives were developed with an acknowledgement of what the refuge can accomplish over the next 15 years as detailed in section 4.2 above. It is important to note that the application of any individual objective will be site- and context-specific. Using grassland habitat as an example, objectives for grassland birds will only be appropriate at the largest tracts of grassland habitat, which occur in the Savanna District. At smaller tracts of grassland, objectives addressing plant species composition or native invertebrate pollinator communities will be appropriate.

Where possible, objectives for wildlife Priority Resources of Concern are provided in this document which directly link to habitat management that is planned for specific management units as identified in Appendix F of the HMP. In some instances, a direct linkage to specific management units identified in Appendix F is not easily done or feasible because the refuge does not plan to conduct habitat management within the time-frame of the HMP that would be relevant to the Priority Resource of Concern. An example is planting tree seedlings to restore or create bottomland forest in areas such as agricultural fields. During the HMP time-frame, the planted trees would have minimal value to the majority of the priority resources of concern such as tree roosting bats, cerulean warblers, and red-shouldered hawks. The true habitat value of such an action for these priority resources of concern likely would not be realized until well after multiple generations of updated HMPs.

The refuge acknowledges that partners play an important role in management activities of many habitats on the refuge and will continue to do so for the next 15 years and beyond. To address the role of partnerships in habitat management activities related to both the refuge and the larger UMRS, generalized habitat objectives were developed for seven habitats that address activities that will be possible when the refuge collaborates with partner agencies. These seven habitats are: bottomland forest; wet meadow; marsh; sand and mud on islands, bars, and flats; lentic backwater lakes and impounded areas; lotic main channel borders, secondary channels, and tertiary channels; and lotic main channel (see Table 4-2). In the following text, these activities are referred to as partnership activities. For some wildlife Priority Resources of Concern, management of the habitats they are associated with are possible only through partnership activities and specific objectives linked directly to those wildlife Priority Resources of Concern are not provided in the HMP because they will be developed on a case-by-case basis in efforts such as HREP planning. These wildlife Priority Resources of Concern are canvasback, scaup, limnophilic native fish and mussels, and fluvial-dependent native fish and mussels.

The partnership activity objectives and their rationales re-iterate the refuge's desire to continue to collaborate with partner agencies on habitat management activities and to use existing and future USACE and UMRS partnership documents, plans, and reports as guidance for habitat management. Additionally, partnership habitat projects often specify the refuge will assume operations and maintenance (O&M) responsibilities once projects are completed. The refuge fully intends to continue with currently-held O&M responsibilities on completed projects, and to assume O&M responsibilities on future projects where appropriate and when determined by partnership planning and execution efforts.

Table 4-2 summarizes refuge habitats and objectives that were developed for refuge-specific activities and those conducted with partners. This table is intended as a general guide but there may be some exceptions, limited in scale and scope, to how refuge-specific and partnership activities are associated with individual habitats. For example, grassland habitat is associated with refuge-specific activities but there is an instance where the WI Department of Natural Resources manages grassland habitat on a small refuge tract, adjacent to Rush Creek State Natural Area, under a cooperative agreement with the refuge.

Table 4-2. Habitat management objectives conducted by either the refuge alone or with partnerships.

Habitat	Refuge-specific Activities	Partnership Activities
Upland forest	X	
Savanna	X	
Grassland	X	
Bottomland forest	X	X
Wet meadow	X	X
Marsh	X	X
Sand and mud on islands, bars, and flats		X
Lentic backwaters and impounded areas		X
Lotic main channel border, secondary channel, tertiary channel		X
Lotic main channel		X

In keeping with the organization used in Chapters 2 and 3, habitat management objectives are presented in order of elevation relative to the river - starting at the bluffs and moving down towards the main river channel. Refuge-specific activities objectives are presented first, followed by partnership activities objectives when applicable.

All Habitats Objective - Documenting Management Activities and Actions

For all management activities in all habitats, spatial data will be created that documents important information including, but not limited to, the extent of the management activity, the date of occurrence, the type of activity or action, and the individuals involved. Spatial data will be recorded in the Region 3 Management Actions database (or a successor database) and will facilitate the tracking of actions, determination of success, and planning of future activities. Additionally, management unit data will be housed in the NWRS priority dataset "Management Units" which is managed at a national level with individual stations responsible for maintaining their local data therein.

Upland Forest Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance or restore at least 182 acres of upland forest habitat (182 acres in the Savanna District). This habitat is typically found outside the Mississippi River floodplain and therefore is not usually the focus of larger partnership efforts, however, some areas of this habitat are found in isolated instances within the floodplain. It is managed through actions conducted solely by the refuge to benefit the biological integrity of Midwestern Forests and Woodlands. Upland forest habitat on the refuge will have one or more of the following characteristics:

- Management of stands with thinning should follow U.S. Forest Service guidance for upland central hardwoods (Dale and Hilt 1989) to maintain percent stocking between lines A and B on the stocking chart provided in Dale and Hilt (1989).

- Stand regeneration should be facilitated with extended harvest rotations of 150–250 years (Wisconsin Department of Natural Resources undated). Exact rotation length will depend on site-specific characteristics.

- At least three snags per acre.

- Total canopy cover will be at least 50 percent.

- On south and west-facing slopes, at least 50 percent of the canopy species will be composed of fire-tolerant hard mast producing tree species (i.e., *Quercus* spp, *Carya* spp.).

- Mature canopy tree height will average at least 50 feet.

- Composition of ground layer herbaceous vegetation will be at least 60 percent native species.

- Composition of shrub cover will be at least 60 percent native species.

Rationale
Upland forest is a USFWS Guidance Priority 1 habitat for the refuge because there is a limited amount of this habitat within the refuge and there are limited locations in the surrounding landscape where this habitat is actively managed in a manner that addresses USFWS and refuge priorities and BIDEH. The refuge has the potential to solely conduct management activities and these can be accomplished within the existing capacity.

The refuge has 867 acres of upland forest, located primarily along the bluffs (See Figure 2-8) and demarcates the edge of the river floodplain. Historically, these forests, especially on the south-facing slopes, were subject to fires that promoted fire-adapted species such as oaks. Although tree density and canopy cover are greater in upland forest than in savanna habitats, fires did prevent complete closure of the canopy in many areas. Decades of fire exclusion over the recent past has likely resulted in most of the upland forests on the refuge and within the surrounding landscape having a greater degree of canopy closure and a shift in species composition in both the overstory and understory vegetation to less fire-adapted species (Nowacki and Abrams 2008). The upland forests of the region are important habitat for transient Neotropical migrant landbirds during critical times of the year (Knutson et al. 2006). However, continued shifts in tree species composition of Midwestern forests from fire-adapted species to less fire-adapted species may diminish the value of this habitat to migrant landbirds (Wood et al. 2012). Restoring and enhancing 182 acres of upland forest through management activities such as prescribed fire, targeted tree harvest, and planting of fire-adapted species such as oaks and hickories will support the ecological integrity of typical Midwest Forests and Woodlands and provide habitat for transient Neotropical migrant landbirds.

The Savanna District has the majority of upland forest habitat on the refuge (698 acres). The remaining 169 acres are scattered among the Winona (41 acres), La Crosse (16 acres), and McGregor Districts (112 acres). Although the acreage of this habitat is limited on the refuge, it is important because it contributes to the historical mosaic of habitats such as prairie, savanna, and bottomland forests (Fremling 2005). The refuge has limited staff available with expertise in forest management and silvicultural techniques. Assistance with forest management planning and writing prescriptions is available from the U.S. Army Corps of Engineers, state Departments of Natural Resources, and Minnesota Audubon. Guyon et al. (2012) provides many characteristics of desirable future conditions for bottomland forests and some of these were used to inform construction of objectives for upland forests in this document. Further guidance is available in Dale and Hilt (1989), Wisconsin Department of Natural Resources (undated), and Brose et al. (2008). Guidance provided in these resources, as well as the objectives specified in this document, will be continually evaluated as updated information is obtained from newly published literature and data from ongoing forest inventory efforts. Habitat management objectives for upland forests will need to be flexible in light of these increases in knowledge and understanding. The section on bottomland forest objectives provides a review of many of the restoration, enhancement, and management techniques that can be used.

Savanna Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, or restore at least 493 acres of savanna habitat (31 acres in La Crosse; 12 acres in McGregor; 450 acres in Savanna) through activities conducted solely by the refuge to benefit the native plant community typical of north-central bur oak openings and other benefitting species. Savanna habitat on the refuge will have one or more of the following characteristics:

- Total tree canopy cover will be less than 50 percent.

- At least 75 percent of canopy species composition will be represented by fire-tolerant hard mast producing tree species.

- Herbaceous species composition will consist of at least five species of native grasses, two species of native cool-season grasses, and 20 species of native forbs.

- Shrub cover will be less than 50 percent.

- Native forb cover will be at least 25 percent.

- Native grasses cover will be between 40–75 percent.

Rationale
Savanna is a USFWS Guidance Priority 1 habitat for the refuge because it is a highly endangered habitat that is under-represented in the larger landscape and typically in a degraded condition. Within the Prairie Hardwood Transition Bird Conservation Region (BCR 23), the UMRGLR JV 2007 Implementation Plan identifies a need for approximately 2 million acres of mixed open woodland (analogous to the savanna Broad habitat in this HMP) to be maintained and protected within the states of Iowa, Illinois, Minnesota, and Wisconsin, in order to maintain current populations of breeding birds associated with this habitat; a similar amount needs to be restored or enhanced to achieve breeding bird population objectives (Upper Mississippi River and Great Lakes Region Joint Venture 2007). Although there is a relatively limited amount of this habitat on the refuge, the refuge does have the potential to solely conduct management activities and these can be accomplished within the existing capacity. See Chapter 3 for a discussion on the distinction between Priority 1 and Priority 2 habitats. The designation of Priority 1 does not require the refuge to focus solely on this habitat or limit it from pursuing management actions on other habitats, but rather is used to support management actions when deciding how to allocate refuge resources.

Savanna represents the transition between the western prairie and the eastern forests as increased average annual precipitation moving to the east provides favorable conditions for the establishment and maintenance of trees (Anderson 1998). Historically, savanna covered between 27 million and 32 million acres in the Midwest prior to European settlement (Nuzzo 1986). Savanna habitat was one of the most widespread vegetation communities in southern Wisconsin (Curtis 1959) and was the predominant vegetation type in the Driftless region (Shea et al. 2014). At the time of European settlement, savanna covered approximately 4.5 million acres in Minnesota (Marschner 1974, Wendt 1983). Estimates of the amount of savanna in Illinois and Iowa prior to settlement are more difficult because pre-settlement vegetation maps have not distinguished savanna as a separate vegetation type (Illinois) or lacked information on what defines savanna (Iowa; Nuzzo 1986). Currently only 0.02 percent of intact savanna exists throughout the pre-settlement range in the Midwest (Nuzzo 1986). Savanna was lost during and following settlement due to fire suppression, overgrazing and then lack of grazing, cropland conversion, and invasive species establishment (Anderson 1998).

The definition of savanna varies in the Upper Midwest. In Wisconsin, Curtis (1959) defined savanna as having greater than one mature tree/acre, but less than 50 percent total tree cover. The MNDNR's Natural Heritage Program defines savanna as a grassland community with single or clumped trees with a tree cover of 10 to 80 percent (Wendt 1983). The Illinois Natural Areas Inventory uses a similar definition (White and Madany 1978). The Iowa Natural Areas Inventory defines tallgrass savanna as being dominated by bur oak and a variety of prairie grasses along with some forbs that are dependent on site conditions (Nuzzo 1986). The common features of savannas include open canopies, primarily composed of oak species with a combination of prairie forb and grass species (Anderson 1998). Fire is a critical ecological process in savannas. Frequent, low to high intensity fires prevented the establishment of fire-intolerant woody species and prevented fire-tolerant woody species from becoming abundant, and tall enough, to result in closed canopy conditions.

Although highly impacted from management or lack of management, research indicates that savanna restoration may be possible because savannas appear to be highly resilient (Brudvig and Asbjornsen 2009).

Savanna restoration includes conducting frequent fires, creating a mosaic of sunny and shady microsites (Leach and Givnish 1999) and removing woody vegetation encroachment (Bowles and McBride 1998, Brudvig and Asbjornsen 2009). A short-term study in Michigan indicated that a combination of burning and thinning produced an increase in light at the ground level, higher forb bloom abundance and diversity, and a decrease in shrub and canopy cover over just burning alone (Lettow et al. 2014). Peterson and Reich (2001) reported that a fire frequency of three or more times per decade in savanna habitat in Minnesota's Anoka Sand Plain prevented the development of the sapling layer and canopy in-growth; however, mature tree mortality, especially in northern pin oaks increased. Mature bur oak mortality decreased with fire frequency.

Savanna restoration on the refuge will require an understanding of the refuge's soils, topography, and current and historic vegetation to help guide where restoration should occur to provide long term, sustained success. Leach and Givnish (1999) recommended that, in addition to looking for open grown oak trees it would be useful to look for areas of high native plant diversity in the ground layer, including prairie and forest species along with the few savanna specialist species.

The majority of the potential savanna restoration activities will occur in the Savanna District. Although the amount of existing and restorable savanna habitat on the refuge is limited, management activities could have a positive benefit for species that are dependent or utilize savanna. Restoration of pockets of savanna would benefit species such as red-headed woodpeckers, mourning doves, indigo buntings, and other migratory birds that prefer open, savanna-like tree canopies for nesting. Davis et al. (2000) reported that savanna in Central Minnesota being restored through burning alone resulted in a decrease in insectivorous birds that use the upper canopy (leaves and air space) and an increase in omnivorous birds that use the ground layer and lower canopy such as Baltimore oriole, eastern king bird, vesper sparrow, field sparrow, and lark sparrow. Woodpeckers such as the red-headed woodpecker also increased due to standing dead trees resulting from fire. Savanna restoration provides scattered mature trees, standing dead trees and snags, and a mix of understory and ground vegetation that is attractive to birds that prefer open-country-like conditions. Restoring savanna would also support the restoration and maintenance of the refuge's ecological integrity (BIDEH).

Grassland Objective – Refuge-specific Activities

Over the lifetime of the HMP maintain, enhance, or restore at least 3,744 acres of grassland habitat (135 acres in Winona; 1950 acres in La Crosse; 178 acres in McGregor; 3,236 acres in Savanna) through activities conducted solely by the refuge to provide breeding and migratory habitat for Henslow's sparrow, grasshopper sparrow, dickcissel, and eastern meadowlark as well as the full life cycle requirements for ornate box turtle and native invertebrate pollinators.

Grassland habitat on the refuge will have one or more of the following characteristics:

- Percent cover of trees will be less than 10 percent.
- Percent cover of shrubs will be less than 25 percent.
- Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs.
- Native grass cover will be between 40–75 percent.
- Native forb cover will be at least 25 percent.
- On an annual basis, maintain and enhance 3,752 acres of grassland habitat across all four districts of the refuge that will support 474,816 milkweed stems, providing host plant resources for breeding monarch butterflies.

- In areas managed for grassland birds, treeless habitat patches of at least 74 acres will be provided or maintained.

Wildlife Priority Resources of Concern Objectives

- On an annual basis, maintain at least two patches of treeless grassland habitat, each at least 74 acres in size, at the Lost Mound Unit of the Savanna District to support at least 243 breeding pairs of Henslow's sparrows and 221 breeding pairs of dickcissels. These habitat patches will be characterized by percent cover of litter at least 25%, percent cover of bare ground less than 10%, percent cover of native grasses between 40–75%, and percent cover of native forbs at least 25%.

- On an annual basis, maintain at least two patches of treeless grassland habitat, each at least 74 acres in size, at the Lost Mound Unit of the Savanna District to support at least 115 breeding pairs of grasshopper sparrows. These habitat patches will be characterized by percent cover of litter less than 25% and percent cover of bare ground greater than 10%.

- On an annual basis, maintain at least two patches of treeless grassland habitat, each at least 74 acres in size, at the Lost Mound Unit of the Savanna District to support at least 12 pairs of eastern meadowlarks. These habitat patches will be characterized by percent cover of native grasses between 40–75%, and percent cover of native forbs at least 25%.

- On an annual basis, maintain at least 2,837 acres of grassland habitat at the Lost Mound Unit of the Savanna District to support a population of at least 100 ornate box turtles. This habitat will be characterized by percent cover of trees less than 10%, percent cover of shrubs less than 25%, percent cover of native grasses between 40–75%, and percent cover of native forbs at least 25%.

- On an annual basis, maintain and enhance 3,752 acres of grassland habitat across all four districts of the refuge that will support 474,816 milkweed stems, providing host plant resources for breeding monarch butterflies.

Rationale

Grassland is a USFWS Guidance Priority 1 habitat for the refuge because native, high diversity grasslands are under-represented in the larger landscape and typically in a degraded condition. Within the Prairie Hardwood Transition Bird Conservation Region (BCR 23), the UMRGLR JV 2007 Implementation Plan identifies a need for approximately 555,000 acres of grassland to be maintained and protected within the states of Iowa, Illinois, Minnesota, and Wisconsin, in order to maintain current populations of breeding birds associated with this habitat; a similar amount needs to be restored or enhanced to achieve breeding bird population objectives (Upper Mississippi River and Great Lakes Region Joint Venture 2007). The refuge has the potential to solely conduct grassland management activities and these can be accomplished within the existing capacity. See chapter 3 for a discussion on the distinction between Priority 1 and Priority 2 habitats. The designation of Priority 1 does not require the refuge to focus solely on this habitat or limit it from pursuing management actions on other habitats, but rather is used to support management actions when deciding how to allocate refuge resources.

Prior to European settlement, much of the Upper Midwest (Illinois, Iowa, Minnesota, and Wisconsin) was prairie. Approximately 67.5 million acres covered the states of Illinois (Illinois Department of Natural Resources 2005), Iowa (Smith 1998), and Minnesota (Marschner 1974) combined with the state of Wisconsin contributing another 2.1 million acres (Curtis 1959). Much of the UMRS floodplain was also prairie (Theiling et al. 2000) and was extensive enough to support large grazers such as bison and elk (Fremling 2005). The McGregor and Savanna Districts historically had the greatest amount of prairie. For example, in Pool 12 – 14 (Geomorphic Reach 5) where the Savanna District is located approximately 57 percent of the land cover was prairie (Theiling et al. 2000). In the Winona and La Crosse Districts, prairie accounted for approximately 8 percent of the total land cover.

Today, greater than 99 percent of the prairie in three of the four states where the refuge exists has been lost primarily due to agricultural conversion and development (Curtis 1959; Smith 1998; Illinois Department

of Natural Resources 2005). Minnesota has 1.3 percent, or 235,000 acres, of prairie remaining (Minnesota County Biological Survey 2010, Minnesota Prairie Plan Working Group 2011). Prairies in the UMRS suffered a similar fate as they were converted to agricultural land uses or lost due to the development of the lock and dam system so that today only a fraction remains. In the Savanna District, where more than 50 percent of the land cover was once prairie, grasslands currently occupy less than 7 percent of the landscape. In the McGregor District, approximately 5 percent of the landscape remains in prairie and grasslands.

The loss of prairie affected many native plant and wildlife species. Large herbivores such as bison and elk are no longer present on the landscape. Native plant diversity in remaining prairies and existing grasslands is reduced or threatened by invasive species. Grassland-dependent birds have also been impacted by loss of prairie and grassland habitat on the landscape with population declines up to 30 percent since the 1970s (Knopf 1994; North American Bird Conservation Initiative 2016). Today, grassland-dependent birds within the Midwest region depend upon agricultural landscapes and other artificial habitats to maintain populations. Federal farm programs such as the Conservation Reserve Program (CRP), military installations, and some livestock pastures provide features of this habitat today.

The UMRGLR JV plan identifies breeding grassland birds as the most important bird group associated with this particular habitat (Upper Mississippi River and Great Lakes Region Joint Venture 2007). Within the Prairie Hardwood Transition Bird Conservation Region (BCR 23), the UMRGLR JV 2007 Implementation Plan set population goals of 20,100 Henslow's sparrows, 197,800 dickcissels, and 508,000 eastern meadowlarks (Potter et al. 2007). Populations of all of these species are below the goals identified by the UMRGL JV for BCR 23, with a deficit of 10,050 Henslow's sparrow, 64,800 dickcissels, and 254,000 eastern meadowlarks (Potter et al. 2007). For all of the BCR 23, the grassland habitat goal set by the UMRGL JV is 785,053 acres while the goal for grassland habitat strictly in Illinois is 23,227 acres. The UMRGL JV does not consider grasshopper sparrow a focal species but the Partners in Flight Bird Conservation Plan for the Upper Great Lakes Plain considers grasshopper sparrow a priority species along with Henslow's sparrow and dickcissel (Knutson et al 2001). The Partners in Flight Bird Conservation Plan for the Upper Great Lakes Plain does not consider eastern meadowlark a priority species (Knutson et al 2001).

The large amount of grassland habitat at the Lost Mound Unit of the Savanna District, in excess of 2,000 acres, highlights the important role the refuge could play in conserving grassland birds. Large blocks of prairie and grassland habitat to support area-sensitive species such as grasshopper sparrow and Henslow's sparrow (Sample and Mossman 1997, Dechant et al 1998, Herkert 1998) are possible at the Lost Mound Unit of the Savanna District. Minimum patch size recommendations for grasshopper sparrow are at least 74 acres (Dechant et al 1998), which is what may be required in order to maintain grasshopper sparrow breeding populations in Illinois (Herkert 1994, Dechant et al 1998). Minimum patch size recommendations for Henslow's sparrow are to provide at least 74 acres when possible, while 247 acres are preferable (Herkert 1998). Research suggests that dickcissels and eastern meadowlark may not be as area-sensitive as grasshopper sparrow and Henslow's sparrow, and minimum patch sizes required or recommended for these species may be as low 24 acres for dickcissels (Dechant et al. 1999) and 12 acres for eastern meadowlark (Herkert 1994, Hull 2000).

While there is some overlap in the habitat preferences of the four grassland bird species highlighted here (grasshopper sparrow, Henslow's sparrow, dickcissel, and eastern meadowlark), there are some differences that are the basis of management recommendations which differ slightly for the four species (Sample and Mossman 1997, Dechant et al 1998, Herkert 1998, Dechant et al 1999, Hull 2000). Optimal habitat for grasshopper sparrows tends to include greater amounts of bare ground, and lower, sparser vegetation cover relative to optimal habitat for some of the other species (Vickery 1996; Dechant et al. 1998). Conversely, optimal habitat for Henslow's sparrow and dickcissel tends to include taller, denser vegetation cover, and higher levels of accumulated litter (Herkert 1998, Dechant et al 1999). Optimal habitat for dickcissel and eastern meadowlark habitats tend to include greater amounts of forb cover (Dechant et al 1999, Hull 2000).

Because of differences in habitat preferences that some grassland bird species exhibit, habitat management recommendations emphasize it is best to provide a mosaic of habitat conditions within larger landscapes, whereby habitat patches with different vegetation structural characteristics are provided across the landscape to provide optimal conditions for multiple species (Sample and Mossman 1997, Fuhlendorf et al. 2006, Pillsbury et al. 2011, Hovick et al. 2015). Habitat management recommendations for individual species also include managing areas on a rotational basis, providing a mosaic of habitat conditions that shift through space and/or time, to prevent succession of grassland habitats towards communities characterized by excessive dominance of grasses or abundance of woody plants (Dechant et al. 1998, Herkert 1998, Dechant et al. 1999, Hull 2000).

At the Lost Mound Unit of the Savanna District, there is sufficient grassland habitat that can be restored or managed to provide a mosaic of patches representing the various habitat characteristics needed by the suite of grassland birds considered here. Using previously reported values for territory sizes of grassland birds (see Wiens 1969, Robins 1971, Vickery 1996, Temple, 2002, Monroe and Richardson 2005, Gill et al. 2006, Herkert et al. 2008, Jones 2011, Jaster et al. 2012), an average territory size was calculated for grasshopper sparrow, Henslow's sparrow, dickcissel, and eastern meadowlark. The calculated territory size for each species was used to determine a theoretical number of breeding pairs of each species that might be supported by a habitat patch of 74 acres (the minimum size of a habitat patch recommended for grassland bird management at the Lost Mound Unit of the Savanna District). Many limitations to this approach are apparent, such as the possibility that actual breeding pair density of any of these species at the Lost Mound Unit differs substantially from a theoretical average amount calculated using values reported from across these species' ranges. Additionally, dickcissel are known to sometimes employ a polygynous breeding system (Temple 2002) so a breeding pair metric based on the territory size of males may not reflect the actual number of breeding females within a territory.

Notwithstanding these limitations, The Lost Mound Unit of the Savanna District has substantial potential to provide suitable habitat for grassland breeding birds. The previously identified objectives recommend providing a total of at least six patches of treeless grassland habitat, each at least 74 acres in size, with three slightly different habitat characteristics that approximate the preferred habitat characteristics of the four species of grassland birds that are of primary concern to the refuge (grasshopper sparrow, Henslow's sparrow, dickcissel, eastern meadowlark). Under optimal management, at least two patches would be characterized by relatively low amounts of vegetation cover and relatively high amounts of bare ground. These conditions are preferred by grasshopper sparrows and are often present following management actions that impose a form of disturbance such as prescribed fire, grazing, or haying. Furthermore, at least two patches would be characterized by relatively high amounts of vegetation cover and relatively low amounts of bare ground. These conditions are preferred by Henslow's sparrows and dickcissels and are often present following extended periods without management-imposed disturbance. Finally, at least two patches would be characterized by habitat conditions that are intermediate between those of recently disturbed patches and patches that have not been disturbed for extended periods. Compared to grasshopper sparrows, Henslow's sparrows, and dickcissels, Eastern meadowlarks will utilize a relatively broader suite of habitat conditions and could be expected to utilize the three different types of habitat patches (recently-disturbed, intermediate time since disturbance, and extended time since disturbance).

In addition to supporting grassland-dependent birds, maintaining and enhancing prairie and grassland habitat on the refuge supports the needs of other grassland species. The sand prairies of the refuge's Savanna District provide habitat for ornate box turtle, a species listed as SGCN, threatened, and endangered in three of the states along the UMRS. Some of the largest populations in Illinois are found on the refuge in the Savanna District as well as associated conservation properties. At the Lost Mound Unit of the Savanna District, a 19-acre turtle enclosure is used to protect a population of this species from predators until the population within the enclosure reaches a sufficient size to justify release into the surrounding habitat (Strickland et al. 2017, E. Britton pers. comm.). The population of ornate box turtles within the turtle enclosure consists of all individuals that were known to remain at the Lost Mound Unit, some individuals translocated from other nearby areas, and additional individuals that have been added to this population after being "head-started" (grown in captivity to an advanced size for their age) by the Niabi Zoo (Coal Valley, IL), Lincoln Park Zoo (Chicago, IL), and Brookfield Zoo (Chicago, IL). Field work during

the summer of 2019 indicated there were 85 ornate box turtles within the enclosure (N. Richards, pers. comm.). Current plans are for the refuge to conduct annual population monitoring of the ornate box turtle population within the 19-acre enclosure at the Lost Mound Unit of the Savanna District to determine total population size, and reproductive status of head-started individuals. When the total population size is at least 100 individuals and at least some of the head-started individuals have reached reproductive age, the exclosure barriers will be removed, allowing the population to disperse into the surrounding areas of the Lost Mound Unit.

A high number of native invertebrate pollinators characteristic of grasslands are considered SGCN by all four states. Native invertebrate pollinators include bees, butterflies, moths, and other insects and are responsible for the critical ecosystem service of pollinating numerous plant species. The economic value of native bee species alone to pollinating food crops in the U.S. is estimated at over $3 billion annually (Losey and Vaughan 2006). Many native invertebrate pollinator populations have been declining due to habitat loss through conversion to row-crop agricultural, agricultural practices, and urbanization (Cane and Tepedino 2001; Spivak et al. 2011). Maintaining, enhancing, or restoring prairie and grassland habitat with a high diversity of native plant species will benefit native invertebrate pollinators that utilize native plants for both feeding and breeding activities across the entire growing season (Black et al 2007, Harmon-Threatt and Hendrix 2015, Havens and Vitt 2016). Some invertebrate pollinators, such as many native bumble bees, are considered generalists because they can obtain resources such as nectar and pollen from a broad suite of plants (Hatfield et al 2012). Other native invertebrate pollinators require one species of host plant for their larval life stage, such as the federally endangered karner blue butterfly which utilizes wild lupine as a larval host plant (U.S. Fish and Wildlife Service 2003; note that karner blue butterfly populations are known to occur near the refuge but it is not known if any karner blue butterfly populations occur on the refuge). Additional native invertebrate pollinator species rely on a limited group of plant species for critical periods of their life history, such as monarch butterflies which utilize a suite of milkweed species as a larval host plant (Pocius et al 2017). Thogmartin et al. (2017) provided estimates of milkweed stem densities (stems per acre) that would be needed in various scenarios involving multiple Midwestern land cover classes, in order to achieve monarch butterfly population goals set by the U.S. Fish & Wildlife Service. For the Protected Grass land cover class, which would presumably encompass grassland habitats on the refuge and other similar conservation properties such as state Wildlife Management Areas, a theoretical minimum of 126.55 milkweed stems per acre is recommended to contribute to tri-national (Canada, United States, Mexico) monarch population goals (Thogmartin et al. 2017).

Bottomland Forest Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, or restore at least 866 acres of bottomland forest habitat (120 acres in Winona; 460 acres in La Crosse; 286 acres in McGregor) through activities conducted solely by the refuge to provide breeding and migratory habitat for red-shouldered hawk, transient Neotropical migrant passerines, cerulean warbler, prothonotary warbler, and tree-roosting bats. Bottomland forest habitat on the refuge will have one or more of the following characteristics:

- Bottomland forests located in the lowest elevations of the floodplain (subjected to flooding > 40 days during the growing season) will be comprised of species tolerant of flooding such as silver maple, cottonwood, and willow.

- Bottomland forests located on higher elevations of the floodplain (subjected to flooding < 40 days during the growing season) will be comprised of a diverse mixture of species and may include oaks, hickories, hackberry, and American elm.

Regardless of elevation and flooding frequency, bottomland forest will have one or more of the following characteristics where site conditions are appropriate and management actions are feasible:

- Where site conditions are appropriate, overstory canopy cover will be at least 70 percent.

- Where site conditions are appropriate, there will be at least two co-occurring tree species other than silver maple in the co-dominant size class at the plot scale.

- In locations that are appropriate, naturally occurring regeneration (800+ trees per acre with at least 4.5" DBH) will be occurring on at least 10 percent of the bottomland forest to ensure succession of desired tree species into the forest canopy.

- In 90 percent or less of bottomland forest, age structure at the landscape scale will be approximately 20 percent saplings (0–5 inches DBH), 35 percent pole (5–12 inches DBH), and 45 percent mature/over-mature age classes (≥12 inches DBH).

- Where site conditions are appropriate and planting is done in areas with little to no currently existing vegetation, desired stocking level of seedlings 1" or less in diameter should be between 825–1,200 seedlings per acre. Desired stocking level 10 years after the planting should be approximately 700 seedlings approximately 3" in diameter per acre. Seedlings can include both those that have planted as well as those that occur because of natural regeneration. These are minimum acceptable recommendations and the appropriate stocking guide should be consulted when planning planting efforts for specific sites.

- Where site conditions are appropriate and underplanting is done in currently existing forest stands or areas with currently existing large trees, desired stocking level of seedlings 1" in diameter should be no less than 10 containerized or 40 bare root seedlings per acre. Desired stocking level 10 years after the planting should be approximately six containerized or 24 seedlings approximately 3" in diameter per acre. Seedlings can include both planted seedlings and seedlings that occur in a stand as result of natural regeneration. These are minimum acceptable recommendations and the appropriate stocking guide should be consulted when planning planting efforts for specific sites.

- Percent cover of reed canarygrass will be less than 15 percent.

- Composition of ground layer herbaceous vegetation will be at least 60 percent native species.

- Composition of shrub cover will be at least 60 percent native species.

Wildlife Priority Resource of Concern Objectives

- On an annual basis, maintain at least 7,764 acres of bottomland forest in Pool 10 of the McGregor District to support up to 31 breeding pairs of red-shouldered hawks. Forest stands with at least 70% canopy closure are most likely to be used as nesting habitat by red-shouldered hawks.

- On an annual basis, maintain at least 7,764 acres of bottomland forest in Pool 10 of the McGregor District to support up to 2,449 breeding pairs of cerulean warbler. Forest stands with a complex canopy characterized by a mixture of pole (5–12 inches DBH) and mature/over-mature (≥12 inches DBH) age classes with scattered canopy gaps, and oak spp. in the canopy layer, are more likely to be used by breeding cerulean warblers.

- On an annual basis, maintain at least 7,764 acres of bottomland forest in Pool 10 of the McGregor District to support up to 9,851 breeding pairs of prothonotary warbler. Forest stands with pole (5–12 inches DBH) and mature/over-mature (≥12 inches DBH) age classes are more likely to provide cavities used by breeding prothonotary warblers.

- Over the life of the plan, protect and manage bottomland forest for the benefit of diverse communities (N >35 species) and abundant populations of transient Neotropical migrant passerines during the spring migration (mid-April to end of May).

- Over the life of the plan, create or maintain a snag density of at least 15 snags per acre on 420 acres of bottomland forest in the La Crosse District to support northern long-eared bats.

Rationale
Bottomland forest is a USFWS Guidance Priority 1 habitat for the refuge because there is an extensive amount of this habitat on the refuge (approximately 65,000 acres) and management supports a high number of the selected ROCs. Additionally, the bottomland forest on the refuge and along the Upper Mississippi River beyond the boundaries of the refuge, likely represents a large proportion of the total amount of this habitat across the larger Upper Midwest landscape (Knutson et al 1996, Romano 2010). While a substantial proportion of the total bottomland forest acreage managed by the refuge is cooperatively managed with the U.S. Army Corps of Engineers (U.S. Army Corps of Engineers 2011a), there are opportunities for the refuge to conduct habitat management activities outside of these cooperative agreements. These opportunities occur on parcels where the USFWS holds fee-title ownership and projects can be accomplished within the constraints of the refuge's existing capacity. In many instances, the refuge will continue to work with the USACE, state DNR, and NGO partners to plan restoration and enhancement projects on USFWS fee title lands even though the implementation of these projects will be done primarily or entirely with existing refuge resources. Management of lands where the USACE holds fee-title ownership will continue to be done cooperatively with the USACE and management activities will continue to be coordinated with the USACE. Large-scale projects will require partnerships with the USACE and other entities. See chapter 3 for a discussion on the distinction between Priority 1 and Priority 2 habitats. The designation of Priority 1 does not require the refuge to focus solely on this habitat or limit it from pursuing management actions on other habitats, but rather is used to support management actions when deciding how to allocate refuge resources.

Bottomland forest, or commonly referred to as floodplain forest in other UMRS planning documents, was one of the most abundant cover types in Geomorphic Reaches 2–6 during pre-settlement, making up approximately 40 percent of the land cover (Theiling et al. 2000). Initially, bottomland forests along the river were harvested for lumber and firewood for the steamboat industry (Guyon et al. 2012). Following the development of the lock and dam system, many of the forests were flooded and converted to open water habitat and the available acreage for less flood-tolerant species such as oak and hickory decreased (Urich et al. 2002). Between the 1800s and 1989, bottomland forest decreased in Geomorphic Reaches 2–6 by nearly 50 percent to make up approximately 22 percent of the total land cover (or approximately 98,000 acres) in the UMRS (Theiling et al. 2000). Bottomland forest loss was due to agricultural and urban development, logging, water level regulation, island erosion, and invasive species (Urich et al. 2002). Between 1989 and 2000, bottomland forest in the entire UMRS decreased 5 percent system-wide including a 4 percent decrease (3,400 acres) in the Pools 1–13, which includes Geomorphic Reaches 2–6 (Johnson and Hagerty 2008). The continued loss of bottomland forest was due to continued conversion to agriculture and ecological changes associated with the impoundment of the river and resulting water level changes. The establishment of the refuge was key to protecting additional bottomland forest habitat from further degradation or loss (Theiling et al. 2000).

