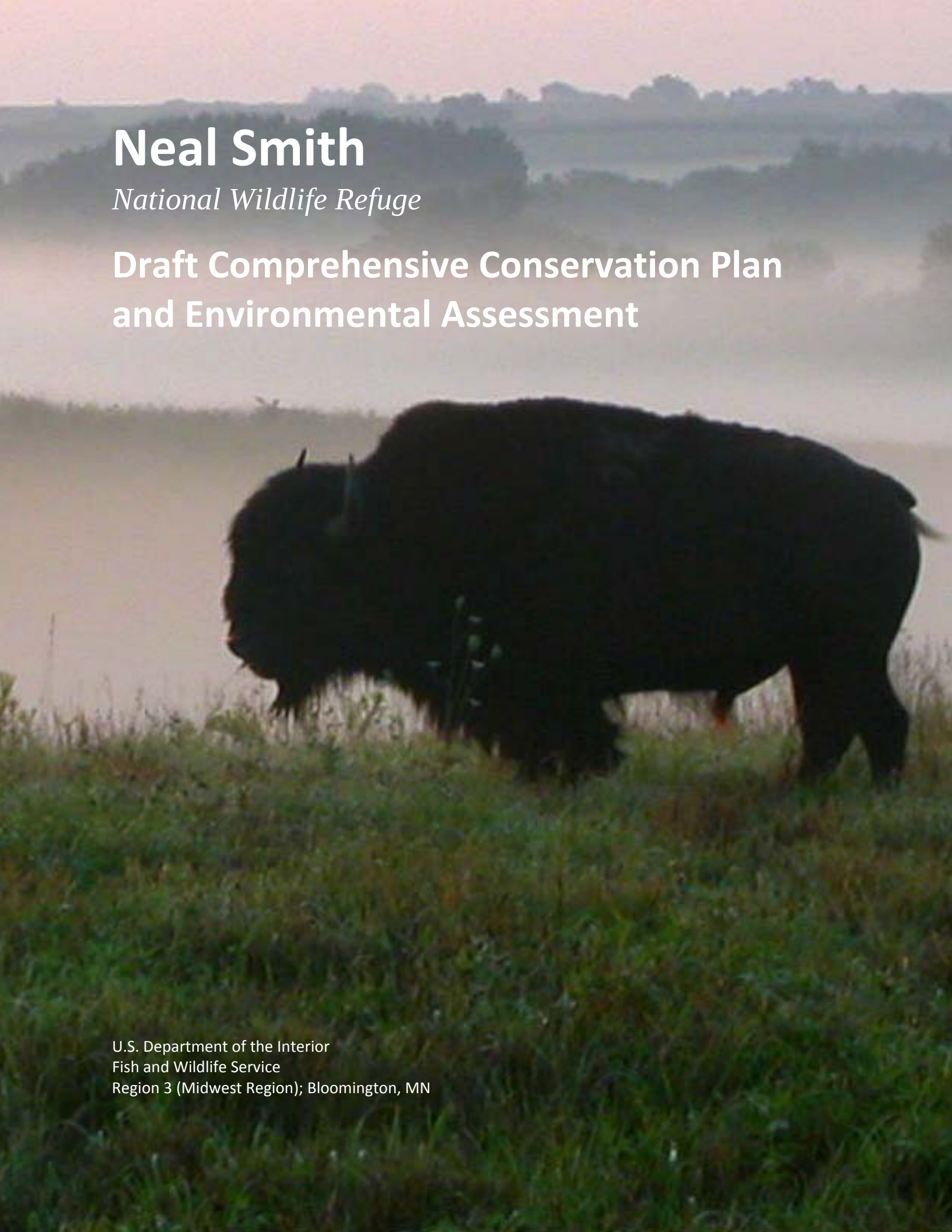


Neal Smith

National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Assessment

U.S. Department of the Interior
Fish and Wildlife Service
Region 3 (Midwest Region); Bloomington, MN

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

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

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

United States Department of the Interior

FISH AND WILDLIFE SERVICE

5600 American Boulevard West, Suite 990
Bloomington, Minnesota 55437-1458

IN REPLY REFER TO:

FWS-NWRS/CP

August 20, 2012

Dear Reviewer:

We are pleased to provide you with this Draft Comprehensive Conservation Plan (CCP) and Environmental Assessment (EA) for Neal Smith National Wildlife Refuge (NWR).

Neal Smith NWR is located in central Iowa about 20 miles east of Des Moines and currently encompasses about 5,500 acres of tallgrass prairies, oak savanna, and sedge meadow.

The CCP will guide management of the Refuge for the next 15 years and will help the Refuge meet its purposes and contribute to the mission of the National Wildlife Refuge System. The CCP will provide both broad and specific guidance on various issues; describe a vision, goals, and measurable objectives; and list strategies for reaching the objectives.

We invite you to review and comment on the Draft CCP and EA. By sharing your thoughts, you can help ensure that the final CCP is both visionary and practical. We will host an open house where you will be able to ask questions, seek understanding, and voice concerns and suggestions. A meeting date and location will be announced through the media and other means.

Written comments are also welcome during the 30-day comment period and should be addressed to: U.S. Fish & Wildlife Service, Neal Smith NWR, Attention: CCP Comment, P.O. Box 399, Prairie City, IA 50228. You may also send comments to us through the following web address: http://www.fws.gov/midwest/planning/NealSmith/

To be considered in preparing the final CCP, comments must be received by September 21, 2012.

We look forward to continuing the dialogue on the future of the Refuge, and thank you for your continued interest in keeping this Refuge a special place for wildlife and people.

Sincerely,

Karen Westphall

Karen Westphall
Refuge Planner, Division of Conservation Planning

Neal Smith

National Wildlife Refuge

Draft Comprehensive Conservation Plan and Environmental Assessment

Table of Contents

Chapter 1: Introduction and Planning Background 1

1.1 Introduction 1

1.2 Purpose and Need for Plan 2

1.3 Refuge Establishment and Purposes 2

1.4 Refuge Vision and Goals 5

1.5 Legal and Policy Framework 6

1.6 Other Conservation Initiatives 8

Chapter 2: The Planning Process 12

2.1 Introduction 12

2.2 Scoping and Public Involvement 12

2.3 Summary of Issues 13

2.4 Preparation, Finalization, and Implementation of the CCP 19

Chapter 3: Refuge Environment and Management 20

3.1 Refuge Environment 20

3.2 Refuge Management 42

Chapter 4: Future Management Direction 68

4.1 Introduction 68

4.2 Goals, Objectives, Strategies, and Rationales 68

Chapter 5: Plan Implementation 94

5.1 Introduction 94

5.2 Funding 94

5.3 Staffing 96

5.4 Partnership Opportunities 97
5.5 Step-Down Management Plans 97
5.6 Monitoring and Evaluation 98
5.7 Plan Review and Revision 98
Appendix A: Environmental Assessment 99
A.1 Purpose and Need for the Proposed Action 99
A.2 Description of Alternatives 104
A.3 Affected Environment 115
A.4 Environmental Consequences 121
Appendix B: Land Protection Plan 133
B.1 Introduction 133
B.2 Threats to Resources 133
B.3 Proposed Action 134
B.4 Other Land Protection Alternatives Considered 136
B.5 Land Acquisition Funding 138
B.6 Sociocultural Impacts 138
Appendix C: Compatibility Determinations 141
Appendix D: Appropriate Use Determinations 170
Appendix E: Bibliography 181
Appendix F: Summary of Refuge Ecosystems 185
Appendix G: Birds of Special Consideration 186
Appendix H: Invasive Plants 187
Appendix I: Species Lists 189
I.1 Neal Smith NWR Bird Checklist 189
I.2 Neal Smith NWR Butterflies 192
I.3 Neal Smith NWR Mammals 192
I.4 Neal Smith NWR Reptiles (likely to occur) 193
I.5 Neal Smith NWR Amphibians 193
I.6 Neal Smith NWR Plants 193
Appendix J: Research Publications (2001–2011) 200
Appendix K: Compliance Requirements 204
Appendix L: Glossary 210

Appendix M: Mailing List 213

Appendix N: List of Preparers 215

List of Figures

Figure 1-1: Location of Neal Smith NWR 1
Figure 1-2: Aerial Photo of Neal Smith NWR 3
Figure 1-3: Landscape Conservation Cooperatives 10
Figure 3-1: Conservation Lands in the Area of Neal Smith NWR 21
Figure 3-2: Landforms of Iowa 23
Figure 3-3: Soil associations 25
Figure 3-4: Walnut Creek Watershed 28
Figure 3-5: Stream channel evolution 29
Figure 3-6: Current Land Cover, Neal Smith NWR 33
Figure 3-7: Current Visitor Services Facilities, Neal Smith NWR 61
Figure 4-1: Neal Smith NWR Generalized Future Land Cover (50 to 100 years) 71
Figure 4-2: Proposed Refuge Boundary Expansion 79
Figure 4-3: Future Configuration of Hiking Trails 89
Figure A-1: Potential Boundary Expansion, Neal Smith NWR 109

List of Tables

Table 3-1: Major soil series and attributes 24
Table 3-2: Changes in population, employment, and income 1995-2005 38
Table 3-3: Prescribed burn history 1993–2010 49
Table 3-4: Visitor numbers 60
Table 3-5: Where do visitors come from? 60
Table 4-1: Bird populations on Neal Smith NWR 82
Table 5-1: Current and proposed Neal Smith NWR staffing 97
Table 5-2: Step-down management plans 98
Table A-1: Summary of Actions by Alternative 111
Table A-2: Estimated Refuge bird numbers under each alternative for three high-priority species 127
Table B-1: Summary of land protection by environmental assessment alternative on Neal Smith NWR 135

Chapter 1: Introduction and Planning Background

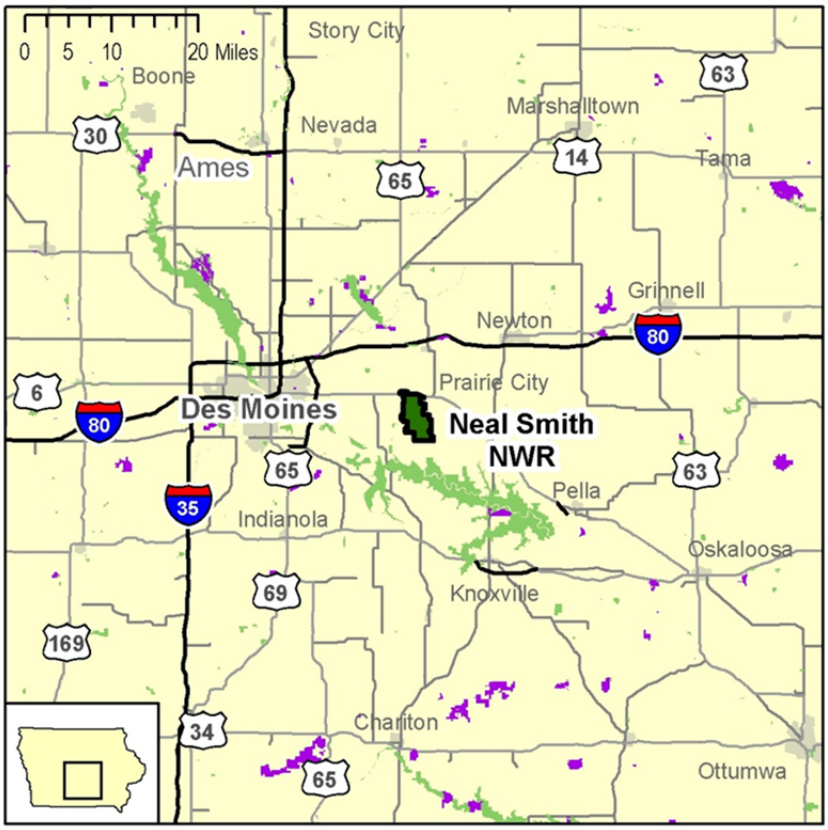
In this chapter

1.1 Introduction
1.2 Purpose and Need for Plan
1.3 Refuge Establishment and Purposes
1.4 Refuge Vision and Goals
1.5 Legal and Policy Framework
1.6 Other Conservation Initiatives

1.1 Introduction

Located about 20 miles east of Des Moines, Iowa (Figure 1-1), Neal Smith National Wildlife Refuge (NWR, Refuge) was established in 1990 as Walnut Creek NWR. The name was changed by Congress in 1998 to honor Congressman Neal Smith, whose support was instrumental in establishment of the Refuge. The U.S. Fish and Wildlife Service (FWS, Service) is authorized to acquire 8,665 acres of land within the Walnut Creek watershed to reconstruct a piece of the tallgrass prairie ecosystem essentially "from scratch" on former farmland. About 5,580 acres have been acquired so far. Although the tallgrass prairie ecosystem once covered much of the central United States and Canada, it is now globally endangered. Less than one percent of this historic mosaic of prairie, savanna, and wetlands remains today. Many prairie-dependent wildlife species are declining range-wide.

Figure 1-1: Location of Neal Smith NWR



Refuge restoration efforts already have provided for a diversity of life on the Refuge including hundreds of native plant species, over 200 bird species, and dozens of mammals, reptiles, amphibians, and butterflies. Prescribed fire and grazing are used to emulate historic processes that maintained the diversity of the landscape.