As previously mentioned in chapter 2, periodic flooding and drought associated with a free-flowing Mississippi River was a major factor in shaping the pre-settlement plant communities (Guyon et al. 2012). The impoundments created by the lock and dam system have not only affected the amount of bottomland forest habitat within the UMRS, but have also changed the forest community. An altered hydrology has favored species that are more flood-tolerant because water levels stay higher for longer periods of time (Johnson and Hagerty 2008). Low elevation forest stands subjected to growing season flood durations of 40 days or longer tend to be dominated by silver maple, while multi-species stands tend to occur on higher elevations subjected to growing season flood durations of less than 40 days (De Jager et al. 2012). The effect of impoundment by the system of locks and dams on the Upper Mississippi River has been a decrease in bottomland forest diversity as measured by the number of species, age classes, canopy height, and understory composition (Yin and Nelson 1995). Currently, the bottomland forest is generally a closed canopy composed of trees greater than 12 inches DBH, between the ages of 50 and 70 years old, dominated by three to four flood-tolerant species, especially silver maple (Yin 1999; Guyon et al. 2012). A decrease in the measured importance value of mast producing trees, compared to pre-settlement conditions, has been documented in some locations (Knutson and Klaas 1998). Recruitment of other species such as cottonwood, black willow, and river birch is limited by the closed canopy (Guyon et al.

2012), high daily and weekly water level variation (Johnson and Hagerty 2008), and the invasion of reed canarygrass (Upper Mississippi River Conservation Committee 2002, Thomsen et al. 2012, De Jager et al. 2017, Urich et al. 2002). Stands on progressively higher elevations are subjected to progressively lesser periods of inundation and tend to have progressively higher densities of stems, indicating the negative effect of inundation on regeneration (De Jager 2012). Large-scale die-offs of the even-aged stands is predicted within the next 50 years and without recruitment of additional trees these areas will likely be converted to wet meadows dominated by reed canarygrass (Yin 1999). Urich et al. (2002) outlined additional changes to be expected in bottomland forests over the next 50 years without management action:

- A reduction in cottonwood and willow due to a lack of high sunlight, early successional habitat.
- More open forest canopy as mature trees die off and are replaced by reed canarygrass and other non-woody vegetation, instead of younger trees.
- Continued loss of forest in the lower parts of the pools due to island erosion.
- Conversion of forest to other vegetation types in mid-pools as high water levels make conditions less favorable for trees and more suitable for reed canarygrass and other herbaceous vegetation.
- Fewer mast producing trees due to a reduction in habitat and limited dispersal during high water conditions.
- Increase in shade tolerant species such as boxelder and mulberry, which can establish under a maple canopy, but are less desirable than other bottomland forest species.

The refuge contains in excess of 65,000 acres of bottomland forest. Through activities undertaken solely by the refuge, approximately 867 acres will be maintained, enhanced, or restored over the next 15 years. Work will primarily occur on the Winona, La Crosse, and McGregor Districts because those districts have the most amount of habitat that can be managed within the refuge's sole capabilities. Objectives for bottomland forests in this document align with USACE's desired stand conditions outlined in the current UMR Systemic Forest Stewardship Plan (Guyon et al. 2012) as well as research on the ability to control reed canarygrass in bottomland forest restoration and management settings (Thomsen et al. 2012). Guidance provided in these and other resources, as well as the objectives specified in this document, will be continually evaluated as updated information is obtained from newly published literature and data from ongoing forest inventory efforts. Habitat management objectives for bottomland forests will need to be flexible in light of these increases in knowledge and understanding.

Urich et al. (2002) outlines different management strategies that can be undertaken to improve bottomland forest habitat. Group selection is a technique that mimics natural, small canopy openings. A small opening is created by removing trees from an area 1.5 to 2 times the height of the tallest tree. This technique is intended for intermediate shade intolerant species such as oaks, hickories, sycamores, and hackberries that can be planted following tree removal. This technique is relatively easy for the refuge to complete and will be used on higher elevations where mast producing tree restoration will likely be more successful and beneficial to wildlife resources. There may be instances where execution of this strategy may require follow-up herbicide treatments to suppress reed canarygrass.

Shelterwood harvest is a technique that removes the existing canopy in a multi-step process while allowing for partial shade to remain between harvest events to deter herbaceous vegetation such as reed canarygrass from outcompeting young tree seedlings and saplings. The shelterwood technique additionally creates conditions where residual trees function as a seed source capable of regenerating a new cohort. After trees become established above the height of most herbaceous vegetation, a second harvest event removes the remaining canopy trees. The level of effort required for this technique is greater than the group selection technique; however, it can be applied to a variety of conditions and settings in the bottomland forest of the refuge. It may also be used in areas where reed canarygrass control or reduction is possible. Modified shelterwood systems may also be utilized to regenerate stands while leaving some large residual

trees uncut for wildlife and seed production. Modified shelterwood systems do not utilize a final overstory removal cut and thus leave large residual trees within the stand.

Seed tree technique is another harvest method where almost all trees are removed except for single or clumped mature trees that can act as a natural seed source. This technique is limited to areas on the refuge where reed canarygrass is not already established as a monotypic stand or has the potential to easily invade. In addition to tree harvest (group selection, shelterwood, seed tree), strategies such as tree planting or seeding, protection of planted stock from herbivory, and both pre- and post-planting herbicide treatments may be required during habitat management activities (Guyon et al. 2012; Thomsen et al. 2012).

Thinning techniques, often referred to as timber stand improvement or TSI, may also be used to promote better growth among specific trees and remove less desirable stems. Thinning will focus on promoting the growth habit and form of residual trees by providing increased light and removing competitive neighbor trees. Thinning should follow the appropriate stocking tables for the forest type in which managers are working. Thinning may be used to promote growth in wildlife trees and increase vigor throughout a stand.

Depending on site-specific characteristics, natural regeneration is a viable treatment strategy. Chemical site preparation and subsequent soil scarification, and in some cases soil scarification alone, may be used as a technique to create bare mineral soil where tree seeds can germinate. Creating bare mineral soils within a stand can allow naturally occurring tree species better success establishing on a site. Tools such as tractor mounted discs, anchor chains, and mulching heads may be used to physically scarify forest soils and create a bare mineral soil surface that is conducive to tree seed germination. Scarification treatments mimic historical conditions resulting from sedimentation deposited by floodwaters.

A potentially important factor in bottomland forest habitat management may be the consideration of adequate habitat block size. The UMR Systemic Forest Stewardship Plan (Guyon et al. 2012) has an objective of establishing and maintaining larger blocks of at 2,500 acres, with widths and lengths of at least 1/3 mile. However, one analysis of forest cover in the Upper Mississippi and Illinois River Floodplains indicates that large blocks of unbroken forest cover are relatively rare, especially in the Upper Impounded portion of the Upper Mississippi River, and that most blocks of what is considered “core forest” occur at relatively small spatial scales (De Jager and Rohweder 2011). Another key component is adequate spatial distribution along the river corridor to provide stopover sites for feeding and resting birds during migration. As will be discussed further herein, a well-developed forest structure may be an important habitat component within forested ecosystems. A mixture of canopy trees, midstory trees, understory shrubs, and a diverse ground cover provide numerous feeding and nesting opportunities, as well as protective cover to escape predation.

Maintaining, enhancing, and restoring bottomland forest structure and composition on the refuge is important to provide for the habitat needs of other non-priority ROCs and the resources that they represent. For example, 93 percent of the bald eagles nests observed in the Winona District were in super canopy trees primarily consisting of cottonwoods and silver maples (Mundahl et al. 2013). Large cottonwoods and silver maples are equally important for providing natural cavities for wood duck nests. In a study of bottomland forest in west central Illinois, approximately 74 percent wood duck nests were found in large silver maples (Yetter et al. 1999). As Urich et al. (2002) indicated, over the next 50 years boxelders and mulberries, which may have less wildlife value, may be the only trees growing in the understory to replace these larger trees once they die without management action.

A variety of studies have indicated that canopy closure of at least 70% is an important habitat characteristic for breeding red-shouldered hawks (summarized by Jacobs and Jacobs 2002). Although those conditions exist today in many areas on the refuge, Urich et al. (2002) suggest a more open-canopy forest may result from the invasion of reed canarygrass. Using previously reported values for red-shouldered hawk nest densities (Stewart 1949, Bosakowski et al. 1992, McLeod and Andersen 1998, Dykstra et al. 2000, Dykstra et al. 2008, Woodford et al. 2008), an average nest density was calculated to determine a theoretical number of breeding pairs of red-shouldered hawks that could be supported on a per-acre basis in Pool 10 of the McGregor District. Limitations to this approach include the possibility that actual red-shouldered hawk breeding pair density in Pool 10 of the McGregor District differs substantially from a theoretical

average amount calculated using values reported from across this species' range. Additionally, some of the reported nest densities are from studies conducted in suburban areas.

Habitat management recommendations for cerulean warblers include protecting, restoring, and managing forest stands of at least 200 acres, providing structural complexity within the forest canopy, retaining large trees (>70 feet tall, >15 in DBH), and encouraging the regeneration of oak trees (Wisconsin Department of Natural Resources 2012a, Minnesota Audubon 2014). Within the Upper Mississippi River floodplain, landscape and habitat characteristics that are important for cerulean warblers include: 1) topographic diversity, or a variety of elevation ranges within a landscape; 2) areas representing the interface of floodplain forests and upland forests; and 3) gaps in the forest canopy (King et al 2019). King et al. (2019) noted that current suggestions for restoration of bottomland forests of the Upper Mississippi River include a land surface elevation target resulting in inundation less than 40% of the growing season, in order to grow tree species other than flood-tolerant silver maple. However, King et al. (2019) suggest that for restorations to benefit cerulean warblers and maximize the restoration of ecosystem functions, a more appropriate restoration target might be inundation periods of around 6% during the growing season. Habitat management recommendations for prothonotary warblers include enlarging bottomland stands to at least 250 acres, the retention of trees or snags with cavities suitable for nesting, and ensuring forest regeneration by controlling invasive plant species such as reed canary grass (Wisconsin Department of Natural Resources 2012b, Minnesota Audubon 2014).

Using previously reported values for territory sizes (Oliarnyk and Robertson 1996, Petit and Petit 1996, Twedt and Henne-Kerr 2001, Clarkson 2007, Cooper et al. 2009, Robbins et al. 2009, Buehler et al. 2013, Kaminski and Islam 2013, Perkins and Wood 2014, Nemes and Islam 2017, Carpenter and Wand 2018), an average territory size was calculated for cerulean warbler and prothonotary warbler. The calculated territory size for each species was used to determine a theoretical number of breeding pairs of each species that might be supported on a per-acre basis in Pool 10 of the McGregor District. Many limitations to this approach are apparent, such as the possibility that actual breeding pair density of any of these species in Pool 10 of the McGregor District differs substantially from a theoretical average amount calculated using values reported from across these species' ranges. Finally, preliminary results from current work in Pool 10 of the McGregor District indicates that cerulean warblers are distributed unevenly across the pool, with some areas (i.e., Sny McGill) having relatively high numbers of cerulean warblers detected during the breeding season while in other areas (i.e., Bagley Bottoms) they are relatively uncommon (Reiter-Marolf and Meier 2018).

Within Pool 10 of the McGregor District, the refuge is currently conducting research that seeks to identify how habitat variables such as tree species composition, overstory height, and overstory closure are related to the distribution and abundance of cerulean warbler and prothonotary warbler, and other breeding landbirds as well (Reiter-Marolf and Meier 2018). This research is conducted with bird point counts (Knutson et al 2016) on plots where forest inventory data are also collected using U.S. Corps of Engineers MVP/MVR/MVS Regional Forest Inventory Phase II Protocols. Insights gained through this research will guide future habitat management intended to benefit cerulean and prothonotary warblers and be incorporated in future revisions of the HMP.

The refuge lies within the Mississippi Flyway and is an important stopover site for many species of birds (Knutson and Klaas 1997, 1998; Urich et al. 2002; Kirsch et al. 2013). Kirsch et al. 2013 observed 35 species of transient Neotropical (N=26) and temperate-zone (N=9) migrants within the Upper Mississippi River area during spring migration (mid-April to end of May). Neotropical and temperate-zone migrants spend up to one-third of each year migrating (Mehlman et al. 2005) and the greatest constraint during migration is the acquisition of adequate food to replenish fat stores (Moore et al. 1995). During spring migration, the 65,168 acres of bottomland forest within the refuge provide foraging opportunities, shelter, and protection from predators so these migrants can replenish fat stores before continuing to their breeding grounds. However, climate change has the potential to alter the suitable climate space favored by individual species and their habitats, change resource availability, increase habitat disturbance, change phenology, and alter migration routes or stop migration for some species altogether (Moore 2011). Management will focus on providing bottomland forest habitat and associated food resources (i.e. aquatic, aerial, and terrestrial insects) as species respond to climate change.

Dead trees or dead stems/limbs of living trees, cavities within trees, and exfoliating bark are commonly used as roost sites by tree-roosting bats but it should be noted that some species, such as the tri-colored bat, roost in foliage (Kalcounis-Rüppell et al. 2005, Schaefer 2017). Previous research has determined that tree-roosting bats generally select roost trees where the density of snags in the area around a roost tree is higher than the density of snags around randomly located trees in the landscape (Kalcounis-Rüppell et al. 2005, Lacki and Baker 2003). Habitat characteristics of northern long-eared bats include the use of sites where average snag density is at least 15 snags per acre (Lacki and Schwierjohann 2001, Lacki et al 2009). When considering roost tree diameter for northern long-eared bats, the average of reported values from several studies is approximately 13 inches (Foster and Kurta 1999, Lacki and Schwierjohann 2001, Menzel et al. 2002, Carter and Feldhamer 2005, Lacki et al. 2009). Potential roosts in northern long-eared bat summer habitat has also been described as live trees and/or snags that are three or more inches in diameter at breast height, and have exfoliating bark, cracks, crevices, and/or cavities (U.S. Fish and Wildlife Service 2019). In the La Crosse District, timber stand improvement (i.e. thinning) will be used on 420 acres across six management units (Upper Pool 7 – 50 acres; Black River Bottoms - 100 acres; Black River Delta – 100 acres; Upper Pool 8 – 20 acres; Root River Tract East – 50 acres; Lawrence Lake – 100 acres). Timber stand improvement actions will seek to achieve desired species composition of remaining trees such as oaks and hickories, increase the vigor of remaining trees, and enhance regeneration of new trees. Timber stand improvement can include the girdling of trees to kill them but allowing them to remain standing after they have been killed, providing snags that can be used by roosting bats. Tree species with peeling or shaggy bark, especially shagbark hickory, provide roost sites for bats even when alive.

Bottomland Forest Objective – Partnership Activities

The refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage bottomland forest habitat through the Upper Mississippi River Restoration Program's Habitat Rehabilitation and Enhancement Project element (UMRR HREP), as well as other cooperative ventures that generate benefits to fish, wildlife, and water resources. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II, the Upper Mississippi River Systemic Forest Stewardship Plan, and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP and operational projects associated with the USACE Mississippi River Project Offices, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
The refuge will continue to work with partners to implement bottomland forest management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge-alone.

Wet Meadow Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, or restore at least 300 acres of wet meadow habitat in La Crosse District through actions conducted solely by the refuge to provide nesting and migratory needs for dabbling ducks, the full life cycle requirements of eastern massasauga, and the native plant community of Midwestern Wet Prairie and Meadows. Wet meadow habitat on the refuge will have one or more of the following characteristics:

- Tree and shrub canopy cover within habitat patches will be less than 10 percent.
- Native herbaceous cover will be at least 50 percent.
- Native sedges cover will be at least 25 percent.

- In areas managed for dabbling ducks, vegetation height during fall and spring migration will be less than 10 inches.

Wildlife Priority Resource of Concern Objectives

- On an annual basis, provide up to 693,550 total energy days (mallard model) in the fall on 266 acres of wet meadow habitat managed for dabbling ducks in the La Crosse District.

- By 2025, identify, acquire, and manage at least 247 acres of wet meadow habitat in the Black River Bottoms of the La Crosse District that will support at least 27 female eastern Massasauga rattlesnakes.

Rationale
Wet meadow, as defined for this HMP, includes the GWVCS habitats of wet meadow, wet meadow shrub, and sedge meadow (Dieck and Robinson 2004, Dieck et al. 2015). The creation of the lock and dam system and invasion by reed canarygrass has changed the distribution and characteristics of this habitat in the UMRS and the refuge. Many areas that were wet meadow prior to the lock and dam system are now inundated and are part of the open water aquatic habitats (Theiling et al. 2000). Conversely, wet meadows dominated by reed canarygrass are developing on newly created landforms within the UMRS and replacing bottomland forests in forest openings due to the ability of reed canarygrass to outcompete tree seedlings.

There are approximately 9,600 acres of wet meadow habitat on the refuge. Unlike other habitats, wet meadow is distributed relatively even across the districts with Winona District having the least amount (1,269 acres) and the La Crosse District having the greatest amount (3,704 acres). The 266 acres targeted for management solely by refuge activities represent existing areas that can be managed to benefit dabbling ducks, eastern massasauga, and the native plant community.

Under the current conditions, the ability to reduce reed canarygrass in wet meadow habitats on the refuge is limited. Multiple herbicide treatments and a combination of techniques are often required to control or reduce established invasions (Lavergne and Molofsky 2006). Continual re-invasion via the import of propagules during flood events is another compounding factor that limits control. Even when this habitat is highly altered by an invasive species, it can provide some benefits to wildlife species. Some bird species will utilize reed canarygrass in wetlands and wet meadows during the breeding season (Kirsch et al. 2007; Spyreas et al. 2010), and reed canarygrass meadows can be used by waterfowl for feeding and loafing during migration.

The UMRGL JV identified broadly defined primary and secondary habitat associations required by waterfowl during the non-breeding season (Soulliere et al. 2017). For the purposes of this HMP, wet meadow areas managed for dabbling ducks in the La Crosse District are considered part of the emergent primary habitat (persistent and non-persistent herbaceous vegetation) described by Soulliere et al. (2017). Using the daily energy requirement of mallards (1,493 kJ) and the total energy available in emergent habitats in the fall migration period (3,894,323 kJ/acre) provided by Soulliere et al. (2017), a theoretical amount of up to 693,550 daily energy days (mallard model) could be provided by the 266 acres of wet meadow habitat managed for dabbling ducks in the La Crosse District. This calculated value of daily energy days available in wet meadow habitat should be interpreted with caution, however, in part because the total energy available in emergent habitats reported by Soulliere et al. (2017) was based on data from numerous sources originating from a broad suite of emergent habitats, including many from moist soil habitats. Whether the total energy available (kJ/acre) reported for emergent habitats by Soulliere et al. (2017) is truly representative of what can be provided by management of wet meadow habitats in the La Crosse District is not currently known.

Wet meadows are also an important habitat for the eastern massasauga, a federally listed threatened species as well as a listed species in the four states of Iowa, Illinois, Minnesota, and Wisconsin (Johnson et al. 2000; Szymanski et al. 2016). Durbian et al. (2007) reported eastern massasauga rattlesnake home ranges varied depending on home range calculation method, as well the sex, reproductive status, and age of the snakes they studied. When a Minimum Convex Polygon method was used to calculate home ranges

for adult snakes, home range size was reported to be 8.9 acres for non-gravid females, 12.6 acres for gravid females, and 94.6 acres for males (Durbian et al. 2007). The minimum target area for habitat restoration or enhancement recommended by Durbian et al. (2007) was 247 acres, which would presumably provide habitat for up to 27 non-gravid females or 19 gravid females. Faust et al. (2015) modeled the probability of quasi-extinction for eastern massasauga rattlesnake populations across their range, given site-specific factors, and they used a quasi-extinction benchmark of 50 individuals, which would be 25 females in a population where sex ratios are roughly 50:50. The quasi-extinction benchmark of 50 (i.e., 25 females) was based on expert opinion solicited from eastern massasauga species experts, and is very close to the number of females that might be sustained by the amount of habitat recommended by Durbian et al (2007).

Wet Meadow Objective – Partnership Activities

The refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage wet meadow habitat through the Upper Mississippi River Restoration Program's Habitat Rehabilitation and Enhancement Project element (UMRR HREP), as well as other cooperative ventures that generate benefits to fish, wildlife, and water resources. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP and operational projects associated with the USACE Mississippi River Project Offices, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
The refuge will continue to work with partners to implement wet meadow management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge-alone.

Marsh Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, and restore at least 5,620 acres of marsh habitat (3,500 acres in La Crosse District, 62 acres in the McGregor District, and 1,792 acres in Savanna District) where the refuge, solely through refuge-based activities, has existing capabilities to manage water levels. Water level management will provide wetlands characterized by moist soil plants and wetlands dominated by emergent and rooted floating-leaved perennial aquatic vegetation to provide food and cover for secretive marsh birds and waterfowl (especially tundra swans and dabbling ducks) as well as other wetland-dependent wildlife such as black terns.

Marsh habitats will have one or more of the following characteristics:

- In areas managed for perennial marsh vegetation, native perennial plants such as arrowhead, bur-reed, and bulrush will be at least 60% of the total cover.
- In areas managed for moist-soil conditions, annual, seed-producing plant species such as smartweed and wild millet will be at least 65 percent of the total cover.
- In areas managed for moist-soil conditions, perennial plant species such as bulrush, reed canarygrass and purple loosestrife will be no greater than 35 percent of the total cover.
- In areas managed for moist-soil conditions, woody plants will be no greater than 35 percent of the total cover.
- In areas managed for moist-soil conditions, water depths during fall and spring migration periods will be between 0.5–10 inches.

Wildlife Priority Resource of Concern Objectives

- On an annual basis, provide up to 483,505 total energy days (tundra swan model) in the spring on 2,550 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District (Blue Lake, Target Lake, and Lawrence Lake).

- On an annual basis, provide up to 9,125,662 total energy days (mallard model) in the fall on 3,500 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District (Black River Delta, Middle Pool 7, Lake Onalaska, Upper Halfway Creek South, Brown's Marsh, Blue Lake, Target Lake, Lawrence Lake).

- On an annual basis, provide up 161,655 total energy days (mallard model) in the fall on 62 acres of marsh habitat managed for annual, seed producing plants at the Guttenberg Ponds of the McGregor District.

- On an annual basis, provide up to 4,672,339 total energy days (mallard model) in the fall on 1,792 acres of marsh habitat managed for annual, seed producing plants as well as native perennial marsh vegetation in the Savanna District (Sloane, Upper Spring Lake, Duckfoot, Pleasant Creek).

- On an annual basis, maintain through passive habitat management at least two black tern nesting colonies in marsh habitat of the refuge that are protected from human disturbance.

- Over the life of the HMP, maintain or enhance at least 3,500 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District that will support up to 811 soras.

Rationale

Marsh is a Priority 1 habitat for the refuge because there is an extensive amount of habitat on the refuge and management supports a high number of the selected ROCs. The UMRGLR JV 2007 Implementation Plan identifies multiple wetland habitats, such as shallow semi-permanent marsh and mudflat/moist soil, habitats that are that are captured by the marsh broad habitat of this HMP. Within the Prairie Hardwood Transition Bird Conservation Region (BCR 23), the UMRGLR JV 2007 Implementation Plan identifies a need for approximately 440,000 acres of shallow semi-permanent marsh to be maintained and protected within the states of Iowa, Illinois, Minnesota, and Wisconsin, in order to maintain current populations of breeding birds associated with this habitat; to achieve breeding bird population objectives, approximately 76,000 acres of shallow semi-permanent marsh needs to be restored or enhanced (Upper Mississippi River and Great Lakes Region Joint Venture 2007). To meet non-breeding season population goals, approximately 186,000 acres of shallow semi-permanent marsh needs to be maintained or protected and 3,367 acres needs to be restored or enhanced within Iowa, Illinois, Minnesota, and Wisconsin; while approximately 11,000 acres of wet mudflat and moist soil habitat needs to be maintained and protected, and approximately 3,278 acres need to be restored or enhanced (Upper Mississippi River and Great Lakes Region Joint Venture 2007). The refuge does have the potential to solely conduct management activities at some locations and these can be accomplished within the existing capacity; however, large-scale projects at many locations will require partnerships. See chapter 3 for a discussion on the distinction between Priority 1 and Priority 2 habitats. The designation of Priority 1 does not require the refuge to focus solely on this habitat or limit it from pursuing management actions on other habitats, but rather is used to support management actions when deciding how to allocate refuge resources.

The lock and dam system resulted in an increase in the percent of marsh habitat in Geomorphic Reaches 2 through 5 from approximately 5 percent in the late 1800s to approximately 9 percent by 1989 (Theiling et al. 2000). The amount of marsh habitat increased in Geomorphic Reaches 2 and 5 by 4.5 percent and 1.1 percent, respectively. Prior to the lock and dam system, Geomorphic Reach 3 had approximately 15 percent marsh habitat, but currently has 8 percent. Marsh habitat increased in Geomorphic Reach 4 from 4.5 percent to approximately 18 percent.

There are approximately 38,000 acres of marsh habitat on the refuge spread relatively evenly among the four districts. The McGregor District has the highest amount of marsh habitat (13,381 acres); however, marsh habitat composes a greater percent of the total habitat acreages for the Winona District and La Crosse District, 19 and 20 percent respectively. Marsh habitat, as defined for this HMP, includes a variety of shallow to deep marsh habitats comprised of both annual and perennial emergent, submersed, and floating-leaved vegetation. Many of the objectives specified for this habitat applies to areas where water levels can be managed by the refuge to provide conditions that promote important seed-producing annual plants (moist-soil management) as well as areas where other management practices such as disking or prescribed burning can be conducted. These management practices provide benefits for migrating waterfowl, shorebirds, secretive marsh birds, and other wetland-dependent birds and wildlife.

The UMRS is important to millions of migrating waterfowl and other wetland-dependent birds because it is a stopover on the journey from overwintering areas to breeding grounds in the spring and vice versa in the fall (Soulliere et al. 2007a, 2007b). The plants, seeds, and invertebrates produced by marsh habitats primarily composed of annual vegetation is critical to providing the resources for dabbling and diving ducks to complete the migration and to successfully breed (Fredrickson and Taylor 1982, LaGrange and Dinsmore 1989; Anteau and Afton 2004; Devries et al. 2008). Providing high quality marsh habitat will contribute to the conservation of continental and regional populations of waterfowl and other waterbirds (Gratz et al.1997, Thorson et al. 2002, Kenow et al 2003a, Darrah and Krementz 2009, Darrah and Krementz 2010, Bolenbaugh et al. 2011, Schlect undated).

Moist-soil management on the refuge is limited by the ability to control water levels during the growing season. Under ideal conditions, marsh areas designated for moist-soil management are typically flooded in the spring to provide stopover habitat for migrating birds, dewatered in early summer to allow annual vegetation establishment and growth, and re-flooded prior to the fall migration period to provide additional stopover habitat.

In some instances, the refuge is capable of conducting management actions targeting marsh habitats characterized by perennial vegetation, such as shallow marsh perennial and deep marsh perennial habitats. Prescribed burning, mowing, grazing, disking, and herbicide applications are management actions that can improve marsh habitat conditions for wildlife. Some of the effects of these management actions include: removal of excessive plant biomass; increasing the amount of surface water that is available to wildlife because it is not covered by plant biomass; increasing the diversity of plant species in areas characterized by monocultures; increasing the vigor of marsh plants resulting in greater seed or tuber production; and controlling the spread of invasive species. Prescribed burning is a large scale management action that could be applied to a mosaic of these marsh habitats in instances where suitable firebreaks encompass the entity of a large management unit representing multiple habitats.

Pool-scale drawdowns are another management action that can benefit perennial marsh vegetation but this management action is only capable when done within a larger partnership effort. Prior to the creation of the lock and dam system, marsh habitats along the Upper Mississippi River were subject to seasonal variations in water levels. Throughout summer, shallow areas would dry out and the bare soil would be colonized by annual wetland vegetation, such as smartweed, that produced nutrient-rich seeds. In the fall, these areas would be re-flooded and the seeds, along with abundant invertebrates, would be important food sources for migrating waterfowl and other wetland-dependent birds (Frederickson and Taylor 1982). Pool scale drawdowns can also enhance the germination and establishment of perennial emergent aquatic vegetation such as arrowhead (Kenow et al. 2016, Kenow et al. 2018). Because pool-scale drawdowns require resources beyond the sole capabilities of the refuge and can only be completed by partners and coordinated with USACE, they are covered under the Marsh – Partnership Activities objective.

The UMRGL JV identified broadly defined primary and secondary habitat associations required by waterfowl during the non-breeding season (Soulliere et al. 2017). For the purposes of this HMP, marsh habitat managed for native perennial marsh vegetation as well as marsh habitat managed for annual, seed producing plants are both considered part of the emergent primary habitat (persistent and non-persistent herbaceous vegetation) described by Soulliere et al. (2017). Using the daily energy requirement of tundra swans (5,489 kJ) and the total energy available in emergent habitats in the spring migration period

(1,040,769 kJ/acre) provided by Soulliere et al. (2017), a theoretical amount of up to 483,505 total energy days (tundra swan model) could be provided for tundra swans on an annual basis during spring migration at Blue Lake, Target Lake, and Lawrence Lake in the La Crosse District. These areas will be managed by the refuge to maintain at least 60% cover of native perennial marsh vegetation but they are open to hunting so they receive little to no use by tundra swans during the fall migration. Tundra swans do use these areas during some spring migrations and would benefit from habitat management that ensures their preferred food plants, such as arrowhead, are maintained.

However, the calculation of total energy days for tundra swans should be interpreted with caution for several reasons. First, the acreage of marsh habitat used in these calculations represents a broad suite of GWVCS land cover types (also referred to as UMR class 31) that were collapsed into the broad category of marsh habitat during the habitat mapping effort conducted for this HMP, and not all of GWVCS land cover types are likely to represent habitats potentially used by tundra swans. Secondly, it is not known how well the habitat mapping effort used for this HMP, or the GWVCS classification scheme itself, crosswalks with the habitat classification scheme used by Soulliere et al. (2017) which was based on National Wetland Inventory data (U.S. Fish and Wildlife Service 2016a) and National Land Cover Data (Homer et al. 2015). Additionally, the food resources (energy) available to tundra swans in the spring is also available to, and would presumably be consumed by a broad suite of other waterfowl and waterbird species. This highlights a potential disparity between calculations of total energy that might be available relative to calculations of total energy that could or would actually be consumed by this species. Soulliere et al. (2017) accounts for this to a degree by providing a weighted spring mean of forage energy available in emergent wetland types during the spring. However, the weighted spring mean for the emergent wetland type is based on a limited number of studies (n = three studies) relative to the weighted fall mean and total energy available in the fall for the same wetland type (n = 11 studies). Finally, something to note is that Soulliere et al. (2017) describe the primary habitat association for tundra swans as being with aquatic bed habitat with emergent habitat being a secondary habitat association for this species. On the refuge, however, emergent marsh habitats, particularly those dominated by arrowhead, are considered the primary habitat used by tundra swans. Thus, the habitat association we used in making these calculations differs from the primary habitat association described by Soulliere et al. (2017).

Using the daily energy requirement of mallards (1,493 kJ) and the total energy available in emergent habitats in the fall migration period (3,892,747 kJ/acre) provided by Soulliere et al. (2017), a theoretical amount of total energy days (mallard model) were calculated that could be available on marsh habitats at various areas of marsh habitat managed for dabbling ducks on the refuge. A theoretical amount of up to 9,125,662 total energy days (mallard model) could be provided in the fall on 3,500 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District. A theoretical amount of 161,655 total energy days (mallard model) could be provided in the fall on 62 acres of marsh habitat managed for annual, seed producing plants at the Guttenberg Ponds in the McGregor District. A theoretical amount of up to 4,672,339 total energy days (mallard model) could be provided in the fall on 1,792 acres of marsh habitat managed for annual, seed producing plants at various areas of the Savanna District. Again, these calculations should be interpreted with caution for similar reasons previously described for dabbling ducks in wet meadow habitat and for tundra swans in marsh habitat.

Currently there are two known colonies of black terns on the refuge, both in Pool 8 of the La Crosse District (Adams and Dittmer 2018). There is also currently a colony at Trempealeau NWR (upstream from the La Crosse District and adjacent to Pool 6; Adams and Dittmer 2018). Historic records exist of colonies on or adjacent to the refuge in Pools 4, 5, 5a, 6 and 7 (Faber and Nosek 1985, Faber 1992, Custer et al. 1998). Black terns are a UMRGL JV focal species and the 2018 Waterbird Habitat Conservation Strategy estimates there are 12,922 breeding black terns in the UMRGL JV portion of the BCR 23 (Soulliere et al. 2018). This is a deficit of 6,461 individuals relative to the UMRGL JV population objective of 19,383 individuals (Soulliere et al. 2018). Flush counts conducted at the two colonies in the La Crosse District each year during 2015–2018 suggest declining numbers of terns at each location, a trend that has been evident during the same period at the Trempealeau NWR colony (Adams and Dittmer 2018). A similar declining trend in black tern abundance has been documented for colonies across the state of Wisconsin during the 30-year period of 1980–2011 (Matteson et al. 2012).

Soulliere et al. (2018) consider sora a UMRGL JV focal species representing a larger breeding waterbird guild that is dependent on emergent wetland habitats with associated open water and herbaceous habitats. Relative to some other secretive marsh birds it has more general habitat requirements (Manci and Rusch 1988, Soulliere et al 2018) but large areas of emergent vegetation, especially vegetation with tall, robust stems such as cattail, may be important for soras and other secretive marsh birds such as American bittern and Virginia rail (Linz et al. 1997, Bolenbaugh et al. 2011, Glisson et al. 2015). Habitat management recommendations for sora include managing for a mosaic of habitats including live emergent vegetation, open water, and floating mats of dead vegetation (Linz et al. 1997, Soulliere et al. 2018). Management actions across large scales could be staggered so that different areas within the landscape represent different successional stages of emergent vegetation (Linz et al. 1997).

Previously reported values for sora densities during the breeding season (Tanner and Hendrickson 1956, Glahn 1974, Kantrud and Stewart 1984, Manci and Rusch 1988, Linz et al. 1997, Baschuk et al. 2012, Melvin and Gibbs 2012, Anderson et al. 2019) were used to calculate an average sora density of 0.23 birds per acre. This average number of birds per acre was then used to calculate a theoretical number of 811 soras that could be supported on 3,500 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District.

Marsh Objective – Partnership Activities

Over the lifetime of the HMP, the refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage marsh habitats through the UMRR HREP, the Water Level Management Task Force, and other cooperative ventures that generate benefits to fish, wildlife, and water resources that are beyond the sole capabilities of the refuge alone. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP projects, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
The refuge will continue to work with partners to implement marsh habitat management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge-alone.

Sand and Mud on Islands, Bars, and Flats Objective – Partnership Activities

The refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage habitats characterized by sand and mud through the UMRR HREP, as well as other cooperative ventures that generate benefits to fish, wildlife, and water resources. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP projects, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
The refuge will continue to work with partners to implement sand and mud restoration on islands, bars, and flats management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge staff alone.

Lentic Backwater Lakes and Impounded Areas Objective – Partnership Activities

The refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage lentic backwater lake and impounded habitats through the UMRR HREP, the Water Level Management Task Force, as well as other cooperative ventures that generate benefits to fish, wildlife, and water resources. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP projects, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
Within the Prairie Hardwood Transition Bird Conservation Region (BCR 23), the UMRGLR JV 2007 Implementation Plan identifies a need for approximately 102,000 acres of extensive open water (a habitat captured by the Lentic Backwater Lakes and Impounded Areas Broad habitat in this HMP) to be maintained and protected within the states of Iowa, Illinois, Minnesota, and Wisconsin, to meet non-breeding season population goals for birds associated with this habitat; approximately 32,000 acres need to be restored or enhanced to meet non-breeding season population goals (Upper Mississippi River and Great Lakes Region Joint Venture 2007). The refuge will continue to work with partners to implement lentic backwater lakes and impounded areas management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge-alone.

Lotic Main Channel Border, Secondary Channel, Tertiary Channel Objective – Partnership Activities

The refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage lotic habitats in the main channel border, secondary channels, and tertiary channels through the UMRR HREP, as well as other cooperative ventures that generate benefits to fish, wildlife, and water resources, specifically fluvial-dependent mussels and limnophilic native fish. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP projects, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
The refuge will continue to work with partners to implement lotic channel border, secondary channel and tertiary channel management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge-alone.

Lotic Main Channel Objective – Partnership Activities

The refuge will continue to work with the Upper Mississippi River federal, state, tribal, and non-governmental partnership to restore, enhance, and manage lotic main channel habitat, where possible, through the UMRR HREP, as well as other cooperative ventures that generate benefits to fish, wildlife, and water resources for the benefit of migratory fluvial-dependent native fish. In Pools 4–10, the Environmental Pool Plans can provide guidance on potential project locations. Across the refuge, the Habitat Needs Assessment-II and the UMRR-EMP Environmental Design Handbook can provide guidance in developing restoration, enhancement, and management strategies and prescriptions. When the refuge engages in partnership activities, such as UMRR HREP projects, that occur on lands and waters owned or managed by the refuge, the refuge will use priority habitats and priority ROCs identified in this HMP to guide the planning and execution of such efforts.