Approximately 140,000 visitors come to the Refuge each year to enjoy the prairie environment, to learn about the Refuge and the tallgrass heritage of central Iowa, and to participate in wildlife-related outdoor activities. The Neal Smith National Wildlife Visitor Center is a major environmental education facility that includes exhibits, meeting rooms, theater, laboratory-classroom, bookstore, and research facilities.

1.2 Purpose and Need for Plan

The purpose of this Comprehensive Conservation Plan (CCP) is to guide management and administration of the Refuge for the next 15 years and to help ensure that the Refuge meets the purposes for which it was established, contributes to the overall mission of the National Wildlife Refuge System (NWRS, Refuge System), and adheres to Service policies and other mandates. The CCP describes the desired future condition of the Refuge and provides guidance for management actions and decisions. It addresses identified issues of significance, sets goals and measurable objectives, and outlines strategies for reaching those objectives. The planning process informs and involves the general public, state and federal agencies, and non-government groups who have an interest, responsibility, or authority related to the Refuge.

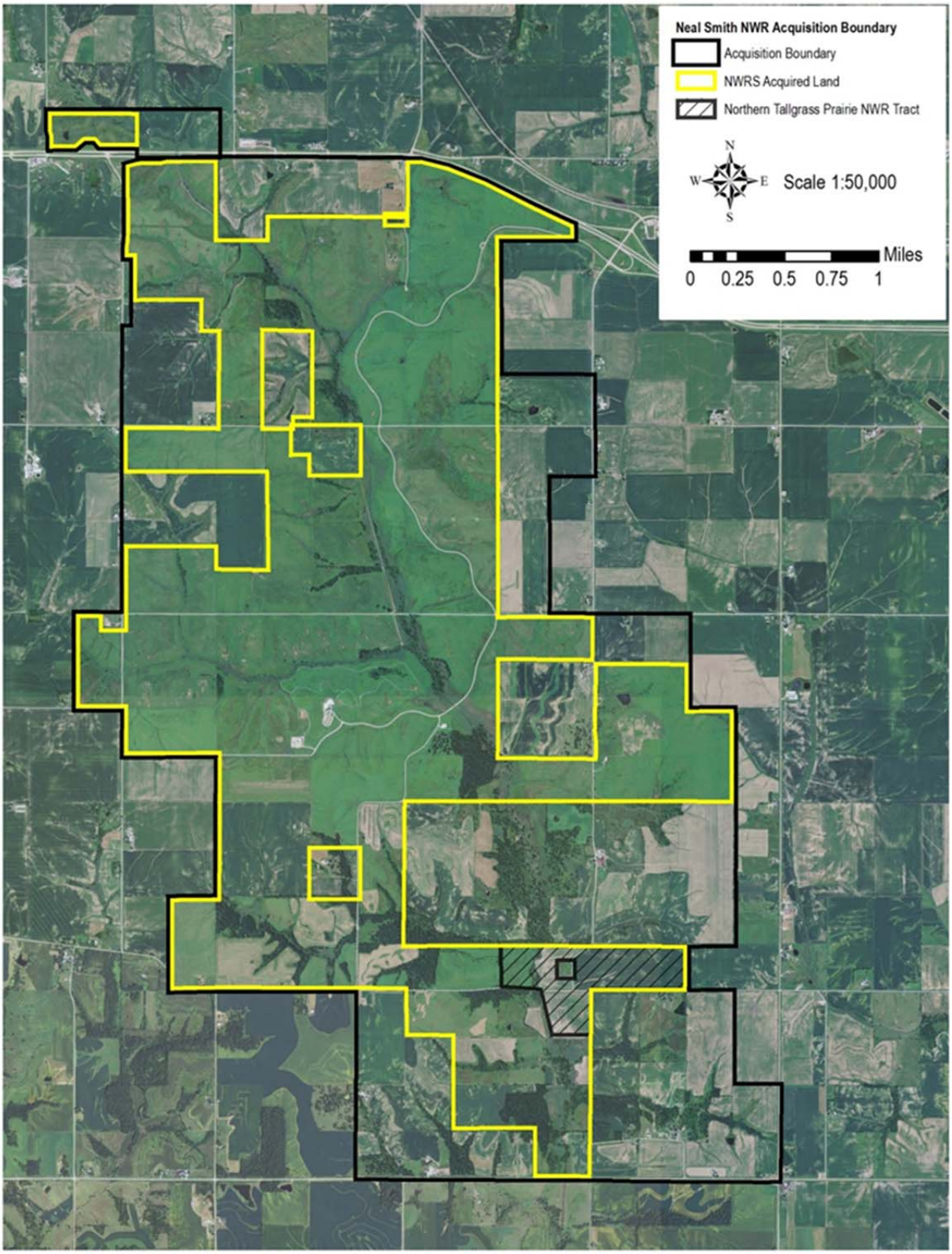
This CCP is needed to provide long-term management direction that reflects lessons learned since the last comprehensive plan (known as a Master Plan) was completed in 1992. Large-scale reconstruction of the tallgrass prairie ecosystem using local ecotype seed had never before been attempted. The Master Plan provided initial guidance for the newly established Refuge and recognized that management programs would need to adapt over time as experimental approaches were tested.

In addition, the landscape has undergone changes that affect habitat and wildlife, new threats to the Refuge are emerging, new laws and policies have been put in place, and new scientific information is available. Updated management guidance is needed that reflects these changes to help achieve Refuge goals for habitat, wildlife, and visitor services.

1.3 Refuge Establishment and Purposes

Congress authorized the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Dire Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the Service in April 1991 from the Redlands Corporation, a subsidiary of Iowa Power. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far (Figure 1-2).

Figure 1-2: Aerial Photo of Neal Smith NWR



Each unit of the Refuge System has one or more purposes specified in or derived from the legal instruments that established, authorized, or expanded it. Chapter 601 FW 1 of the Service Manual provides guidance for determining refuge purposes and using them in administration and management of the Refuge System. The purposes of Neal Smith NWR (formerly known as Walnut Creek NWR) derive from three authorities:

> " . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . " 16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) (*Fish and Wildlife Act of 1956*)
>
> " . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) (*Emergency Wetlands Resources Act of 1986*)
>
> " . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) (*National Wildlife Refuge System Administration Act*)

Our first obligation is to fulfill these broad legislatively-based purposes. The vision, goals, and objectives contained in this CCP meet the purposes of Neal Smith NWR.

We also may manage the Refuge to achieve additional conservation objectives in a manner that first protects Refuge purposes. For example, Congressman Neal Smith of Iowa saw Walnut Creek NWR as "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa,"* and a place where *"tens of thousands of school children"* could use the area for outdoor study. (Congressional Record, H2727)

The Master Plan developed for the new Refuge in 1992 incorporated and expanded upon the Congressman's vision and other early Refuge planning documents. The Master Plan provided ten-year guidance for the Refuge and recognized that changes would be needed as new information became available. Management priorities defined in the Master Plan were:

- Restore native tallgrass prairie, wetland, and woodland habitats for breeding and migratory waterfowl and resident wildlife;
- Serve as a major environmental education center providing opportunities for study;
- Provide outdoor recreation benefits to the public; and
- Provide assistance to local landowners to improve their lands for wildlife habitat.

Although not considered Refuge purposes in the legal sense, these conservation priorities have guided Refuge management activities since 1992. Understanding the original focus of Refuge management has been helpful in informing the goals and objectives of this CCP.

1.4 Refuge Vision and Goals

The vision is a descriptive picture of how the Refuge will look in the future and provides a sense of direction and purpose. From the vision flow broad goal statements, which in turn provide the framework to craft more detailed and measurable objectives which are the heart of the CCP. The vision and goals are important as reference points for keeping objectives and strategies meaningful, focused, and attainable.

1.4.1 Refuge Vision

The Refuge is a vast expanse of wind-swept prairie punctuated by sheltering oak savannas. Walnut Creek and its tributaries, bordered by sedge meadows, meander through the Refuge providing clean water for aquatic wildlife. Bound and connected to natural systems to the north and south, the Refuge forms a sanctuary and corridor for prairie-dependent wildlife species. These ecosystems are alive with a wide diversity of plants and wildlife that are thriving again. The natural processes that contribute to a healthy ecosystem include fire, grazing, nutrient cycling, pollination, and water filtration. These processes are working to improve life for plants, wildlife, and people. The picture of a landscape that existed before European-American settlement is renewed.

Guided by sound biological information and ongoing research, this landscape continues to be rejuvenated through the dedicated work of staff, volunteers, and the support of the public and the many partners of the Refuge. People of all ages and abilities visit to experience the natural world using all of their senses and to contribute to the ongoing efforts. Visitors come to the Visitor Center to learn new concepts and to learn about and use new tools and methods to restore prairies. Visitors leave the Refuge with a sense of belonging coupled with new knowledge of these ecosystems, a connection to the natural history of the region, and a desire to be involved in conservation. The Refuge is an open laboratory where experts and laypersons alike share information to demonstrate how to restore and reconstruct tallgrass prairie, oak savanna, and sedge meadow.

1.4.2 Refuge Goals

Habitat
The Refuge will actively protect, restore, reconstruct, and manage diverse native communities of tallgrass prairie, oak savanna, sedge meadow, and aquatic ecosystems and the natural processes essential to these ecosystems to enhance the vitality and health of the native prairie environment.

Wildlife
The Refuge will protect, restore, and maintain biologically diverse populations of native wildlife associated with healthy prairie, savanna, sedge meadow, and aquatic ecosystems, with an emphasis on grassland and savanna bird species including Greater Prairie-Chicken, Northern Bobwhite, Northern Harrier, Upland Sandpiper, Short-eared Owl, Red-headed Woodpecker, Northern Flicker, Loggerhead Shrike, Bell's Vireo, Sedge Wren, Eastern Bluebird, Eastern Towhee, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Le Conte’s Sparrow, Smith’s Longspur, Orchard Oriole, Dickcissel, Bobolink, Eastern Meadowlark, and Western Meadowlark.

People

The Refuge will provide a variety of wildlife-dependent recreational and educational opportunities for visitors to experience and develop an appreciation for the native tallgrass prairie heritage, ecological processes, and cultural resources while participating in ecological restoration efforts or enjoying other activities on the Refuge.

1.5 Legal and Policy Framework

Neal Smith NWR is managed and administered as part of the Refuge System within a framework of organizational setting, laws, and policy. Key aspects of the framework are outlined below. A list of other laws and executives orders that have guided preparation of the CCP and that guide future implementation are provided in Appendix K, Compliance Requirements.

1.5.1 U.S. Fish and Wildlife Service

The Refuge is administered by the U.S. Fish and Wildlife Service, Department of the Interior (DOI). The Service is the primary federal agency responsible for conserving and enhancing the nation's fish and wildlife populations and their habitats. Although the Service shares this responsibility with other federal, state, tribal, local, and private entities, the Service has specific responsibilities for migratory birds, threatened and endangered species, certain interjurisdictional fish and marine mammals, and the Refuge System. The mission of the Service is:

> *"Working with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people."*

1.5.2 The National Wildlife Refuge System

The National Wildlife Refuge System had its beginning in 1903 when President Theodore Roosevelt used an Executive Order to set aside tiny Pelican Island in Florida as a refuge and breeding ground for birds. From that small beginning, the Refuge System has become the world's largest collection of lands specifically set aside for wildlife conservation, including more than 550 national wildlife refuges covering over 150 million acres, plus 38 wetland management districts. The administration, management, and growth of the Refuge System are guided by the following goals:

- Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
- Develop and maintain a network of habitats for migratory birds, anadromous and interjurisdictional fish, and marine mammal populations that is strategically distributed and carefully managed to meet important life history needs of these species across their ranges.
- Conserve those ecosystems, plant communities, wetlands of national or international significance, and landscapes and seascapes that are unique, rare, declining, or underrepresented in existing protection efforts.
- Provide and enhance opportunities to participate in compatible wildlife-dependent recreation (hunting, fishing, wildlife observation and photography, and environmental education and interpretation).
- Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

1.5.3 National Wildlife Refuge System Improvement Act of 1997 and Related Policy

The National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) amended the National Wildlife Refuge System Administration Act of 1966 and became a true organic act for the Refuge System by providing a mission, policy direction, and management standards. The Improvement Act's main components include:

- A strong and singular wildlife conservation mission for the Refuge System;
- A requirement that the Secretary of the Interior maintain the biological integrity, diversity, and environmental health of the Refuge System;
- A new process for determining compatible uses on refuges;
- A recognition that wildlife-dependent public uses involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation, when determined to be compatible, are legitimate and appropriate public uses of the Refuge System;
- That these compatible wildlife-dependent recreational uses are the priority general public uses of the Refuge System; and
- A requirement to prepare a Comprehensive Conservation Plan for each refuge.

Compatibility Policy
No use that the Service has authority to regulate may be allowed on a unit of the Refuge System unless it is determined to be compatible (Service Manual, 603 FW 2). 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, National Wildlife Refuge System in the respective Service region.

Biological Integrity, Diversity, and Environmental Health Policy
The Service is directed by the 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 (Service Manual, 601 FW 3) helps define and clarify this directive by providing guidance on what conditions constitute biological integrity, diversity, and environmental health; 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 biological integrity, diversity, and environmental health.