Rationale
The refuge will continue to work with partners to implement lotic main channel management on areas of the refuge and within the UMRS where the scope and scale is beyond the current and future capacity of the refuge-alone.

Chapter 5. Management Strategies

5.1 Development of Management Strategies and Prescriptions

This chapter outlines management strategies for Priority I habitats to address the habitat management goals and objectives outlined in chapter 4. Management strategies identify the tools and techniques utilized to achieve the habitat objectives. Management prescriptions provide greater detail about elements such as sequence, timing and location, by which the strategies will be implemented. Many factors, including wildlife populations, seasonal variations, and habitat conditions affect the management prescriptions and their ability to achieve objectives from year to year. As such, prescriptions and their details will be identified in Annual Habitat Work Plans specific to each refuge district. The identified strategies were selected by reviewing past refuge practices and their effectiveness in supporting management priorities, as well as consultation with refuge staff.

Only Priority I habitats are included in this chapter because those are the habitats where the refuge can have the most influence to achieve a particular objective, and the objectives can be achieved through work conducted completely or nearly completely by the refuge. Strategies outlined below are based on current and presumed future funding and staff resources, and what will be required to achieve the desired 15-year vision to *maintain* the refuge's habitats, as discussed in chapter three. The addition of staff and resources beyond current levels may increase the capacity to achieve habitat objectives faster or in a more efficient manner. However, the scope and scale of refuge-specific objectives are also limited by the overall operation and maintenance of the lock and dam system under the jurisdiction of the USACE. As mentioned in chapter 4, strategies used to fulfill the partnership-based objectives will primarily be driven by existing and future USACE and partner guidance documents as they align with Service policy, mandates, and refuge purpose.

It is impossible to predict the full suite of management strategies and prescriptions required over the next 15-year period. As knowledge about natural resource management increases, and funding or staff resources change, some strategies may need to be amended or added as available resources. These changes will be identified in Annual Habitat Work Plans as warranted.

For some habitats, *Potential Inventory, Monitoring, and Research Activities to Inform Management of Priority Wildlife Resources of Concern* are provided. These are provided in this HMP, prior to completion of the refuge's Inventory and Monitoring Plan, to further elucidate the linkage between wildlife Priority Resources of Concern and habitat management objectives. For many wildlife Priority Resources of Concern, a potential inventory, monitoring, and research activity that is identified is the location and compilation of all known refuge data, and information such as historical reports, for a species or group of species, and constructing a comprehensive database and/or writing a comprehensive report. Following those efforts, the comprehensive datasets and reports should be archived in ServCat. ServCat (Service Catalog) is a centralized database that allows USFWS staff to organize, preserve, and make discoverable important USFWS data, information, and documents that can be used to inform management of USFWS resources. Organizing, preserving, and making discoverable refuge information in ServCat will allow staff from across the refuge, and successive generations of managers and biologists within individual refuge districts, to access and utilize definitive information that is often otherwise lost or irretrievable when staff retire or transfer to other locations.

5.2 Prioritization of District Management Units

The refuge is large, spanning four states, and over 260 river miles. Habitat conditions and the influence of the 12 USACE lock and dams vary spatially across the refuge. Adding to the spatial complexity arising from

the size and extent of the refuge, the refuge is characterized by organizational complexity in that it is divided into four districts, each with a distinct set of district managers and staff.

Management strategies herein are described at the refuge level. However, not all management strategies will be implemented on each district or within every unit on each district. Tables 1-4 in Appendix F identify management units in each district where habitat work is planned during the life of the HMP. Only the management units that fall under the ability for the refuge to complete the work alone are included. Management units where work requires a partner or is outside of the jurisdiction of the refuge are not included in Tables 1-4 of Appendix F.

5.3 Management Strategies by Habitat Objective

Upland Forest Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance or restore at least 182 acres of upland forest habitat (182 acres in the Savanna District) through actions conducted solely by the refuge to benefit the biological integrity of Midwestern Forests and Woodlands and other benefitting species. Upland forest habitat on the refuge will have one or more of the following characteristics:

- Management of stands with thinning should follow U.S. Forest Service guidance for upland central hardwoods (Dale and Hilt 1989) to maintain percent stocking between lines A and B on the stocking chart provided in Dale and Hilt (1989).
- Stand regeneration should be facilitated with extended harvest rotations of 150–250 years (Wisconsin Department of Natural Resources undated). Exact rotation length will depend on site specific characteristics.
- At least three snags per acre.
- Total canopy cover will be at least 50 percent.
- On south and west-facing slopes, at least 50 percent of the canopy species will be composed of fire-tolerant hard mast producing tree species (i.e., *Quercus* spp, *Carya* spp.).
- Mature canopy tree height will average at least 50 feet.
- Composition of ground layer herbaceous vegetation will be at least 60 percent native species.
- Composition of shrub cover will be at least 60 percent native species.

Strategies (Activities completed by the refuge arranged by topic):

<u>Enhancement and Restoration Activities</u>

- Use selective thinning to simulate natural forest processes based on site location and limitations including presence of invasive species, ability to complete maintenance operations, and desired outcome.
- Use group selection harvest to create forest gap openings. Follow up tree harvest with planting of oaks, hickories, and other appropriate taxa.
- Use shelterwood and modified shelterwood harvest to encourage existing tree seedling growth or promote tree plantings while deterring invasive species. Select tree species for planting based on individual site conditions. Complete second harvest after sapling growth exceeds the height of the herbaceous layer.

- Use seed tree harvest in areas where reed canarygrass is not already established. Remove the majority of the trees within a project area, leaving mature trees to act as a seed source.

- Promote, preserve, or maintain mature trees with cavities, snags, and loose bark in forested areas where they do not pose a safety or forest health hazard.

- Select and plant tree species based on site slope, aspect, and hydrology. Use a mixture of hard producing trees species and shrub species. Also, consider the future potential management fire regime when selecting species.

- Use prescribed fires to kill seedlings of shade-intolerant species, reduce litter, and increase light levels at the ground layer.

- Use spraying, mowing, and grazing as appropriate to treat invasive species such as honeysuckle, multiflora rose, and garlic mustard.

Maintenance Activities

- Maintain upland forest via mechanical and chemical treatments. Eventually use prescribed burns to control honeysuckle, multiflora rose, garlic mustard, and other invasive species.

- Where appropriate, use prescribed fires to kill seedlings of shade-intolerant species, reduce litter, and increase light levels at the ground layer.

- Monitor for invasive plant species. Identify and prioritize locations where treatment provides the highest potential for success.

Savanna Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, or restore at least 493 acres of savanna habitat (31 acres in La Crosse; 12 acres in McGregor; 450 acres in Savanna) through activities conducted solely by the refuge to benefit the native plant community typical of north-central bur oak openings and other benefitting species. Savanna habitat on the refuge will have one or more of the following characteristics:

- Total tree canopy cover will be less than 50 percent

- At least 75 percent of canopy species composition will be represented by fire-tolerant hard mast producing tree species.

- Herbaceous species composition will consist of at least five species of native grasses, two species of native cool-season grasses, and 20 species of native forbs.

- Shrub cover will be less than 50 percent.

- Native forb cover will be at least 25 percent.

- Native grasses cover will be between 40–75 percent.

Strategies (Activities completed by the refuge arranged by topic):

Enhancement and Restoration Activities

- Selectively remove woody understory vegetation and canopy trees, including oaks, to achieve the desired canopy coverage outlined in the objective. Consider a combination of hand and mechanical removal based on the site, slope, and soil characteristics.

- Chemically treat stumps to prevent re-growth.

- Re-seed with local ecotype native plant species, when possible. Consider seeding historical savanna indicator plant species.

- Conduct prescribed burns as needed during restoration and maintenance phases of habitat management. Fire return intervals during habitat restoration phases may need to be shorter than during habitat maintenance phases.

Maintenance Activities

- Use prescribed burning, mowing, chemicals and/or grazing to control invasive species, enhance herbaceous species, and control re-growth of woody vegetation.

Grassland Objective – Refuge-specific Activities

Over the lifetime of the HMP maintain, enhance, or restore at least 3,744 acres of grassland habitat (135 acres in Winona; 1,950 acres in La Crosse; 178 acres in McGregor; 3,236 acres in Savanna) through activities conducted solely by the refuge to provide breeding and migratory habitat for Henslow's sparrow, grasshopper sparrow, dickcissel, and eastern meadowlark as well as the full life cycle requirements for ornate box turtle and native invertebrate pollinators.

Grassland habitat on the refuge will have one or more of the following characteristics:

- Percent cover of trees will be less than 10 percent.

- Percent cover of shrubs will be less than 25 percent.

- Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs.

- Native grass cover will be between 40–75 percent.

- Native forb cover will be at least 25 percent.

- On an annual basis, maintain and enhance 3,752 acres of grassland habitat across all four districts of the refuge that will support 474,816 milkweed stems, providing host plant resources for breeding monarch butterflies.

- In areas managed for grassland birds, treeless habitat patches of at least 74 acres will be provided or maintained.

Grassland bird objectives

- On an annual basis, maintain at least two patches of treeless grassland habitat, each at least 74 acres in size, at the Lost Mound Unit of the Savanna District to support at least 243 breeding pairs of Henslow's sparrows and 221 breeding pairs of dickcissels. These habitat patches will be characterized by percent cover of litter at least 25%, percent cover of bare ground less than 10%, percent cover of native grasses between 40–75%, and percent cover of native forbs at least 25%.

- On an annual basis, maintain at least two patches of treeless grassland habitat, each at least 74 acres in size, at the Lost Mound Unit of the Savanna District to support at least 115 breeding pairs of grasshopper sparrows. These habitat patches will be characterized by percent cover of litter less than 25% and percent cover of bare ground greater than 10%.

- On an annual basis, maintain at least two patches of treeless grassland habitat, each at least 74 acres in size, at the Lost Mound Unit of the Savanna District to support at least 12 pairs of eastern meadowlarks. These habitat patches will be characterized by percent cover of native grasses between 40–75%, and percent cover of native forbs at least 25%.

Ornate box turtle objective

- On an annual basis, maintain at least 2,837 acres of grassland habitat at the Lost Mound Unit of the Savanna District to support a population of at least 100 ornate box turtles. This habitat will be characterized by percent cover of trees less than 10%, percent cover of shrubs less than 25%, percent cover of native grasses between 40–75%, and percent cover of native forbs at least 25%.

Native invertebrate pollinator objective

- On an annual basis, maintain and enhance 3,752 acres of grassland habitat across all four districts of the refuge that will support 474,816 milkweed stems, providing host plant resources for breeding monarch butterflies.

Strategies (Activities completed by the refuge arranged by topic):

Habitat Enhancement and Restoration Activities

- Prepare sites for seeding through spraying, prescribed burning, haying, grazing, mowing, or disking to reduce competition from invasive species and cool season grasses.

- Convert non-native cool season grasslands and low diversity seeded native prairies to high diversity native prairies using local ecotype seed when available. Consider soil type, slope, aspect, and hydrology when designing seed mixes. Use multiple mixes to tailor seedings to individual sites if necessary.

- Use appropriate seeding methods and timing for optimal success. Typical application is broadcast dormant or spring seeding. Use an average rate of 14 to 18 pure live seed (PLS) per acre during the dormant season (fall, winter, spring).

- Mow, prescribe graze, or spot spray newly seeded areas as needed during the establishment phase to control exotic and invasive plants and enhance growth of seeded species

Habitat Maintenance Activities

- Control invasive and woody plant species on established prairie seeding sites and remnant prairies using spraying, prescribed burning, haying, grazing, or mowing.

- Management actions should occur frequently enough to maintain characteristics identified in objectives (i.e., control of woody vegetation, cool season grasses and other invasive species, forb diversity).

Potential Inventory, Monitoring, and Research Activities to Inform Management of Priority Wildlife Resources of Concern

- Map treeless habitat patches that are at least 75 acres, and would be suitable for area-sensitive grassland breeding bird habitat, at the Lost Mound Unit of the Savanna District.

- Map all areas that can be cleared of trees to create additional 75-acre patches of habitat for area-sensitive grassland breeding birds at the Lost Mound Unit of the Savanna District.

- Initiate research to estimate breeding densities and productivity of grassland birds at the Lost Mound Unit of the Savanna District during three consecutive breeding seasons, as well as habitat and landscape characteristics associated with grassland bird breeding territories.

- Conduct annual population monitoring of the ornate box turtle population within the 19-acre enclosure at the Lost Mound Unit of the Savanna District to determine total population size, and reproductive status of head-started individuals. When the total population size is at least 100 individuals and at least some of the head-started individuals have reached reproductive age, remove the exclosure barriers and allow the population to disperse into the surrounding areas of the Lost Mound Unit.

- Monitor grassland vegetation to determine percent cover of native forbs, native forb species richness, and milkweed stem density.

- Locate all currently existing information (i.e. data, reports) on the distribution and abundance of rusty-patched bumblebee on the refuge. Construct a comprehensive database and write a comprehensive report, and archive it in ServCat.

- Locate all currently existing information (i.e. data, reports) generated from work done on the refuge, which documents the distribution and abundance of native invertebrate pollinators and other terrestrial invertebrates on the refuge, and archive them in ServCat. Write a comprehensive report that summarizes all of the currently existing information, and archive it in ServCat.

Bottomland Forest Objective – Refuge-specific Activities

While a substantial proportion of the total bottomland forest acreage managed by the refuge is cooperatively managed with the U.S. Army Corps of Engineers (U.S. Army Corps of Engineers 2011a), there are opportunities for the refuge to conduct habitat management activities outside of these cooperative agreements. These opportunities occur on parcels where the USFWS holds fee-title ownership and projects can be accomplished within the constraints of the refuge's existing capacity. Management of lands where the USACE holds fee-title ownership will continue to be cooperatively managed with the USACE and management activities will continue to be coordinated with the USACE. Large-scale projects will require partnerships with the USACE and other entities.

Over the lifetime of the HMP, maintain, enhance, or restore at least 866 acres of bottomland forest habitat (120 acres in Winona; 460 acres in La Crosse; 286 acres in McGregor) through activities conducted solely by the refuge to provide breeding and migratory habitat for red-shouldered hawk, transient Neotropical migrant passerines, cerulean warbler, prothonotary warbler, and tree-roosting bats. Bottomland forest habitat on the refuge will have one or more of the following characteristics:

- Bottomland forests located in the lowest elevations of the floodplain (subjected to flooding > 40 days during the growing season) will be comprised of species tolerant of flooding such as silver maple, cottonwood, and willow.

- Bottomland forests located on higher elevations of the floodplain (subjected to flooding < 40 days during the growing season) will be comprised of a diverse mixture of species and may include oaks, hickories, hackberry, and American elm.

Regardless of elevation and flooding frequency, bottomland forest will have one or more of the following characteristics where site conditions are appropriate and management actions are feasible:

- Where site conditions are appropriate, overstory canopy cover will be at least 70 percent.

- Where site conditions are appropriate, there will be at least two co-occurring tree species other than silver maple in the co-dominant size class at the plot scale.

- In locations that are appropriate, naturally occurring regeneration (800+ trees per acre with at least 4.5" DBH) will be occurring on at least 10 percent of the bottomland forest to ensure succession of desired tree species into the forest canopy.

- In 90 percent or less of bottomland forest, age structure at the landscape scale will be approximately 20 percent saplings (0–5 inches DBH), 35 percent pole (5–12 inches DBH), and 45 percent mature/over-mature age classes (≥12 inches DBH).

- Where site conditions are appropriate and planting is done in areas with little to no currently existing vegetation, desired stocking level of seedlings 1" or less in diameter should be between 825–1,200 seedlings per acre. Desired stocking level 10 years after the planting should be approximately 700 seedlings approximately 3" in diameter per acre. Seedlings can include both those that have been planted as well as those that occur because of natural regeneration. These are minimum acceptable recommendations and the appropriate stocking guide should be consulted when planning planting efforts for specific sites.

- Where site conditions are appropriate and underplanting is done in currently existing forest stands or areas with currently existing large trees, desired stocking level of seedlings 1" in diameter should be no less than 10 containerized or 40 bare root seedlings per acre. Desired stocking level 10 years after the planting should be approximately six containerized or 24 seedlings approximately 3" in diameter per acre. Seedlings can include both planted seedlings and seedlings that occur in a stand as result of natural regeneration. These are minimum acceptable recommendations and the appropriate stocking guide should be consulted when planning planting efforts for specific sites.

- Percent cover of reed canarygrass will be less than 15 percent.

- Composition of ground layer herbaceous vegetation will be at least 60 percent native species.

- Composition of shrub cover will be at least 60 percent native species.

Wildlife Priority Resource of Concern Objectives

- On an annual basis, maintain at least 7,764 acres of bottomland forest in Pool 10 of the McGregor District to support up to 31 breeding pairs of red-shouldered hawks. Forest stands with at least 70% canopy closure are most likely to be used as nesting habitat by red-shouldered hawks.

- On an annual basis, maintain at least 7,764 acres of bottomland forest in Pool 10 of the McGregor District to support up to 2,449 breeding pairs of cerulean warbler. Forest stands with a complex canopy characterized by a mixture of pole (5–12 inches DBH) and mature/over-mature (≥12 inches DBH) age classes with scattered canopy gaps, and oak spp. in the canopy layer, are more likely to be used by breeding cerulean warblers.

- On an annual basis, maintain at least 7,764 acres of bottomland forest in Pool 10 of the McGregor District to support up to 9,851 breeding pairs of prothonotary warbler. Forest stands with pole (5–12 inches DBH) and mature/over-mature (≥12 inches DBH) age classes are more likely to provide cavities used by breeding prothonotary warblers.

- Over the life of the plan, protect and manage bottomland forest for the benefit of diverse communities (N >35 species) and abundant populations of transient Neotropical migrant passerines during the spring migration (mid-April to end of May).

- Over the life of the plan, create or maintain a snag density of at least 15 snags per acre on 420 acres of bottomland forest in the La Crosse District to support northern long-eared bats.

Strategies (Activities completed by the refuge arranged by topic):

Enhancement and Restoration Activities

- Use selective thinning to simulate natural forest processes based on site location and limitations including presence of invasive species, ability to complete maintenance operations, and desired outcome.

- Use group selection harvest to create forest gap openings. Follow up tree harvest with planting of appropriate species based on elevation.

- Use shelterwood and modified shelterwood harvest to encourage existing tree seedling growth or promote tree plantings while deterring reed canarygrass. Select tree species for planting based on individual site conditions. Complete second harvest after sapling growth exceeds the height of reed canarygrass.

- Use seed tree harvest in areas where reed canarygrass is not already established. Remove the majority of trees within a project area, leaving mature trees to act as a seed source.

- Plant tree species appropriate for the elevation, aspect, and hydrology. Consider the use of RPM trees when funding allows.

- Use chemical site preparation and/or soil scarification to create bare mineral soil, facilitating natural regeneration by providing a seed where tree seeds can germinate and establish.

Maintenance Activities

- Annually monitor and survey for invasive species. Specifically focus on areas where maintenance, enhancement, and restoration activities are occurring.

- For bottomland forest maintenance, enhancement, or restoration projects, monitor tree seedling and sapling survival every other year for six years.

- Use prescribed grazing where appropriate to reduce invasive plant species, decrease herbaceous plant competition or prepare a site for tree planting.

- Use prescribed fire where appropriate to promote growth of oaks, hickories, and other fire-tolerant species.

- Use mechanical, chemical, and physical techniques to reduce herbaceous vegetation and invasive plant species competition during establishment.

- In some instances, it may be necessary to prevent or reduce damage to seedlings, saplings, and larger trees from white-tailed deer, beaver, and voles. Strategies include lethal control, capture and relocation, exclusion with fencing and other barriers, and chemical repellents.

Potential Inventory, Monitoring, and Research Activities to Inform Management of Priority Wildlife Resources of Concern

- During the life of the plan, compile and evaluate all currently existing information (data, reports) on the breeding season distribution of red-shouldered hawks on the refuge. Construct a comprehensive geospatial database capturing all known geospatial data and write a

comprehensive report about the breeding distribution of red-shouldered hawks on the refuge. Archive the database and report on ServCat.

- During the life of the plan, continue to evaluate breeding bird habitat associations in bottomland forests of Pool 10 of the McGregor District and the relationship of distribution and abundance to habitat variables measured in USACE forest inventory plots. Determine which habitat variables effectively predict breeding bird presence/absence as well as abundance and can be used to construct future habitat management prescriptions.

- During the life of the plan, collect long-term data on species presence, diversity and abundance of transient Neotropical migrant passerines in USACE forest inventory plots located within bottomland forest. Determine which habitat variables effectively predict breeding bird presence/absence as well as abundance and can be used to construct future habitat management prescriptions. Annual monitoring of species diversity and abundance of transient Neotropical migrant passerines will provide information regarding species distributional changes, species turnover (as distributions change the refuge may lose some species but gain others), and changes in abundance due to climate change, land use, and other environmental changes.

- During the life of the plan, continue to collect data on USACE forest inventory plots to determine density of snags that could be used by tree roosting bats.

- During the life of the plan, initiate inventory efforts in bottomland forests of the La Crosse District to determine presence of tree roosting bat species using this habitat. During the lifetime of the plan, expand inventory efforts across all districts.

- During the life of the plan, collect long-term data on species presence, diversity and abundance of tree roosting bats in USACE forest inventory plots located within bottomland forest. This will help determine which habitat variables effectively predict bat presence/absence as well as relative abundance or activity level and can be used to construct future habitat management prescriptions.

Wet Meadow Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, or restore at least 300 acres of wet meadow habitat in La Crosse District through actions conducted solely by the refuge to provide nesting and migratory needs for dabbling ducks, the full life cycle requirements of eastern massasauga, and the native plant community of Midwestern Wet Prairie and Meadows. Wet meadow habitat on the refuge will have one or more of the following characteristics:

- Tree and shrub canopy cover within habitat patches will be less than 10 percent.

- Native herbaceous cover will be at least 50 percent.

- Native sedges cover will be at least 25 percent.

- In areas managed for dabbling ducks, vegetation height during fall and spring migration will be less than 10 inches.

Wildlife Priority Resource of Concern Objectives

- On an annual basis, provide up to 693,550 total energy days (mallard model) in the fall on 266 acres of wet meadow habitat managed for dabbling ducks in the La Crosse District.

- By 2025, identify, acquire, and manage at least 247 acres of wet meadow habitat in the Black River Bottoms of the La Crosse District that will support at least 27 female eastern Massasauga rattlesnakes.

Strategies (Activities completed by the refuge arranged by topic):

Enhancement and Restoration Activities

- Control reed canarygrass, where possible.

- Focus efforts to control reed canarygrass at locations where re-introduction from outside sources is reduced. Plan for a multi-year, integrated approach to reed canarygrass control including prescribed burning, mowing, spraying, grazing, and haying.

- Re-seed areas where reed canarygrass control is possible with local ecotype native species consistent with Midwestern Wet Prairie and Meadows.

- Reduce tree and shrub cover through prescribed burning, spraying, and mowing, when necessary.

- Use mowing, haying, and grazing to achieve and maintain desired vegetation height in areas managed for dabbling ducks.

Maintenance Activities

- Reduce tree and shrub cover through prescribed burning, spraying, or mechanical removal, when necessary.

- Management actions should occur frequently enough to maintain characteristics identified in objectives (i.e., control of woody vegetation, invasive species).

Potential Inventory, Monitoring, and Research Activities to Inform Management of Priority Wildlife Resources of Concern

- During the life of the plan, identify and map current wet meadow habitat that is potentially suitable for eastern massasauga rattlesnakes in the La Crosse District, as well as potential habitat added through new acquisitions.

- During the life of the plan, conduct three surveys during each of three years of wet meadow habitat in the La Crosse District that is potentially suitable for eastern massasauga rattlesnakes to determine presence and relative abundance.

Marsh Objective – Refuge-specific Activities

Over the lifetime of the HMP, maintain, enhance, and restore at least 5,620 acres of marsh habitat (3,500 acres in La Crosse District, 62 acres in the McGregor District, and 1,792 acres in Savanna District) where the refuge, solely through refuge-based activities, has existing capabilities to manage water levels. Water level management will provide wetlands characterized by moist soil plants and wetlands dominated by emergent and rooted floating-leaved perennial aquatic vegetation to provide food and cover for secretive marsh birds and waterfowl (especially tundra swans and dabbling ducks) as well as other wetland-dependent wildlife such as black terns.

Marsh habitats will have one or more of the following characteristics:

- In areas managed for perennial marsh vegetation, native perennial plants such as arrowhead, bur-reed, and bulrush will be at least 60% of the total cover.

- In areas managed for moist-soil conditions, moist soil, seed-producing plant species such as smartweed and wild millet will be at least 65 percent of the total cover.

- In areas managed for moist-soil conditions, perennial plant species such as bulrush, reed canarygrass and purple loosestrife will be no greater than 35 percent of the total cover.

- In areas managed for moist-soil conditions, woody plants will be no greater than 35 percent of the total cover.

- In areas managed for moist-soil conditions, water depths during fall and spring migration periods will be between 0.5–10 inches.

Wildlife Priority Resource of Concern Objectives

- On an annual basis, provide up to 483,505 total energy days (tundra swan model) in the spring on 2,550 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District (Blue Lake, Target Lake, and Lawrence Lake).

- On an annual basis, provide up to 9,125,662 total energy days (mallard model) in the fall on 3,500 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District (Black River Delta, Middle Pool 7, Lake Onalaska, Upper Halfway Creek South, Brown's Marsh, Blue Lake, Target Lake, Lawrence Lake).

- On an annual basis, provide up 161,655 total energy days (mallard model) in the fall on 62 acres of marsh habitat managed for annual, seed producing plants at the Guttenberg Ponds of the McGregor District.

- On an annual basis, provide up to 4,672,339 total energy days (mallard model) in the fall on 1,792 acres of marsh habitat managed for annual, seed producing plants as well as native perennial marsh vegetation in the Savanna District (Sloane, Upper Spring Lake, Duckfoot, Pleasant Creek).

- On an annual basis, maintain through passive habitat management at least two black tern nesting colonies in marsh habitat of the refuge that are protected from human disturbance.

- Over the life of the HMP, maintain or enhance at least 3,500 acres of marsh habitat managed for native perennial marsh vegetation in the La Crosse District that will support up to 811 soras.

Strategies (Activities completed by the refuge arranged by topic):

<u>Enhancement and Restoration Activities</u>

- Use prescribed fires, herbicide, grazing, mowing, disking, and other mechanical treatments to manage invasive species such as reed canarygrass, hybrid cattail, common reed, and other species including native species that have the potential to form monocultures and reduce the amount of desirable moist soil plants and desirable perennial plants.

<u>Maintenance Activities</u>

- Conduct management unit drawdowns with existing and future water level management capabilities.

<u>Potential Inventory, Monitoring, and Research Activities to Inform Management of Priority Wildlife Resources of Concern</u>

- On an annual basis, locate every black tern nesting colony and protect them from human disturbance with buoys, signs, and public outreach. Continue to use methodology currently that is

currently used for quantifying relative colony size. Develop and employ a method for quantifying human activity and/or disturbance in proximity to nesting colonies.

- During the life of the plan, compile and evaluate all currently existing information (data, reports) on the breeding season and non-breeding season distribution of secretive marsh birds on the refuge. Construct a comprehensive geospatial database capturing all known geospatial data and write a comprehensive report about the breeding season and non-breeding season distribution of secretive marsh birds on the refuge. Archive the database and report on ServCat.

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Appendix A - Common and Scientific Names of Organisms Mentioned in the Text

Taxonomy is from the Integrated Taxonomic Information System on-line database (http://www.itis.gov). Note that Appendix D represents a document created in 2013 whose taxonomy may not conform to that presented here Appendix A.

Common name	Scientific name
Acadian flycatcher	*Empidonax virescens*
Alder	*Alnus* spp.
American basswood	*Tilia americana*
American bittern	*Botaurus lentiginosus*
American black duck	*Anas rubripes*
American elm	*Ulmus americana*
American hazelnut	*Corylus americana*
American kestrel	*Falco sparverius*
American lotus	*Nelumbo lutea*
American robin	*Turdus migratorius*
American white pelican	*Pelecanus erythrorhynchos*
American wigeon	*Anas americana*
Arrowhead	*Sagittaria* spp.
Bald eagle	*Haliaeetus leucocephalus*
Baltimore oriole	*Icterus galbula*
Barnyard grass	*Echinochloa* spp.
Beaver	*Castor canadensis*
Beggarstick	*Bidens* spp.
Belted kingfisher	*Megaceryle alcyon*
Big bluestem	*Andropogon gerardii*
Bighead carp	*Hypophthalmichthys nobilis*
Birdfoot violet	*Viola pedata*
Bison	*Bison bison*
Bitternut hickory	*Carya cordiformis*
Black carp	*Mylopharyngodon piceus*
Black locust	*Robinia pseudoacacia*
Black oak	*Quercus velutina*
Black tern	*Chlidonias niger*
Black locust	*Robinia pseudoacacia*
Black willow	*Salix nigra*
Bladderwort	*Utricularia* spp.
Blanchard's cricket frog	*Acris crepitans blanchardi*
Blanding's turtle	*Emydoidea blandingii*
Bluegill	*Lepomis macrochirus*
Bluejoint reedgrass	*Calamagrostis canadensis*

Blue-winged teal	*Anas discors*
Bobolink	*Dolichonyx oryzivorus*
Bowfin	*Amia calva*
Box elder	*Acer negundo*
Brown creeper	*Certhia americana*
Brown thrasher	*Toxostoma rufum*
Bufflehead	*Bucephala albeola*
Bullhead	*Ameiurus* spp.
Bulrush	Cyperaceae
Bur oak	*Quercus macrocarpa*
Bur-reed	*Sparganium* spp.
Bush honeysuckle	*Lonicera tatarica*
Buttonbush	*Cephalanthus occidentalis*
Canada goose	*Branta canadensis*
Canadian waterweed	*Elodea canadensis*
Canvasback	*Aythya valisineria*
Cattail	*Typha* spp.
Central mudminnow	*Umbra limi*
Cerulean warbler	*Setophaga cerulea*
Channel catfish	*Ictalurus punctatus*
Cherry	*Prunus* spp.
Chestnut-sided warbler	*Setophaga pensylvanica*
Chokecherry	*Prunus virginiana*
Common carp	*Cyprinus carpio*
Common gallinule	*Gallinula chloropus*
Common map turtle	*Graptemys geographica*
Common merganser	*Mergus merganser*
Common reed	*Phragmites australis*
Common tern	*Sterna hirundo*
Compass plant	*Silphium laciniatum*
Coontail	*Ceratophyllum demersum*
Cottonwood	*Populus deltoides*
Crappie	*Pomoxis* spp.
Crown vetch	*Securigera varia*
Curly-leafed pondweed	*Potamogeton crispus*
Cylindric blazing star	*Liatris cylindracea*
Dickcissel	*Spiza americana*
Dogwood	*Cornus* spp.
Dotted blazing star	*Liatris punctata*
Double-crested cormorant	*Phalacrocorax auritus*
Downy woodpecker	*Picoides pubescens*
Duckweed	*Lemna* spp.
Eastern cricket frog	*Acris crepitans crepitans*

Eastern hognose snake	*Heterodon platirhinos*
Eastern kingbird	*Tyrannus tyrannus*
Eastern massasauga	*Sistrurus catenatus*
Eastern musk turtle	*Sternotherus odoratus*
Eastern whip-poor-will	*Caprimulgus vociferus*
Emerald ash borer	*Agrilus planipennis*
Eurasian water milfoil	*Myriophyllum spicatum*
Elderberry	*Sambucus nigra*
Elk	*Cervus elaphus*
Elm	*Ulmus* spp.
Eurasian milfoil	*Myriophyllum spicatum*
European buckthorn	*Rhamnus cathartica*
False boneset	*Brickellia eupatorioides*
False indigo	*Amorpha fruticosa*
False map turtle	*Graptemys pseudogeographica*
Faucet snail	*Bithynia tentaculata*
Field sparrow	*Spizella pusilla*
Fingernail clam	*Musculium transversum*
Flathead catfish	*Pylodictis olivaris*
Flatsedge	*Cyperus* spp.
Flat-topped white aster	*Doellingeria umbellata*
Flowering spurge	*Euphorbia corollata*
Forster's tern	*Sterna forsteri*
Freshwater drum	*Aplodinotus grunniens*
Gadwall	*Anas strepera*
Gar	*Lepisosteus* spp.
Garlic mustard	*Alliaria petiolata*
Giant burr-reed	*Sparganium eurycarpum*
Giant reed	*Phragmites* spp.
Giant floater	*Pyganodon grandis*
Golden eagle	*Aquila chrysaetos*
Goldenrod	*Solidago* spp.
Grass carp	*Ctenopharyngodon idella*
Grasshopper sparrow	*Ammodramus savannarum*
Gray dogwood	*Cornus racemosa*
Gray-headed coneflower	*Ratibida pinnata*
Great blue heron	*Ardea herodias*
Great crested flycatcher	*Myiarchus crinitus*
Great egret	*Ardea alba*
Greater scaup	*Aythya marila*
Green arrow arum	*Peltandra virginica*
Green ash	*Fraxinus pennsylvanica*
Green heron	*Butorides virescens*

Green-winged teal	*Anas crecca*
Hackberry	*Celtis occidentalis*
Hairy false goldenaster	*Heterotheca villosa*
Hardstem bulrush	*Schoenoplectus acutus*
Harebell	*Campanula* spp.
Heart-leaf alexanders	*Zizia aptera*
Heath aster	*Symphyotrichum ericoides*
Henslow's sparrow	*Ammodramus henslowii*
Hickory	*Carya* spp.
Hickorynut	*Obovaria olivaria*
Higgins eye pearlymussel	*Lampsilis higginsii*
Honey locust	*Gleditsia triacanthos*
Honeysuckle	*Lonicera* spp.
Hooded merganser	*Lophodytes cucullatus*
hophornbeam	*Ostrya virginiana*
Indiana bat	*Myotis sodalis*
Indiangrass	*Sorghastrum nutans*
Japanese knotweed	*Fallopia japonica*
Joe pye weed	*Eutrochium* spp.
Kalm's brome	*Bromus kalmii*
King rail	*Rallus elegans*
Lake sedge	*Carex lacustris*
Lake sturgeon	*Acipenser fulvescens*
Large-flowered beardtongue	*Penstemon grandiflorus*
Largemouth bass	*Micropterus salmoides*
Lark sparrow	*Chondestes grammacus*
Leadplant	*Amorpha canescens*
Leafy spurge	*Euphorbia esula*
Least bittern	*Ixobrychus exilis*
Least shrew	*Cryptotis parva*
Least tern	*Sternula antillarum*
Lesser scaup	*Aythya affinis*
Little bluestem	*Schizachyrium scoparium*
Little brown myotis	*Myotis lucifugus*
Loggerhead shrike	*Lanius ludovicianus*
Louisiana waterthrush	*Parkesia motacilla*
Low serviceberry	*Amelanchier humilis*
Mallard	*Anas platyrhynchos*
Maple	*Acer* spp.
Mapleleaf viburnum	*Viburnum acerifolium*
Marsh muhly	*Muhlenbergia racemosa*
Mayfly	Ephemeroptera
Meadowlark	*Sturnella* spp.