Wildlife-Dependent Recreation Policy (Service Manual, 605 FW 1)
The Improvement Act identifies six priority wildlife-dependent recreational uses; hunting, fishing, wildlife observation and photography, and environmental education and interpretation. Congress directed the Service to grant these six wildlife-dependent public uses special consideration in the planning, management, establishment, and expansion of Refuges. In addition, if determined compatible on a refuge, these six uses assume priority status over any other uses proposed or occurring on a refuge. The Service is to facilitate priority wildlife-dependent public use opportunities when they do not interfere with the ability to fulfill refuge purposes or the mission of the Refuge System.

1.5.4 Wilderness Review

Refuge planning policy mandates that wilderness reviews be conducted through the comprehensive conservation planning process. The criteria are size, naturalness, opportunities for solitude or primitive recreation, and supplemental values. No lands within Neal Smith NWR met the criteria for wilderness established by Congress and described in Service policy (Service Manual, 605 FW1). Neal Smith NWR does not contain 5,000 contiguous acres of roadless, natural lands, nor does the Refuge possess any units of sufficient size to make their preservation practicable as wilderness. Refuge lands and waters have been substantially altered by humans, especially by agriculture, dam construction, river channel modifications, and road building.

1.6 Other Conservation Initiatives

The Service works closely with other government agencies and conservation organizations in developing a variety of regional, national, and international conservation plans and initiatives. Several of these efforts relevant to Neal Smith NWR are described below; their recommendations and priorities were reviewed and integrated where appropriate into this CCP.

1.6.1 Iowa Wildlife Action Plan

Congress mandated that all state fish and wildlife agencies develop a comprehensive wildlife conservation plan by October 1, 2005 as a condition of receiving federal funds through the State Wildlife Grant Program. These plans address the needs of a wide array of wildlife, including fish and many invertebrates, but focus primarily on species of greatest conservation need (SGCN) and their habitats. The Iowa Wildlife Action Plan includes priorities for protecting and enhancing existing habitats that benefit SGCN, and developing new 3,000–5,000 acre habitat blocks connected by travel corridors for wildlife. The plan recognizes that no single entity can implement all needed conservation actions and emphasizes the importance of partnerships. Neal Smith NWR and other nearby conservation areas are identified as high-priority areas for cooperative conservation partnerships.

1.6.2 Migratory Bird Conservation Initiatives

Partners in Flight (PIF) was launched in 1990 in response to growing concerns about declines in the populations of many landbird species. The North American Landbird Conservation Plan includes priorities and objectives to guide national and international conservation efforts. PIF also has developed regional bird conservation plans based on physiographic areas. Neal Smith NWR lies within Physiographic Area 32, the Dissected Till Plains. The *P*artners in Flight Bird Conservation Plan for the Dissected Till Plains (Physiographic Area 32), completed in 2000, identifies priority bird species for grassland, savanna, riparian forest, and big river vegetation communities. Priority PIF species that also are of concern to Neal Smith NWR include Greater Prairie-Chicken, Northern Bobwhite, Northern Harrier, Short-eared Owl, Red-headed Woodpecker, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Dickcissel, and Bobolink. The plan describes population and habitat objectives, research and monitoring needs, conservation opportunities, and outreach priorities.

The *North American Waterfowl Management Plan (NAWMP)* began in 1986 as a partnership effort to restore waterfowl populations to historic levels through habitat conservation but has since expanded its focus to include other taxonomic groups. The plan is international in scope but is implemented through

regional partnerships called "joint ventures." The U.S. Shorebird Conservation Plan provides a scientific framework to determine shorebird species, sites, and habitats that most urgently need conservation action. The Upland Sandpiper is a shorebird of high concern in the Upper Mississippi Valley/Great Lakes region, which includes Neal Smith NWR. The North American Waterbird Conservation Plan provides a continental framework for conserving wading birds, marsh birds, gulls, terns, pelicans, and sea birds and their habitats.

The *North American Bird Conservation Initiative (NABCI)* is a continental effort to integrate all migratory bird conservation programs under one umbrella. The goal is to facilitate bird conservation through regionally-based, biologically-driven, landscape-oriented partnerships. NABCI has defined Bird Conservation Regions (BCR) as its planning units. BCRs are becoming increasingly common as the unit of choice for regional bird conservation efforts. Neal Smith lies within BCR 22, the Eastern Tallgrass Prairie. High priority grassland birds in BCR 22 include Greater Prairie-Chicken and Henslow's Sparrow. Red-headed Woodpecker leads the list of savanna specialists.

Birds of Conservation Concern 2008 (FWS, 2008a) was developed by the Service to identify migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent the Service's highest conservation priorities. The list encompasses three distinct geographic scales—NABCI Bird Conservation Regions, FWS Regions, and National—and uses assessment scores from three bird conservation plans: the North American Landbird Conservation Plan, the U.S. Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. The assessment scores are based on several parameters including population trend, threats, distribution, abundance, and the importance of an area to a species. Eleven species of the tallgrass prairie ecosystem are considered Birds of Conservation Concern for the area that includes the Refuge: Upland Sandpiper, Short-eared Owl, Red-headed Woodpecker, Northern Flicker, Loggerhead Shrike, Bell's Vireo, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Smith's Longspur, and Dickcissel.

1.6.3 Partners for Fish and Wildlife Program

The Service established the Partners for Fish and Wildlife Program (Partners Program) in 1987 to work beyond the boundaries of refuges with landowners and other partners to improve habitat on private lands for fish and wildlife. The program is voluntary, relies heavily on a partnership approach, and leverages both ideas and funding from a variety of sources. Cost sharing agreements and technical assistance are important components.

The overall goal of Partners Program projects is to return a site to the ecological condition that likely existed prior to loss or degradation. Priority ranking is given to proposed projects that meet these conditions:

- Improve habitat for migratory birds, threatened and endangered species, interjurisdictional fish, marine mammals, and other declining species.
- Complement activities on Refuge System lands, or contribute to the resolution of problems on refuges that are caused by off-refuge practices.
- Address species and habitat priorities that have been identified through Service planning teams (with our partners), or in collaboration with state fish and wildlife agencies.
- Reduce habitat fragmentation or serve as buffers for federal or state conservation lands.
- Result in self-sustaining systems that are not dependent on artificial structures.

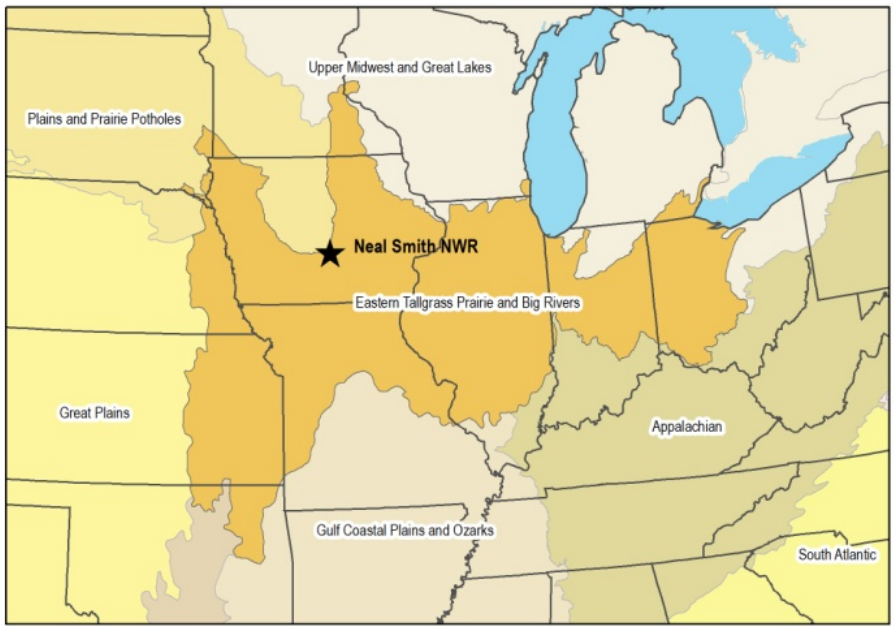
Service biologists work one-on-one with landowners to plan, implement, and monitor their projects. This level of personal attention and follow-through is a significant strength of the Program. Through the Partners Program, the Service has restored 8,200 acres of wetland and 30,000 acres of upland on private lands in Iowa between 1987 and 2008.

Neal Smith NWR lies within the Lower Des Moines River Corridor, a primary focus area of the Partners Program in Iowa. This focus area was established to help address connectivity of Iowa's major habitat units. Program activities in the corridor are centered on restoration and enhancement of floodplain forest, riparian wetland, oak savanna, and tallgrass prairie. The primary goal is to increase connectivity of habitat for songbirds and waterfowl migrating between the Mississippi River and the Prairie Pothole Region. Other benefits include improved habitat for resident wildlife, enhanced water quality in the river, and increased resilience to environmental stressors such as climate change.

1.6.4 Landscape Conservation Cooperatives

The Service and the DOI have begun developing a national network of Landscape Conservation Cooperatives (LCCs). LCCs are management-science partnerships between the Service and other federal agencies, states, tribes, non-governmental organizations, universities, and other stakeholders. LCCs will inform management decisions to address landscape-scale stressors such as habitat fragmentation, genetic isolation, spread of invasive species, and water scarcity, all of which are magnified by accelerating climate change. LCCs will connect site-specific protection, restoration, and management effort to larger goals supporting fish and wildlife populations and the natural systems that sustain them. They are intended to provide a strong link between science and conservation delivery without duplicating existing partnerships. By functioning as a network of interdependent units, LCC partnerships can accomplish a conservation mission no single agency can accomplish alone. Each LCC will focus on a defined geographic area. Neal Smith NWR falls within the boundary of the Eastern Tallgrass Prairie and Big Rivers LCC (Figure 1-3).

Figure 1-3: Landscape Conservation Cooperatives



1.6.5 FWS Climate Change Strategic Plan

The Service's strategic plan for responding to climate change (FWS, 2010) establishes a basic framework for efforts to ensure the sustainability of fish, wildlife, and habitats. It includes three key elements:

Adaptation: Minimizing the impact of climate change on fish and wildlife through the application of cutting-edge science in managing species and habitats.

Mitigation: Reducing levels of greenhouse gases in the Earth's atmosphere.

Engagement: Joining forces with others to seek solutions to the challenges and threats to fish and wildlife conservation posed by climate change.

The plan recognizes the role of healthy ecosystems in helping fish and wildlife populations adapt to a changing climate. It also allows resource managers to be responsive as science, technology, and experience evolve over time, as explained in the plan:

> *"We will increase our adaptation efforts significantly in the near term as we respond to increasing climate change impacts. Our initial emphasis will be on reactive adaptation, as we work to build resilience in ecosystems through our management efforts and, in some cases, to buy additional time to increase our certainty regarding future landscape conditions. . . Over the long term, however, we will work with partners to assemble the technical and institutional capability to increase anticipatory adaptation efforts, particularly as the impacts of climate change become more certain."*

Chapter 2: The Planning Process

In this chapter

2.1 Introduction
2.2 Scoping and Public Involvement
2.3 Summary of Issues
2.4 Preparation, Finalization, and Implementation of the CCP

2.1 Introduction

The Comprehensive Conservation Plan (CCP) process for Neal Smith National Wildlife Refuge (NWR, Refuge) meets the dual requirements of compliance with the National Wildlife Refuge System Improvement Act of 1997 and the National Environmental Policy Act of 1969 (NEPA), both of which require the Service to actively seek public involvement in the preparation of environmental documents. NEPA also requires the U.S. Fish and Wildlife Service (FWS, Service) to seriously consider all reasonable alternatives to its Preferred Alternative including the "No Action" alternative, which represents continuation of current conditions and management practices.

Key steps in the CCP process include:

1. Form the planning team and conduct pre-planning.
2. Initiate scoping and public involvement.
3. Identify issues and develop vision and goal statements.
4. Develop alternatives and assess their environmental effects.
5. Identify the preferred alternative.
6. Publish the Draft CCP and NEPA document for public comment.
7. Revise and publish the final plan.
8. Implement the CCP.

2.2 Scoping and Public Involvement

The Notice of Intent to prepare a CCP and Environmental Assessment (EA) for Neal Smith NWR was published in the *Federal Register* dated December 17, 2008 (Vol. 73, No. 243, page 76677).

Internal scoping began in April 2009 when Service planning staff and Neal Smith NWR staff developed a preliminary list of issues, concerns, and opportunities associated with management of the Refuge. A second internal scoping session was held with the Service's Regional Office staff at Fort Snelling, Minnesota in October 2009 to get input on issues from regional supervisors, biologists, planners, and other program specialists.

Public scoping began in June 2009, when Refuge staff hosted two open house events in Des Moines and Prairie City, Iowa to inform the public of the planning process and to solicit their input on issues of concern. About 15 people attended. In addition, CCP information and comment sheets were available in the Visitor Center and were sent to the several hundred stakeholders on the Refuge mailing list. Written and e-mailed comments were received from a total of 24 people.

In August 2009, the Refuge convened a team of resource professionals to share their perspectives on the biological and visitor services programs at Neal Smith NWR. Participants outside the Service included partner agencies, researchers, educators, and Refuge volunteers. Purposes of the workshop were to review the draft list of issues, begin discussing options for addressing them, and ensure that the best-available scientific and socioeconomic information was being considered.