Mink	*Neovison vison*
Monarch butterfly	*Danaus plexippus*
Mud darter	*Etheostoma asprigene*
Mulberry	*Morus* spp.
Multiflora rose	*Rosa multiflora*
Muskrat	*Ondatra zibethicus*
Nashville warbler	*Leiothlypis ruficapilla*
Northern bedstraw	*Galium boreale*
Northern cardinal	*Cardinalis cardinalis*
Northern flicker	*Colaptes auratus*
Northern harrier	*Circus cyaneus*
Northern leopard frog	*Lithobates pipiens*
Northern long-eared bat	*Myotis septentrionalis*
Northern pike	*Esox lucius*
Northern pintail	*Anas acuta*
Northern red oak	*Quercus rubra*
Northern shoveler	*Anas clypeata*
Northern waterthrush	*Parkesia noveboracensis*
Oak	*Quercus* spp.
Orchard oriole	*Icterus spurius*
Ornate box turtle	*Terrapene ornata*
Ouachita map turtle	*Graptemys ouachitensis*
Paddlefish	*Polyodon spathula*
Painted turtle	*Chrysemys picta*
Pallid sturgeon	*Scaphirhynchus albus*
Paper pondshell	*Utterbackia imbecillis*
Parrot feather	*Myriophyllum aquaticum*
Pasqueflower	*Anemone patens*
Pickerel frog	*Lithobates palustris*
Pickerelweed	*Pontederia cordata*
Pied-billed grebe	*Podilymbus podiceps*
Pirate perch	*Aphredoderus sayanus*
Plains hog-nosed snake	*Heterodon nasicus*
Plains muhly	*Muhlenbergia cuspidata*
Poison ivy	*Toxicodendron rydbergii*
Pondweed	Potamogetonaceae
Porcupine grass	*Hesperostipa spartea*
Prairie coreopsis	*Coreopsis palmata*
Prairie dropseed	*Sporobolus heterolepis*
Prairie rose	*Rosa arkansana*
Prairie sandreed	*Calamovilfa longifolia*
Prairie violet	*Viola pedatifida*
Prairie vole	*Microtus ochrogaster*

Prickly gooseberry	*Ribes cynosbati*
Prothonotary warbler	*Protonotaria citrea*
Pugnose minnow	*Opsopoeodus emiliae*
Purple loosestrife	*Lythrum salicaria*
Purple prairie clover	*Dalea purpurea*
Quagga mussel	*Dreissena bugensis*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Redhorse	*Moxostoma* spp.
Red-shouldered hawk	*Buteo lineatus*
Reed canarygrass	*Phalaris arundinacea*
Rice cutgrass	*Leersia oryzoides*
River birch	*Betula nigra*
River bulrush	*Bolboschoenus fluviatilis*
River otter	*Lontra canadensis*
Rusty blackbird	*Euphagus carolinus*
Rusty patched bumble bee	*Bombus affinis*
Sago pondweed	*Stuckenia pectinata*
Salamander mussel	*Simpsonaias ambigua*
Sand dropseed	*Sporobolus cryptandrus*
Sandbar willow	*Salix exigua*
Sauger	*Sander canadensis*
Sedge	Cyperaceae
Sedge wren	*Cistothorus platensis*
Shagbark hickory	*Carya ovata*
Shovelnose sturgeon	*Scaphirhynchus platorynchus*
Siberian elm	*Ulmus pumila*
Side-oats grama	*Bouteloua curtipendula*
Silky aster	*Symphyotrichum pratense*
Silver carp	*Hypophthalmichthys molitrix*
Silver maple	*Acer saccharinum*
Silverleaf scurfpea	*Pediomelum argophyllum*
Skipjack herring	*Alosa chrysochloris*
Sky blue aster	*Aster oolentangiensis*
Slippery elm	*Ulmus rubra*
Smallmouth bass	*Micropterus dolomieu*
Smartweed	*Persicaria* spp.
Smooth blue aster	*Symphyotrichum laeve*
Smooth softshell	*Apalone mutica*
Smooth sumac	*Rhus glabra*
Snapping turtle	*Chelydra serpentina*
Softstem bulrush	*Schoenoplectus tabernaemontani*
Sora	*Porzana carolina*
Southern bog lemming	*Synaptomys cooperi*

Southern flying squirrel	*Glaucomys volans*
Spike rush	*Eleocharis spp.*
Spiked muhly	*Muhlenbergia glomerata*
Spiny softshell	*Apalone spinifera*
Spotted knapweed	*Centaurea stoebe*
Stiff sunflower	*Helianthus pauciflorus*
Sucker	Catostomidae
Sugar maple	*Acer saccharum*
Swamp milkweed	*Asclepias incarnata*
Swamp white oak	*Quercus bicolor*
Sycamore	*Platanus occidentalis*
Timber rattlesnake	*Crotalus horridus*
Tree swallow	*Tachycineta bicolor*
Tundra swan	*Cygnus columbianus*
Upright sedge	*Carex stricta*
Vesper sparrow	*Pooecetes gramineus*
Virginia rail	*Rallus limicola*
Walleye	*Sander vitreus*
Water hyacinth	*Eichhornia crassipes*
Water lettuce	*Pistia stratiotes*
Water plantain	*Alisma* spp.
Water milfoil	*Myriophyllum* spp.
Water smartweed	*Persicaria amphibia*
Water stargrass	*Heteranthera dubia*
Water willow	*Justicia americana*
Weed shiner	*Notropis texanus*
Western ragweed	*Ambrosia psilostachya*
Western sand darter	*Ammocrypta clara*
Western snowberry	*Symphoricarpos occidentalis*
White bass	*Morone chrysops*
White oak	*Quercus alba*
White prairie clover	*Dalea candida*
White sage	*Artemisia ludoviciana*
White waterlily	*Nymphaea odorata*
Wild celery	*Vallisneria americana*
Wild plum	*Prunus americana*
Wild rice	*Zizania aquatica*
Willow	*Salix* spp.
Wood duck	*Aix sponsa*
Wood thrush	*Hylocichla mustelina*
Wood turtle	*Glyptemys insculpta*
Woodland vole	*Microtus pinetorum*
Yellow perch	*Perca flavescens*

Yellow-billed cuckoo	*Coccyzus americanus*
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*
Zebra mussel	*Dreissena polymorpha*

Appendix B

Figure 2-1. Watersheds of rivers and streams that affect the Upper Mississippi River National Wildlife & Fish Refuge.

Figure 2-2. Bird Conservation Regions associated with the Upper Mississippi River National Wildlife & Fish Refuge.

Figure 2-3. Partners in Flight Physiographic Areas associated with the Upper Mississippi River National Wildlife & Fish Refuge.

Figure 2-4. Landscape Conservation Cooperatives associated with the Upper Mississippi River National Wildlife & Fish Refuge.

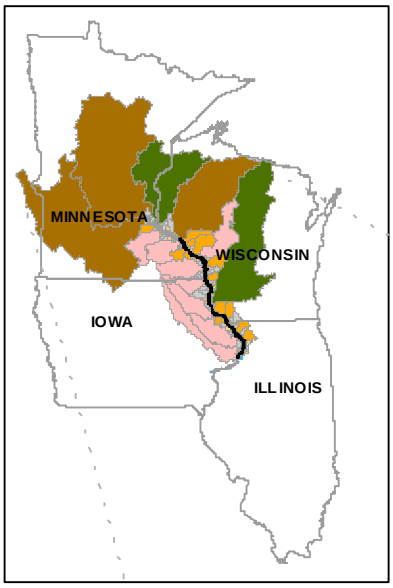
Figure 2-5. North American Joint Ventures associated with the Upper Mississippi River National Wildlife & Fish Refuge.

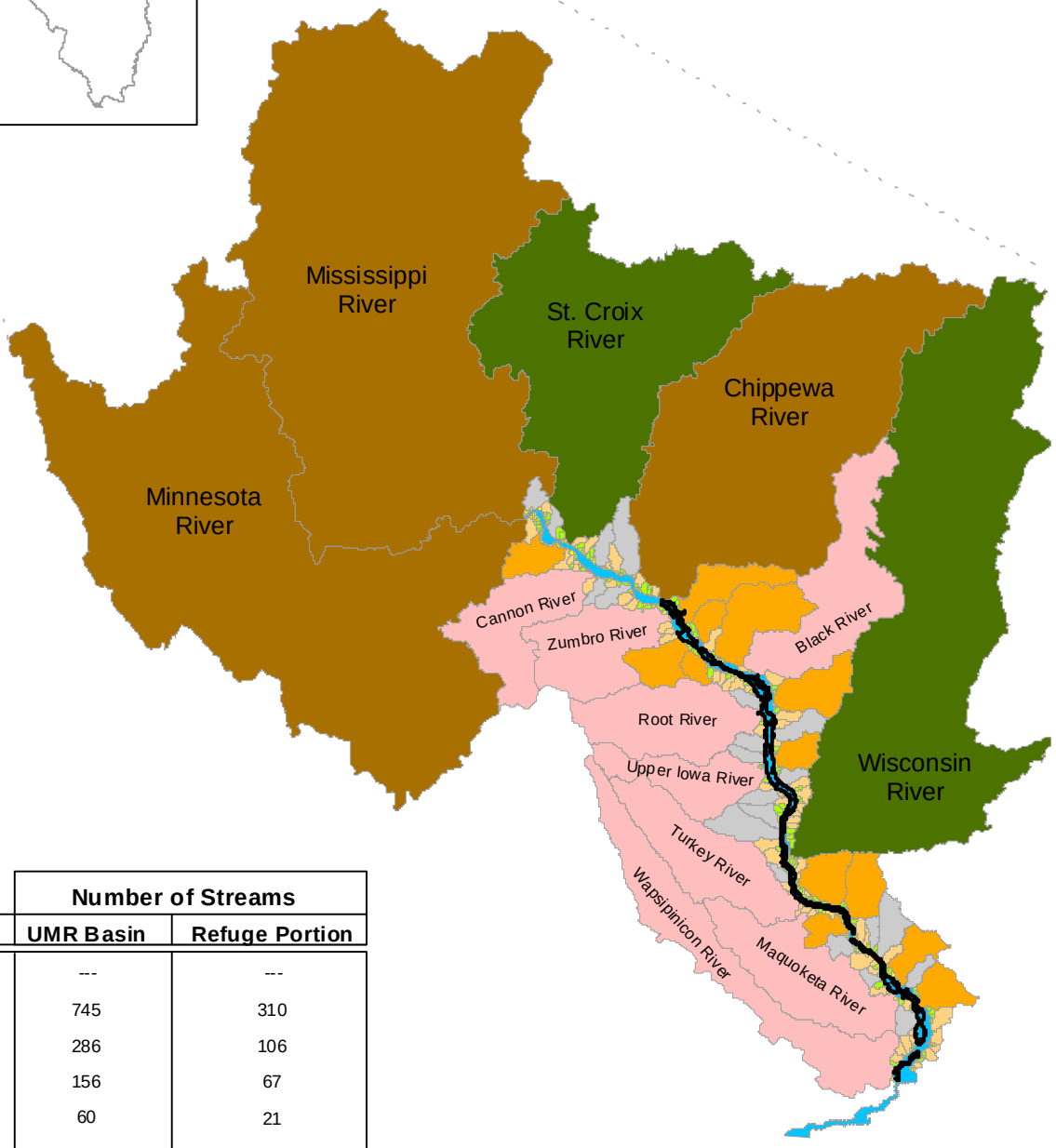
Figures 2-6 through 2-17. Historic (1890) land cover in Pools 4–14.

Figures 2-18 through 2-29. Contemporary (2010) land cover in Pools 4–14. Note that in 2010, Pool 11 land cover data was not available; data obtained in 2000 represented the most recent data available for Pool 11 and is depicted.

Figure 2-1. Watersheds of rivers and streams that affect the Upper Mississippi River National Wildlife & Fish Refuge.

Watersheds of rivers and streams that impact the Upper Mississippi River NW&FR





Stream Order	Number of Streams	
	UMR Basin	Refuge Portion
Main Stem	---	---
1st Order	745	310
2nd Order	286	106
3rd Order	156	67
4th Order	60	21
5th Order	28	13
6th Order	13	8
7th Order	7	2
8th Order	5	3
Total	**1300**	**530**

Upper Mississppi River NW&FR Boundary

0 25 50 100 Miles

0 25 50 100 Kilometers

N W E S

Figure 2-2. Bird Conservation Regions associated with the Upper Mississippi River National Wildlife & Fish Refuge.

Upper Mississippi River National Wildlife & Fish Refuge

Bird Conservation Regions

Figure 2-3. Partners in Flight Physiographic Areas associated with the Upper Mississippi River National Wildlife & Fish Refuge.

Upper Mississippi River National Wildlife & Fish Refuge

Partners in Flight Physiographic Areas

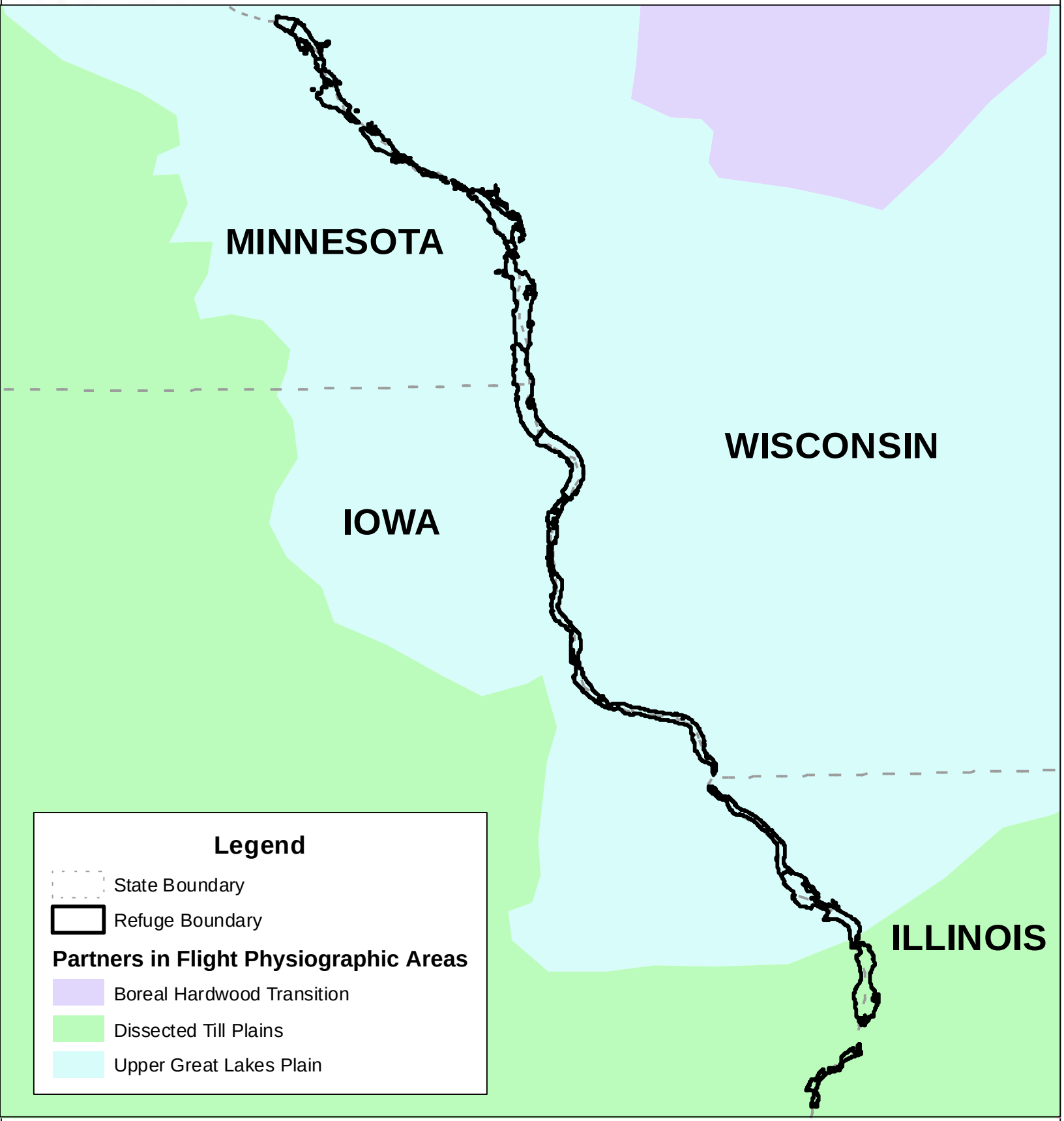


Figure 2-4. Landscape Conservation Cooperatives associated with the Upper Mississippi River National Wildlife & Fish Refuge.

Upper Mississippi River National Wildlife & Fish Refuge

Landscape Conservation Cooperatives

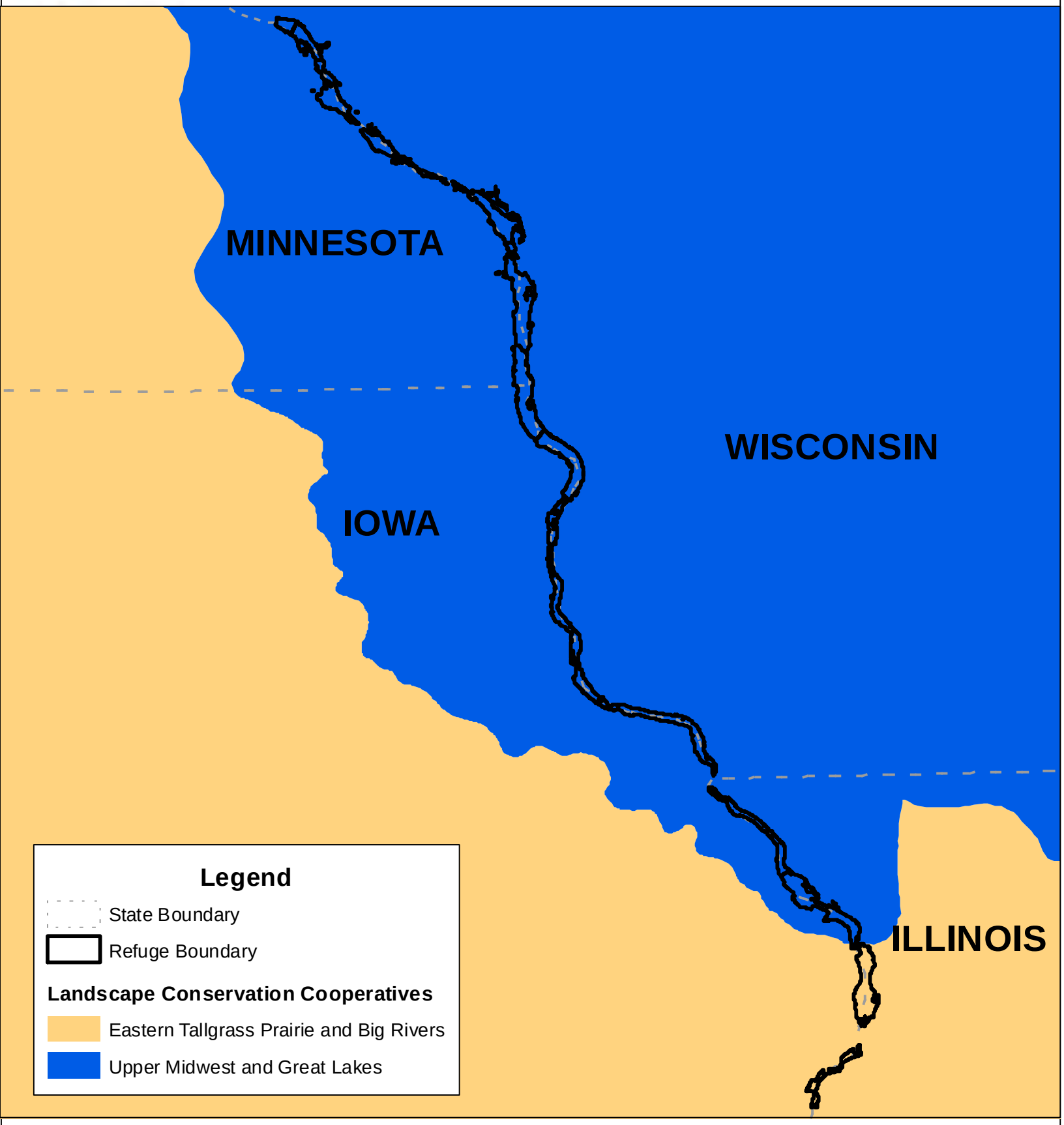
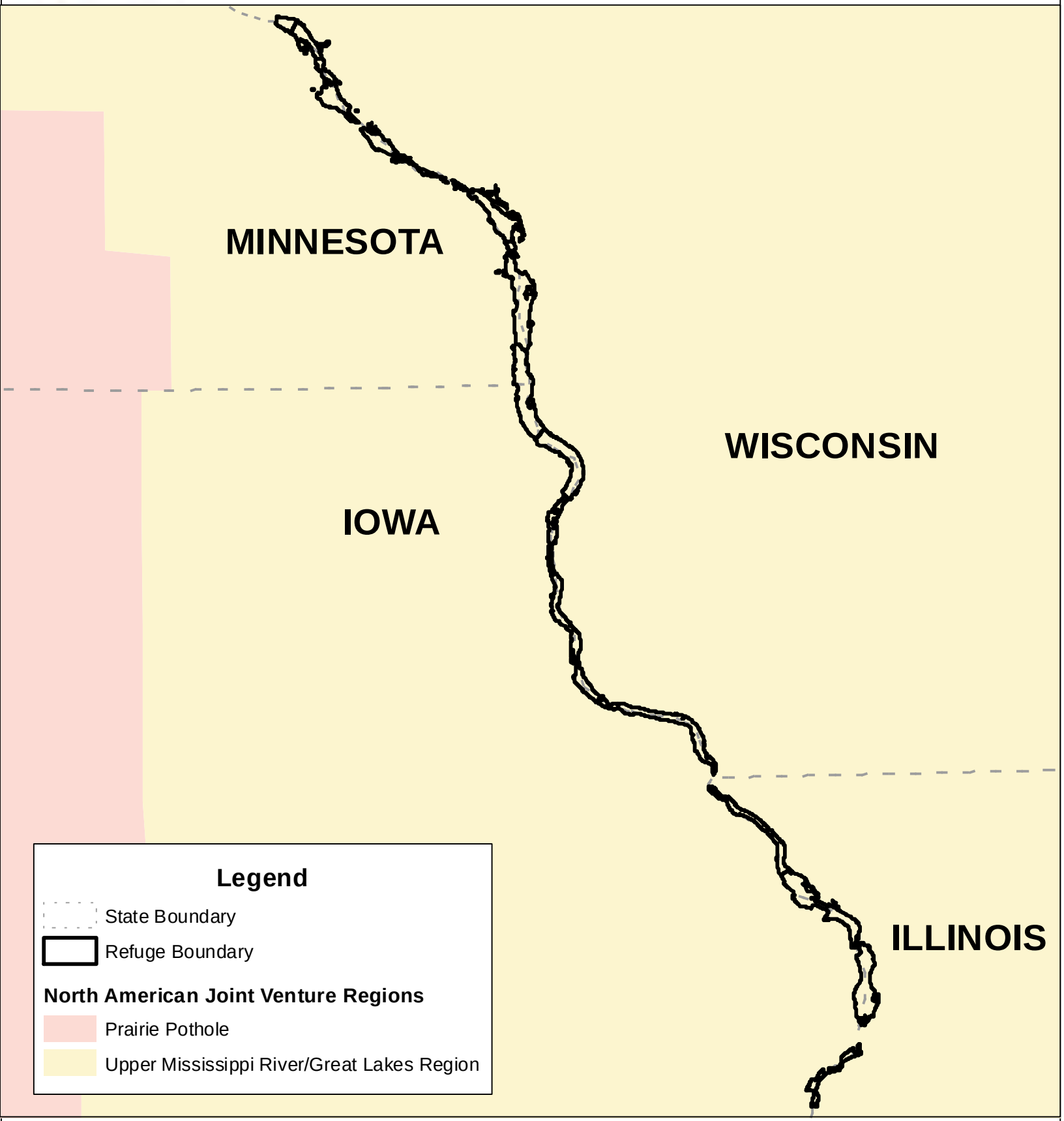


Figure 2-5. North American Joint Ventures associated with the Upper Mississippi River National Wildlife & Fish Refuge.

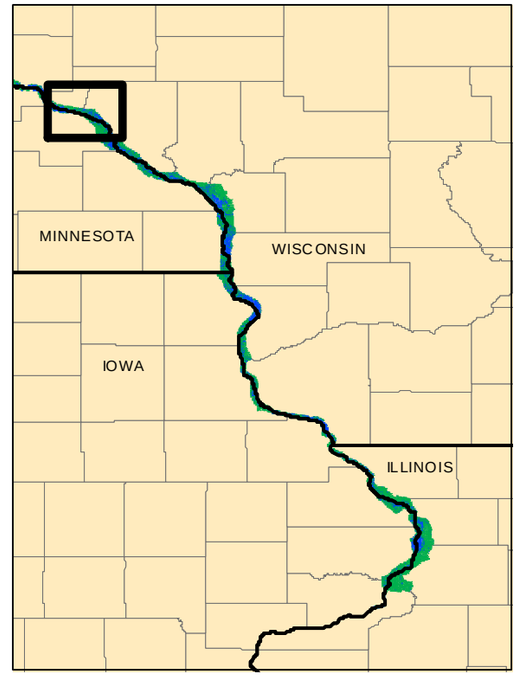
Upper Mississippi River National Wildlife & Fish Refuge

North American Joint Venture Regions



Figures 2-6 through 2-17. Historic (1890) land cover in Pools 4–14.

Pool 4
Winona District
1890 Land Cover



Buffalo County
WISCONSIN

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 2,779 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 570 Acres
- Wet Meadow - 1,728 Acres
- Sand and Mud - 253 Acres
- Agriculture - 37 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 956 Acres
- Bottomland Forest - 6,148 Acres
- Upland Forest - No Data
- Developed - 12 Acres
- Other - 627 Acres

Wabasha

Wabasha County
MINNESOTA

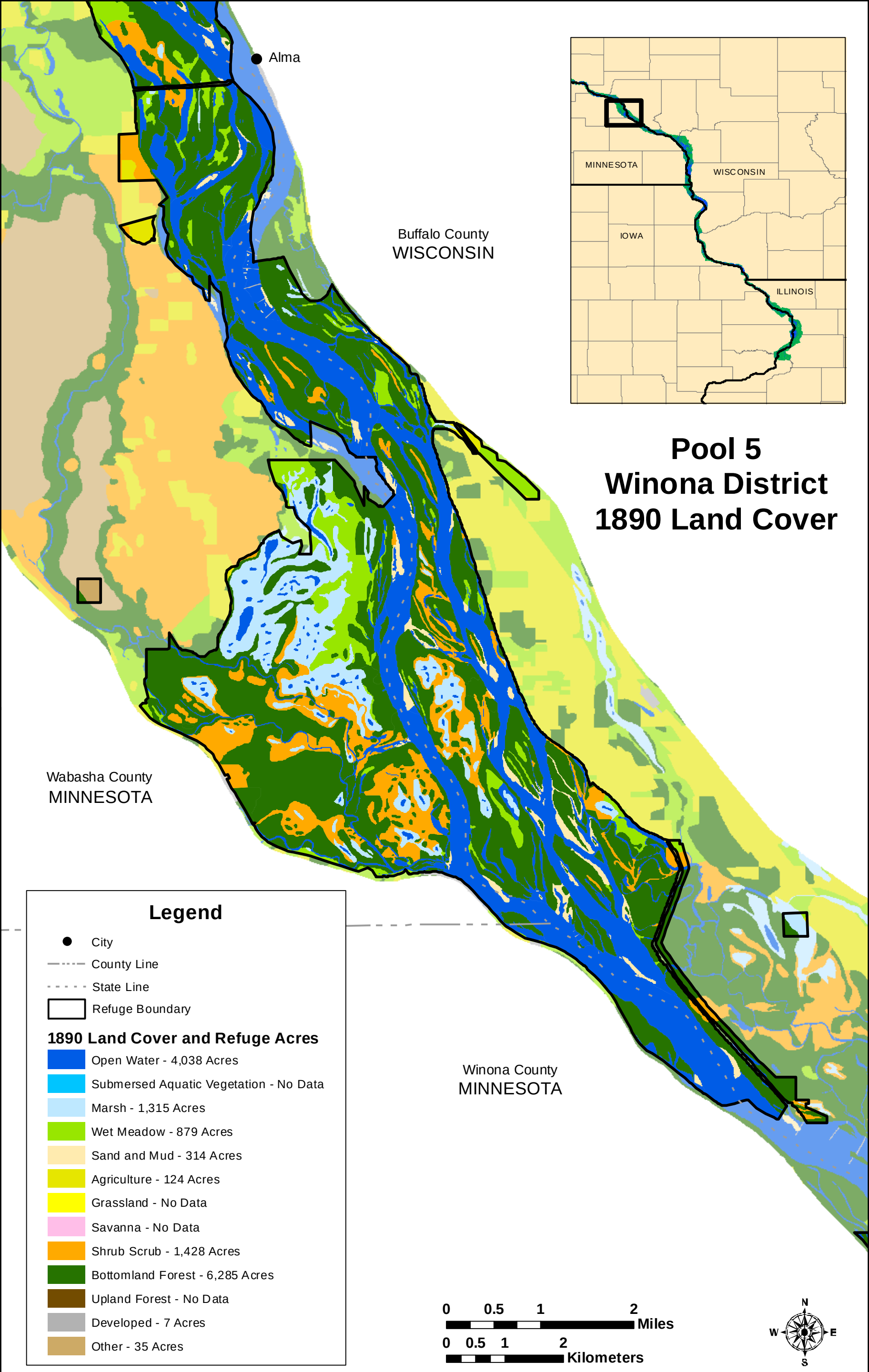
Alma

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

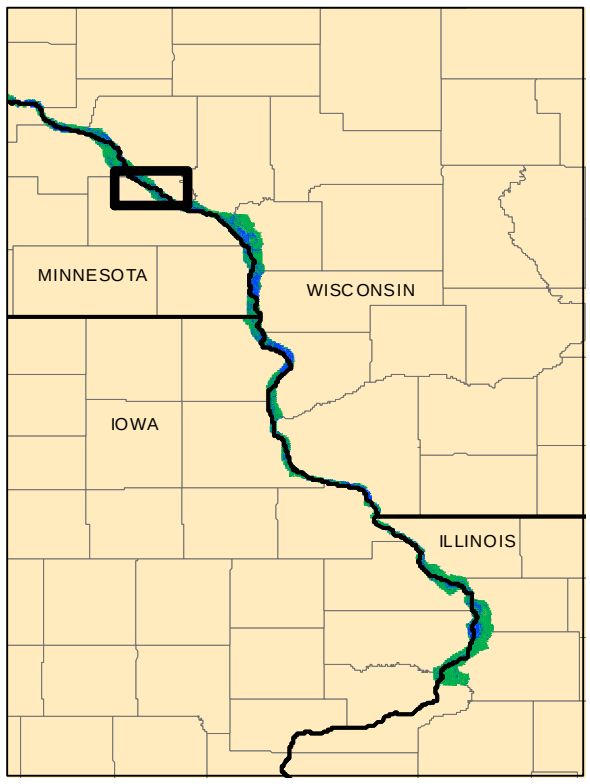
Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.



Pool 5
Winona District
1890 Land Cover

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 5A
Winona District
1890 Land Cover



Buffalo County
WISCONSIN

Winona County
MINNESOTA

Fountain City

Winona

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 1,726 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 355 Acres
- Wet Meadow - 857 Acres
- Sand and Mud - 78 Acres
- Agriculture - 9 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 414 Acres
- Bottomland Forest - 4,280 Acres
- Upland Forest - No Data
- Developed - 5 Acres
- Other - 21 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

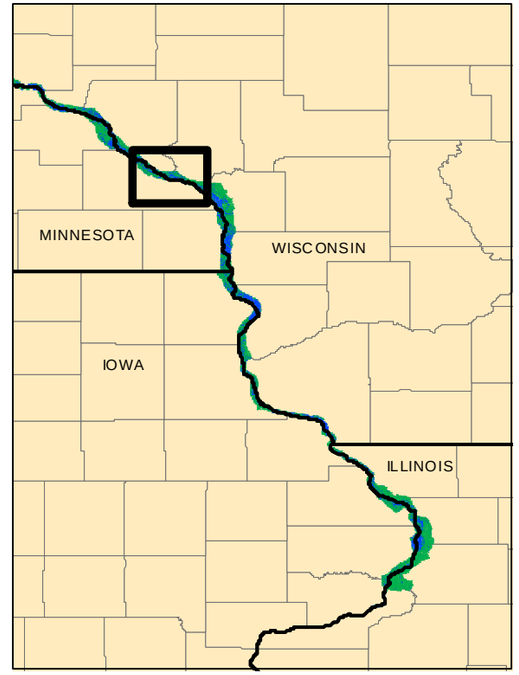
N W E S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 6
Winona District
1890 Land Cover

Buffalo County
WISCONSIN

Trempealeau County
WISCONSIN



Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 956 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 171 Acres
- Wet Meadow - 237 Acres
- Sand and Mud - 22 Acres
- Agriculture - 0 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 295 Acres
- Bottomland Forest - 1,623 Acres
- Upland Forest - No Data
- Developed - 0 Acres
- Other - 82 Acres

Winona

Trempealeau

Winona County
MINNESOTA

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 7
La Crosse District
1890 Land Cover

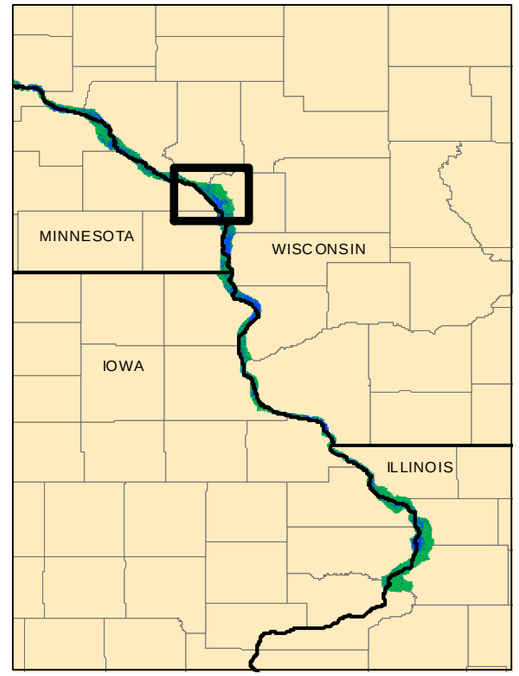
Trempealeau

Trempealeau County
WISCONSIN

La Crosse County
WISCONSIN

Dakota

Winona County
MINNESOTA



Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

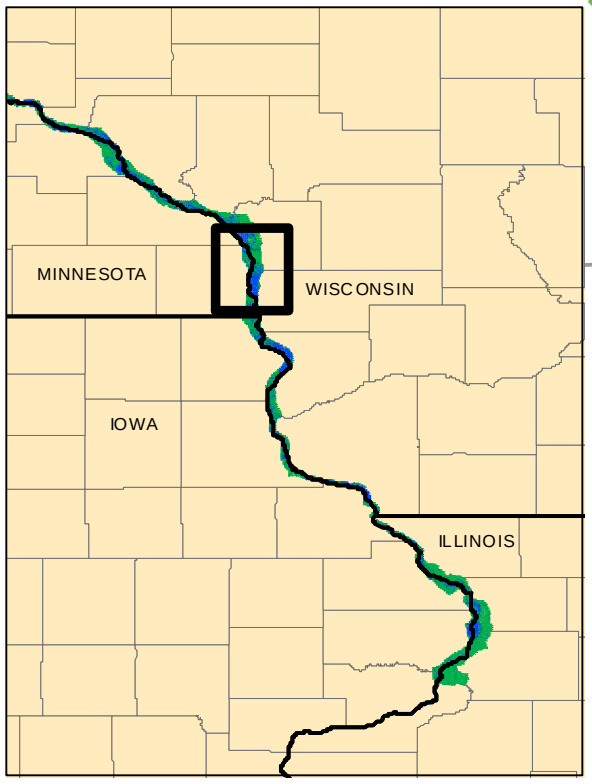
- Open Water - 2,457 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 1,555 Acres
- Wet Meadow - 4,174 Acres
- Sand and Mud - 208 Acres
- Agriculture - 979 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 354 Acres
- Bottomland Forest - 7,704 Acres
- Upland Forest - No Data
- Developed - 2 Acres
- Other - 1,392 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.



Winona County
MINNESOTA

La Crescent

La Crosse

Pool 8
La Crosse District
1890 Land Cover

La Crosse County
WISCONSIN

Houston County
MINNESOTA

Vernon County
WISCONSIN

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

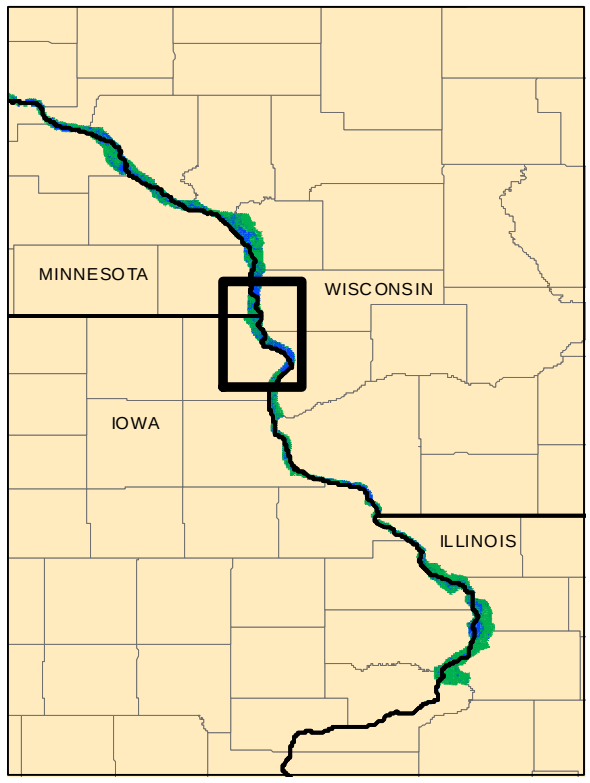
- Open Water - 5,487 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 810 Acres
- Wet Meadow - 5,416 Acres
- Sand and Mud - 651 Acres
- Agriculture - 173 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 3,433 Acres
- Bottomland Forest - 12,598 Acres
- Upland Forest - No Data
- Developed - 13 Acres
- Other - 384 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.