In April 2011, a newsletter update was sent to all stakeholders on the Refuge mailing list. The newsletter summarized comments received during the scoping period, described the primary management issues being considered during development of alternatives, and outlined the schedule and next steps leading to completion of the CCP.

2.3 Summary of Issues

Issues were identified through the scoping process described above. These issues represent input from the public, other agencies and organizations, and Service staff. The following section summarizes the major issues that were identified and analyzed as part of the CCP process. The issues were critical in framing the objectives for the various alternatives considered and formed the basis for evaluating environmental effects.

2.3.1 How will we effectively and sustainably restore native prairie, savanna, and sedge meadow plant communities on the Refuge?

Although much progress has been made in converting agricultural fields and restoring remnant prairie, savanna, and sedge meadow sites, much work still remains. Knowledge gained from these initial efforts is important in setting objectives and priorities for the next phase of reconstruction and restoration in order to make effective and efficient use of limited resources. Individual tracts of land are in different stages of reconstruction/restoration so management needs vary, but several main issues predominate:

- Native plant diversity
- Management of non-native invasive plants
- Effects of subsurface drainage and other watershed alterations
- Disruption of historic fire and grazing regimes

Several public comments stated the importance of restoring the tallgrass prairie/oak savanna ecosystem, and invasive species control was often mentioned as an important issue. Other comments recommended increasing plant diversity on prairie sites, focusing more effort on completely restoring small areas first before expanding outward, focusing more effort on savanna restoration, and stopping tree cutting on the Refuge. The use of bison and elk to facilitate the natural process of grazing by large mammals was seen as worthwhile and was preferred over the use of cattle. Careful consideration of the potential effects of climate change on long-term Refuge restoration and management was recommended.

Tallgrass Prairie Reconstruction

The initial approach to reconstructing tallgrass prairie on former agricultural lands was to quickly plant as many fields as possible with as much diversity as possible. Early seed mixes contained small amounts of many species but were dominated by warm season grasses that were available in larger quantities. Diversity of seed mixes used to plant agricultural fields is increasing compared to earlier efforts as seed

from more species becomes available in larger quantities, but plant diversity continues to vary between reconstructed prairie units. All need more native cool season grasses and forbs, but this type of seed is still not easily obtained. All contain non-native invasive plants, and management of these invasive plants is time-intensive. Terraces, gullies, trees, roads, fences, and drain tiles still need to be removed on some previously planted sites. Some farm fields and former pastures have not yet been planted with native prairie species.

Native Prairie and Savanna Remnants

Patches of degraded tallgrass prairie and oak savanna remnants are found on the Refuge. These remnants are in varying stages of degradation, but many still held high potential for restoration when the initial vegetation survey was conducted in 1991 (Drobney and Bryant, 1991). These remnants provide valuable genetic diversity that is adapted to local conditions.

Refuge remnants currently vary in quality and diversity. Some have a relatively low diversity of native prairie and savanna species compared with what they historically held. Most include non-native plants. The historic fire regime has been disrupted, resulting in many remnants becoming overgrown with trees and woody shrubs. In the early years of the Refuge, management of remnants was a lower priority than native plantings on agricultural fields, so restoration efforts have been minimal to date. Where restoration has taken place the response of prairie and savanna understory species has been positive. These restored remnants contain plants not found elsewhere on the Refuge, are valuable seed collection sites, and contain remnant populations of native invertebrates (Klaas and Bishop, 1995). Refuge remnants are irreplaceable and must be restored soon before their integrity is lost.

Sedge Meadow

Dominant native plants found in healthy sedge meadows include prairie cordgrass (*Spartina pectinata*), sedges, rushes, and some forbs. In low-lying sedge meadows near Walnut Creek and its tributaries, invasive reed canarygrass (*Phalaris arundinacea*) has become a tenacious competitor due in large part to hydrologic changes to the stream and its floodplain. Over 300 acres of these low-lying Refuge lands are covered by more than 75 percent reed canarygrass. Sedge meadows on upland areas near seeps and ravines are degraded from their natural state but often still retain some diversity. Subsurface drainage tiles have reduced the level of soil saturation in seeps and ravines and have reduced the quality and diversity of sedge meadows found there.

Fire and Grazing

Fire and grazing are natural disturbances that were important in maintaining the diversity and heterogeneity of plant communities in the historic tallgrass prairie ecosystem. Both were disrupted by human settlement, and both are now important management tools for restoring prairie, savanna, and sedge meadow on the Refuge.

Variability in timing of prescribed fire promotes diversity of plant species; however, the majority of burns on the Refuge to date have been in spring. More extensive summer and fall burn seasons are difficult to implement due to weather conditions and staffing shortages, but creative and persistent use of prescribed fire in spring, summer, fall, and even winter if conditions permit, would enhance the ability to achieve Refuge goals and objectives.

Bison and elk have been reintroduced to the Refuge to re-create the historic role of large grazers. These animals cannot be allowed to roam onto private land and so must be kept within a fenced enclosure. The enclosure size is 700 acres, which restricts the use of grazing as a management tool to only a small

portion of the Refuge. The 1992 Master Plan recommended an eventual enclosure size of 2,000 acres when land acquisition is completed, but even that size would limit grazing to about one-fourth of the Refuge. A sound decision on whether and how to expand bison and elk grazing is hampered by limited data on the effects of the current program on the success of restoration. A lack of measurable objectives for grazing and restoration has precluded a strict monitoring program.

Adding cattle, sheep, and/or goat to address specific management issues would enhance flexibility and facilitate expansion of the grazing program. Although cattle have been used successfully elsewhere to increase prairie diversity and heterogeneity, some studies encourage their use only when it is not possible to have bison due to differences in behavior and grazing patterns. Electric fencing and watering tanks would need to be installed and removed seasonally, and herds would be removed from the Refuge entirely during non-grazing periods. Economic feasibility and private interest in grazing cattle on the Refuge have not been evaluated in any detail and would likely depend in large part on the specific protocol developed. Service policy (Service Manual, 601 FW3) allows for livestock grazing on refuges to meet wildlife and habitat objectives only when more natural methods, such as fire or grazing by native herbivores, cannot meet Refuge goals and objectives.

2.3.2 How will we maintain and enhance native wildlife populations on the Refuge?

The Refuge seeks to protect, restore, and maintain biologically diverse populations of native wildlife associated with a healthy tallgrass prairie ecosystem.

Grassland Birds

Grassland birds are of particular concern, because their populations have exhibited steeper, more consistent declines than any other group of North American birds. Many species largely disappeared from central Iowa due to habitat loss as the prairies were cleared for agriculture, but many, including Northern Harrier, Short-eared Owl , Sedge Wren, Field, Grasshopper, and Henslow's Sparrows, Dickcissel, Bobolink, and Eastern and Western Meadowlarks, have returned to the Refuge as former agricultural lands were restored to tallgrass prairie. Some grassland bird species are using the Refuge as a migration stopover, including Swainson's Hawk, Le Conte's Sparrow, Savanna Sparrow, and Smith's Longspur. Others such as Upland Sandpiper, Northern Bobwhite, and Loggerhead Shrike are sometimes present on the Refuge in small numbers.

Additional improvements to quality and quantity of habitat would be expected to increase the number, diversity, and productivity of grassland birds that the Refuge can support. Management strategies for conservation of grassland-nesting birds and other wildlife usually center on protecting or establishing large contiguous grassland blocks, providing plant diversity as well as structurally diverse habitat, eliminating mid-season grassland mowing, reducing edge, and controlling woody encroachment.

Bison and Elk

Bison and elk were reintroduced to a fenced enclosure to re-create the historic role of large grazers in maintaining diverse prairies, to study their effects on the ecosystem, and as a learning experience for visitors. The optimum enclosure size and configuration to best meet multiple Refuge needs has not been determined. The optimum herd size under the current management program also has not been firmly established, although a range of 73-129 animals could be supported by the vegetation based on the available forage at a moderate stocking rate. More information is needed on the effects of grazing and other behaviors on reconstructed prairie. Doubling the size of the enclosure is feasible given the current Refuge boundary. A larger enclosure would expand the ability to manage and manipulate the grazing

program creating more biological and structural diversity throughout the Refuge but also might reduce the visibility of the animals to visitors. Expanding the enclosure would also allow the Refuge to move the fence away from creeks and tributaries where it causes erosion or impedes waterflow. Bison are not the cause of erosion, because they do not loaf along streams and creeks. Several waterways run through the enclosure; none are eroding due to use by bison.

The desired number of elk on the Refuge is fifteen. Animals usually are culled when the population gets above twenty. Inbreeding is a concern with such a small number of animals. The effects of their grazing on overall habitat diversity in the enclosure are probably small due to the small number of elk. Information about their impacts on Refuge habitat is limited. Refuge staff conducts weekly health monitoring, but because of their habits the elk are difficult to observe. Tranquilizers are necessary to handle them, and darting them is difficult and dangerous for staff and can be fatal for the elk, so research involving marking or tracking animals is not conducted. Live elk are not handled, and management focuses on morbidity and mortality. A study of habitat selection and diet of bison and elk in the enclosure was conducted in 2006-2007 (Kagima, 2008). Chronic Wasting Disease is a potential threat to the long-term viability of elk on the Refuge and prohibits removal or addition of live elk.

The bison and elk are extremely popular with the public, and most Refuge visitors come specifically to see the herds. Public scoping comments strongly supported the program, stating that the animals are an integral part of the Refuge, an important link to our past, and a valuable opportunity for environmental education and interpretation. Some recommended a larger enclosure. Others wanted the animals to be more visible to the public.

Other Wildlife Reintroductions

In addition to bison and elk, the regal fritillary butterfly has been successfully reintroduced on the Refuge. Other wildlife species also might need some help. Even if enough suitable habitat is available, the Greater Prairie-Chicken is unlikely to recolonize on its own due to distance from the nearest population. For reptiles, amphibians, small mammals, and invertebrates, more information is needed on current status, historic range, and/or habitat requirements before well-reasoned decisions can be made on whether or not reintroduction is warranted. All wildlife reintroduction decisions will be made in coordination and collaboration with the Iowa Department of Natural Resources.

Public comments supported restoration of the overall floral and faunal diversity of the Refuge. A specific recommendation was made to remove unnecessary roads and power lines to create more suitable habitat for Greater Prairie-Chicken reintroduction. (Determining the feasibility of road and power line removal would require coordination and planning with Jasper County and MidAmerican Energy.) Careful consideration of the potential impacts of climate change on Refuge wildlife was recommended.

2.3.3 How will we encourage more people to connect more closely with the Refuge while ensuring visitor safety and minimizing disturbance to wildlife and habitat?

The Refuge seeks to provide a variety of compatible wildlife-dependent recreational and educational opportunities so visitors can experience and treasure our native tallgrass prairie heritage. Visitors love the Refuge, and requests for additional activities are more than can be met with current resources. The Refuge must balance visitor services with safety concerns and the potential for disturbance to wildlife and habitat.

Environmental Education and Interpretation
The Visitor Center has excellent facilities for environmental education and interpretation programs. Current program offerings include Project Bluestem teacher training workshops, the Partner Schools program, and a variety of ranger-led environmental education programs and special events. Demand for these programs is high. In addition, many new ideas have been proposed for reaching new audiences. The potential for program expansion is much greater than staff and volunteers can meet, so priorities need to be set.

Non-personal interpretation outside the building includes kiosks, signs, and trail brochures, but more interpreted sites on the Refuge are desired, such as spotting scopes along the entry road where visitors can see bison and elk. The Visitor Center exhibits are high quality but in need of updating, possibly to include new interpretive messages. The Visitor Center is open seven days per week requiring full staffing to meet the public demand. The station is fortunate to have dedicated volunteers to operate the information desk and bookstore.

Many public scoping comments strongly supported an important role for the Refuge as an environmental education leader in central Iowa. Commenters also requested more activities throughout the year, more interpretive programs geared toward adults and families, and handicapped parking closer to the building entrance. Some made suggestions for new exhibits and brochures.

Wildlife Observation and Photography
Wildlife observation and photography are popular Refuge uses. Many visitors come just to drive the auto tour route to see bison and elk without leaving their vehicles. Four designated foot trails are available, as well as pull-offs along the entrance road. Some visitors also want to walk the mowed fire breaks or explore off-trail. Close visitor connection to the tallgrass prairie ecosystem is a meaningful experience to be encouraged. However, there are safety concerns when staff is burning, mowing, or spraying on the Refuge or when visitors get out of their vehicles to look at the bison and elk. Although current demand for Refuge access off the main trails is low (mostly hunters and birders), wildlife disturbance could become an issue if demand increases. A well-defined policy is needed that balances visitor access and exploration with safety concerns and the potential for wildlife disturbance.

Comments during the scoping process supported increased public access and participation on the Refuge without losing sight of the primary wildlife mission. Some had an interest in making wildlife viewing easier including allowing foot access in the bison and elk enclosure.

Hunting
About two-thirds of the Refuge is currently open for deer, squirrel, rabbit, pheasant, and quail hunting. All are open during the full state season with the exception of cottontail rabbit. All hunting on the Refuge ceases on January 31 of each year to accommodate research, biological monitoring, and other non-consumptive recreational activities on the Refuge. Shotgun, archery, and muzzleloader hunting are allowed. Drive hunting for deer is currently allowed, which is traditional in the local community, but there are safety concerns and potential conflict with other recreational uses.

Public comments have supported banning drive hunts or limiting group size. There have been requests by the public for turkey and furbearer hunting. No special disabled or youth hunts are offered. There are multiple entry points onto the Refuge, ten hunter parking lots, and no required on-Refuge registration, so accurate assessments of hunter use are not available. Trespass occurs on adjacent private lands; 200-yard shooting zones are marked. There is no regular law enforcement presence.

Other Recreational Opportunities
Public comments indicate support for development of a designated biking trail on the Refuge. Additional horseback riding opportunities are desired by some. Other uses requested by visitors have included camping, picnicking, snowmobiling, antler collecting, and creation of potholes for winter ice fishing and for wildlife. Some visitors would like to bring their dogs on the Refuge.

2.3.4 How will we improve our communication and community outreach efforts?

Communication and partnerships with area residents and local communities are crucial to the success of Neal Smith NWR. The Refuge is an active partner with the nearby town of Prairie City and has a supportive volunteer group called Friends of Neal Smith National Wildlife Refuge (Friends). In 2010, volunteers contributed more than 13,000 hours of service to Refuge programs. Refuge staff and volunteers provide current news and event information to the public through a quarterly Friends newsletter, the Friends website, news releases sent to local media, presentations to community groups, and participation in the Prairie City Business Association. When first established, the Refuge was a big story in the local media. Now, however, few area newspapers and radio stations publish the news releases, and few television stations have covered stories about the Refuge in several years. As is common at refuges across the nation, there are many residents in the Des Moines area who are unaware that the Refuge exists.

The importance of developing strong community outreach and partnerships was a frequent theme during the public scoping period. Comments included the need to promote and publicize the Refuge at every opportunity; increase outreach in metropolitan Des Moines and the Midwest; and collaborate with other local organizations such as libraries, historical societies, and garden clubs. The partnership with Prairie City received praise, and continued development of that relationship was recommended. Recruitment of additional volunteers was encouraged, including more volunteers from the Prairie City area.

2.3.5 How will we address conservation concerns related to urban development and loss of wildlife habitat outside the Refuge boundary?

The Refuge is located in a primarily rural area just 20 miles east of urban Des Moines. Development is increasing rapidly near the Refuge as the city and suburbs expand. Additional homes may be built close to the Refuge boundary and throughout the watershed; commercial development likely will increase near the highway. Wildlife movement between the Refuge and other protected areas will decrease. Our long-term ability to restore and sustain native vegetation and wildlife on Refuge lands depends in part on the integrity of the surrounding landscape. As more agricultural areas are developed, opportunities for the Service to influence land use decisions and reduce habitat fragmentation will become increasingly rare.

Many conservation options are available on private lands outside the Refuge boundary including cooperative efforts with landowners, conservation easements, or fee acquisition from willing sellers in some cases. Public comments often named development as a significant threat to the Refuge. Some commenters encouraged continued emphasis on land acquisition near the Refuge and/or creation of habitat corridors connecting the Refuge to other public lands in the area.

2.4 Preparation, Finalization, and Implementation of the CCP

The CCP and EA are being prepared by the staff of Neal Smith NWR and the Service's Midwest Regional Office. The CCP/EA will be published in two phases in accordance with NEPA. The EA (Appendix A: Environmental Assessment) presents a range of alternatives for future management and identifies the preferred alternative, which is also the Draft CCP. A public review period of at least 30 days will follow release of the draft document and will include one or more open houses to provide an opportunity for people to comment in person. Written and electronic comments also will be accepted.

Comments received by the Service will be incorporated where appropriate and perhaps result in modifications to the preferred alternative or in the selection of one of the other alternatives. The alternative that is ultimately selected will become the basis of the final CCP, which will provide guidance for managing the Refuge over the next 15 years. It will guide the development of more detailed step-down management plans for specific resource areas, and it will underpin the annual budgeting process through Service-wide allocation databases. Most importantly, it lays out the general approach to managing habitat, wildlife, and people at Neal Smith NWR that will direct day-to-day decision making and actions.

Chapter 3: Refuge Environment and Management

In this chapter

3.1 Refuge Environment
3.2 Refuge Management

3.1 Refuge Environment

3.1.1 Geographic/Ecosystem Setting

Ecological Land Classification
Neal Smith National Wildlife Refuge (NWR, Refuge) lies within the Prairie Parkland (Temperate) Province as defined by Bailey's ecological classification system, developed by Bob Bailey and others in the U.S. Forest Service. The Prairie Parkland (Temperate) Province covers an extensive area from Canada to Oklahoma, with alternating prairie and deciduous forest. Summers are usually hot, and winters are cold. Vegetation is characterized by intermingled prairie, groves, and strips of deciduous trees. The prairies seem to be areas that have not yet become forested, either because of frequent fires or because the last glaciation was too recent for final successional stages to have been reached. Due to generally favorable conditions of climate and soil, most of the province is cultivated, and little of the original vegetation remains (Bailey, 1995).

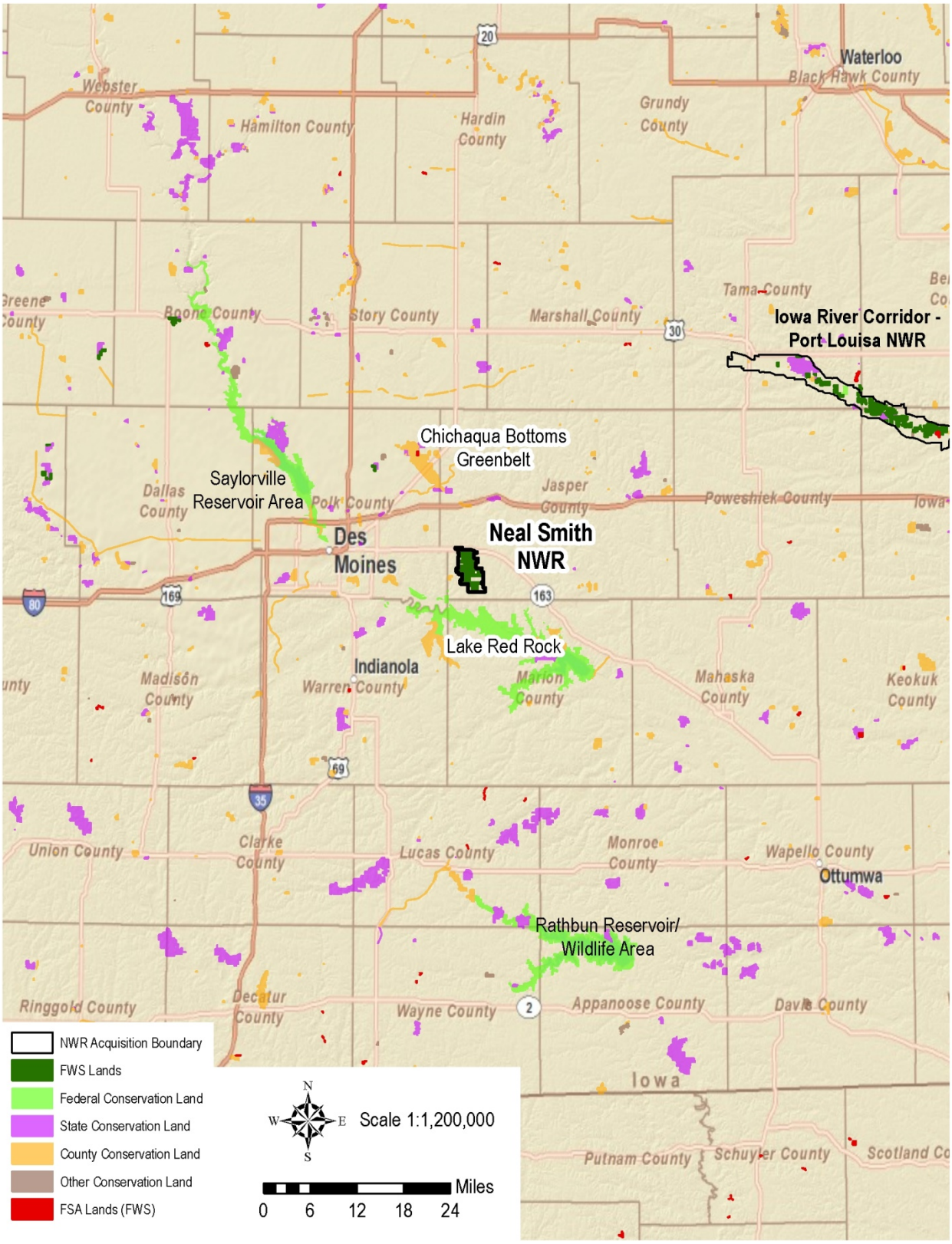
In Bailey's classification system, sections are subdivisions of provinces based on terrain features. The Refuge lies within the Central Dissected Till Plain Section, which includes southern Iowa and portions of Illinois, Missouri, Kansas, and Nebraska. Key characteristics include:

- Moderately dissected, glaciated, flat-to-rolling plains that slope gently toward the Missouri and Mississippi River valleys.
- An estimated 60 percent of the land surface was tallgrass prairie, with bur oak and white oak savannas interspersed. Upland forest (white oak-shagbark hickory) occurred on more dissected land, grading into bottomland forests and wet bottomland prairies along rivers.
- A well-developed dendritic drainage network is carved into the land surface. Natural lakes and ponds are rare or non-existent. Many streams now are straightened by channelization and silted-in from agricultural run-off. A few bottomland wetlands have been preserved from drainage enterprises.
- Fire and grazing by herds of bison and elk were the most important disturbance regimes in creation and maintenance of this landscape.

Other Conservation Areas

Chichaqua Bottoms Greenbelt is a 9,100-acre wildlife area along the Skunk River in Polk County that contains county, state, and federal lands (Figure 3-1). It is managed by the Polk County Conservation Board and includes dry, mesic, and wet prairies; floodplain wetlands, pothole marshes, wooded oxbow wetlands, and riparian woodlands. Much of the wildlife habitat has been restored and protected through the Wetlands Reserve Program administered by the Natural Resources Conservation Service.

Figure 3-1: Conservation Lands in the Area of Neal Smith NWR



Lake Red Rock is a flood control reservoir project and conservation area located about 3 miles south of the Refuge along the Des Moines River. At 52,800 acres, it's the largest contiguous public land mass in Iowa. Lake Red Rock conservation lands are managed by multiple agencies including the U.S. Army Corps of Engineers, Iowa Department of Natural Resources (DNR), and Marion County Conservation Board. Habitats include open water, forested corridor, wetland, prairie, savanna, and some fields and cropland.

Neal Smith NWR and Lake Red Rock are located within the boundary of the Des Moines Recreational River and Greenbelt, a 410,000-acre open space corridor along the Des Moines River. Authorized by Congress in 1985 and administered by the Corps of Engineers, the purpose of the Greenbelt is to develop and manage natural resources, cultural features, outdoor recreation facilities, and environmental education programs in a manner that makes wise use of resources and attracts outdoor recreation use and economic development to the area.

The National Audubon Society has identified Neal Smith NWR, Chichaqua Bottoms Greenbelt, and Lake Red Rock as Important Bird Areas (IBA). Sites that meet IBA criteria are considered to be the most essential habitats for support of the most seriously declining species of birds. The Chichaqua–Neal Smith region has been designated as a Grassland Bird Conservation Area by the Iowa DNR, following guidelines established by Partners in Flight. Such conservation areas are identified throughout the Iowa Wildlife Action Plan as providing significant habitat protection and restoration potential for Species of Greatest Conservation Need.

Northern Tallgrass Prairie National Wildlife Refuge (NTGP) was established to provide a means of working with individuals, groups, and government entities to permanently preserve and restore native prairie and wetland remnants in western Minnesota and northwestern Iowa. The project presently includes about 2,800 fee-title acres and 2,400 easement acres in widely scattered tracts. All or portions of 37 Iowa counties lie within the NTGP project area. One 192-acre tract on Neal Smith NWR has been purchased through the NTGP program. This tract, known as the Southeast Unit of the NTGP is managed as part of Neal Smith NWR and will be restored to prairie and savanna habitats as appropriate.

3.1.2 Physical Environment

Geology

Landforms of Iowa (Prior, 1991) divides Iowa into eight landforms based on glaciation, soils, topography, and river drainage. Neal Smith NWR is located in the Southern Iowa Drift Plain landform region (Figure 3-2), which covers most of the southern half of Iowa and contains all or part of 66 counties, including Jasper County. This region was created by repeated glacial expansion and retreat, wind-deposited loess, and erosion.

The glaciers that created the Drift Plain are hundreds of thousands of years older than those that created the Des Moines Lobe to the north. Consequently, this terrain has had much more time to be reshaped by erosion, resulting in a landscape characterized by steeply rolling hills interspersed with generally level hilltops and valley bottoms. The flat hilltops are remnants of the old glacial plain. The region is heavily dissected by drainage systems such as the Walnut Creek basin. The Southern Iowa Drift Plain contains some of the most productive agricultural land in the world.