Houston County
MINNESOTA

New Albin

Allamakee County
IOWA

Vernon County
WISCONSIN

Pool 9
McGregor District
1890 Land Cover

Crawford County
WISCONSIN

Lansing

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

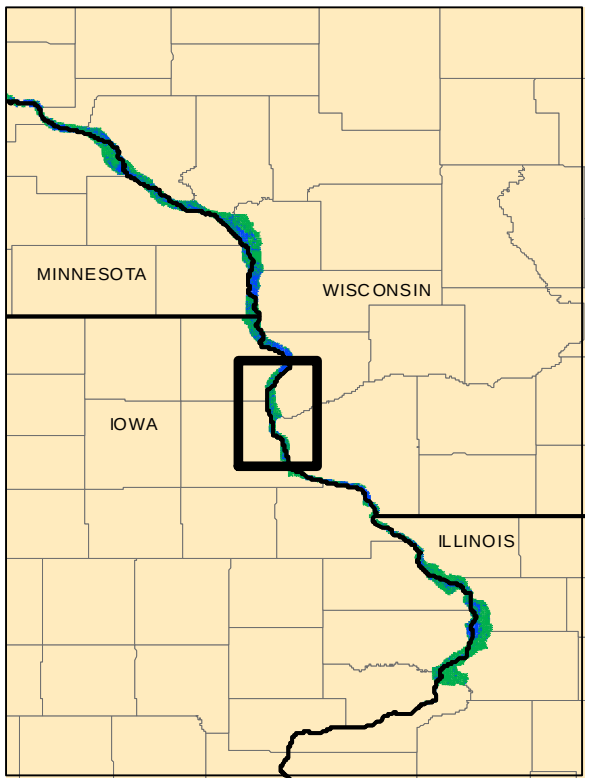
- Open Water - 7,800 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 0 Acres
- Wet Meadow - 7,544 Acres
- Sand and Mud - 418 Acres
- Agriculture - 50 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 5,349 Acres
- Bottomland Forest - 23,419 Acres
- Upland Forest - No Data
- Developed - 2 Acres
- Other - 29 Acres

0 0.5 1 2
Miles

0 0.5 1 2
Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.



Pool 10
McGregor District
1890 Land Cover

Harper's Ferry

Allamakee County
IOWA

Clayton County
IOWA

Prairie du Chien

Crawford County
WISCONSIN

Grant County
WISCONSIN

Guttenberg

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 4,752 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 28 Acres
- Wet Meadow - 1,991 Acres
- Sand and Mud - 985 Acres
- Agriculture - 322 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 3,772 Acres
- Bottomland Forest - 10,429 Acres
- Upland Forest - No Data
- Developed - 1 Acre
- Other - 114 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Pool 11
McGregor District
1890 Land Cover

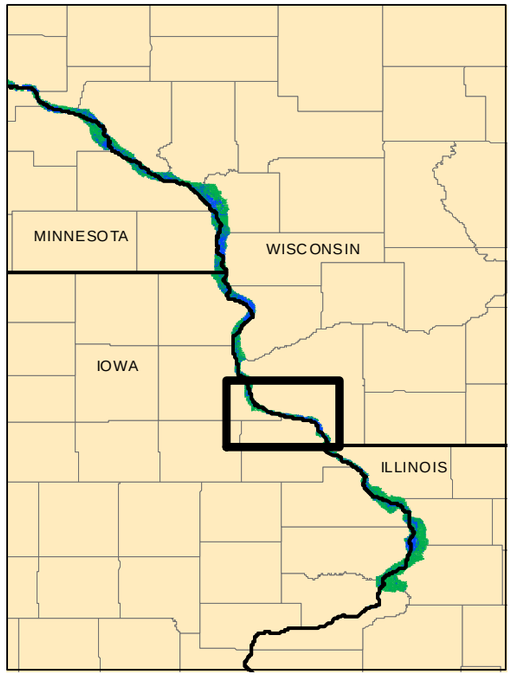
Guttenberg

Cassville

Grant County
WISCONSIN

Clayton County
IOWA

Dubuque County
IOWA



Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 6,901 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 139 Acres
- Wet Meadow - 541 Acres
- Sand and Mud - 1,364 Acres
- Agriculture - 617 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 2,556 Acres
- Bottomland Forest - 12,552 Acres
- Upland Forest - No Data
- Developed - 6 Acres
- Other - 59 Acres

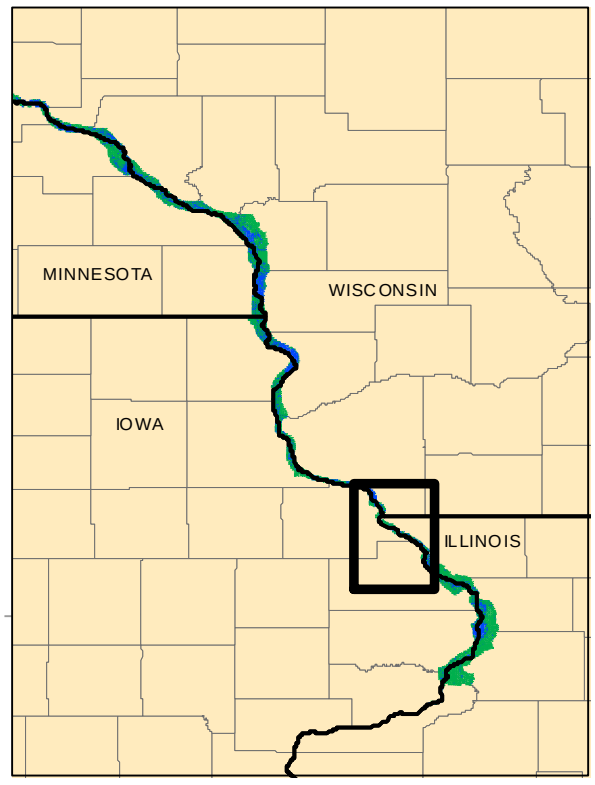
0 0.5 1 2
Miles

0 0.5 1 2
Kilometers

N
W E
S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 12
Savanna District
1890 Land Cover



Grant County
WISCONSIN

Dubuque

East Dubuque

Jo Daviess County
ILLINOIS

Dubuque County
IOWA

Jackson County
IOWA

Bellevue

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 4,025 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 0 Acres
- Wet Meadow - 311 Acres
- Sand and Mud - 940 Acres
- Agriculture - 618 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 1,383 Acres
- Bottomland Forest - 6,077 Acres
- Upland Forest - No Data
- Developed - 5 Acres
- Other - 0 Acres

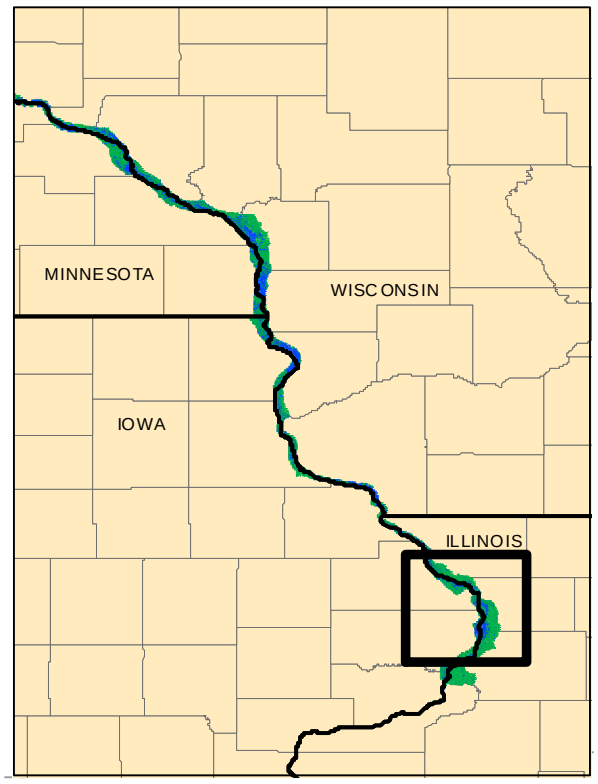
0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N W E S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Pool 13
Savanna District
1890 Land Cover



Bellevue

Jo Daviess County
ILLINOIS

Carroll County
ILLINOIS

Savanna

Jackson County
IOWA

Clinton County
IOWA

Whiteside County
ILLINOIS

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

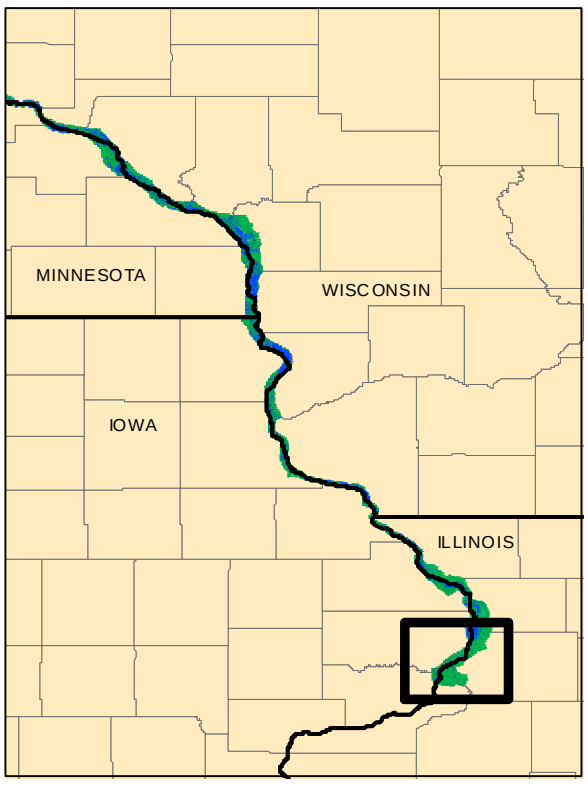
- Open Water - 9,193 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 0 Acres
- Wet Meadow - 3,386 Acres
- Sand and Mud - 1,265 Acres
- Agriculture - 3,904 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 7,372 Acres
- Bottomland Forest - 16,565 Acres
- Upland Forest - No Data
- Developed - 4 Acres
- Other - 3,371 Acres

0 0.5 1 2 Miles

00.51 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.



Fulton

Clinton

Clinton County
IOWA

Whiteside County
ILLINOIS

Pool 14
Savanna District
1890 Land Cover

Scott County
IOWA

Princeton

Rock Island County
ILLINOIS

Legend

- City
- County Line
- State Line
- Refuge Boundary

1890 Land Cover and Refuge Acres

- Open Water - 1,632 Acres
- Submersed Aquatic Vegetation - No Data
- Marsh - 0 Acres
- Wet Meadow - 257 Acres
- Sand and Mud - 721 Acres
- Agriculture - 235 Acres
- Grassland - No Data
- Savanna - No Data
- Shrub Scrub - 1,396 Acres
- Bottomland Forest - 3,654 Acres
- Upland Forest - No Data
- Developed - 0 Acres
- Other - 0 Acres

0 0.5 1 2 Miles

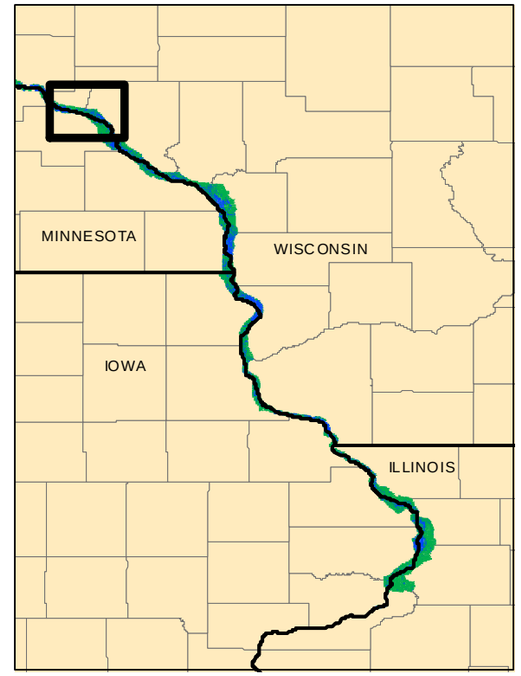
0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Figures 2-18 through 2-29. Contemporary (2010) land cover in Pools 4–14. Note that in 2010, Pool 11 land cover data was not available; data obtained in 2000 represented the most recent data available for Pool 11 and is depicted.

Pool 4
Winona District
2010 Land Cover



Buffalo County
WISCONSIN

Wabasha County
MINNESOTA

Wabasha

Alma

Lock and Dam 4

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

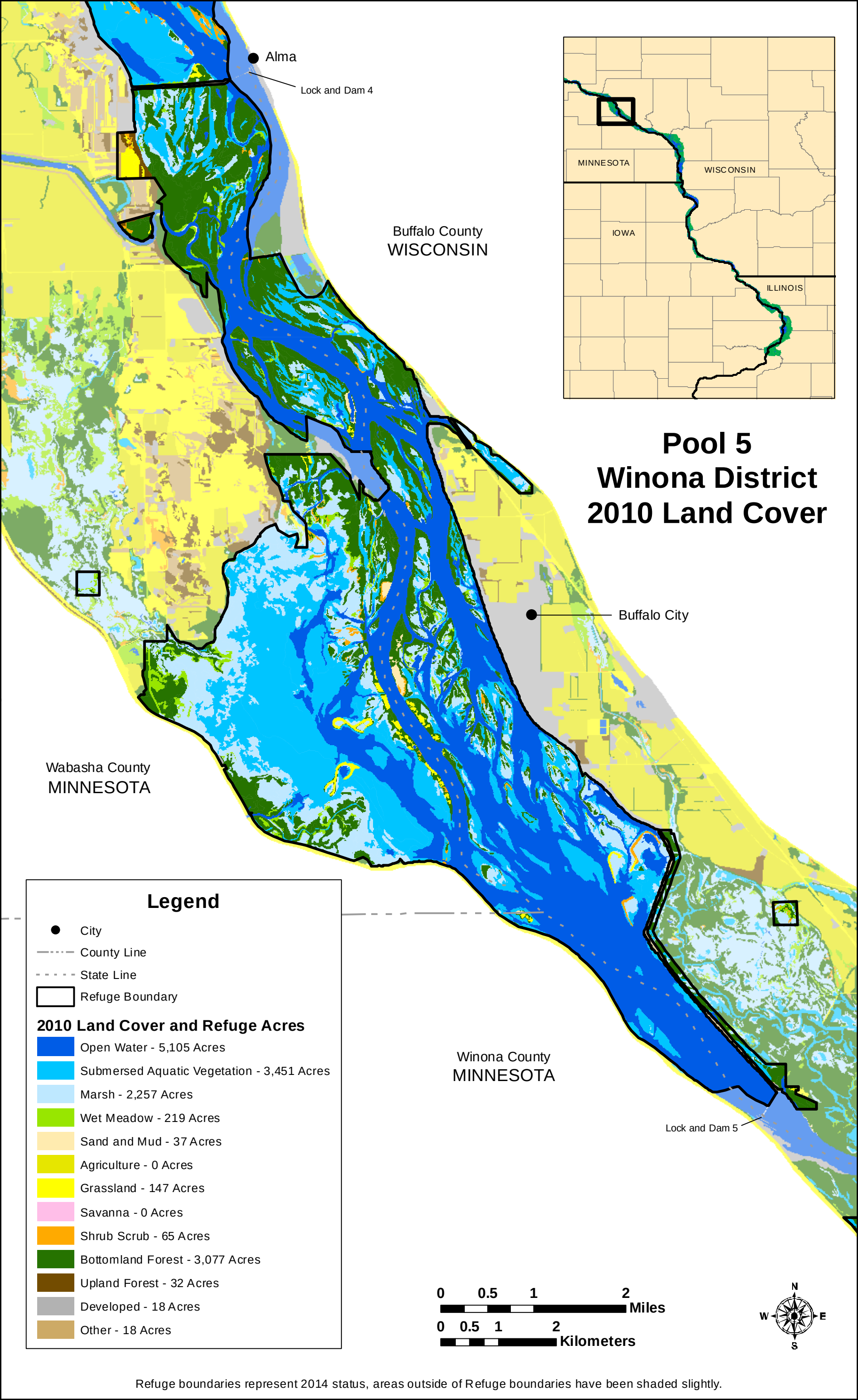
- Open Water - 2,740 Acres
- Submersed Aquatic Vegetation - 2,795 Acres
- Marsh - 2,713 Acres
- Wet Meadow - 631 Acres
- Sand and Mud - 97 Acres
- Agriculture - 0 Acres
- Grassland - 37 Acres
- Savanna - 0 Acres
- Shrub Scrub - 109 Acres
- Bottomland Forest - 3,973 Acres
- Upland Forest - 9 Acres
- Developed - 7 Acres
- Other - 0 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

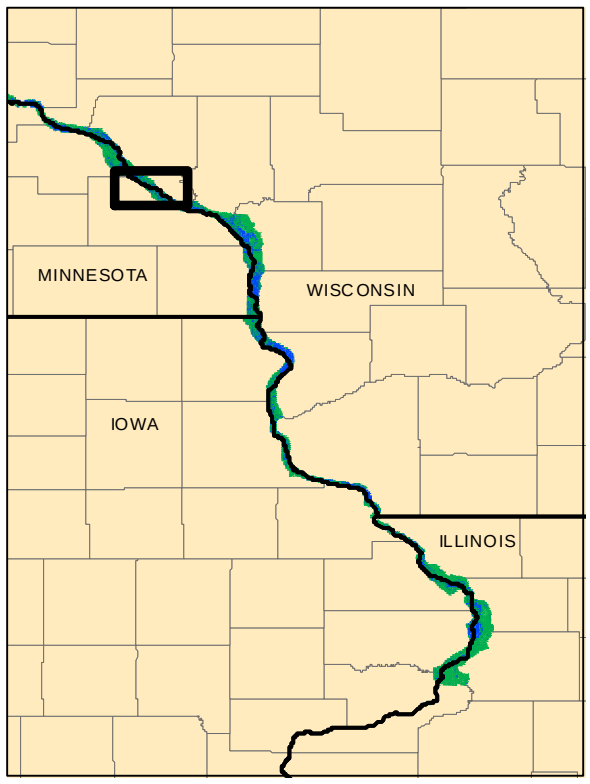
N W E S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.



Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 5A
Winona District
2010 Land Cover



Buffalo County
WISCONSIN

Lock and Dam 5

Winona County
MINNESOTA

Fountain City

Lock and Dam 5A

Winona

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 1,833 Acres
- Submersed Aquatic Vegetation - 1,022 Acres
- Marsh - 1,735 Acres
- Wet Meadow - 191 Acres
- Sand and Mud - 5 Acres
- Agriculture - 0 Acres
- Grassland - 47 Acres
- Savanna - 0 Acres
- Shrub Scrub - 34 Acres
- Bottomland Forest - 2,863 Acres
- Upland Forest - 0 Acres
- Developed - 7 Acres
- Other - 7 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N W E S

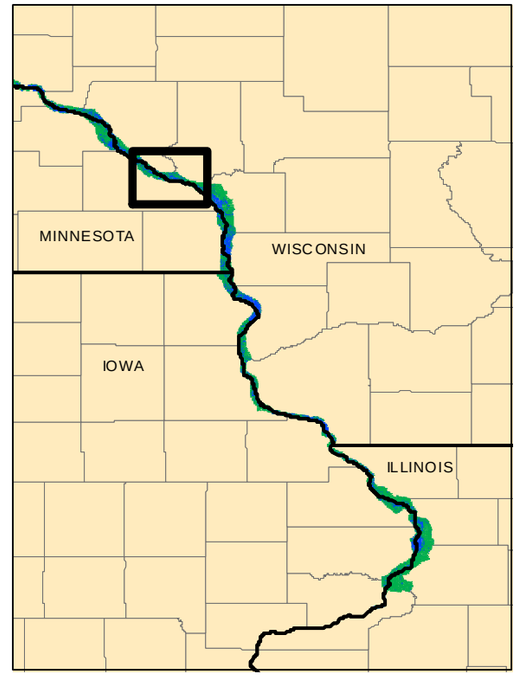
Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 6
Winona District
2010 Land Cover

Lock and Dam 5A

Buffalo County
WISCONSIN

Trempealeau County
WISCONSIN



Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 976 Acres
- Submersed Aquatic Vegetation - 403 Acres
- Marsh - 532 Acres
- Wet Meadow - 46 Acres
- Sand and Mud - 19 Acres
- Agriculture - 0 Acres
- Grassland - 43 Acres
- Savanna - 0 Acres
- Shrub Scrub - 19 Acres
- Bottomland Forest - 1,334 Acres
- Upland Forest - 0 Acres
- Developed - 4 Acres
- Other - 8 Acres

Winona

Trempealeau

Winona County
MINNESOTA

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

Lock and Dam 6

N
W E
S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 7
La Crosse District
2010 Land Cover

Trempealeau

Lock and Dam 6

Trempealeau County
WISCONSIN

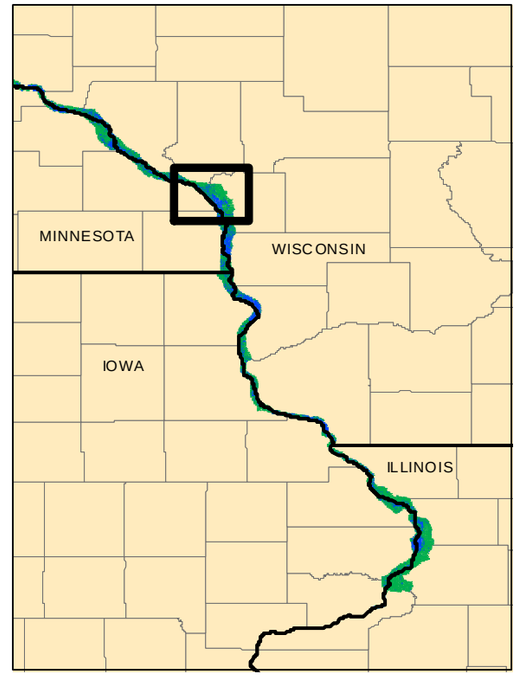
La Crosse County
WISCONSIN

Dakota

Winona County
MINNESOTA

Onalaska

Lock and Dam 7



Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 5,652 Acres
- Submersed Aquatic Vegetation - 2,957 Acres
- Marsh - 3,807 Acres
- Wet Meadow - 1,195 Acres
- Sand and Mud - 16 Acres
- Agriculture - 14 Acres
- Grassland - 279 Acres
- Savanna - 8 Acres
- Shrub Scrub - 133 Acres
- Bottomland Forest - 4,683 Acres
- Upland Forest - 16 Acres
- Developed - 39 Acres
- Other - 15 Acres

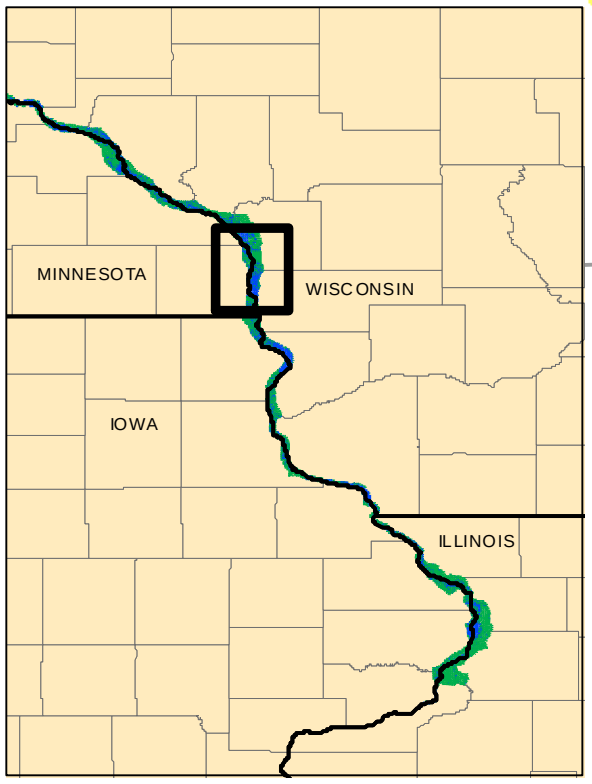
0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N W E S

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Winona County
MINNESOTA



Lock and Dam 7

La Crescent

La Crosse

Pool 8
La Crosse District
2010 Land Cover

La Crosse County
WISCONSIN

Houston County
MINNESOTA

Vernon County
WISCONSIN

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 9,717 Acres
- Submersed Aquatic Vegetation - 5,836 Acres
- Marsh - 5,780 Acres
- Wet Meadow - 2,355 Acres
- Sand and Mud - 14 Acres
- Agriculture - 0 Acres
- Grassland - 99 Acres
- Savanna - 23 Acres
- Shrub Scrub - 24 Acres
- Bottomland Forest - 5,076 Acres
- Upland Forest - 0 Acres
- Developed - 20 Acres
- Other - 20 Acres

0 0.5 1 2 Miles

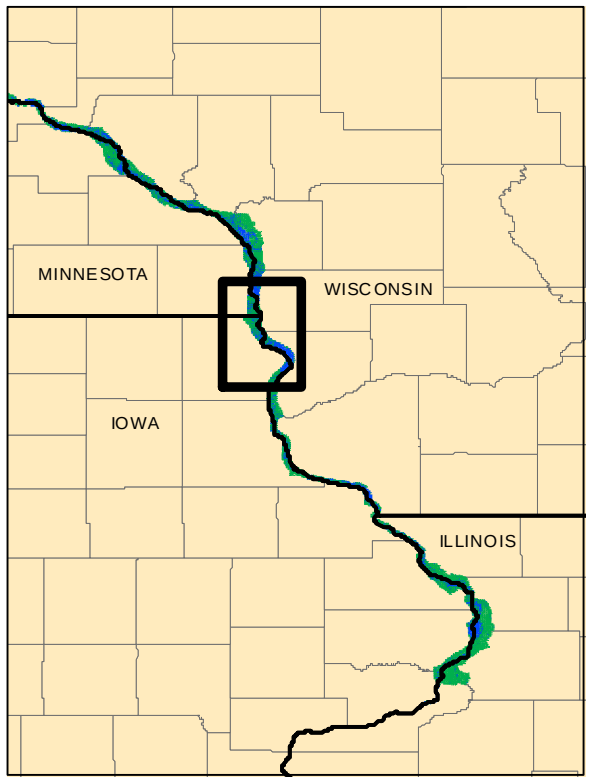
0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Lock and Dam 8

Pool 9
McGregor District
2010 Land Cover



Houston County
MINNESOTA

Lock and Dam 8

New Albin

Allamakee County
IOWA

Vernon County
WISCONSIN

Crawford County
WISCONSIN

Lansing

Lock and Dam 9

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

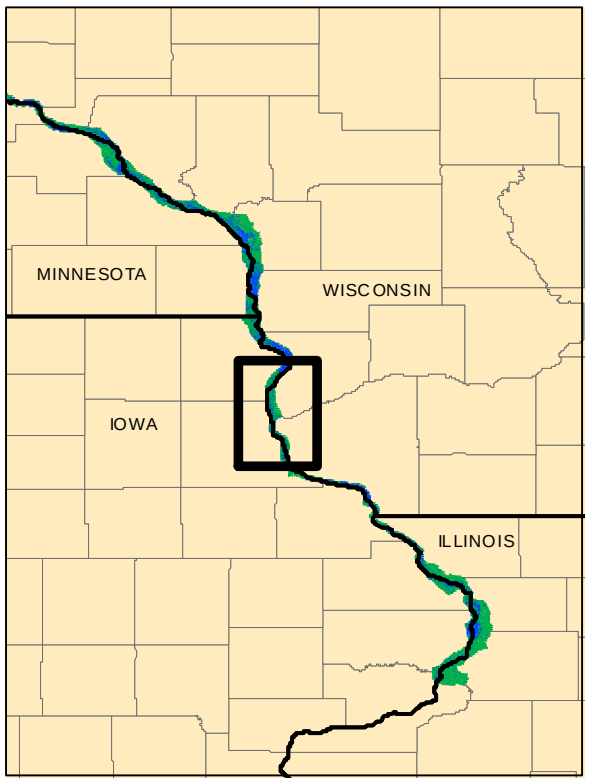
- Open Water - 12,911 Acres
- Submersed Aquatic Vegetation - 10,838 Acres
- Marsh - 7,812 Acres
- Wet Meadow - 1,390 Acres
- Sand and Mud - 7 Acres
- Agriculture - 0 Acres
- Grassland - 78 Acres
- Savanna - 12 Acres
- Shrub Scrub - 16 Acres
- Bottomland Forest - 11,519 Acres
- Upland Forest - 0 Acres
- Developed - 8 Acres
- Other - 19 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.



Pool 10
McGregor District
2010 Land Cover

Lock and Dam 9

Harper's Ferry

Allamakee County
IOWA

Clayton County
IOWA

Prairie du Chien

Crawford County
WISCONSIN

Grant County
WISCONSIN

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 6,712 Acres
- Submersed Aquatic Vegetation - 3,864 Acres
- Marsh - 3,319 Acres
- Wet Meadow - 506 Acres
- Sand and Mud - 4 Acres
- Agriculture - 0 Acres
- Grassland - 56 Acres
- Savanna - 0 Acres
- Shrub Scrub - 40 Acres
- Bottomland Forest - 7,764 Acres
- Upland Forest - 88 Acres
- Developed - 20 Acres
- Other - 20 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Guttenberg

Lock and Dam 10

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Pool 11
McGregor District
2000 Land Cover

Guttenberg

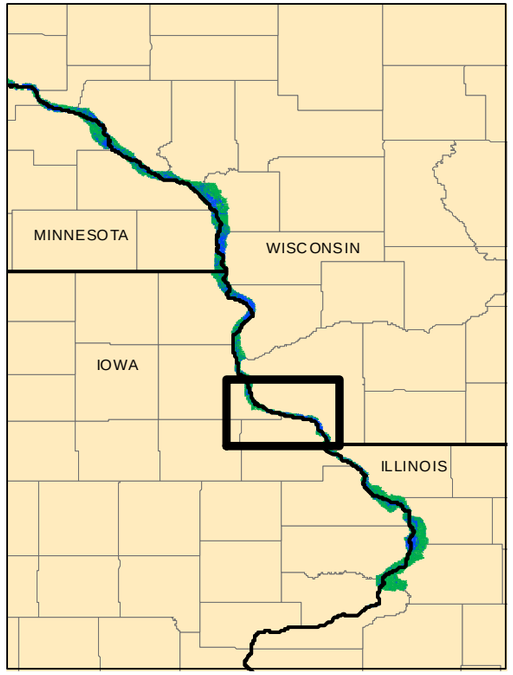
Lock and Dam 10

Cassville

Grant County
WISCONSIN

Clayton County
IOWA

Dubuque County
IOWA



Legend

- City
- County Line
- State Line
- Refuge Boundary

2000 Land Cover and Refuge Acres

- Open Water - 15,151 Acres
- Submersed Aquatic Vegetation - 626 Acres
- Marsh - 2,250 Acres
- Wet Meadow - 846 Acres
- Sand and Mud - 185 Acres
- Agriculture - 0 Acres
- Grassland - 50 Acres
- Savanna - 0 Acres
- Shrub Scrub - 168 Acres
- Bottomland Forest - 5,408 Acres
- Upland Forest - 24 Acres
- Developed - 5 Acres
- Other - 21 Acres

0 0.5 1 2 Miles

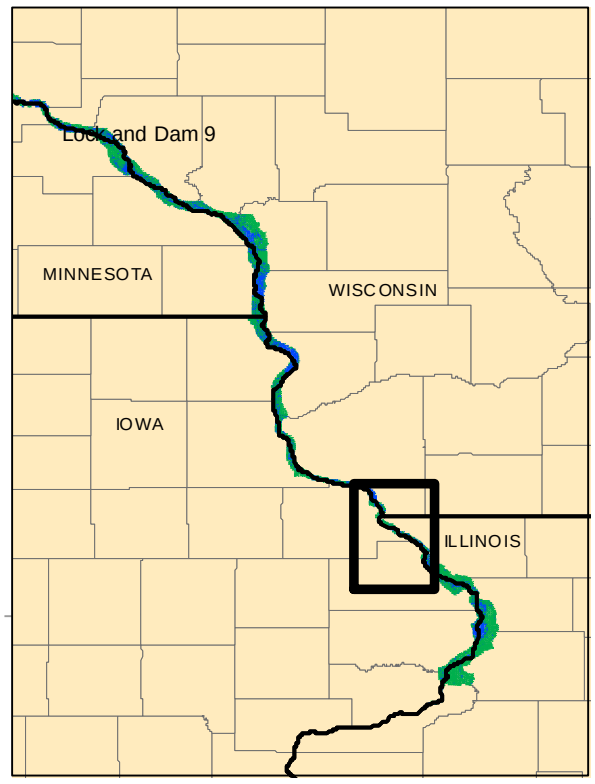
0 0.5 1 2 Kilometers

N
W E
S

Lock and Dam 11

Refuge boundaries represent 2014 status, areas outside of Refuge boundaries have been shaded slightly.

Pool 12
Savanna District
2010 Land Cover



Lock and Dam 11

Grant County
WISCONSIN

Dubuque

East Dubuque

Jo Daviess County
ILLINOIS

Dubuque County
IOWA

Jackson County
IOWA

Lock and Dam 12

Bellevue

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 4,990 Acres
- Submersed Aquatic Vegetation - 1,718 Acres
- Marsh - 1,530 Acres
- Wet Meadow - 725 Acres
- Sand and Mud - 5 Acres
- Agriculture - 0 Acres
- Grassland - 46 Acres
- Savanna - 0 Acres
- Shrub Scrub - 27 Acres
- Bottomland Forest - 4,120 Acres
- Upland Forest - 150 Acres
- Developed - 46 Acres
- Other - 0 Acres

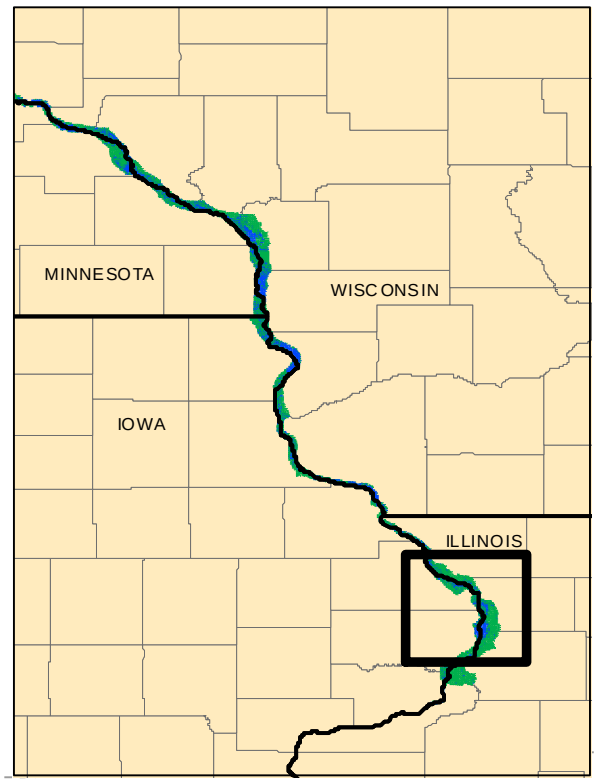
0 0.5 1 2
Miles

0 0.5 1 2
Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Pool 13
Savanna District
2010 Land Cover



Lock and Dam 12

Bellevue

Jo Daviess County
ILLINOIS

Carroll County
ILLINOIS

Savanna

Jackson County
IOWA

Clinton County
IOWA

Lock and Dam 13

Whiteside County
ILLINOIS

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

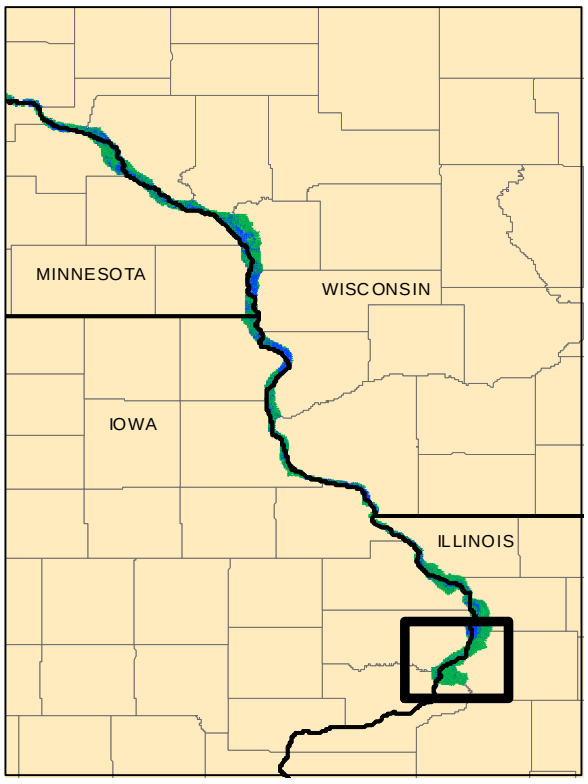
- Open Water - 14,830 Acres
- Submersed Aquatic Vegetation - 7,845 Acres
- Marsh - 5,987 Acres
- Wet Meadow - 922 Acres
- Sand and Mud - 16 Acres
- Agriculture - 142 Acres
- Grassland - 3,176 Acres
- Savanna - 450 Acres
- Shrub Scrub - 269 Acres
- Bottomland Forest - 10,662 Acres
- Upland Forest - 548 Acres
- Developed - 53 Acres
- Other - 166 Acres

0 0.5 1 2 **Miles**

0 0.5 1 2 **Kilometers**

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.