The current Refuge landscape consists of loess and alluvium over glacial till and bedrock. Loess, a fine, ash-like, wind-deposited material, typically occurs on uplands. Alluvium, found on valley bottoms, is eroded material from upland areas. The loess deposits tend to be thinner on valley slopes where they

have been subject to erosion than on the ridgetops. Although the underlying bedrock is generally buried to a considerable depth by glacial till and loess, narrow outcrops of sandstone occur in a few locations.

Figure 3-2: Landforms of Iowa

Topography

The Refuge landscape has been molded by the erosive activities of Walnut Creek and its tributaries. Elevations within the Refuge range from a low of approximately 785 feet above mean sea level along Walnut Creek near the southern boundary to a high of approximately 930 feet above mean sea level at several locations on the ridgetops that occur at the periphery of the Refuge.

The majority of the Refuge consists of relatively level 0 to 5 percent slopes (approximately 43 percent) and gently sloping 5 to 9 percent slopes (approximately 41 percent). Approximately 15 percent of the Refuge consists of moderately to steeply sloping land (10 to 20 percent slopes). These slopes, which are associated with stream valleys, tend to face east or west along Walnut Creek and north or south along its tributaries.

Soils

Refuge soils formed as a result of the interaction of climate with the growth of tallgrass prairie and deciduous trees in loess, glacial till, and alluvial deposits. Decomposition of the deep fibrous root systems of grasses and forbs over many centuries produced the rich, black organic soils characteristic of tallgrass prairie. Soils formed under deciduous trees are generally lighter in color and more acidic than soils formed under tallgrass prairie. Based on interpretation of the soils data for the 1992 Master Plan, the majority of Refuge soils were formed under tallgrass prairie (62 percent) and oak savanna (36 percent); a much smaller portion of the Refuge (less than 2 percent) formed under deciduous woodlands. However, soil is just one factor in determining historic distribution of vegetation types;

geomorphic setting (slope, aspect, etc.), rainfall, and fire regime also affect the distribution of vegetation over time.

Approximately 60 percent of Refuge soils are subject to moderate erosion. These soils are located on valley slopes, which are subject to water erosion and on flatter ridgetops, which are more prone to wind erosion. Agricultural development during the last 150 years may have resulted in the erosion of up to six feet of topsoil from some upland areas, thus, accounting for the thin and weakly developed soil profiles currently encountered in the upland areas. Some of the soil has been deposited in lowland areas, creating soil levels higher than historic levels in these areas.

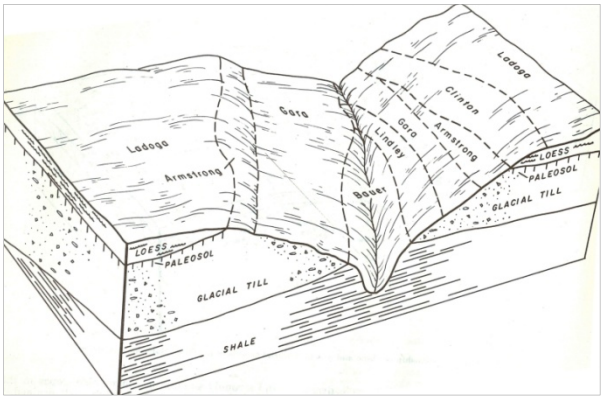
Soils can be grouped into soil associations, which are landscapes that have a distinctive pattern of soils in defined proportions. They typically consist of one or more major soils and at least one minor soil (Table 3-1). Soil associations provide a general understanding of the soil types in a particular survey area and are useful for comparing different parts of the Refuge. Neal Smith NWR contains four soil associations: Tama-Killduff-Muscatine, Downs-Tama-Shelby, Otley-Mahaska, and Ladoga-Gara (U.S. Department of Agriculture, 1979).

Table 3-1: Major soil series and attributes

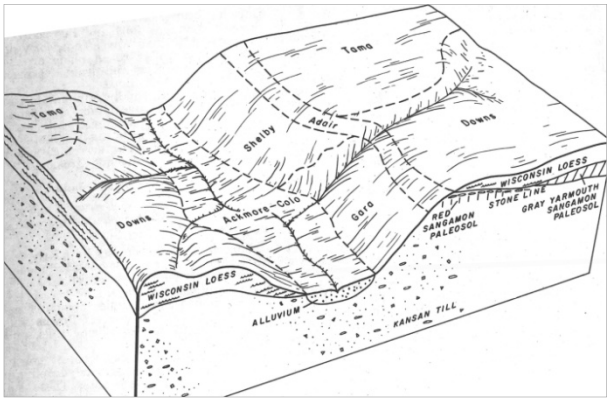
Major Soil Series	Drainage	Texture	Slope	Location	Conditions of Formation
Tama	Well drained	Silty clay loam	0 to 4 %	Convex ridgetops and side slopes	Formed in loess under grass
Killduff	Moderately well drained	Silty clay loam	5 to 18 %	Convex side slopes near threads of drainageways	Formed in loess under grass
Muscatine	Somewhat poorly drained	Silty clay loam	0 to 2 %	Broad upland divides	Formed in loess under grass
Downs	Well drained	Silt loam	0 to 18 %	Convex ridgetops and side slopes	Formed in loess under deciduous trees and tall prairie grasses
Shelby	Moderately well drained	Loam	9 to 25 %	Convex side slopes next to drainageways	Formed in glacial till under prairie grasses
Otley	Moderately well drained	Silty clay loam	2 to 14 %	Ridgetops and side slopes	Formed in loess under grass
Mahaska	Somewhat poorly drained	Silty clay loam	0 to 2 %	Upland divides	Formed in loess under grass
Ladoga	Moderately well drained	Silt loam	2 to 14 %	Convex ridgetops and side slopes	Formed in loess under deciduous trees and tall prairie grasses
Gara	Moderately well drained to well drained	Loam	9 to 40 %	Convex side slopes	Formed in glacial till under a mixture of prairie grass and timber

Within each association, individual soil series typically can be arranged based on slope position as illustrated in the diagrams (Figure 3-3). Soil series information is needed to make decisions on specific tracts, because the soils within an association ordinarily vary in slope, depth, stoniness, drainage, and other characteristics that affect their management.

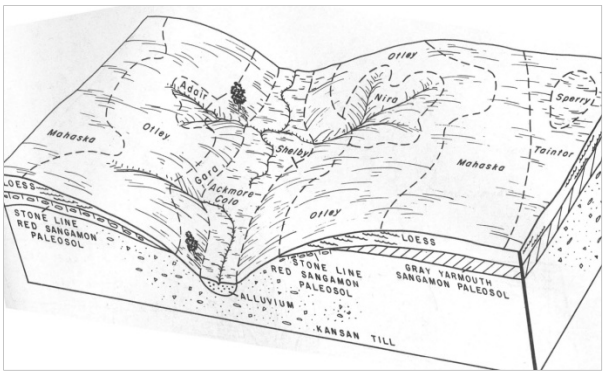
Figure 3-3: Soil associations



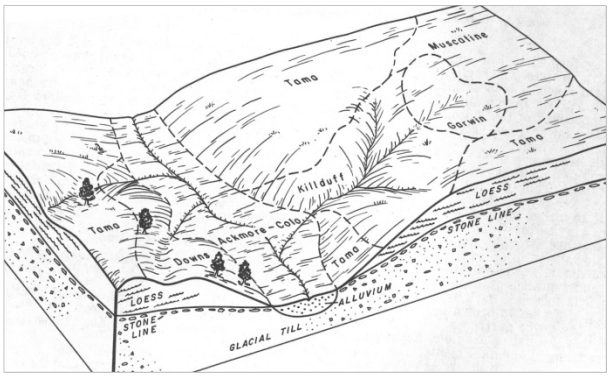
Ladoga-Gara



Downs-Tama-Shelby



Otley-Mahaska



Tama-Killduff-Muscatine

Climate

The climate of central Iowa, classified as humid continental, is characterized by warm, humid summers and cold, relatively dry winters. Average temperatures typically range from 72 °F in the summer to 22 °F in the winter. Approximately 70 percent of the average annual rainfall (32 inches in Jasper County) falls between April and September. The typical seasonal snowfall is approximately 27 inches. The amount of precipitation is a primary factor in the historic dominance of tallgrass prairie in the region: drier areas to the west support midgrass or shortgrass prairie, while deciduous forest is the native vegetation typically occurring in moister regions to the east. Prevailing winds in the region are from the northwest in the winter and from the southwest in the summer. The typical growing season begins sometime after the first week in April and lasts until the middle of October, with about 165 growing days.

Climate change

Iowa's annual average temperature has increased since 1873 at a modest rate, but seasonal and day-night changes have been proportionately larger. Temperatures have increased six times more in winter (0.18 °F/decade) than in summer (0.03 °F/decade), and nighttime temperatures have been increasing more than daytime temperatures. Iowa now has a statewide average of five more frost-free days per year than 50 years ago and eight to nine more than at the beginning of the 20th century. Higher winter

and spring temperatures seem to be causing earlier and more protracted snowmelt and a reduced probability of spring flooding (Iowa Climate Change Impacts Committee [ICCIC], 2011).

Precipitation in Iowa has gradually increased over the last 100 years, although year-to-year variability is high. Eastern Iowa has a higher upward trend than the statewide average. Most of the precipitation increase has come in the first half of the year and less in the second half, leading to wetter springs and drier autumns. Trends toward more precipitation and changed seasonality, as well as higher increases in eastern Iowa, are projected to continue. Growing evidence points to stronger summer storm systems in the Midwest due to warming temperatures and increasing humidity levels. The increased number of large summertime rain events, increased soil moisture, and other factors seem to be leading to increased summer flooding. This new pattern of seasonal flood occurrence in Iowa is expected to continue (ICCIC, 2011).

Predictions of continued increases in temperature and precipitation may cause accelerated growth of woody vegetation, which could eventually allow oak savannas to expand into non-wooded areas (if they are not cropped). Increased rainfall could make prescribed fire more difficult to implement, allowing fire intolerant species to more rapidly invade grasslands and savannas. Monitoring climate change effects on the Refuge will require a cadre of varying expertise. In the short term it will be difficult to determine or predict what the impacts of climate change will be on management of the Refuge. However, continuing to restore a healthy, resilient ecosystem in the face of current uncertainty will help wildlife and plants adapt to the changing climate over time.

Water and Hydrology

The Refuge is located within the 30.7-square mile Walnut Creek watershed, which lies within the Des Moines River drainage basin. The acquisition boundary for Neal Smith NWR encompasses about 44 percent of the watershed (Figure 3-4). From its headwaters, located two to three miles north of the Refuge, Walnut Creek flows south approximately ten miles to its confluence with the Des Moines River at the upper end of the Red Rock Reservoir. The approximately 6.5-mile stretch of Walnut Creek within the Refuge boundary bisects the Refuge from north to south and is fed by numerous tributary streams that generally flow in an east-west orientation (Figure 3-4).

Stream flow increases substantially from north to south, with flows in the southern portion of the Refuge averaging about three times greater than flows in the northern portion of the Refuge. Typically, volume has been greatest in the spring following heavy rains, decreasing throughout the summer, although this pattern could be altered as climate change progresses. Walnut Creek changes from an intermittent stream north of the Refuge to a perennial stream sustained by groundwater discharge, subsurface tile drainage, and tributary inflows as it flows south through the Refuge. Groundwater seeps are located on the Refuge where the upland mantle of loess has thinned and groundwater discharges at the contact between the loess and exposed paleosols or glacial till.

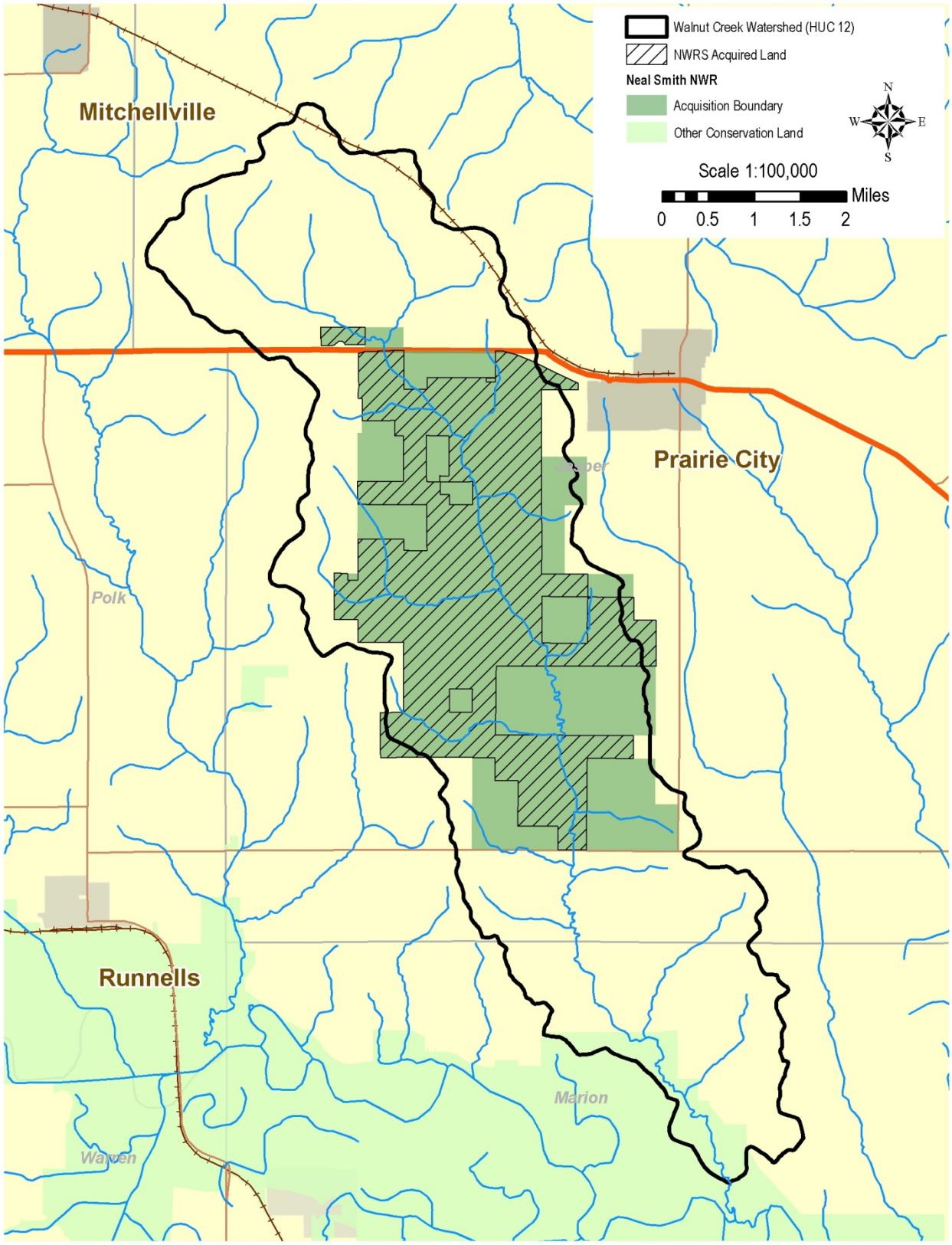
Water Quality

Water quality in Walnut Creek varies with changes in discharge and runoff and is typical of many warm water streams in Iowa. A Walnut Creek water quality monitoring program was established in 1995 in conjunction with habitat restoration efforts on the Refuge. Because the Walnut Creek watershed was intensively farmed in the past, the restoration of Neal Smith NWR provides a valuable opportunity to study sediment transport and nutrient cycling in a modified stream and monitor how quickly water quality can be improved by land management changes.

Sediment moves very rapidly downstream in the watershed in response to precipitation and snowmelt. Approximately 10,000 to 20,000 tons of sediment is transported each year in the Walnut Creek channel. The majority of highly erodible land occurs within the Refuge area whereas the headwaters area, above the Refuge, is the more gently sloping portion of the basin.

In addition to sediment, Walnut Creek is affected by agricultural non-point-source water pollutants including nutrients, pesticides, and animal waste. Between 1995 and 2005, nitrate concentrations significantly decreased in the Walnut Creek watershed as acreage of row crops decreased. Phosphorus concentrations varied between 0.06 mg/l and 0.2 mg/l but did not statistically change between 2001 and 2005. Herbicide detection frequencies were greater than 70 percent. Fecal coliform bacteria were detected frequently above water quality standards of the Environmental Protection Agency, with highest counts often occurring between May and October during high stream flow periods associated with rainfall runoff (Schilling et al., 2006).

Figure 3-4: Walnut Creek Watershed



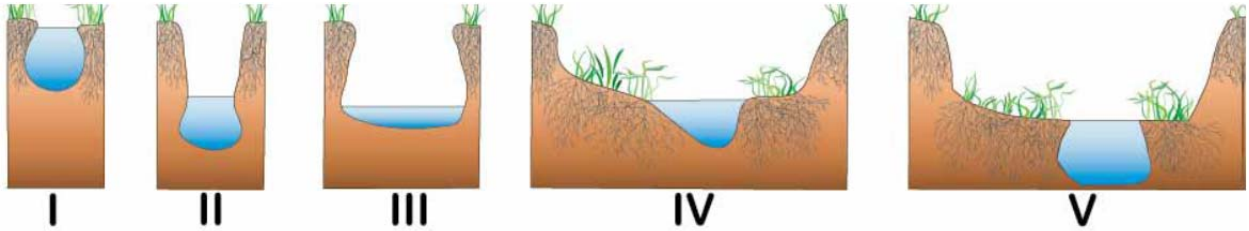
Hydrologic Alteration

Walnut Creek Floodplain

As tallgrass prairie was converted to agriculture, most of the natural meanders in Walnut Creek were straightened and deepened, and subsurface drainage tiles were installed throughout the watershed. These measures had the desired effect of moving water off crop fields and down Walnut Creek more efficiently, thereby increasing farm productivity. However, the increased volume and velocity of water in the straightened creek also caused significant channel scouring. Today the channel is incised as much as ten feet in many places, the groundwater table is lowered near the channel, and Walnut Creek is disconnected from its historic floodplain. As a result, floodplain soils are drier, particularly near the stream, and native vegetation has been overtaken in many locations by a monoculture of invasive reed canarygrass. Although much of the main stem of Walnut Creek has been straightened, an 840-acre Refuge inholding (surrounded by U.S. Fish and Wildlife Service [FWS, Service] fee title lands) includes a reach of the creek with meanders largely intact. This reach has retained some of the original geomorphology, but the hydrology is still altered; the area is a bottleneck for large volumes of water and sediment moving down the ditched portions of the creek.

The creek has benefitted from reduced human disturbance and is slowly moving toward a new state of equilibrium as it attempts to balance parameters such as slope, sediment loads, water volume, and channel geometry. Given current trends, the creek will eventually restore many of its natural functions. The incision of the creek bed has largely stabilized, and the channel is gradually widening as the stream banks collapse (Schilling et al., 2011). This is a natural process resulting from the channel encountering more resistant layers of alluvium and till, and probably aided by conversion of former agricultural fields to native prairie on the Refuge and widespread use of conservation tillage on farmland upstream. As the channel widens, slope of banks will decrease, terraces and channel meanders will begin to emerge, and floodplain vegetation communities will become established (Figure 3-5). The “new” floodplain will be connected to the stream stage but the abandoned floodplain will continue to be largely unsaturated. The new floodplain could be populated by pre-settlement vegetation (sedge meadow), whereas the old floodplain terrace could be populated by floodplain savanna. The time needed for these changes to occur naturally is unknown but would be on the order of decades to centuries (Schilling et al., 2012).

Figure 3-5: Stream channel evolution



(From MN Dept. of Natural Resources, 2010.)

I. A properly shaped stream in equilibrium and connected to its floodplain prior to disturbance.
II. Channel incision from ditching or by a headcut originating in a channelized reach due to increased slope and flow.
III. Channel widening as the channel begins to meander again.
IV. A more properly shaped stream as it evolves to re-establish equilibrium and rebuild a new floodplain.
V. A new, properly shaped channel in equilibrium with a lowered floodplain.

Subsurface Drainage System

The subsurface drainage system in the Walnut Creek watershed follows the natural branched drainage pattern of the land. Typically, a perforated tile line was buried under each ravine to sufficiently dry these

low areas enough for farmers to drive across and plant. The tile lines lower surficial groundwater levels by draining water out of the soil column above and adjacent to the tile. The diameter and length of tile lines varies depending on location and the amount of water each was designed to carry. Many of the small tributary streams in the watershed originate from tile drains. The system has not been mapped but is extensive—more than 50 outlets have been found on the Refuge along Walnut Creek and throughout several of its tributaries.

The branched drainage system of Walnut Creek is fairly common in the Southern Iowa Drift Plain but unusual in many other places (Schilling et al., 2012). Watersheds in the Des Moines Lobe and other recently glaciated areas are typically drained by pattern tile systems laid out in a dense grid designed to lower entire surficial groundwater tables below the root zone for increased crop yields. The extent, volume, and water quality concerns of pattern tile drainage are much more significant than for branched tile. However, although downstream impacts of Walnut Creek tile drainage on the Iowa and Mississippi River systems are small when compared with pattern tile systems, local impacts to habitat restoration on the Refuge are of concern.

State Highway 163 runs east-west through the Walnut Creek watershed. Refuge lands lie almost entirely south of the highway. Tile lines originating in the upper watershed, north of Highway 163, do not pull water from Refuge uplands; they empty directly into the creek before reaching the Refuge. Tile lines located south of the highway do affect many prairie, savanna, and upland sedge meadow sites on the Refuge by reducing the amount of available water in the soil. Reducing or eliminating the subsurface drainage system south of the highway would restore more natural waterflow to the Refuge uplands, likely resulting in more diverse and sustainable native plant communities.

Breaking, plugging, or complete removal of tile lines also has the potential for undesired effects: plugs might create overly wet conditions in adjacent areas as water continues to discharge above the plug; breaking the tiles might allow some continued drainage and potential headcutting at the break points; and full removal has the potential for increased erosion in some areas. Headcuts will always be a concern in the highly erodible soils found on and near the Refuge, but as Walnut Creek continues moving toward a new state of equilibrium, active erosion and headcut risk will decrease dramatically over time.

Nonetheless, restoring the hydrology of upland areas on the Refuge should be fairly straightforward, especially after the techniques have been mastered. The real challenge may be in locating the tile lines and addressing segments outside the Refuge boundary. Some tile lines lie completely within the Refuge boundary, but many are thought to originate on private agricultural lands up-gradient of the Refuge. Breaking, plugging, or removing these tiles only within the Refuge boundary would not be enough to restore local hydrology; off-Refuge portions would remain intact, continuing to discharge groundwater onto Refuge lands and possibly backing water onto adjacent private property.

3.1.3 Biological Environment

Vegetation

Historic Ecosystem

At the time of European settlement, prairie covered 28.6 million acres in Iowa (Smith, 1998). Oak savannas covered 11 to 13 million acres in the Midwest (Nuzzo, 1985) and about 2.4 million acres in Iowa (Smith, 1998). According to 1846 General Land Office survey records, the land cover of the current Neal Smith NWR at the time of European settlement consisted of tallgrass prairie in the northern half,

extending into the southwestern and southeastern portions of the Refuge; a lobe of oak savanna extended from the south along Walnut Creek to the center of the Refuge.

The pattern of vegetation across the landscape was dependent on a complex combination of environmental factors such as climate, topography, hydrology, grazing, and soils; combined with the effects of fire either caused naturally by lightning or deliberately set by humans. Fire was an important factor in the ecology of the ecosystem, promoting deep-rooted herbaceous plants, reducing litter build-up, and suppressing the growth of woody vegetation. Bison and elk provided essential functions such as grazing and other disturbances that, together with fire, maintained the diverse and dynamic nature of a system dominated by herbaceous vegetation. As these environmental factors varied over time and space, so too did the distribution of vegetation communities. The landscape was a mosaic of prairie flowing to oak savanna and sedge meadow with no abrupt edges between them.

Tallgrass prairie is dominated by grasses and forbs. Typically there is little cover of woody vegetation, although some shrub species are appropriate. Plant species are adapted to sunny conditions. Spring-blooming species are smaller in stature with each successive wave of bloom coming on taller plants until late summer and autumn, when tall forbs bloom amidst warm season grasses. Several hundred plant species are adapted to prairie conditions with variation in moisture regime and soil type.

Oak savanna is characterized by spreading, open-grown oak trees. The scattered trees or groves of trees typically have a canopy ranging between 10 and 70 percent. On the Refuge, bur oak (*Quercus macrocarpa*) is the dominant tree species interspersed with red oak (*Quercus rubra*), black oak (*Quercus velutina*), shagbark hickory (*Carya ovata*), and bitternut hickory (*Carya cordiformis*). Sapling and pole trees help maintain a subcanopy layer and replace mature overstory trees that age and eventually drop out of the canopy. Historically, trees probably were denser in wet areas and along north and east slopes.

The mosaic of open, closed, and partially shaded areas created by the trees provide for a unique mix of herbaceous understory plants—sun-loving prairie species, shade-adapted forest species, and savanna-specific species can all be found in oak savanna. Shrubs may or may not be present depending on fire frequency. Savanna fires are often slow and creeping, compared to raging prairie fires. Historically, oak savanna represented a dynamic ecotone between prairie and forest, slowly expanding and contracting as climate and fire regime shifted over thousands of years.

Sedge meadow is a very shallow wetland community characterized by hydric soils and dominated by a variety of sedges. Sedge meadows occur along a gradient from mesic tallgrass prairie to wet prairie to sedge meadow to wetland. They require moisture close to the surface for an extended period during the growing season. The plants require full sun and frequent fire. In addition to sedges, sedge meadows contain prairie cordgrass, rushes, and some forbs. Sedges often form tussocks, creating unique habitat for wildlife. Sedge meadows are a unique mix of aquatic and terrestrial ecosystems, with fluctuating water levels.

European Settlement

The tallgrass prairie ecosystem was quickly settled and cleared as European-Americans arrived in the Midwest in the mid-1800s. Oaks provided firewood and building material. When settlement began it was believed that the best soil for farming was under wooded areas so many were rapidly cleared for agriculture. The rich prairie soils were soon discovered and quickly plowed as the state was settled. By the late 1800s, most of the prairies had been plowed or heavily grazed, and today less than one percent of tallgrass prairie remains east of the Missouri River, and less than 0.1 percent in Iowa (Smith, 1998).