Lock and Dam 13

Fulton

Clinton

Clinton County
IOWA

Whiteside County
ILLINOIS

Pool 14
Savanna District
2010 Land Cover

Scott County
IOWA

Princeton

Rock Island County
ILLINOIS

Lock and Dam 14

Legend

- City
- County Line
- State Line
- Refuge Boundary

2010 Land Cover and Refuge Acres

- Open Water - 2,700 Acres
- Submersed Aquatic Vegetation - 208 Acres
- Marsh - 176 Acres
- Wet Meadow - 55 Acres
- Sand and Mud - 0 Acres
- Agriculture - 0 Acres
- Grassland - 14 Acres
- Savanna - 0 Acres
- Shrub Scrub - 10 Acres
- Bottomland Forest - 4,689 Acres
- Upland Forest - 0 Acres
- Developed - 23 Acres
- Other - 17 Acres

0 0.5 1 2 Miles

0 0.5 1 2 Kilometers

N
W E
S

Refuge boundaries represent 2014 status,
areas outside of Refuge boundaries have been shaded slightly.

Appendix C - Species That Were Considered as Candidate Resources of Concern

Taxonomic lists of candidate Resources of Concern for the Upper Mississippi River National Wildlife and Fish Refuge. Initial population of this list was conducted by Refuge staff and subsequent suggestions by individuals representing partner agencies and individuals with taxon familiarity were incorporated. Acronyms indicate which conservation list or plan a species was addressed by or treated within as of 2013; a lack of acronyms indicates the species was not included in any conservation list or plan. An index of acronyms is provided at the end of Appendix C. Taxonomy in this list, which was completed in 2013, may not conform to taxonomy provided in Appendix A.

<u>Waterbirds</u>

- Common loon (*Gavia immer*): suggested by K. Kenow, USGS.
    - MN SWAP
- Pied-billed grebe (*Podilymbus podiceps*): suggested by A. Forbes and T. Will, USFWS R3 MBP.
    - R3 birds, BCC, UMRGLR JV, IBMBC
- American white pelican (*Pelicanus erythrorhynchos*)
    - MN SWAP, WI NHWL, CCP, SBM, UMVGL WCP
- American bittern (*Botaurus lentiginosus*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, UMRGLR JV, IBMBC, UMVGL WCP
- Least bittern (*Ixobrychus exilis*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, CCP, R3 birds, BCC 2008, UMRGLR JV, IBMBC, UMVGL WCP
- Great blue heron (*Ardea herodias*)
    - CCP
- Great egret (*Ardea alba*)
    - IL SWAP, WI NHWL, WI SWAP, CCP
- Green heron (*Butorides virescens*): suggested by S. Warner, USFWS R3 ES.
    -
- Black-crowned night heron (*Nycticorax nycticorax*): suggested by A. Forbes, and B. Russell, USFWS R3 MBP; and J. Edwards, MN DNR.
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, R3 birds, R3 all, BCC, UMRGLR JV, IBMBC
- Yellow-crowned night heron (*Nyctanassa violacea*): suggested by B. Russell, USFWS R3 MBP.
    - IA SWAP, IL SWAP, WI NHWL, WI SWAP, UMRGLR JV, IBMBC
- Sandhill crane (*Grus canadensis*): suggested by J. Edwards, MN DNR.
    - IA SWAP, IL SWAP, PIF
- Sora (*Porzana carolina*)
    - CCP, UMRGLR JV, IBMBC, UMVGL WCP
- King rail (*Rallus elegans*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, MBP FS, PIF, UMRGLR JV, ABC, IBMBC, UMVGL WCP
- Virginia rail (*Rallus limicola*)
    - MN SWAP, CCP, UMVGL WCP
- Common gallinule (*Gallinula chloropus*): suggested by S. Warner, USFWS R3 ES.
    - IA SWAP, IL SWAP, MN SWAP, R3 all, IBMBC
- American coot (*Fulica americana*): suggested by S. Warner, USFWS R3 ES.
    - IBMBC
- Black tern (*Chlidonias niger*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, UMRGLR JV, IBMBC, UMVGL WCP
- Forster's tern (*Sterna forsteri*): suggested by L. Pfannmuller, MN Audubon.

    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, PIF
- Common tern (*Sterna hirundo*): suggested by S. Warner, USFWS R3 ES.
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 birds, BCC, MBP FS, UMRGLR JV

Waterfowl

- Trumpeter swan (*Cygnus buccinator*): suggested by J. Janvrin, WI DNR.
    - IA SWAP, MN SWAP, WI SWAP, WI NHWL, PIF, R3 all, ABC
- Tundra swan (*Cygnus columbianus*)
    - CCP, UMRGLR JV
- Wood duck (Aix sponsa)
    - CCP, R3 all, R3 birds, UMRGLR JV
- American wigeon (*Anas americana*)
    - CCP, UMRGLR JV
- Northern pintail (*Anas acuta*)
    - IA SWAP, MN SWAP, CCP, MBP FS, UMRGLR JV, IBMBC
- Blue-winged teal (*Anas discors*): suggested by J. Janvrin, WI DNR
    - WI SWAP
- American black duck (*Anas rubripes*): suggested by S. Houdek, USGS.
    - MN SWAP, WI SWAP, MBP FS, UMRGLR JV, PIF
- Canvasback (*Aythya valisineria*)
    - IA SWAP, IL SWAP, WI SWAP, CCP, R3 all, PIF, UMRGLR JV
- Lesser scaup (*Aythya affinis*)
    - IL SWAP, MN SWAP, WI SWAP, CCP, R3 all, MBP FS, UMRGLR JV
- Bufflehead (*Bucephola albeola*)
    - CCP, PIF
- Hooded merganser (*Lophodytes cucullatus*)
    - IL SWAP, CCP, PIF
- Common merganser (*Mergus merganser*): suggested by B. Russell, USFWS R3 MBP.

Shorebirds

- Semipalmated plover (*Charadrius semipalmatus*)
    - ABC
- Upland sandpiper (*Bartramia longicauda*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, UMRGLR JV
- Wilson's snipe (*Gallinago delicata*): suggested by S. Warner, USFWS R3 ES.
    - IL SWAP, UMRGLR JV, IBMBC
- Lesser yellowlegs (*Tringa flavipes*)
    - R3 birds
- Greater yellowlegs (*Tringa melanoleuca*)
    - MN SWAP, IL SWAP, R3 all
- Solitary sandpiper (*Tringa solitaria*)
    - WI SWAP, R3 birds, BCC 2008, UMRGLR JV
- Dunlin (*Calidris alpine*)
    - MN SWAP, WI SWAP, UMRGLR JV
- Stilt sandpiper (*Calidris himantopus*)
    - IL SWAP, R3 all, ABC
- Pectoral sandpiper (*Calidris melanotos*)
    - ABC
- Semipalmated sandpiper (*Calidris pusilla*)
    - MN SWAP, R3 birds, MBP FS

- Short-billed dowitcher (*Limnodromus griseus*)
    - IA SWAP, IL SWAP, MN SWAP, WI SWAP, R3 all, R3 birds, BCC 2008, PIF, UMRGLR JV
- American woodcock (*Scolopax minor*)
    - IL SWAP, MN SWAP, WI SWAP, R3 all, MBP FS, PIF, UMRGLR JV, SBM, IBMBC
- Wilson's phalarope (*Phalaropus tricolor*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, R3 all, PIF, UMRGLR JV, IBMBC

Raptors

- Osprey (*Pandion haliaetus*)
    - IA SWAP, IL SWAP, WI SWAP, CCP
- Golden eagle (*Aquila chrysaetos*): suggested by B. Russell, USFWS R3 MBP; S. Warner, USFWS R3 ES; and S. Houdek, USGS.
- Bald eagle (*Haliaeetus leucocephalus*)
    - IA SWAP, IL SWAP, MN SWAP, WI SWAP, CCP, T&E-delisted, R3 all, R3 birds, BCC 2008, MBP FS, PIF
- Northern harrier (*Circus cyaneus*)
    - IA SWAP, IL SWAP, MN SWAP, WI SWAP, CCP, R3 all, PIF
- Red-shouldered hawk (*Buteo lineatus*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, R3 all
- Peregrine falcon (*Falco peregrinus*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, T&E-delisted, R3 all, R3 birds, BCC 2008, PIF
- American kestrel (*Falco sparverius*): suggested by T. Will, USFWS R3 MBP and S. Warner, USFWS R3 ES.
    - IBMBC
- Short-eared owl (*Asio flammeus*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, R3 birds, BCC 2008, PIF, UMRGLR JV
- Long-eared owl (*Asio otus*)
    - IA SWAP, WI NHWL, CCP, R3 all, PIF

All Other Landbirds

- Northern bobwhite (*Colinus virginianus*): suggested by T. Will, USFWS R3 MBP.
    - IL SWAP, WI NHWL, WI SWAP, PIF
- Yellow-billed cuckoo (*Coccyzus americanus*): suggested by B. Russell and T. Will, USFWS R3 MBP.
    - IA SWAP, IL SWAP, WI SWAP, PIF
- Black-billed cuckoo (*Coccyzus erythropthalmus*)
    - IA SWAP, MN SWAP, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, PIF, SBM, IBMBC
- Eastern whip-poor-will (*Antrostomus vociferus*): suggested by T. Will, USFWS R3 MBP and S. Warner, USFWS R3 ES.
    - IL SWAP, MN SWAP, WI SWAP, R3 birds, R3 all, BCC, UMRGLR JV, PIF, IBMBC
- Common nighthawk (*Chordeiles minor*): suggested by T. Will, USFWS R3 MBP and S. Warner, USFWS R3 ES.
    - IL SWAP, MN SWAP, WI NHWL
- Chimney swift (*Chaetura pelagica*): suggested by T. Will, USFWS R3 MBP and S. Warner, USFWS R3 ES.
    - IL SWAP, UMRGLR JV, PIF, IBMBC
- Belted kingfisher (*Megaceryle alcyon*): suggested by T. Will, USFWS R3 MBP and S. Warner, USFWS R3 ES.
    - IBMBC
- Northern flicker (*Colaptes auratus*): suggested by B. Russell and T. Will, USFWS R3 MBP.
    - IL SWAP, R3 birds, R3 all, BCC, IBMBC
- Red-headed woodpecker (*Melanerpes erythrocephalus*)
    - IA SWAP, IL SWAP, MN SWAP, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, PIF, UMRGLR JV, ABC, IBMBC

- Acadian flycatcher (*Empidonax virescens*): suggested by T. Will, USFWS R3 MBP.
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 birds, R3 all, BCC, PIF, IBMBC
- Eastern kingbird (*Tyrannus tyrannus*): suggested by T. Will, USFWS R3 MBP.
    - IBMBC
- Purple martin (*Progne subis*): T. Will, USFWS R3 MBP.
    - WI NHWL
- Bank swallow (*Riparia riparia*): suggested by T. Will, USFWS R3 MBP.
    -
- Brown thrasher (*Toxostoma rufum*): suggested by B. Russell and T. Will, USFWS R3 MBP.
    - MN SWAP, WI SWAP, R3 birds, BCC, PIF, IBMBC
- Veery (*Catharus fuscescens*): J. Edwards, MN DNR.
    - IA SWAP, MN SWAP, WI SWAP, UMRGLR JV, IBMBC, SBM
- Loggerhead shrike (*Lanius ludovicianus*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, PIF, IBMBC
- Bell's vireo (*Vireo bellii*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, PIF, UMRGLR JV, ABC, IBMBC
- Sedge wren (*Cistothorus platensis*)
    - IL SWAP, MN SWAP, CCP, R3 all, R3 birds, PIF, SBM
- Marsh wren (*Cistothorus palustris*)
    - IL SWAP, MN SWAP, CCP, R3 birds, BCC 2008, PIF, IBMBC
- Wood thrush (*Hylocichla mustelina*)
    - IL SWAP, MN SWAP, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, PIF, UMRGLR JV, ABC, IBMBC
- Yellow-throated vireo (*Vireo flavifrons*): suggested by T. Will, USFWS R3 MBP.
    - PIF
- Louisiana waterthrush (*Parkesia motacilla*): suggested by B. Russell, USFWS R3 MBP; S. Warner, USFWS R3 ES; J. Edwards, MN DNR; and L. Pfannmuller, MN Audubon.
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP, R3 birds, R3 all, UMRGLR JV, PIF
- Prothonotary warbler (*Protonotaria citrea*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, PIF, UMRGLR JV, ABC, IBMBC
- Cerulean warbler (*Setophaga cerulean*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, UMRGLR JV, ABC, , IBMBC
- Hooded warbler (*Setophaga citrina*): suggested by S. Warner, USFWS R3 ES.
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP, PIF
- Yellow-throated warbler (*Setophaga dominica*): suggested by S. Warner, USFWS R3 ES.
    - WI NHWL, WI SWAP
- Chestnut-sided warbler (*Setophaga pensylvanica*).
    - SBM
- Blue-winged warbler (*Vermivora cyanoptera*): suggested by T. Will, USFWS R3 MBP.
    - IA SWAP, MN SWAP, WI SWAP, R3 birds, R3 all, BCC, UMRGLR JV, PIF, IBMBC
- Henslow's sparrow (*Ammodramus henslowii*)
    - MN SWAP, IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, UMRGLR JV, ABC, IBMBC
- Grasshopper sparrow (*Ammodramus savannarum*)
    - MN SWAP, IL SWAP, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, IBMBC
- Lark sparrow (*Chondestes grammacus*): suggested by B. Russell, USFWS R3 MBP.
    - WI NHWL, WI SWAP, IBMBC
- Eastern towhee (*Pipilo erythrophthalmus*): suggested by T. Will, USFWS R3 MBP.
    -
- Rose-breasted grosbeak (*Pheucticus ludovicianus*): suggested by J. Edwards, MN DNR.

    - MN SWAP, SBM
- Dickcissel (*Spiza americana*)
    - MN SWAP, WI SWAP, CCP, R3 birds, R3 all, BCC 2008, PIF, UMRGLR JV, IBMBC
- Field sparrow (*Spizella pusilla*): suggested by T. Will, USFWS R3 MBP.
    - IL SWAP, MN SWAP, WI SWAP, R3 birds, R3 all, BCC, PIF, IBMBC
- Bobolink (*Dolichonyx oryzivorus*)
    - IL SWAP, MN SWAP, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, SBM, IBMBC
- Rusty blackbird (*Euphagus carolinus*)
    - MN SWAP, IA SWAP, IL SWAP, WI SWAP, CCP, R3 all, R3 birds, BCC 2008, MBP FS, PIF, UMRGLR JV, ABC
- Baltimore oriole (*Icterus galbula*): suggested by T. Will, USFWS R3 MBP; J. Edwards, MN DNR.
    - PIF, SBM
- Orchard oriole (*Icterus spurius*): suggested by B. Russell, USFWS R3 MBP.
    - R3 birds
- Eastern Meadowlark (*Sturnella magna*)
    - MN SWAP, WI SWAP, CCP, R3 all, UMRGLR JV, IBMBC
- Western meadowlark (*Sturnella neglecta*)
    - WI NHWL, WI SWAP, CCP, R3 all, IBMBC
- Yellow-headed blackbird (*Xanthocephalus xanthocephalus*): suggested by T. Will, USFWS R3 MBP; and L. Pfannmuller, MN Audubon.
    - IL SWAP, WI NHWL

<u>Mammals</u>

- Big brown bat (*Eptesicus fuscus*)
    - WI NHWL
- Silver-haired bat (*Lasionycteris noctivagans*)
    - WI SWAP
- Eastern red bat (*Lasiurus borealis*)
    - WI SWAP
- Hoary bat (*Lasiurus cinereus*)
    - WI SWAP
- Little brown myotis (*Myotis lucifugus*)
    - WI NHWL
- Northern myotis (*Myotis septentrionalis*)
    - MN SWAP, WI NHWL, WI SWAP
    - **NOTE* this species was listed as threatened by the USFWS in 2015*
- Indiana myotis (*Myotis sodalis*)
    - IA SWAP, IL SWAP, T&E, R3 all
- Evening bat (*Nycticeius humeralis*)
    - IA SWAP
- Eastern pipistrelle (*Pipistrellus subflavus*)
    - MN SWAP, WI NHWL
- Southern flying squirrel (*Glaucomys volans*): K. Kinkead, IA DNR.
    - IA SWAP
- Beaver (*Castor canadensis*): suggested by J. Janvrin, WI DNR.
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- Prairie vole (*Microtus ochrogaster*): suggested by J. Edwards, MN DNR; R. Staffen, WI DNR.
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP
- Woodland vole (*Microtus pinetorum*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Muskrat (*Ondatra zibethicus*): suggested by J. Janvrin, WI DNR.
    - IL SWAP

- Southern bog lemming (*Synaptomys cooperi*): suggested by J. Edwards, MN DNR.
    - IA SWAP
- Meadow jumping mouse (*Zapus hudsonius*): suggested by J. Kath, IL DNR.
    -
- Gray fox (*Urocyon cinereoargenteus*): suggested by J. Kath, IL DNR.
    -
- Otter (*Luntra canadensis*)
    - IA SWAP, IL SWAP, CCP
- Least weasel (*Mustela nivalis*): suggested by J. Kath, IL DNR.
    - IL SWAP, MN SWAP
- Mink (*Mustela vison*): suggested by J. Janvrin, WI DNR.
    -
- American badger (*Taxidea taxus*): suggested by J. Kath. IL DNR; J. Edwards MN DNR.
    - IL SWAP, MN SWAP
- Least shrew (*Cryptotis parva*): suggested by J. Edwards, MN DNR.
    - IA SWAP, MN SWAP, WI NHWL

Amphibians

- Blanchard's cricket frog (*Acris blanchardi*)
    - WI SWAP, CCP
- Eastern cricket frog (*Acris crepitans*)
    - IA SWAP, MN SWAP, WI NHWL, CCP, PARC
- American bullfrog (*Lithobates catesbeianus*): suggested by A. Badje, WI DNR.
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- Pickerel frog (*Lithobates palustris*): suggested by J. Edwards, MN DNR; A. Badje, WI DNR; R. Staffen, WI DNR.
    -
- Northern leopard frog (*Lithobates pipiens*): R. Staffen, WI DNR.
    -
- Tiger salamander (*Ambystoma tigrinum*): P. Frese, IA DNR.
    -
- Four-toed salamander (*Hemidactylium scutatum*): suggested by A. Badje, WI DNR.
    - IL SWAP, MN SWAP, WI SWAP, PARC
- Mudpuppy (*Necturus maculosus*)
    - IA SWAP, IL SWAP, MN SWAP, WI SWAP, CCP, PARC
- Eastern newt (*Notophthalmus viridescens*): P. Frese, IA DNR.
    - IA SWAP

Reptiles

- Six-lined racerunner (*Aspidoscelis sexlineata*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP
- Common five-lined skink (*Plestiodon fasciatus*): suggested by J. Edwards, MN DNR; A. Badje, WI DNR.
    - MN SWAP
- Western wormsnake (*Carphophis vermis*): suggested by A. Badje, WI DNR.
    - IA SWAP, WI NHWL, WI SWAP, PARC
- North American racer (*Coluber constrictor flaviventris*): suggested by A. Badje, WI DNR; R. Staffen, WI DNR.
    - MN SWAP, WI NHWL, WI SWAP
- Prairie ring-necked snake (*Diadophis punctatus arnyi*): suggested by A. Badje, WI DNR.
    - WI NHWL, WI SWAP
- Timber rattlesnake (*Crotalus horridus*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, PARC

- Plains hog-nosed snake (*Heterodon nasicus*)
    - IA SWAP, IL SWAP, MN SWAP, PARC
- Eastern hog-nosed snake (*Heterodon platirhinos*): suggested by J. Edwards, MN DNR; A. Badje, WI DNR.
    - MN SWAP
- Smooth green snake (*Opheodrys vernalis*)
    - IA SWAP, IL SWAP, MN SWAP, PARC
- Gray ratsnake (*Pantherophis spiloides*): suggested by A. Badje, WI DNR; R. Staffen, WI DNR.
    - WI NHWL
- Western fox snake (*Pantherophis vulpinus*): suggested by J. Edwards, MN DNR.
    - PARC
- Bull snake (*Pituophis catenifer sayi*)
    - IA SWAP, WI NHWL, WI SWAP
- Graham's crayfish snake (*Regina grahamii*): P. Frese, IA DNR.
    -
- Eastern massasauga (*Sistrurus catenatus*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, T&E-candidate, R3 all, PARC
    - **NOTE* this species was listed as threatened by the USFWS in 2015*
- Plains gartersnake (*Thamnophis radix*): suggested by A. Badje, WI DNR.
    - WI NHWL, PARC

<u>Turtles</u>

- Smooth softshell (*Apalone mutica*)
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, PARC
- Spiny softshell turtle (*Apalone spinifera*): suggested by J. Janvrin, WI DNR.
    -
- Snapping turtle (*Chelydra serpentina*): suggested by J. Janvrin, WI DNR.
    - MN SWAP
- Blanding's turtle (*Emydoidea blandingii*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, PARC
- Wood turtle (*Glyptemys insculpta*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP, CCP, PARC
- False map turtle (*Graptemys pseudogeographica*)
    - WI NHWL, CCP, PARC
- Eastern musk turtle (*Sternotherus odoratus*): suggested by J. LeCleere, MN DNR; P. Frese, IA DNR; K. Kinkead, IA DNR; J. Janvrin, WI DNR.
    - IA SWAP
- Ornate box turtle (*Terrapene ornata*)
    - IA SWAP, IL SWAP, WI NHWL, WI SWAP, CCP, PARC

<u>Fish</u>

- Chestnut lamprey (*Ichthyomyzon castaneus*)
    - IA SWAP, MICRA
- Silver lamprey (*Ichthyomyzon unicuspis*): suggested by J. Janvrin, WI DNR.
    - IA SWAP, IL SWAP

- American brook lamprey (*Lampetra appendix*): suggested by K. Schmidt, MN.
    - IA SWAP, IL SWAP, MN SWAP
- Lake sturgeon (*Acipenser fulvescens*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, MICRA
- Shovelnose sturgeon (*Scaphirhynchus platorynchus*)
    - IL SWAP, MN SWAP, R3 all, MICRA
- Paddlefish (*Polyodon spathula*)

    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, MICRA
- Longnose gar (*Lepisosteus osseus*): suggested by D. Dieterman and K. Stauffer, MN DNR.
    - IA SWAP, MICRA
- Shortnose gar (*Lepisosteus platostomus*): suggested by D. Dieterman and K. Stauffer, MN DNR.
    - MICRA
- Goldeye (*Hiodon alosoides*)
    - IA SWAP, WI NHWL, WI SWAP, MICRA
- American eel (*Anguilla rostrata*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, MICRA
- Skipjack herring (*Alosa chrysochloris*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP, MICRA
- Mississippi silvery minnow (Hybognathus nuchalis)
    - IA SWAP, MN SWAP
- Pallid shiner (*Hybopsis amnis*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, MICRA
- Shoal chub (*Macrhybopsis hyostoma*): suggested by K. Schmidt, MN.
    - WI SWAP
- Silver chub (*Macrhybopsis storeriana*): suggested by K. Schmidt, MN.
    - WI NHWL
- Ghost shiner (*Notropis buchanani*)
    - IL SWAP, IA SWAP
- Weed shiner (*Notropis texanus*)
    - IA SWAP, IL SWAP, WI NHWL, MICRA
- Pugnose minnow (*Opsopoeodus emiliae*): suggested by K. Schmidt, MN and W. Popp, MN DNR.
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, MICRA
- Blackstripe topminnow (*Fundulus notatus*): suggested by J. Tiemann, IL NHS.
    - IA SWAP
- Starhead topminnow (*Fundulus dispar*): suggested by K. Schmidt, MN.
    - IL SWAP, WI NHWL, WI SWAP
- Blue sucker (*Cycleptus elongatus*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, MICRA
- Lake chubsucker (*Erimyzon sucetta*): suggested by K. Schmidt, MN.
    - IL SWAP, WI NHWL, WI SWAP, MICRA
- Smallmouth buffalo (*Ictiobus bubalus*): suggested by J. Janvrin, WI DNR.
    - MICRA
- Bigmouth buffalo (*Ictiobus cyprinellus*): suggested by J. Janvrin, WI DNR.
    - MICRA
- Black buffalo (*Ictiobus niger*)
    - MN SWAP, WI NHWL, WI SWAP, MICRA
- Spotted sucker (*Minytrema melanops*): suggested by D. Dieterman and K. Stauffer, MN DNR.
    - IA SWAP, MICRA
- River redhorse (*Moxostoma carinatum*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, MICRA
- Greater redhorse (*Moxostoma valenciennesi*): suggested by J. Janvrin, WI DNR.
    - IA SWAP, IL SWAP, MN SWAP, WI SWAP, WI NHWL, MICRA
- Black bullhead (*Ameiurus melas*): suggested by J. Janvrin, WI DNR.
    - MICRA
- Yellow bullhead (Ameiurus natalis): suggested by J. Janvrin, WI DNR.
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- Brown bullhead (Ameiurus nebulosus): suggested by J. Janvrin, WI DNR.
    - IA SWAP, IL SWAP

- Channel catfish (Ictalurus punctatus): suggested by J. Janvrin, WI DNR.
    - MICRA
- Flathead catfish (Pylodictis olivaris): suggested by J. Janvrin, WI DNR.
    - MICRA
- Central mudminnow (*Umbra limi*)
    - IA SWAP, IL SWAP
- Pirate perch (*Aphredonerus sayanus*)
    - IA SWAP, MN SWAP, WI NHWL, MICRA
- Trout perch (*Percopsis omiscomaycus*)
    - IA SWAP, IL SWAP
- Warmouth (*Lepomis gulosus*): suggested by K. Schmidt, MN; J. Janvrin, WI DNR.
    - MN SWAP
- Orange-spotted sunfish (*Lepomis humilis*): suggested by J. Janvrin, WI DNR.
    -
- Bluegill (*Lepomis macrochirus*): suggested by J. Janvrin, WI DNR.
    - MICRA
- Smallmouth bass (*Micropterus dolomieu*): suggested by J. Janvrin, WI DNR.
    - IL SWAP, MICRA
- Largemouth bass (*Micropterus salmoides*): suggested by J. Janvrin, WI DNR.
    - MICRA
- Yellow bass (*Morone mississippiensis*): suggested by K. Schmidt, MN.
    - MN SWAP
- Western sand darter (*Ammocrypta clara*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, MICRA
- Crystal darter (*Crystallaria asprella*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all, MICRA
- Mud darter (*Etheostoma asprigene*)
    - IA SWAP, MN SWAP, WI NHWL, MICRA
- Bluntnose darter (*Etheostoma chlorosoma*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, MICRA
- Iowa darter (*Etheostoma exile*)
    - IL SWAP
- Banded darter (*Etheostoma zonale*)
    - IA SWAP, MICRA
- Yellow perch (*Perca flavescens*): suggested by J. Janvrin, WI DNR.
    - IL SWAP, MICRA
- Blackside darter (Percina maculata)
    - IA SWAP, MICRA
- Sauger (*Stizostedion canadense*): suggested by J. Janvrin, WI DNR.
    - IL SWAP, MICRA
- Walleye (*Stizostedion vitreum*): suggested by J. Janvrin, WI DNR.
    - IL SWAP, MICRA
- Freshwater drum (*Aplodinotus grunniens*): suggested by J. Janvrin, WI DNR.
    - MICRA

<u>Mussels</u>

- Spectaclecase (*Cumberlandia monodonta*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, T&E – candidate, R3 all
- Purple wartyback (*Cyclonaias tuberculata*): suggested by T. Newton, USGS UMESC.
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Elephant-ear (*Elliptio crassidens*)

    - IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Spike (*Elliptio dilatata*)
    - IA SWAP, IL SWAP, MN SWAP
- Ebonyshell (*Fusconaia ebena*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Round pigtoe (*Pleurobema sintoxia*)
    - IA SWAP, IL SWAP, MN SWAP, R3 all
- Washboard (*Megalonaias nervosa*)
    - MN SWAP, WI NHWL, R3 all
- Sheepnose (*Plethobasus cyphus*)
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP, T&E – candidate, R3 all
- Winged mapleleaf (*Quadrula fragosa*): suggested by M. Davis, MN DNR
    - WI NHWL, WI SWAP, T&E
- Monkeyface (*Quadrula metanerva*): suggested by M. Davis, MN DNR
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all
- Wartyback (*Quadrula nodulata*): suggested by M. Davis, MN DNR
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP
- Pistolgrip (*Tritogonia verrucosa*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all
- Rock pocketbook (*Acridens confragosus*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all
- Salamander Mussel (*Simpsonaias ambigua*)
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all
- Mucket (*Actinonaias ligamentina*): suggested by M. Davis, MN DNR
    - MN SWAP
- Butterfly (*Ellipsaria lineolata*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Snuffbox (*Epioblasma triquetra*): suggested by M. Davis, MN DNR
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP, R3 all
- Higgins eye pearlymussel (*Lampsilis higginsi*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, T&E, R3 all
- Yellow sandshell (*Lampsilis teres anodontoides*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP
- Slough sandshell (*Lampsilis teres teres*)
    - IA SWAP, MN SWAP, WI NHWL, WI SWAP
- Black sandshell (*Ligumia recta*)
    - IL SWAP, MN SWAP, R3 all
- Fawnsfoot (*Truncilla donaciformis*): suggested by M. Davis, MN DNR
    - IA SWAP, WI NHWL, WI SWAP

<u>Butterflies</u>

- Iowa skipper (*Atrytone arogos iowa*)
    - IA SWAP, IL SWAP, MN SWAP, Xerces
- Dusted skipper (*Atrytonopsis hianna*)
    - IA SWAP, IL SWAP, WI NHWL
- A nocturid moth (*Bagisara gulnare*)
    - IL SWAP, WI NHWL
- Swamp metalmark (*Calephelis mutica*)
    - IA SWAP, IL SWAP, WI NHWL, WI SWAP, T&E – candidate
- Frosted elfin (*Callophrys irus*)
    - IL SWAP, WI NHWL, WI SWAP, Xerces

- Abbreviated underwing moth (*Catocala abbreviatella*)
    - WI NHWL, IL SWAP
- Whitney's underwing moth (*Catocala whitneyi*)
    - IL SWAP, WI NHWL, WI SWAP
- Gorgone checkerspot (*Chlosyne gorgone*)
    - IL SWAP, WI NHWL
- Dreamy duskywing (*Erynnis icelus*)
    - IA SWAP, IL SWAP
- Columbine duskywing (*Erynnis lucillus*)
    - IA SWAP, IL SWAP, WI NHWL, WI SWAP
- Mottled duskywing (*Erynnis martialis*)
    - IL SWAP, WI NHWL, WI SWAP
- Persius duskywing (*Erynnis persius*)
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP, Xerces
- Olympia white (*Euchloe olympia*)
    - IA SWAP, IL SWAP
- Two-spotted skipper (*Euphyes bimacula*)
    - IA SWAP, IL SWAP, MN SWAP
- Sedge skipper (*Euphyes dion*)
    - IA SWAP, IL SWAP
- Silvery blue (*Glaucopsyche lygdamus*)
    - IA SWAP, IL SWAP
- Slender clearwing (*Hemaris gracilis*)
    - IL SWAP, WI NHWL, WI SWAP
- Midwestern Fen Buckmoth (*Hemileuca nevadensis ssp. 3*)
    - IL SWAP, WI NHWL, WI SWAP
- Leonardus skipper (*Hesperia leonardus*)
    - IA SWAP, IL SWAP, MN SWAP
- Cobweb skipper (*Hesperia metea*)
    - IL SWAP, WI NHWL, WI SWAP
- Ottoe skipper (*Hesperia ottoe*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, Xerces
- Purplish copper (*Lycaena helloides*)
    - IA SWAP, IL SWAP
- Poweshiek skipperling (*Oarisma powesheik*)
    - IA SWAP, IL SWAP, WI NHWL, WI SWAP, T&E - candidate, Xerces
- Liatris borer moth (*Papaipema beeriana*)
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Silphium borer moth (*Papaipema silphii*)
    - IL SWAP, WI NHWL, WI SWAP
- West Virginia white (*Pieris virginiensis*)
    - IL SWAP, WI NHWL, WI SWAP
- Broad-winged skipper (*Poanes viator*)
    - IA SWAP, IL SWAP
- Byssus skipper (*Problema byssus*)
    - IA SWAP, IL SWAP, WI NHWL, WI SWAP, Xerces
- Pink Swallow (*Psectraglaea carnosa*)
    - IL SWAP, WI NHWL, WI SWAP
- Sprague's pygarctia (*Pygarctia spraguei*)
    - IL SWAP, WI NHWL, WI SWAP
- Edward's hairstreak (*Satyrium edwardsii*)

    - IA SWAP, IL SWAP
- Phlox moth (*Schinia indiana*)
    - IL SWAP, MN SWAP, WI NHWL, WI SWAP
- Leadplant flower moth (*Schinia lucens*)
    - IL SWAP, WI NHWL
- Regal fritillary (*Speyeria idalia*)
    - IA SWAP, IL SWAP, MN SWAP, WI NHWL, WI SWAP, Xerces

Vascular Plants

- False Indian plantain (Asteraceae; *Hasteola sauveolens*)
    - IA ETSCP, MN ETSCS
- Fragile prickly pear (Cactaceae; *Opuntia fragilis*): M. Cole, IL DNR.
    - IA ETSCP, IL CETAP, WI NHWL
- Water starwort (Callitrichaceae; *Callitriche heterophylla*)
    - IA ETSCP, MN ETSCS, WI NHWL
- Jame's clammyweed (Capparaceae; *Polanisia jamesii*): M. Cole, IL DNR.
    - IA ETSCP, IL CETAP, WI NHWL
- False heather (Cistaceae; *Hudsonia tomentosa*): M. Cole, IL DNR.
    - IA ETSCP, IL CETAP, MN ETSCS
- Star sedge (Cyperaceae; *Carex echinata*)
    - IA ETSCP, IL CETAP
- Tuckerman's sedge (Cyperaceae; *Carex tuckermanii*)
    - IA ETSCP, IL CETAP
- Northern gooseberry (Grossulariaceae; *Ribes hirtellusm*)
    - IA ETSCP, IL CETAP
- Blackfoot quillwort (Isoetaceae; *Isoetes melanopoda*)
    - IA ETSCP, MN ETSCS
- Showy lady's slipper (Orchidaceae; *Cypripedium reginae*)
    - IA ETSCP, IL CETAP
- Clustered broomrape (Orobanchaceae; *Orobanche fasiculata*): M. Cole, IL DNR.
    - IA ETSCP, IL CETAP, MN ETSCS, WI NHWL
- Blue mudplantain (Pontederiaceae; *Heteranthera limosa*)
    - IA ETSCP, MN ETSCS
- Narrowleaf pondweed (Potamogetonaceae; *Potamogeton strictifolius*)
    - IA ETSCP, IL CETAP
- Kittentails (Scrophulariaceae; *Besseya bullii*): M. Cole, IL DNR.
    - IA ETSCP, IL CETAP, MN ETSCS, WI NHWL
- Marsh speedwell (Scrophulariaceae;, *Veronica scutellata*)
    - IA ETSCP, IL CETAP
- Summer grape (Vitaceae, *Vitis aestivalis* var. *argentinfolia*)
    - IA ETSCP, MN ETSCS

Remove: the following were removed from earlier versions of the lists by Refuge staff or were suggested for removal from the list by partner individuals.

Birds

- American white pelican: not a priority along the river according to L. Pfannmuller, MN Audubon; J. Janvrin, WI DNR.
- Great Blue Heron: suggested by M. Fisher, IA TNC.
- Virginia rail: considered fairly common according to L. Pfannmuller, MN Audubon.
- Sora: considered fairly common according to L. Pfannmuller, MN Audubon.
- Canada goose: ranked low by G. Soulliere, USFWS R3 MBP.

- Trumpeter swan: Refuge staff believes this species is minimally represented on Refuge lands.
- Wood duck; ranked low by G. Soulliere, USFWS R3 MBP; suggested by M. Fisher, IA TNC.
- American wigeon: not a high priority along the river according to L. Pfannmuller, MN Audubon.
- Gadwall: only addressed in the CCP.
- American black duck: ranked low by G. Soulliere, USFWS R3 MBP.
- Blue-winged teal: ranked low by G. Soulliere, USFWS R3 MBP.
- Shoveler: ranked low by G. Soulliere, USFWS R3 MBP; only addressed in the CCP.
- Green-winged teal: only addressed in the CCP.
- Ring-necked duck: only addressed in the CCP.
- Lesser scaup: not a high priority according to L. Pfannmuller, MN Audubon.
- Greater scaup: probably doesn't occur often on the Refuge in sizeable numbers.
- Bufflehead: ranked low by G. Soulliere, USFWS R3 MBP; not a high priority according to L. Pfannmuller, MN Audubon; **but** B. Russell, USFWS R3 MBP, notes the Refuge/UMR hosts some of the highest numbers on the continent.
- Common goldeneye: ranked low by G. Soulliere, USFWS R3 MBP.
- Hooded merganser: ranked low by G. Soulliere, USFWS R3 MBP; suggested by M. Fisher, IA TNC.
- Ruddy duck: only addressed in the CCP.
- All shorebirds other than woodcock: uncommon migrants of low priority, L. Pfannmuller, MN Audubon.
- American golden plover: suggested by B. Russell, USFWS R3 MBP.
- Killdeer: only addressed in the UMRGLR JV.
- Spotted sandpiper: not addressed in any plan or list.
- Sanderling: suggested by B. Russell, USFWS R3 MBP.
- Semipalmated sandpiper: only addressed in the ABC; suggestion to drop by B. Russell, USFWS R3 MBP; **but** suggestion to keep by A. Forbes, USFWS R3 MBP.
- Pectoral sandpiper: only addressed in the ABC.
- Stilt sandpiper: suggested by B. Russell, USFWS R3 MBP.
- Osprey: not a high priority according to L. Pfannmuller, MN Audubon.
- Bald eagle: suggested by M. Fisher, IA TNC.
- Northern harrier: not a high priority along the river according to L. Pfannmuller, MN Audubon.
- Short-eared owl: not a high priority along the river according to L. Pfannmuller, MN Audubon.
- Horned lark: suggested by A. Forbes and T. Will, USFWS R3 MBP; only addressed in the CCP.
- Golden-winged warbler: suggested by A. Forbes, B. Russell, and T. Will, USFWS R3 MBP; not a concern along the river according to L. Pfannmuller, MN Audubon; J. Janvrin, WI DNR.
- Savannah sparrow: suggested by A. Forbes, B. Russell, and T. Will, USFWS R3 MBP.

<u>Mammals</u>

- Otter: should do ok with typical management according to K. Kinkead, IA DNR.
- White-tailed deer: not addressed in any plan or list.

<u>Herps</u>

- Northern leopard frog: only addressed in the CCP; not in need of focused conservation effort according to P. Frese, IA DNR; should do ok with typical management according to K. Kinkead, IA DNR.
- Blue-spotted salamander: Refuge habitat may not be suitable and if so, Refuge contribution may be minimal compared to range-wide occurrence according to R. Staffen, WI DNR; P. Frese, IA DNR; K. Kinkead, IA DNR.
- Smooth green snake: Refuge habitat may be marginal and Refuge contribution may be minimal compared to range-wide occurrence according to R. Staffen, WI DNR.
- Spiny softshell: only addressed in the CCP.
- Western painted turtle: only addressed in the CCP.
- Northern map turtle: only addressed in the CCP.
- Ouachita map turtle: only addressed in the CCP.
- False map turtle: should do ok with typical management according to K. Kinkead, IA DNR.
- Wood turtle: K. Kinkead, IA DNR.

Fish

- Silver lamprey: suggested by S. Yess and A. Runstrom, USFWS R3 FWCO.
- Chestnut lamprey: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Shovelnose sturgeon: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Goldeye: suggested by D. Dieterman and K. Stauffer, MN DNR; J. Janvrin, WI DNR.
- Skipjack herring: suggested by D. Dieterman and K. Stauffer, MN DNR; J. Janvrin, WI DNR.
- Mississippi silvery minnow: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Pallid shiner: suggested by D. Dieterman and K. Stauffer, MN DNR; J. Janvrin, WI DNR.
- Ghost shiner: suggested by D. Dieterman and K. Stauffer, MN DNR; J. Janvrin, WI DNR.
- Weed shiner: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Black buffalo: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Central mudminnow: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Trout perch: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Pirate perch: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Western sand darter: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Mud darter: suggested by A. Runstrom, USFWS R3 FWCO.
- Bluntnose darter: suggested by D. Dieterman and K. Stauffer, MN DNR; J. Janvrin, WI DNR.
- Iowa darter: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Banded darter: suggested by D. Dieterman and K. Stauffer, MN DNR.
- Blackside darter: suggested by D. Dieterman and K. Stauffer, MN DNR.

Mussels

- Slippershell: only one historical record according to P. Thiel, USFWS R3 FWCO.
- Creek heelsplitter: only one historical record according to P. Thiel, USFWS R3 FWCO.
- Winged mapleleaf: suggested by P. Delphy, USFWS R3 ES.
- Spectaclecase: only one recent occurrence in TCFO area according to P. Delphy, USFWS R3 ES.
- Fat pocketbook: does not occur in TCFO area according to P. Delphy, USFWS R3 ES; J. Janvrin, WI DNR; **but**, according to J. Tiemann, IL NHS, plans are underway to propagate and introduce to pools 2, 15 and 16.
- Snuffbox: probably does not occur in the Refuge portion of the TCFO area according to P. Delphy, USFWS R3 ES; no records in recent decades according to P. Thiel, USFWS R3 FWCO.
- Scaleshell: may not occur on the Refuge according to P. Delphy, USFWS R3 ES; no records in a half century according to P. Thiel, USFWS R3 FWCO (note – a check of the 2010 final scaleshell recovery plan indicates it does not currently exist on in the Upper Mississippi River).
- Ellipse: extralimital in the Mississippi mainstem according to P. Thiel, USFWS R3 FWCO.
- Iowa Pleistocene snail: not likely to occur on the Refuge according to Mike Coffey, USFWS RIFO; Cathy Henry, USFWS Port Louisa NWR.
- Briarton Pleistocene snail: not likely to occur on the Refuge according to Mike Coffey, USFWS RIFO; Cathy Henry, USFWS Port Louisa NWR.
- Hubricht's vertigo snail: not likely to occur on the Refuge according to Mike Coffey, USFWS RIFO; Cathy Henry, USFWS Port Louisa NWR.
- Midwest Pleistocene vertigo snail: not likely to occur on the Refuge according to Mike Coffey, USFWS RIFO; Cathy Henry, USFWS Port Louisa NWR.
- Variable Plesitocene vertigo snail: not likely to occur on the Refuge according to Mike Coffey, USFWS RIFO; Cathy Henry, USFWS Port Louisa NWR.

Butterflies

- Arogos skipper: no records from IA counties associated with the Refuge according to S. Shepher, IA DNR.
- Swamp metalmark: may not be present in the Upper Mississippi River portion of Wisconsin according to P. Delphy, USFWS R3 ES; no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR; J. Janvrin, WI DNR.
- Frosted elfin: suggested by J. Janvrin, WI DNR.
- Mottled duskywing: suggested by J. Janvrin, WI DNR.

- Persius duskywing: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR; J. Janvrin, WI DNR.
- Two-spotted skipper: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR.
- Sedge skipper: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR.
- Dakota skipper: probably not on the Refuge according to P. Delphy, USFWS R3 ES; no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR; J. Janvrin, WI DNR.
- Cobweb skipper: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR; J. Janvrin, WI DNR.
- Ottoe skipper: probably only present on good hill prairies in the vicinity of the Refuge according to P. Delphy, USFWS R3 ES.
- Karner blue: probably not on the Refuge according to P. Delphy, USFWS R3 ES; no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR; J. Janvrin, WI DNR.
- Purplish copper: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR.
- Powesheik skipperling: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR; J. Janvrin, WI DNR.
- Silphium borer moth: suggested by J. Janvrin, WI DNR.
- Broad-winged skipper: no records from IA counties associated with the Refuge according to S. Shepherd, IA DNR.
- Phlox moth: suggested by J. Janvrin, WI DNR.

Other Insects

- Hine's emerald dragonfly: probably not on the Refuge according to P. Delphy, USFWS R3 ES; never been found in IA according to A. Johnson; 2011 survey of MN did not find this species and its specific habitat (calcareous fens) probably doesn't occur on the Refuge according to K. Mead, MOSP.
- American burying beetle: probably not on the Refuge according to P. Delphy, USFWS R3 ES.

Plants

- False Indian plantain: more common than previously thought according to C. Anderson, WI DNR.
- American feverfew: likely not found on Refuge properties according to R. Henderson, WI DNR; proposed for delisting in WI according to K. Doyle, WI DNR; core populations don't encompass Refuge according to C. Anderson, WI DNR.
- Showy lady's slipper: suggested by J. Janvrin, WI DNR.
- Ravenfoot sedge: likely not found on Refuge properties according to K. Doyle, WI DNR; core populations don't encompass Refuge according to C. Anderson, WI DNR.
- Smooth sheath sedge: likely not found on Refuge properties according to K. Doyle, WI DNR; core populations don't encompass Refuge according to C. Anderson, WI DNR.
- Snailseed pondweed: likely not found on Refuge properties according to K. Doyle, WI DNR; core populations don't encompass Refuge according to C. Anderson, WI DNR.
- Spotted pondweed: core populations don't encompass Refuge according to C. Anderson, WI DNR.
- Waxy meadowrue: likely not found on Refuge properties according to K. Doyle, WI DNR; core populations don't encompass Refuge according to C. Anderson, WI DNR.

Conservation plans and lists in which candidate Resources of Concern species were addressed or treated (as of 2013); other resources utilized in compiling or assessing the list of candidate ROCs.

ABC - American Bird Conservancy. 2007. United States Watchlist of Birds of Conservation Concern. Available at http://www.abcbirds.org/abcprograms/science/watchlist/WatchList.pdf

BCC 2008 - USFWS. 2008. Birds of Conservation Concern 2008. USFWS, Arlington, VA.

CCP - USFWS. 2006. Upper Mississippi River National Wildlife and Fish Refuge Final Environmental Impact Statement and Comprehensive Conservation Plan. USFWS, Washington, DC.

Species are identified as being treated in the CCP if the treatment was beyond a generalized manner. For example, "Migratory Birds" are identified as a "Wildlife Resource Conservation Priority" in the CCP, and within that category waterfowl, songbirds, colonial nesting waterbirds, secretive marsh birds, and raptors are all specifically addressed. Thus they are indicated in this list as being addressed in the CCP. Shorebirds, however, were not specifically addressed in the CCP as a group or individually, thus they are not identified in this list as being addressed in the CCP.

Cummings and Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey Manual 5. Available at http://www.inhs.illinois.edu/animals_plants/mollusk/fieldguide.html

IA ETSCP – Iowa Natural Resource Commission. Endangered, threatened, and special concern plants. Available at http://www.iowadnr.gov/Environment/ThreatenedEndangered.aspx
Used for compiling the plant portion of the ROC list.

IA SWAP - Iowa Department of Natural Resources. 2005. Securing a Future for Fish and Wildlife: A Conservation Legacy for Iowans.
Species are identified as being addressed in the IA SWAP list if their State Heritage Rank was S1–S3. Species are not identified as being addressed in the IA SWAP if their State Heritage Rank was S4.

IBMBC – 2012. An Implementation Blueprint for Minnesota Bird Conservation: Blueprint Recommendations for Minnesota's Eastern Broadleaf Forest Province – DRAFT.

IL CETAP - Illinois Endangered Species Protection Board. Checklist of endangered and threatened animals and plants of Illinois. Available at http://www.dnr.illinois.gov/ESPB/Documents/ETChecklist2011.pdf
Used for compiling the plant portion of the ROC list; it is assumed that wildlife species in the IL CETAP are captured in the IL SWAP.

IL SWAP - Illinois Department of Natural Resources. 2005. The Illinois Comprehensive Wildlife Conservation Plan & Strategy.
The IL SWAP does not explicitly report State Heritage Ranks.

IL SWAP - Moorehouse and Brinkman. 2012. Upper Mississippi River Conservation Opportunity Area Wildlife Action Plan – Draft 2. Illinois Department of Natural Resources.
Moorehouse and Brinkman represents an implementation plan for the IL SWAP.

MBP FS - USFWS. 2011. Migratory Bird Program Focal Species Strategy: FY2012-FY2016 Focal Species. Available at http://www.fws.gov/migratorybirds/CurrentBirdIssues/Management/FocalSpecies/Plans/focalspecies2012.pdf

MICRA – Interjurisdictional fishes of the Mississippi River Basin. Mississippi Interstate Cooperative Resource Association. Available at http://www.micrarivers.org/

MN ETSCS - Minnesota DNR. Minnesota's list of endangered, threatened, and special concern species. Available at http://files.dnr.state.mn.us/natural_resources/ets/endlist.pdf
Used for compiling the plant portion of the ROC list; it is assumed that wildlife species in the MN ETSCS are captured in the MN SWAP.

MN SWAP - Minnesota Department of Natural Resources. 2006. Tomorrow's Habitat for the Wild & Rare: An Action Plan for Minnesota Wildlife.
The MN SWAP does not explicitly report State Heritage Ranks.

PARC - Midwest Partners in Amphibian and Reptile Conservation. 2011. Midwest PARC Species. Available at http://www.mwparc.org/species/

Species are identified as being addressed in the Midwest PARC list if its PARC ranking category was A–E; a species was not included if it's PARC ranking category was F–G.

Paveglio and Taylor. 2010. Identifying Refuge Resources of Concern and Management Priorities: a handbook. USFWS, Washington, DC.

PIF - Fitzgerald and Pashley. 2000. Partners in Flight Bird Conservation Plan for The Dissected Till Plains (Physiographic Area 32). Partners In Flight. Brentwood, MO.

PIF - Knutson et al. 2001. Partners in Flight Bird Conservation Plan for the Upper Great Lakes Plain (Physiographic Area 16). USGS Upper Midwest Environmental Sciences Center in Cooperation with Partners In Flight, La Crosse, WI.

R3 all - USFWS. 2002. Region 3 Fish & Wildlife Resource Conservation Priorities. USFWS, Washington, DC.

R3 birds - USFWS. 2012. USFWS Midwest Region: Midwest Birds of Concern. Available at http://www.fws.gov/midwest/midwestbird/concern.html

SBM – Pfannmuller. 2012. Stewardship Birds of Minnesota. Audubon Minnesota, Saint Paul, MN

Steuck et al. 2010. Distribution and relative abundance of Upper Mississippi River fishes. Upper Mississippi River Conservation Committee, Onalaska, WI. Available at http://www.umrcc.org/Publications.html

T&E - USFWS. 2012. Endangered, Threatened, Proposed and Candidate Species. Available at http://www.fws.gov/midwest/endangered/lists/e_th_pr.html

USFWS. Service Manual. Available at http://www.fws.gov/policy/manuals/

WI NHWL – Wisconsin Natural Heritage Program, Bureau of Endangered Resources. 2012. Wisconsin Natural Heritage Working list. Available at http://dnr.wi.gov/topic/NHI/WList.html
Species are identified as being addressed in the WI NHWL list if their State Heritage Rank was S1–S3. Species are not identified as being addressed in the WI NHWL if their State Heritage Rank was S4.

WI SWAP - Wisconsin Department of Natural Resources. 2005. Strategy for Wildlife Species of Greatest Conservation Need.
The WI SWAP does not explicitly report State Heritage Ranks.

UMRGLR JV - Potter et al. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Landbird Habitat Conservation Strategy. USFWS, Fort Snelling, MN.

UMRGLR JV - Potter et al. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Shorebird Habitat Conservation Strategy. USFWS, Fort Snelling, MN.

UMRGLR JV - Soulliere et al. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Waterbird Habitat Conservation Strategy. USFWS, Fort Snelling, MN.

UMRGLR JV - Soulliere et al. 2007. Upper Mississippi River and Great Lakes Region Joint Venture Waterfowl Habitat Conservation Strategy. USFWS, Fort Snelling, MN.

UMVGL WBCP – Wires et al 2010. Upper Mississippi Valley/Great Lakes Waterbird Conservation Plan. A plan associated with the Waterbird Conservation for the Americas Initiative. Final Report submitted to the US Fish & Wildlife Service, Fort Snelling, MN. Available at: http://www.waterbirdconservation.org/umvgl.html

Xerces - Xerces Society for Invertebrate Conservation. Red List of Butterflies and Moths. Available at http://www.xerces.org/red-list-of-butterflies-and-moths-sorted/

Appendix D - Resource of Concern (ROC) Scores Generated from the Resources of Concern Selection Tool for America's Refuges (ROCSTAR)

Table 1. Broad habitats, number of ROC Species affiliated with each broad habitat, and the average ROCSTAR score for each broad habitat. ROCSTAR scores were generated by refuge staff and partner representatives in 2013 through application of the ROCSTAR tool developed by Cardno JFNew (see Section 3.4 for more information). ROCSTAR scores did not represent ultimate declarations of which Resources of Concern would be selected as Priority Resources of Concern, but were instead used to inform ultimate decisions regarding Priority Resources of Concern.

Broad habitat	Geomorphic Areas	# of ROC Species	Average ROCSTAR Score
Upland forest	N/A	15	3.95
Savanna	N/A	9	3.66
Grassland	N/A	57	3.44
Bottomland forest	N/A	47	4.64
Shrub/scrub	N/A	6	3.92
Wet meadow	N/A	7	3.80
Marsh	N/A	45	4.88
Main channel, main channel border, secondary and tertiary channel, and impounded Non-fish and non-mussels	N/A	13	4.67
Main channel, main channel border, secondary and tertiary channel, and impounded Fish and mussels	Main channel	1	6.25
Main channel, main channel border, secondary and tertiary channel, and impounded Fish and mussels	Main channel border, secondary and tertiary channel	46	4.88
Main channel, main channel border, secondary and tertiary channel, and impounded Fish and mussels	Contiguous backwater floodplain lake and backwater shallow aquatic area	23	4.38

Table 2. ROC species, and their ROCSTAR score, affiliated with the upland forest habitat.

Species	ROCSTAR Score
northern flicker	6.08
brown thrasher	5.95
least shrew	5.95
peregrine falcon	4.84
wood thrush	4.25
gray fox	3.80
eastern hognose snake	3.75
showy lady's slipper	3.65
woodland vole	3.65
summer grape	3.40
veery	3.25
southern flying squirrel	3.05

Species	ROCSTAR Score
eastern whip-poor-will	3.05
star sedge (*Carex echinata*)	2.50
timber rattlesnake	2.15

Table 3. ROC species, and their ROCSTAR scores, affiliated with the savanna habitat.

Species	ROCSTAR Score
red-headed woodpecker	6.38
American kestrel	4.85
loggerhead shrike	4.28
Phlox moth	3.30
orchard oriole	3.25
mottled duskywing	3.25
pink swallow	2.55
Sprague's pygarctia	2.55
Edward's hairstreak	2.50

Table 4. ROC species, and their ROCSTAR scores, affiliated with the grassland habitat.

Species	ROCSTAR Score
prairie vole	6.45
grasshopper sparrow	5.94
ornate box turtle	5.73
dickcissel	5.63
eastern meadowlark	5.54
Ottoe skipper	5.50
bobolink	5.44
blue-winged teal	5.18
field sparrow	5.15
Henslow's sparrow	5.06
regal fritillary	5.05
dusted skipper	4.75
Leonardus skipper	4.75
northern harrier	4.65
byssus skipper	4.20
Gorgone checkerspot	4.10
cobweb skipper	3.80
abbreviated underwing moth	3.75
upland sandpiper	3.65
Whitney's underwing moth	3.55
leadplant flower moth	3.50
Olympia white	3.50
columbine duskywing	3.40
short-eared owl	3.23
western meadowlark	2.98
American badger	2.98
Poweshiek skipperling	2.80
swamp metalmark	2.75
common nighthawk	2.68
persius duskywing	2.65
lark sparrow	2.60
frosted elfin	2.60
Iowa skipper	2.60
Liatris borer moth	2.60
clustered broomrape	2.60
kittentails	2.60
plains hognose snake	2.60
six-lined racerunner	2.60
smooth green snake	2.60

Species	ROCSTAR Score
dreamy duskywing	2.55
Silphium borer moth	2.55
slender clearwing	2.55
false heather	2.55
fragile prickly pear	2.55
James' clammyweed	2.55
bull snake	2.55
North American racer	2.55
a nocturid moth (*Bagisara gulnare*)	2.50
purplish copper	2.50
silvery blue	2.50
blackfoot quillwort	2.50
false Indian plantain	2.50
plains gartersnake	2.50
prairie ring-necked snake	2.50
common five-lined skink	2.45
meadow jumping mouse	2.40
golden eagle	1.78

Table 5. ROC species, and their ROCSTAR scores, affiliated with the bottomland forest habitat.

Species	ROCSTAR Score
prothonotary warbler	8.23
bald eagle	7.25
wood duck	7.09
cerulean warbler	6.58
red-shouldered hawk	6.21
great blue heron	6.06
beaver	6.03
hooded merganser	5.92
yellow-billed cuckoo	5.65
little brown myotis	5.50
Indiana myotis	5.35
great egret	5.33
silver-haired bat	5.20
belted kingfisher	5.20
northern myotis	5.15
green heron	5.14
big brown bat	5.13
rusty blackbird	5.10
rose-breasted grosbeak	5.03
Baltimore oriole	4.98
eastern pipistrelle	4.95
western fox snake	4.90
black-billed cuckoo	4.80
wood turtle	4.80
osprey	4.78
eastern red bat	4.65
long-eared owl	4.40
hoary bat	4.30
Acadian flycatcher	4.10
black-crowned night heron	4.10
eastern newt	4.05
chestnut-sided warbler	3.95
hooded warbler	3.95
least weasel	3.95
Louisiana waterthrush	3.85
yellow-crowned night heron	3.80
chimney swift	3.70
purple martin	3.68

Species	ROCSTAR Score
western wormsnake	3.30
northern gooseberry	3.20
yellow-throated warbler	3.10
yellow-throated vireo	2.99
midwestern fen buckmoth	2.55
West Virginia white	2.55
four-toed salamander	2.50
evening bat	2.45
gray rat snake	2.45

Table 6. ROC species, and their ROCSTAR scores, affiliated with the shrub/scrub habitat.

Species	ROCSTAR Score
blue-winged warbler	4.65
eastern kingbird	4.38
American woodcock	3.85
Bell's vireo	3.65
northern bobwhite	3.51
eastern towhee	3.50

Table 7. ROC species, and their ROCSTAR scores, affiliated with the wet meadow habitat.

Species	ROCSTAR Score
sedge wren	4.79
broad-winged skipper	4.50
Tuckerman's sedge	4.35
eastern massasauga	4.33
two-spotted skipper	3.95
sedge skipper (*Euphyes dion*)	2.50
southern bog lemming	2.15

Table 8. ROC species, and their ROCSTAR scores, affiliated with the marsh habitat.

Species	ROCSTAR Score
black tern	7.10
tundra swan	6.37
northern pintail	6.36
sora	6.15
Virginia rail	6.15
blue-winged teal	6.04
marsh wren	5.99
American coot	5.98
muskrat	5.88
American wigeon	5.87
Wilson's snipe	5.65
pickerel frog	5.60
pied-billed grebe	5.59
American black duck	5.53
mink	5.52
northern leopard frog	5.45
lesser yellowlegs	5.22
eastern cricket frog	5.20
American bittern	5.13
least bittern	5.09
pectoral sandpiper	4.97
semipalmated sandpiper	4.72
trumpeter swan	4.65
sandhill crane	4.62

Species	ROCSTAR Score
tiger salamander	4.55
greater yellowlegs	4.55
narrowleaf pondweed	4.53
common gallinule	4.52
semipalmated plover	4.45
short-billed dowitcher	4.45
king rail	4.43
marsh speedwell	4.40
Graham's crayfish snake	4.30
solitary sandpiper	4.25
dunlin	4.15
water starwort	4.00
yellow-headed blackbird	3.98
Wilson's phalarope	3.90
stilt sandpiper	3.75
Blanding's turtle	3.73
American bullfrog	3.65
blue mudplantain	3.50
snailseed pondweed	3.45
eastern musk turtle	3.15
Blanchard's cricket frog	2.90

Table 9. Non-fish and non-mussel ROC species, and their ROCSTAR scores, affiliated with the main channel, channel border, secondary and tertiary channel, and impounded habitat.

Species	ROCSTAR Score
canvasback	7.59
lesser scaup	7.28
false map turtle	5.70
smooth softshell	5.30
bufflehead	5.19
spiney softshell	5.16
American white pelican	5.01
common merganser	4.44
bank swallow	4.22
mudpuppy	3.39
common tern	2.63
Forster's tern	2.48
common loon	2.38

Table 10. Fish and mussel ROC species, and their ROCSTAR scores, affiliated with the main channel, or the main channel border, secondary channel, and tertiary channel geomorphic areas.

Species	Geomorphic area	ROCSTAR Score
shovelnose sturgeon	main channel	6.25
sauger	main channel border, secondary channel, and tertiary channel	6.40
channel catfish	main channel border, secondary channel, and tertiary channel	6.25
walleye	main channel border, secondary channel, and tertiary channel	6.10
freshwater drum	main channel border, secondary channel, and tertiary channel	6.05
smallmouth bass	main channel border, secondary channel, and tertiary channel	5.80
flathead catfish	main channel border, secondary channel, and tertiary channel	5.75
paddlefish	main channel border, secondary channel, and tertiary channel	5.70
river redhorse	main channel border, secondary channel, and tertiary channel	5.35
lake sturgeon	main channel border, secondary channel, and tertiary channel	5.24
greater redhorse	main channel border, secondary channel, and tertiary channel	4.92

Species	Geomorphic area	ROCSTAR Score
smallmouth buffalo	main channel border, secondary channel, and tertiary channel	4.72
silver chub	main channel border, secondary channel, and tertiary channel	4.64
bigmouth buffalo	main channel border, secondary channel, and tertiary channel	4.61
western sand darter	main channel border, secondary channel, and tertiary channel	4.46
silver lamprey	main channel border, secondary channel, and tertiary channel	4.36
blue sucker	main channel border, secondary channel, and tertiary channel	4.21
shoal chub	main channel border, secondary channel, and tertiary channel	4.06
trout perch	main channel border, secondary channel, and tertiary channel	3.85
Mississippi silvery minnow	main channel border, secondary channel, and tertiary channel	3.79
chestnut lamprey	main channel border, secondary channel, and tertiary channel	3.69
American eel	main channel border, secondary channel, and tertiary channel	3.61
goldeye	main channel border, secondary channel, and tertiary channel	3.55
skipjack herring	main channel border, secondary channel, and tertiary channel	3.46
pallid shiner	main channel border, secondary channel, and tertiary channel	3.17
crystal darter	main channel border, secondary channel, and tertiary channel	2.71
ghost shiner	main channel border, secondary channel, and tertiary channel	2.50
wartyback	main channel border, secondary channel, and tertiary channel	5.85
Higgins eye pearlymussel	main channel border, secondary channel, and tertiary channel	5.68
black sandshell	main channel border, secondary channel, and tertiary channel	5.60
rock pocketbook	main channel border, secondary channel, and tertiary channel	5.45
monkeyface	main channel border, secondary channel, and tertiary channel	5.45
round pigtoe	main channel border, secondary channel, and tertiary channel	5.35
fawnsfoot	main channel border, secondary channel, and tertiary channel	5.35
washboard	main channel border, secondary channel, and tertiary channel	5.30
butterfly mussel	main channel border, secondary channel, and tertiary channel	5.30
spectaclecase	main channel border, secondary channel, and tertiary channel	5.30
sheepnose	main channel border, secondary channel, and tertiary channel	5.25
pistolgrip	main channel border, secondary channel, and tertiary channel	5.18
slough sandshell	main channel border, secondary channel, and tertiary channel	5.10
yellow sandshell	main channel border, secondary channel, and tertiary channel	5.10
mucket	main channel border, secondary channel, and tertiary channel	5.10
spike	main channel border, secondary channel, and tertiary channel	5.05
purple wartyback	main channel border, secondary channel, and tertiary channel	5.00
winged mapleleaf	main channel border, secondary channel, and tertiary channel	5.00
ebonyshell	main channel border, secondary channel, and tertiary channel	5.00
elephant-ear	main channel border, secondary channel, and tertiary channel	4.95

Table 11. Fish ROC species, and their ROCSTAR scores, affiliated with the contiguous backwater floodplain lake and backwater shallow aquatic geomorphic areas.

Species	Geomorphic area	ROCSTAR Score
bluegill	contiguous backwater floodplain lake and backwater shallow aquatic	7.40
largemouth bass	contiguous backwater floodplain lake and backwater shallow aquatic	6.40
yellow perch	contiguous backwater floodplain lake and backwater shallow aquatic	6.10
mud darter	contiguous backwater floodplain lake and backwater shallow aquatic	5.35
longnose gar	contiguous backwater floodplain lake and backwater shallow aquatic	5.25
shortnose gar	contiguous backwater floodplain lake and backwater shallow aquatic	5.08
weed shiner	contiguous backwater floodplain lake and backwater shallow aquatic	5.06
spotted sucker	contiguous backwater floodplain lake and backwater shallow aquatic	4.73
pugnose minnow	contiguous backwater floodplain lake and backwater shallow aquatic	4.47
bluntnose darter	contiguous backwater floodplain lake and backwater shallow aquatic	4.29
yellow bullhead	contiguous backwater floodplain lake and backwater shallow aquatic	4.16
brown bullhead	contiguous backwater floodplain lake and backwater shallow aquatic	4.15
black bullhead	contiguous backwater floodplain lake and backwater shallow aquatic	4.04
warmouth	contiguous backwater floodplain lake and backwater shallow aquatic	3.84
orangespotted sunfish	contiguous backwater floodplain lake and backwater shallow aquatic	3.80
yellow bass	contiguous backwater floodplain lake and backwater shallow aquatic	3.62
lake chubsucker	contiguous backwater floodplain lake and backwater shallow aquatic	3.50
starhead topminnow	contiguous backwater floodplain lake and backwater shallow aquatic	3.39
black buffalo	contiguous backwater floodplain lake and backwater shallow aquatic	3.39

Species	Geomorphic area	ROCSTAR Score
central mudminnow	contiguous backwater floodplain lake and backwater shallow aquatic	3.26
Iowa darter	contiguous backwater floodplain lake and backwater shallow aquatic	3.18
blackstripe topminnow	contiguous backwater floodplain lake and backwater shallow aquatic	3.16
pirate perch	contiguous backwater floodplain lake and backwater shallow aquatic	3.15

Appendix E - CCP Goals and Objectives

The 2006 CCP listed six goals to guide refuge management for a 15-year period (USFWS 2006). Two of the goals are pertinent to habitat management on the refuge and were used as a starting point when developing habitat management objectives.

- Environmental Health Goal (CCP Goal 2; with four objectives relevant to the HMP)
- Wildlife and Habitat Goal (CCP Goal 3; with 10 objectives relevant to the HMP)

Environmental Health Goal (CCP Goal 2)

We will strive to improve the environmental health of the refuge by working with others.

Objective 2.1: Water Quality

Working with others and through a more aggressive refuge program, seek a continuous improvement in the quality of water flowing through and into the refuge in terms of parameters measured by the Long Term Resource Monitoring Program of the Environmental Management Program (dissolved oxygen, major plant nutrients, suspended material, turbidity, sedimentation, and contaminants).

Objective 2.2: Water Level Management

By 2021, in coordination with the Corps of Engineers and the states, complete as many poolwide drawdowns as practicable based on ecological need, engineering feasibility, and available funding.

Objective 2.3: Invasive Plants

Continue current control efforts and by 2008, complete an invasive plant inventory. By 2010, achieve a 10 percent reduction in acres affected by invasive plants such as purple loosestrife, reed canarygrass, Eurasian milfoil, leafy spurge, crownvetch, Russian knapweed, knotweed, European buckthorn, garlic mustard, and Japanese bamboo. Emphasize the use of biological controls.

Objective 2.4: Invasive Animals

Increase efforts to control invasive animals through active partnerships with the states and other Service programs and federal agencies, and increase public awareness and prevention.

Wildlife and Habitat Goal (CCP Goal 3)

Our habitat management will support diverse and abundant native fish, wildlife, and plants.

Objective 3.1: Environmental Pool Plans

By 2021, in cooperation with various agencies and states, implement at least 30 percent of the refuge-priority Environmental Pool Plan actions and strategies in Pools 4-14 as summarized in Table 25 on page 147 (see Appendix N of the Final EIS/CCP (U.S. Fish and Wildlife Service 2006) for examples of Environmental Pool Plan maps).

Objective 3.2: Guiding Principles for Habitat Management Programs

Adopt and use the following guiding principles when designing or providing input to design and construction of habitat enhancement projects:

- Management practices will restore or mimic natural ecosystem processes or functions to promote a diversity of habitat and minimize operations and maintenance costs. Mimicking natural processes in an altered environment often includes active management and/or structures such as drawdowns, moist soil management, prescribed fire, grazing, water control structures, dikes, etc.

- Maintenance and operation costs of projects will be weighed carefully since annual budgets for these items are not guaranteed.

- Terrestrial habitat on constructed islands and other areas needs to best fit the natural processes occurring on the river, which in many cases will allow natural succession to occur.

- If project features in refuge Waterfowl Hunting Closed Areas serve to attract public use during the waterfowl season, spatial and temporal restrictions of uses may be required to reduce human disturbance of wildlife.

- The aesthetics of projects, in the context of visual impacts to the landscape, should be considered in project design in support of refuge Goal 1, Landscape.

Objective 3.3: Monitor and Investigate Fish and Wildlife Populations and Their Habitats

By January 2008, amend the 1993 Wildlife Inventory Plan to include more species groups such as fish, reptiles, mussels, and plants, and increase the amount of applied research being done on the refuge.

Objective 3.4: Threatened and Endangered Species Management

By the end of 2008, begin monitoring of all federally listed threatened or endangered and candidate species on the refuge, and by 2010, have in place management plans for each species to help ensure their recovery. Cooperate with the states in the monitoring and management of state-listed species.

Objective 3.5: Furbearer Trapping

Update the refuge trapping plan by June 2007, continuing the existing trapping program until the update is completed and ready for implementation.

Objective 3.6: Fishery and Mussel Management

By the end of 2008, complete a Fishery and Mussel Management Plan for the refuge which incorporates current monitoring and management by the states, the Corps of Engineers, and other Service offices and agencies.

Objective 3.7: Commercial Fishing and Clamming

By the end of 2008, complete a Fishery and Mussel Management Plan, and by January 2010, have a mechanism or agreements in place to ensure that Refuge System permit requirements are incorporated in state-issued permits.

Objective 3.8: Turtle Management

By spring 2008, initiate a 3- to 5-year turtle ecology study on representative habitats of the entire refuge. Continue to cooperate with the states, U.S. Geological Survey, and the Corps of Engineers in monitoring turtle populations on certain refuge areas.

Objective 3.9: Forest Management

Complete by the end of 2008, in cooperation with the Corps of Engineers, a forest inventory of the refuge, and by 2010, complete a Forest Management Plan for the refuge.

Objective 3.10: Grassland Management

Maintain 5,700 acres of grassland habitat on the refuge through the use of various management tools including prescribed fire, haying, grazing, and control of invasive plants. Address grassland conservation and enhancement in a step-down Habitat Management Plan.

4.3.2 Relationship between CCP and HMP Objectives

The objectives for both CCP Goals were considered during the development of the HMP and amended to reflect the current state of the refuge (updated from the CCP), incorporated into new HMP-derived objectives, and/or modified to better reflect the SMART criteria used for refuge planning (USFWS 2004). Table 4-1 below describes the link between CCP and HMP objectives.

Table 4-1. Revision and reorganization of the the Upper Mississippi River National Wildlife & Fish Refuge CCP Objectives.

CCP Objective	Change between CCP and HMP	HMP Objective(s)	Rationale
Environmental Health Goal (CCP Goal 2)			
Objective 2.1: Water Quality	Elements are included in individual habitat/partnership objectives.	Partnership objectives for five aquatic or wetland habitats	Improving water quality will require partnerships. Including partnerships in individual habitat objectives provides greater detail and focus on desired outcomes.
Objective 2.2: Water Level Management	Updated to meet SMART criteria.	Marsh objectives	Elements of the CCP objective have been integrated into the HMP marsh objectives.
Objective 2.3: Invasive Plants	Updated to meet SMART criteria.	All objectives undertaken by the refuge alone.	Invasive species control is integrated into performance criteria for habitat management objectives.
Objective 2.4: Invasive Animals	Updated to meet SMART criteria.	All objectives undertaken by the refuge alone.	Invasive species control is integrated into performance criteria for habitat management objectives.
Wildlife and Habitat Goal (CCP Goal 3)			
Objective 3.1: Environmental Pool Plans	Partnerships are identified by specific habitats.	Partnership objectives for Bottomland Forest and five aquatic or wetland habitats	Breaking out partnerships by habitat provides greater detail on the needs, roles, and desired outcomes of partnership activities.
Objective 3.2: Guiding Principles for Habitat Management Programs	Updated to meet SMART criteria.	All objectives undertaken by the refuge alone.	Integrated into performance criteria for habitat management objectives.
Objective 3.3: Monitor and Investigate Fish and Wildlife Populations and Their Habitats	Updated to meet SMART criteria and integrated into all objectives.	All objectives undertaken by the refuge alone.	The refuge will be developing an inventory and monitoring plan following the HMP.
Objective 3.4: Threatened and Endangered Species Management	Updated to meet SMART criteria.	All objectives undertaken by the refuge alone.	During the development of the HMP, opportunities to support trust resources were considered and integrated

CCP Objective	Change between CCP and HMP	HMP Objective(s)	Rationale
			into habitat management objectives, when possible.
Objective 3.5: Furbearer Trapping	Completed. Not included as a separate objective in the HMP.	Not applicable.	The refuge completed a plan in 2007.
Objective 3.6: Fishery and Mussel Management	Completed. Not included as a separate objective in the HMP.	Not applicable.	The UMRCC Fisheries Committee completed a fisheries management plan for the Upper Mississippi River in 2010. The refuge adopted this plan in 2014.
Objective 3.7: Commercial Fishing and Clamming	Completed. Not included as a separate objective in the HMP.	Not applicable.	The UMRCC Fisheries Committee completed a fisheries management plan for the Upper Mississippi River in 2010. The refuge adopted this plan in 2014.
Objective 3.8: Turtle Management	Updated to meet SMART criteria and integrated into monitoring for a habitat.	Grassland and Marsh	Turtle populations and/or turtle habitat will be monitored for measuring performance towards this objective. Population monitoring will be addressed in the inventory and monitoring plan.
Objective 3.9: Forest Management	Completed. Not included as a separate objective in the HMP.	Not applicable.	USACE completed an Upper Mississippi River Systemic Forest Stewardship Plan in 2012. The plan was adopted by the refuge in 2013.
Objective 3.10: Grassland Management	Updated to meet SMART criteria.	Grassland objective	Specific measures of what the grassland habitats should look like were added to the HMP objective.

Appendix F - Refuge District Management Units

Management units of each refuge district where habitat management activities are planned. For all management units identified, the habitat designation is based on the preponderance of habitat targeted for management actions within the management unit. In many instances, inclusions of other habitats may occur within the boundaries of the management unit and may be subject to management actions as well, when appropriate. For example, a management unit that is characterized as marsh may have a preponderance of shallow marsh perennial vegetation with smaller inclusions of deep marsh perennial vegetation as well as inclusions of wet meadows characterized by reed canarygrass, and it is possible that the entire mosaic would be subjected to the same management action such as a prescribed burn. The acreage associated with each management unit reflects the largest total area that is targeted for treatment(s), and that total targeted area may include a mosaic of habitats.

Table 1. Winona District management units.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
Grassland	1–5 years	Wabasha Prairie	73	Planted red pines occupy 25 acres of the unit. Numerous areas are invaded by sumac and red oak resprouts. Black locust is prevalent in the southeastern portion of the unit.	Percent cover of trees will be less than10%. Shrub cover will be less than 25%. Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs. Native forbs cover will be at least 25% . Native grass cover will be 40–75%.	The highest priority is for tree and shrub removal on the north side of the unit. Prescribed fire will be a priority management action to achieve objectives. Following achievement of desired condition, maintenance activities will occur during years 5–15.
Grassland	1–5 years	Spring Lake – Deep Hole Island (northeast segment closest to shore)	8	Black locust, crown vetch, and various non-native thistle species are scattered throughout the islands.	Tree cover will be less than10%. Percent cover of shrubs will be less than 25%.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
						Removal of black locust is priority on Deep Hole Island nearest to the shore. Removal will be done using cutting and chemically treating stumps. Following achievement of desired condition, maintenance activities will occur during years 5–15.
Grassland	1–5 years	Prairie Island Dike	25	Canopy cover of sumac and prickly locust is higher than 20% on the east end of the unit. Garlic mustard, leafy spurge, exotic thistles, and spotted knapweed are prevalent.	Percent cover of trees will be less than10%. Percent cover of shrubs will be less than 25%. Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover will be between 40–75%.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Removal of sumac and prickly locust is highest priority using a combination of foliar spray as well as cutting and treating stumps. Leafy spurge, thistle, and spotted knapweed will be treated using chemical methods. Garlic mustard second year plants will be removed by hand.
Grassland	5–10 years	LD4 Peninsula	24	Black willows are abundant across the entire unit.	Tree canopy cover will be less than 5%. Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover will be	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Following restoration activities (cutting and treating of black willow) in years 5-10, maintenance activities will occur during years 10–15.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					between 40–75%.	
Grassland	5-10 years	McNally Landing	5	Canopy cover from sumac is higher than 10 percent.	Tree canopy cover will be less than 5%. Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover be between 40–75%.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Removal of sumac is priority using cutting and chemically treating stumps. Prescribed fire will be a priority management action to achieve objectives.
Bottomland forest	1–5 years	Wabasha Bottoms	80	Dominated by mature silver maples and cottonwood. Poor regeneration of bottomland tree species. Several patches of European buckthorn in the unit.	At least 10 percent of the bottomland forest will be regenerating in the early successional stage. Composition of shrub cover will be at least 90 percent native species.	Use shelterwood harvest on roughly half of the unit to encourage existing tree seedling growth or conduct tree plantings. Invasive species may need to be controlled in areas subjected to management actions. Removal of European buckthorn using mechanical and herbicidal application. During the first six years following management actions, monitor tree seedling and sapling survival three times on a biennial basis.
Bottomland forest	1–5 years	White Water Delta	26	Buckthorn density is variable on the unit. There are at least 4 acres of garlic mustard at high density.	Composition of ground layer herbaceous vegetation will be at least 90% native species. Composition of shrub cover will be at least 90% native species.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE Removal of European buckthorn on 23 acres of the unit using mechanical and herbicidal application.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
						Removal of garlic mustard using herbicidal application in the spring. After the initial herbicidal application, mechanical removal or additional herbicidal treatments should be use to follow up in years 5-10.
Bottomland forest	1–5 years	Spring Lake – Snipe, Bulrush, and Deep Hole Islands (portions of Deep Hole Island extending away from shore)	14	Swamp white oak, cottonwood, and silver maple have been previously planted in the unit. There is cottonwood and birch growing naturally on parts of the unit. All tree species' heights are less than 20ft. Black locust, crown vetch, and various non-native thistle species are scattered throughout the unit.	There will be at least two co-dominant tree species other than silver maple. Overstory canopy cover will be at least 70%.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Removal of black locust is priority and will be done using cutting and chemically treating stumps. Plant tree species appropriate for the elevation, aspect, and hydrology on Snipe Island. Consider the use of RPM trees when funding allows. Once every two years within the first six years of the bottomland forest enhancement, monitor tree sapling survival.

Table 2. La Crosse District management units.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
Grassland	1-5 years	Browns Marsh - Bonsack and Wright	14	Historically a savanna that was converted to crops. Upon purchase by FWS has been planted with various seed mixes. Invasive species present including Siberian elm and spotted knapweed.	Tree canopy cover will be less than 5%. Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses. Native forb cover will be at least 25%. Native grass cover be between 40–75%.	Prescribed fire, mowing, and invasive species control.
Grassland	5-15 years	Browns Marsh - Bonsack and Wright	14	Historically a savanna that was converted to crops. Upon purchase by FWS has been planted back with various seed mixes. Invasive species present including Siberian elm and spotted knapweed.	Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses. Native forb cover will be at least 25%. Native grass cover be between 40–75%.	Prescribed fire, mowing, and invasive species control.
Grassland	1-15 years	Browns Marsh-Mathy	8	Comprised of remnant sand prairie with species such as little and big bluestem, hoary puccoon, stiff goldenrod and purple prairie clover.	Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses. Native forb cover will be at least 25%. Native grass cover be between 40–75%.	six acres of grassland and two acres of tree plantation Prescribed fire, mowing, and invasive species control.
Grassland	1-15 years	Brice Prairie Tract	168	Historically a sand prairie that was converted to	Tree canopy cover will be less than 5%.	Prescribed fire, mowing, and invasive species control.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
				crops and/or bison farm. Has been planted back to prairie with various seed mixes. Some invasive species present include Siberian elm, crown vetch, smooth brome, and Kentucky bluegrass.	Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover be between 40–75%.	
Grassland	1-15 years	Midway Prairie	5	Comprised of remnant sand prairie with species such as little bluestem, prairie and sand dropseed, hoary puccoon, pasque flowers and purple poppy mallow.	Tree canopy cover will be less than 5%. Shrub canopy cover will be less than 10%. Herbaceous species richness will consist of at least five species of native grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover be between 40–75%.	Prescribed fire, mowing, and invasive species control.
Bottomland forest	1-15 years	Upper Pool 7	50	Majority of this unit is even-aged old floodplain forest that ranges from 66-99% density and greater than 50 feet tall, with 72% of stands at greater than 90% density. This unit has a higher proportion of floodplain forest with less than 29 days of flooding annually compared to other units.	Bottomland forests located on higher elevations of the floodplain that are subjected to less-frequent flooding (<29 days flood duration) will be comprised of species such as oaks and hickories. Bottomland forests located on lower elevations of the floodplain that are subjected to	Enhance 10 acres every 3 years via Timber Stand Improvement (TSI) and other forestry practices. Remaining acreage will be in a state of maintenance. 47 acres of upland forest encompassed by this unit are included here because habitat treatments will be the same.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	
Bottomland forest	1-15 years	Black River Bottoms	100	Majority of this unit is even-aged old floodplain forest that ranges from 66-99% density and greater than 50 feet tall, with 55% of stands at greater than 90% density. This unit has the largest contiguous forest blocks in the District.	Bottomland forests located on higher elevations of the floodplain that are subjected to less-frequent flooding (<29 days flood duration) will be comprised of species such as oaks and hickories. Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	Enhance 20 acres every 3 years via Timber Stand Improvement (TSI) and other forestry practices. Remaining acreage will be in a state of maintenance.
Bottomland forest	1-15 years	Black River Delta	100	Currently mapped as wet meadow habitat dominated by reed canary grass. May have some native species such as sedges, cutgrass and forbs as well as a shrub component. Historically these areas were floodplain forest.	Bottomland forest located in the lowest elevations of the floodplain that are subject to frequent flooding will be comprised of species tolerant to flooding (>29 day flood duration) such as silver maple, cottonwood and willow.	Enhance 20 acres every 3 years via Timber Stand Improvement (TSI) and other forestry practices.
Bottomland forest	5-10 years	Upper Pool 8	20	Majority of this unit is even-aged old floodplain forest that ranges from 66-99% density and greater than 50 feet tall, with 90% of stands at greater than 90% density.	Bottomland forests located on higher elevations of the floodplain that are subjected to less-frequent flooding (<29 days flood duration) will be comprised of species such as oaks and	Enhance 20 acres via Timber Stand Improvement. Remaining acreage will be in a state of maintenance.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					hickories. Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	
Bottomland forest	1-15 years	Root River Tract West	20	Dominated by reed canary grass and some native species such as sedges, cutgrass and some forbs.	Bottomland forest located in the lowest elevations of the floodplain that are subject to frequent flooding will be comprised of species tolerant to flooding (>29 day flood duration) such as silver maple, cottonwood and willow.	Year 1-5: RCG control and tree planting and enhance existing forest stands via Timber Stand Improvement (TSI) and other forestry practices Years 6-15: maintenance.
Bottomland forest	1-5 years	Root River Tract East (Overall)	50	This unit is almost entirely comprised of even-aged old floodplain forest of 66-90% density and greater than 50 feet tall (697 acres) with 43% of stands at greater than 90% density, and Salix community (260 acres). Species to control include: Japanese knotweed, Japanese hops, and pampas grass.	Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	Enhance 10 acres every 3 years via Timber Stand Improvement (TSI) and other forestry practices. Chemical and/or mechanical invasive species treatment.
Bottomland forest	5-10 years	Root River Tract East (Overall)	50	This unit is almost entirely comprised of even-aged old floodplain forest of 66-90% density and greater than 50 feet tall (697 acres) with 43% of stands at	Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of	Enhance 10 acres every 3 years via Timber Stand Improvement (TSI), harvest, and/or other forestry practices. Map, treat, and shade out Japanese hops (~2014) along the riverbank and near the levee.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
				greater than 90% density, and Salix community (260 acres).	species such as silver maple, cottonwood, and willow.	Plant RPMs in tree tubes to shade out hops. Remaining acreage will be in a state of maintenance.
Bottomland forest	1-5 years	Root River Tract East - Field 9	10	As of 2016, the condition of Field 9 included a former agricultural field planted with swamp white oak while cottonwood is abundant because of unassisted regeneration.	Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	Thin cottonwood and control RCG to ensure survival of swamp white oak.
Bottomland forest	1-5 years	Root River Tract East - Fields 2, 5, 6, 7	29	Former agricultural fields that have been fallow since 2013.	Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	In 2017 plant bare-root and RPM trees into these locations. Maintain plantings and treat RCG through mowing, burning (years: 2-5).
Bottomland forest	1-15 years	Lawrence Lake	100	This unit is primarily comprised of even-aged old floodplain forest of 66-90% at density and greater than 50 feet tall with 63% of stands at greater than 90% density, and Salix community.	Bottomland forests located on lower elevations of the floodplain that are subjected to more-frequent flooding (~29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	Enhance 20 acres every 3 years via Timber Stand Improvement (TSI), harvest, and/or other forestry practices. Remaining acreage will be in a state of maintenance.
Bottomland forest	5 -15 years	Wisconsin Islands	20	Constructed islands of various ages and elevations that were built as part of UMRR, seeded with native prairie plants, and planted with floodplain forest tree species.	Bottomland forests located on lower elevations of the floodplain that are subjected to more frequent flooding (29-75 days flood duration) will be comprised of species such as silver maple, cottonwood, and willow.	Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Enhance 20 acres via Timber Stand Improvement (TSI), planting, and/or other forestry practices.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
						Treat 17 acres per year over 15 years.
Wet meadow	1-15 years	Upper Halfway Creek North	116	Dominated by sedges with some perennial emergent, and RCG, rice cutgrass and forbs. Some areas have a shrub component.	Tree and shrub canopy cover less than 10%, native herbaceous cover at least 50%, native sedge cover at least 25%.	87 acres of the site are wet meadow and 29 acres are former agriculture. Treat 25 acres with annual haying. Treat 87 acres with prescribed burning twice in 15 years. Mechanical treatments every 5 years.
Wet meadow	1-15 years	Root River Tract East	150	Dominated by sedges with some perennial emergent, and RCG, rice cutgrass and forbs. Some areas have a shrub component.	Tree and shrub canopy cover less than 10%, native herbaceous cover at least 50%, native sedge cover at least 25%.	376 acres of the site are wet meadow while 134 acres are former agriculture. Treat 50 acres/year with haying, mow and/or fecon or discing. Treat approximately 50 acres at least three times with prescribed fire.
Marsh	1-5 years	Black River Delta	700	Shallow marsh perennial vegetation with some inclusions of reed canarygrass and deep marsh perennial vegetation.	Native perennial marsh vegetation cover at least 60%. In suitable areas, such as inclusions of reed canarygrass, vegetation height less than 10 inches during fall and/or spring migration, and/or annual seed-producing plants at least 65% cover.	Biological control of purple loosestrife using beetle treatment, as well as herbicide control if needed. Conduct a prescribed burn and use mowing and disking if possible to create a mosaic of marsh habitats.
Marsh	1-5 years	Middle Pool 7	100	Deep marsh perennial vegetation.	Native perennial marsh vegetation cover at least 60%.	Biological control of purple loosestrife using beetle treatment, as well as herbicide control if needed. Conduct a prescribed burn to create a mosaic of marsh habitats.
Marsh	1-5 years	Lake Onalaska	50	Shallow marsh perennial vegetation with some inclusions of reed canarygrass and deep marsh perennial vegetation.	Native perennial marsh vegetation cover at least 60%. In suitable areas, such as inclusions of reed canarygrass, vegetation height less than 10 inches during fall and/or spring	Biological control of purple loosestrife using beetle treatment, as well as herbicide control if needed. Conduct a prescribed burn and use mowing and disking if possible to create a mosaic of marsh habitats.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					migration, and/or annual seed-producing plants at least 65% cover.	
Marsh	1-5 years	Upper Halfway Creek South	100	Shallow marsh perennial vegetation with some inclusions of reed canarygrass and deep marsh perennial vegetation. Coverage of purple loosestrife approximately 50% of site.	Native perennial marsh vegetation cover at least 60%. In suitable areas, such as inclusions of reed canarygrass, vegetation height less than 10 inches during fall and/or spring migration, and/or annual seed-producing plants at least 65% cover.	Biological control of purple loosestrife using beetle treatment, as well as herbicide control if needed. Conduct a prescribed burn and use mowing and disking if possible to create a mosaic of marsh habitats.
Marsh	1 to 5 years	Browns Marsh	550	Shallow marsh perennial vegetation with some inclusions of reed canarygrass and deep marsh perennial vegetation.	Native perennial marsh vegetation cover at least 60%. In suitable areas, such as inclusions of reed canarygrass, vegetation height less than 10 inches during fall and/or spring migration, and/or annual seed-producing plants at least 65% cover.	Biological control of purple loosestrife using beetle treatment, as well as herbicide control if needed. Conduct a prescribed burn and use mowing, disking and/or grazing if possible to create a mosaic of marsh habitats.
Marsh	1 to 5 years	Blue and Target Lake	1,000	Shallow marsh perennial vegetation with some inclusions of reed canarygrass and deep marsh perennial vegetation.	Native perennial marsh vegetation cover at least 60%. In suitable areas, such as inclusions of reed canarygrass, vegetation height less than 10 inches during fall and/or spring migration, and/or annual seed-producing plants at least 65% cover.	Conduct prescribed burning and use mowing and disking if possible to create a mosaic of marsh habitats.
Marsh	1 to 5 years	Lawrence Lake	1,000	Shallow marsh perennial vegetation with some inclusions of reed	Native perennial marsh vegetation cover at least 60%.	Conduct prescribed burning and use mowing and disking if possible to create a mosaic of marsh habitats.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
				canarygrass and deep marsh perennial vegetation.	In suitable areas, such as inclusions of reed canarygrass, vegetation height less than 10 inches during fall and/or spring migration, and/or annual seed-producing plants at least 65% cover.	

Table 3. McGregor District management units.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
Savanna	1–5 years	Ballard	12	Fire-tolerant tree species represent less than 60% of the canopy species. Invasive exotic herbaceous ground cover greater than 70%.	Total tree canopy cover will be less than 50%. At least 75% of canopy species will be represented by fire-tolerant hard mast producing tree species. Shrub cover will be less than 50%. Native forb cover will be at least 25%. Native grass cover will be between 40–75%.	Restoration efforts started in winter 2013 with a timber sale to open up the tree canopy. Prescribed fire will be a priority management action to achieve objectives. Restoration activities will include prescribed burning, and mechanical removal and/or herbicide spot treatment of exotic and invasive plants.
Savanna	5–10 years	Ballard	12	Fire-tolerant tree species canopy cover of less than 60%. Invasive exotic herbaceous ground cover greater than 70%.	Total tree canopy cover will be less than 50%. At least 75% of canopy species will be represented by fire-tolerant hard mast producing tree species. Shrub cover will be less than 50%. Native forb cover will be at least 25%. Native grass cover will be between 40–75%.	Prescribed fire will be a priority management action to achieve objectives. Continue prescribed burning and mechanical/herbicide treatment of exotic and invasive species. Add native herbaceous species to understory with interseeding.
Grassland	1–5 years	Ballard	22	Species composition is approximately 75% exotic cool-season grasses and 20% exotic forbs.	Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs.	Prescribed fire will be a priority management action to achieve objectives. Broadcast seeding occurred in spring 2014. Control exotic cool-season grasses with prescribed burning; the first burn should occur by 2017. Control exotic forbs with prescribed burning, mowing and spot spraying.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					Native forb cover will be at least 25%. Native grass cover will be between 40–75%.	
Grassland	5–10 years	Sturgeon Slough	2	Mixture of warm season grasses with invasive species.	Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover will be between 40–75%.	Coordinate with DOT along the highway for maintenance. Follow restoration activities by spraying invasive species, maintenance with mowing.
Grassland	10–15 years	Various small units scattered throughout the District	154	Mixture of warm season grasses with invasive species.	Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool-season grasses, and at least 20 species of native forbs. Native forb cover will be at least 25%. Native grass cover will be between 40–75%.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Follow restoration activities by spraying invasive species, maintenance with mowing.
Bottomland forest	1–5 years	Turkey River Bottoms	151	Abundant cottonwood, box elder and willow regeneration in old agricultural field with reed canarygrass and ragweed.	Lowest elevations of floodplain that are subject to frequent flooding will be comprised of species tolerant of flooding. Higher elevations that are subjected to less frequent flooding should be planted to species such as	Some of the areas considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Continue mowing and treating invasive ground cover until trees are above the height of herbaceous vegetation.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					oaks and hickories. At least two co-dominant tree species other than silver maple.	When necessary, treat trees with Plantskydd to reduce deer browsing. Continue planting flood tolerant trees in areas that need restored. Experimental treatments have been conducted in some areas to establish desired tree species in areas dominated by willows.
Bottomland forest	1–5 years	Pool 9 Capoli Slough Islands	32	Recent plantings of oaks, river birch, elm, walnut, and Hackberry in the last 6 years.	Lowest elevations of floodplain that are subject to frequent flooding will be comprised of species tolerant of flooding. Higher elevations that are subjected to less frequent flooding will be comprised of species such as oaks and hickories. At least two co-dominant tree species other than silver maple.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Continue mowing and treating invasive ground cover until trees are above the height of herbaceous vegetation. When necessary, treat trees with Plantskydd to reduce deer browsing. Continue planting flood tolerant trees in areas that need restored. Experimental treatments have been conducted in some areas to establish desired tree species in areas dominated by willows. Additional tree plantings occurred on the Capoli Islands in 2016.
Bottomland forest	1–5 years	Pool 9 Harpers Slough Islands	52	Island construction occurring in 2016.	Lowest elevations of floodplain that are subject to frequent flooding will be comprised of species tolerant of flooding. Higher elevations that	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					are subjected to less frequent flooding will be comprised of species such as oaks and hickories. At least two co-dominant tree species other than silver maple.	Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Continue mowing and treating invasive ground cover until trees are above the height of herbaceous vegetation. When necessary, treat trees with Plantskydd to reduce deer browsing. Continue planting flood tolerant trees in areas that need restored. Experimental treatments have been conducted in some areas to establish desired tree species in areas dominated by willows. Tree planting will commence on the Harpers Slough Islands upon completion of island construction activities.
Bottomland forest	1–5 years	Cold Springs	1	Dominated by reed canarygrass and willow	Lowest elevations of floodplain that are subject to frequent flooding will be comprised of species tolerant of flooding. Higher elevations that are subjected to less frequent flooding will be comprised of species such as oaks and hickories. At least two co-dominant tree species other than silver maple.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Continue mowing and treating invasive ground cover until trees are above the height of herbaceous vegetation. When necessary, treat trees with Plantskydd to reduce deer browsing. Continue planting flood tolerant trees in areas that need restored. Experimental treatments have been conducted in some areas to establish desired tree species in areas dominated by willows.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
						Tree planting at Cold Springs will be done on dredge placement site
Bottomland forest	5–10 years	Whalen	50	Floodplain area dominated by reed canarygrass and willow with recently planted swamp white oaks, river birch, and red osier dogwood.	Lowest elevations of floodplain that are subject to frequent flooding will be comprised of species tolerant of flooding. Higher elevations that are subjected to less frequent flooding will be comprised of species such as oaks and hickories. At least two co-dominant tree species other than silver maple.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Continue mowing and treating reed canarygrass until trees are above vegetation height. If necessary, treat trees to reduce browsing from deer. Some experimental treatments have been conducted to areas, to introduce mixed tree species into willow patches. Willow saplings to shade out reed canarygrass. Conduct additional plantings as necessary to fill in gaps where previous plantings have failed.
Bottomland forest	10–15 years	Turkey River Bottoms	151	Abundant cottonwood, box elder and willow regeneration in old agricultural field with reed canarygrass and rag weed. Recent plantings of oaks, river birch, elm, walnut, and hackberry have been completed during the previous 6 years.	Lowest elevations of floodplain that are subject to frequent flooding will be comprised of species tolerant of flooding. Higher elevations that are subjected to less frequent flooding will be comprised of species such as oaks and hickories. At least two co-dominant tree species other than silver maple.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Continue mowing and treating reed canarygrass until trees are above vegetation height. If necessary, treat trees to reduce browsing from deer. Conduct additional plantings as necessary to fill in gaps where previous plantings have failed.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
Marsh	1–5 years	Guttenberg Ponds	62		Annual, seed-producing plants such as smartweeds will be at least 65% of the total cover. Perennial plant species such bulrush and willows will be no greater that 35% of the total cover.	Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents Two moist soil units where water level management is highly influenced by adjacent river elevations. Follow restoration activities: treating of invasive species, monitor/restore native plant species.

Table 4. Savanna District management units.

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
Upland Forest	1–15 years	Lost Mound	148	Total canopy cover is less than 50%, of which approximately 50% of the canopy species are fire-tolerant hard mast producing tree species. Ground layer herbaceous vegetation is approximately 50% native species. Shrub cover is approximately 50% native species.	Total canopy cover will be at least 50%, and greater than 50% of the canopy species will be fire-tolerant hard mast producing tree species. Ground layer herbaceous vegetation will be at least 60% native species. Shrub cover will be at least 60% native species.	Some of the areas considered here are co-managed by the USFWS, the US Department of Defense, and the Illinois DNR. Management of these areas will continue to be done in coordination with these entities. Prescribed fire will be a priority management action to achieve objectives. Upland forests at the Lost Mound unit are a higher priority than upland forests at the Simpson, Duckfoot, and Feugan's units.
Upland Forest	1–15 years	Simpson	5	Total canopy cover is greater than 70%, of which more than 50% of the total canopy species are fire-tolerant hard mast producing tree species. Average mature canopy tree height is approximately 40 feet Ground layer herbaceous vegetation is approximately 50% native species. Shrub cover is approximately 50% native species.	Total canopy cover will be at least 50%, and greater than 50% of the canopy species will be fire-tolerant hard mast producing tree species. Mature canopy height will average at least 50 feet. Ground layer herbaceous vegetation will be at least 60% native species. Shrub cover will be at least 60% native species.	Prescribed fire will be a priority management action to achieve objectives Upland forests at the Lost Mound unit are a higher priority than upland forests at the Simpson, Duckfoot, and Feugan's units
Upland Forest	1–15 years	Duckfoot	5	Total tree canopy cover is greater than 75% Tree size classes consist of less than 20% being re-sprouts and saplings, less than 30% being pole class, and less than 45% being saw log class	Total canopy cover will be at least 50%, and greater than 50% of the canopy species will be fire-tolerant hard mast producing tree species. Tree size classes will consist of 20% re-sprouts and	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
				Average mature canopy tree height is approximately 40 feet Ground layer herbaceous vegetation is approximately 50% native species Shrub cover is approximately 50% native species	saplings, 35% pole class, and 45% saw log class. Mature canopy tree height will average 50 feet. Ground layer herbaceous vegetation will be at least 60% native species. Shrub cover will be at least 60% native species.	identified in HREP planning and agreement documents. Prescribed fire will be a priority management action to achieve objectives Upland forests at the Lost Mound unit are a higher priority than upland forests at the Simpson, Duckfoot, and Feugan's units
Upland Forest	1-15 years	Fuegen's	24	Total tree canopy cover is approximately 55% Mature canopy tree height is approximately 40 feet Ground layer herbaceous vegetation is approximately 50% native species Shrub cover is approximately 50% native species	Total canopy cover will be at least 50%, and greater than 50% of the canopy species will be fire-tolerant hard mast producing tree species. Mature canopy tree height will average 50 feet. Ground layer herbaceous vegetation cover will be at least 60% native species. Shrub cover will be at least 60% native species.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Prescribed fire will be a priority management action to achieve objectives Upland forests at the Lost Mound unit are a higher priority than upland forests at the Simpson, Duckfoot, and Feugan's units
Savanna	1–15 years	Lost Mound	450	Tree canopy cover is approximately 50% Approximately 50% of the total tree canopy species composition is represented by native fire-tolerant hard mast producing tree species Shrub cover is approximately 35% Native forb cover is approximately 35%	Tree canopy cover will be less than 50%. At least 75% of the tree canopy composition will be represented by native fire-tolerant hard mast producing tree species. Shrub cover will be less than 50%. Native forb cover will be at least 25%. Native grass cover will be 40–75%.	Some of the areas considered here are co-managed by the USFWS, the US Department of Defense, and the Illinois DNR. Management of these areas will continue to be done in coordination with these entities. In many areas the ground layer is dominated by crown vetch Prescribed fire will be a priority management action to achieve objectives Native grass and forb seed can be harvested at many areas and used for reseeding disturbed areas, as well as interseeding areas

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
				Native grass cover is approximately 50%		The optimal time for tree removal activities is the dormant season in part so disturbance to native vegetation is minimized
Grassland	1–15 years	Lost Mound	2,837	Percent cover of shrubs is approximately 25%. Percent cover of native forbs is approximately 25%. Native grass cover is approximately 50%. Percent bare ground is approximately 10%. Percent litter is approximately 30%.	Percent cover of shrubs will be less than 25%. Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool season grasses, and at least 20 species of native forb. Percent cover of native forbs will be at least 25%. Native grass cover will be between 40–75%. Treeless habitat patches of at least 75 acres will be provided or maintained.	Some of the areas considered here are co-managed by the USFWS, the US Department of Defense, and the Illinois DNR. Management of these areas will continue to be done in coordination with these entities. Spotted knapweed, crown vetch and other invasive species are present on ~80% of the area Prescribed fire will be a priority management action to achieve objectives Native grass and forb seed can be harvested at many areas and used for reseeding disturbed areas, as well as interseeding other areas The optimal time for tree removal activities is the dormant season in part so disturbance to native vegetation is minimized Grasslands at the Lost Mound and Thomson units are a higher priority than grasslands at the Ingersoll unit.
Grassland	1–15 years	Thomson	361	Native grass cover is approximately 70%. Shrub cover is approximately 20%. Native forb cover is approximately 25%.	Percent cover of shrubs will be less than 25%. Herbaceous species richness will consist of at least five species of native grasses, at least two of which will be native cool season grasses, and at least 20 species of native forb. Percent cover of native forbs will be at least 25%. Native grass cover will be	Prescribed fire will be a priority management action to achieve objectives The optimal time for tree removal activities is the dormant season in part so disturbance to native vegetation is minimized

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					between 40–75%.	
Grassland	1–15 years	Ingersoll	38	Shrub cover is approximately 20%. Native grass cover is approximately 70%. Native forb cover is approximately 20%.	Shrub cover will be less than 25%. Native forb cover will be at least 25%. Native grass cover will be between 40-70%.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Prescribed fire will be a priority management action to achieve objectives.
Marsh	1–15 years	Sloane	137	Annual, seed-producing plant species such as smartweed and wild millet are approximately 45% of the total cover. Native perennials such as bulrush and cattails are approximately 35% of the total cover. Woody plants are approximately 20% of total cover.	Annual, seed-producing plant species such as smartweed and wild millet will be at least 65% of the total cover. Perennial plant species such as bulrush, reed canarygrass and purple loosestrife will be no greater than 35% of the total cover. Woody plants will be no greater than 35% of the total cover. Water depths during fall and spring migration periods will be between 0.5–10 inches.	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Woody plant removal/control is also necessary on the levees and around water control structures. Prescribed fire, herbicides, and disking treatments will all be used as appropriate and when necessary to achieve objectives Sloane and Spring Lake are higher priorities than Duckfoot and Pleasant Creek
Marsh	1-15 years	Upper Spring Lake	552	Annual, seed-producing plant species such as smartweed and wild millet are approximately 35% of the total cover. Native perennials such as bulrush and cattails are approximately 25% of the total cover. Woody plants are approximately 45% of total cover.	Annual, seed-producing plant species such as smartweed and wild millet will be at least 65% of the total cover. Perennial plant species such as bulrush, reed canarygrass and purple loosestrife will be no greater than 35% of the total cover. Woody plants will be no	The entire area considered here is co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Woody plant removal/control is also necessary on the levees

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					greater than 35% of the total cover. Water depths during fall and spring migration periods will be between 0.5–10 inches.	and around water control structures. Prescribed fire, herbicides, and disking treatments will all be used as appropriate and when necessary to achieve objectives Sloane and Spring Lake are higher priorities than Duckfoot and Pleasant Creek
Marsh	1-15 years	Duckfoot	34	Annual, seed-producing plant species such as smartweed and wild millet are approximately 30% of the total cover. Native perennials such as bulrush and cattails are approximately 30% of the total cover. Woody plants are approximately 40% of total cover.	Annual, seed-producing plant species such as smartweed and wild millet will be at least 65% of the total cover. Perennial plant species such as bulrush, reed canarygrass and purple loosestrife will be no greater than 35% of the total cover. Woody plants will be no greater than 35% of the total cover. Water depths during fall and spring migration periods will be between 0.5–10 inches.	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Woody plant removal/control is also necessary on the levees and around water control structures. Prescribed fire, herbicides, and disking treatments will all be used as appropriate and when necessary to achieve objectives Sloane and Spring Lake are higher priorities than Duckfoot and Pleasant Creek
Marsh	1-15 years	Pleasant Creek	1,069	Annual, seed-producing plant species such as smartweed and wild millet are approximately 30% of the total cover Native perennials such as bulrush and cattails are approximately 30% of the total cover Woody plants are approximately 40% of total cover	Annual, seed-producing plant species such as smartweed and wild millet will be at least 65% of the total cover. Perennial plant species such as bulrush, reed canarygrass and purple loosestrife will be no greater than 35% of the total cover. Woody plants will be no	Some of the areas considered here are co-managed by the USFWS and the USACE. Management of these areas will continue to be done in coordination with the USACE. Some of the areas considered here represent HREP project areas. Management of these areas will continue to support goals and objectives identified in HREP planning and agreement documents. Woody plant removal/control is also

Habitat	Time-line	Management Unit	Acres	Current Condition	Desired Condition	Notes
					greater than 35% of the total cover. Water depths during fall and spring migration periods will be between 0.5–10 inches.	necessary on the levees and around water control structures. Prescribed fire, herbicides, and disking treatments will all be used as appropriate and when necessary to achieve objectives Sloane and Spring Lake are higher priorities than Duckfoot and Pleasant Creek