Only 0.02 percent of midwestern savannas remain, with the rest destroyed or severely degraded (Nuzzo, 1986). Noss et al. (1995) classified tallgrass prairie east of the Missouri River and on mesic sites throughout their range and all midwestern oak savannas as critically endangered. Savannas are the biome with the greatest conservation risk on Earth (Hoekstra et al., 2005).

Populations of wildlife that depended on tallgrass prairie habitats declined quickly as the land was settled and many species disappeared from the area. It is estimated that there were 50–75 million bison present in North America at the time Europeans arrived. The last of the bison (*Bison bison*) were extirpated from Iowa in 1863, and elk (*Cervus elaphus*) were gone by the early 1870s (Dinsmore, 1994). Many species of grassland birds also showed precipitous declines in numbers. The last nesting population of Greater Prairie-Chickens in southern Iowa disappeared in the 1950s, prior to their reintroduction in 1987.

Neal Smith NWR

The entire Walnut Creek watershed and surrounding area were heavily impacted by agriculture. Most prairie and savanna were converted to croplands; lands less suitable for crops were used for grazing livestock or logging. Fire was actively suppressed. Consequently, all of the pre-settlement natural communities were eliminated, degraded, or considerably disturbed. When the Refuge was established, cropland occupied about 69 percent of the approved boundary, grazed pasture occupied approximately 17 percent, and about 7.5 percent had been converted to grassland dominated by non-native brome under the Conservation Reserve Program (CRP). Scattered untilled remnants of native vegetation also remained. Figure 3-6 illustrates current Refuge land cover.

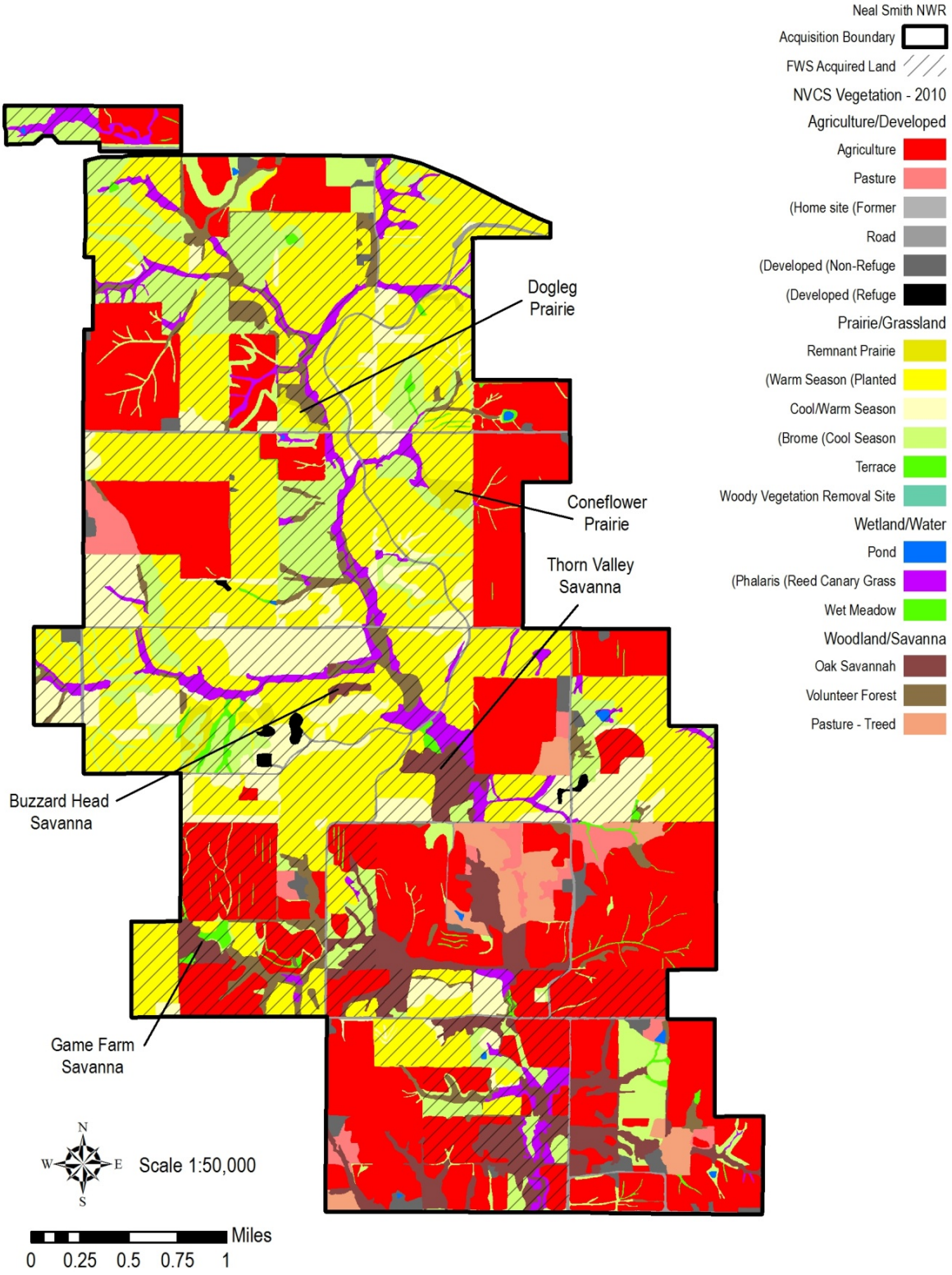
Reconstructed prairie

About 3,400 acres of former cropland have been planted with native prairie species. Prairie reconstructions on the Refuge are of varying quality, from very diverse to those dominated by a few species, primarily warm season grasses including big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and little bluestem (*Schizachyrium scoparium*). Native cool season graminoids (grasses and sedges) and forbs are under-represented throughout the Refuge. Some units have very low densities of forbs and some are beginning to be invaded by woody vegetation. Non-native invasive species are present in many locations.

Many plants that are associated with high quality prairie [such as lead plant (*Amorpha canescens*), prairie lily (*Lilium philadelphicum*), and New Jersey tea (*Ceanothus americanus*)] are beginning to be observed on the Refuge despite having been planted a decade or more ago. These and other species are indicators of a maturing prairie and testimony that ecological restoration is a long-term process.

The 2,500 acres of reconstructed prairie classified as *"Warm Season"* on the 2010 vegetation map (Figure 3-6) are dominated by warm season grasses and native forbs but may contain up to 20 percent cover of non-native grasses (mostly brome) and non-native forbs. Units classified as *"Cool/Warm Season"* (675 acres) have more than 50 percent cover of non-native grasses, especially brome. This category is typical of younger plantings and areas that have been grazed or mowed.

Figure 3-6: Current Land Cover, Neal Smith NWR



Crop fields and old pasture
About 600 acres of Refuge land are still being farmed to prevent weed encroachment until they can be planted to prairie. Another 700 acres are categorized as *"Brome (Cool Season)."* Most of these units were planted for pasture or through the CRP prior to Refuge ownership. They are dominated by smooth brome and other non-native cool season grasses [timothy (*Phleum pretense*), Kentucky bluegrass (*Poa pratensis*), etc.].

Prairie and savanna remnants
About 90 acres of remnant tallgrass prairie and 150 acres of oak savanna remnants are found on the Refuge. When fire was suppressed, non-fire-tolerant woody species began encroaching, eventually forming an overly dense canopy that favors shade-tolerant understory species at the expense of prairie and savanna specialists. Native herbaceous plants that remain often are limited to spring-blooming species that complete much of their life cycle before the trees leaf out. Non-native plant species, both woody and herbaceous, are invading many remnants. Oak regeneration in savannas has been limited by shady conditions, competition with faster-growing trees and shrubs, and browsing by white-tailed deer.

Sedge meadow
Dominant native plants found in sedge meadows include prairie cordgrass, sedges, and rushes. Native forbs occur occasionally. Sedge meadows are located in floodplain depressions associated with Walnut Creek and its tributaries as well as in upland seeps and ravines. In the floodplain, invasive reed canarygrass has become a tenacious competitor due to hydrologic alteration. About 330 acres of low-lying Refuge land are classified as *"Phalaris (Reed Canarygrass)"* on the 2010 vegetation map (Figure 3-6). These areas are dominated by greater than 75 percent reed canarygrass. One ten-acre sedge meadow on the Refuge is the subject of an ongoing reconstruction and research program.

Sedge meadows on upland areas near seeps and ravines often still retain some diversity. Seasonal variations in wetness in these locations make it difficult for many invasive plants to survive, including reed canarygrass, although seeps are vulnerable to cool season exotics like smooth brome. Ravines drain surface runoff into Walnut Creek; many probably contained seeps prior to being tiled and sedges sometimes still survive in these areas. Subsurface drain tiles have reduced the level of soil saturation in seeps and ravines and reduced the quality and diversity of the sedge meadows found there.

Volunteer Woodland
About 220 acres, primarily along Walnut Creek, are currently woodlands that have grown in since European-American settlement. Another 185 acres of trees have been removed since the Refuge was established. Although the trees are primarily native species, they are fire-intolerant and did not occur in these locations in the 1840s. Oak woodland did exist in some parts of southern and eastern Iowa prior to European settlement but not on the Refuge. Evidence indicates that current-day Refuge woodlands are actually overgrown savanna, prairie, or sedge meadow, the result of fire suppression, not historic ecological processes. For example:

- Mature oaks in the Refuge woodlands have widely spreading branches indicating that they grew in strong sunlight.
- There is no ecological relationship between the overstory and understory species in Refuge woodlands indicating that the understory species are present as a result of disturbances in the natural ecological processes.
- The General Land Office (GLO) survey notes make no mention of trees north of the current Visitor Center site.

Ponds
Farm ponds existed on some Refuge lands at the time of purchase, created by previous landowners as a water source for livestock or to reduce soil erosion. Some were silted-in and abandoned at the time of Service acquisition. Most of the dams have been removed so the ponds no longer hold water. Such ponds did not exist in the pre-settlement ecosystem, and their modest wildlife habitat benefits can be replaced by restoration projects that are more appropriate for the ecology of the area.

The 1992 Master Plan called for creation of six small impoundments and moist soil units within the riparian corridor. The purpose was to create marsh habitat to increase the value of the Refuge for wildlife, provide educators with the opportunity to teach the public about wetlands and wildlife, and enhance the visual and biological diversity of the Refuge. The created wetlands would have required dikes, water control structures, and intensive management. However, as a result of the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) and subsequent policy on biological integrity, diversity, and environmental health, National Wildlife Refuge System (NWRS, Refuge System) priorities began to favor management that restores or mimics natural ecosystem processes and functions. The created wetlands identified in the Master Plan were not constructed.

Wildlife and Fish
Birds
More than 200 species of birds now use the Refuge, including more than 80 species during breeding season. Many bird species that had been extirpated from the area due to habitat loss have returned as the ecosystem undergoes restoration.

Birds began showing up in Refuge prairies soon after plantings began, and as the Refuge has grown the number of grassland bird species has increased. Henslow's Sparrow (*Ammodramus henslowii*) was first found on the Refuge in 1999 and is now ubiquitous in the unburned prairies and grasslands each year. Several other species of grassland birds including Sedge Wren (*Cistothorus platensis*) , Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*A. savannarum*) , Dickcissel (*Spiza Americana*) , Bobolink (*Dolichonyx oryzivorus*), and Eastern Meadowlark (*Sturnella magna*) also are common on the Refuge during the breeding season. Western Meadowlark (*S. neglecta*) is found in a few locations including one pair in the bison and elk enclosure most years. Upland Sandpipers are present in small numbers in most years, and fledglings have been confirmed. The Northern Bobwhite (*Colinus virginianus*) is present in small numbers, although some of these birds may be captive-reared birds released for hunting from a nearby game farm. Short-eared Owls (*Asio flammeus*) and Northern Harriers (*Circus cyaneus*) are now consistently seen during winter and migration. Swainson's Hawks (*Buteo swainsoni*), Smith's Longspurs (*Calcarius pictus*), and Le Conte's (*A. leconteii*) and Savanna Sparrows (*Passerculus sandwichensis*) use the Refuge regularly during migration.

Another group of birds on the Refuge uses shrubs for feeding and nesting, including Bell's Vireo (*Vireo bellii*), Gray Catbird (*Dumetella carolinensis*), Brown Thrasher (*Toxostoma rufum*), Yellow-breasted Chat (*Icteria virens*) , and Orchard Oriole (*I. spurius*). Others—such as Loggerhead Shrike (*Lanius ludovicianus*), Willow Flycatcher (*Empidonax traillii*), Eastern Kingbird (*Tyrannus tyrannus*), Vesper Sparrow (*Pooecetes gramineus*), Field Sparrow (*Spizella pusilla*), Lark Sparrow (*Chondestes grammacus*), and American Goldfinch (*Carduelis tristis*)—use scattered shrubs surrounded by grasslands. Loggerhead Shrikes are sometimes present on the Refuge in small numbers. American Tree (*Spizella arborea*) and Harris' Sparrows (*Zonotrichia querula*) and Northern Shrikes (*L. excubitor*) are also present in this habitat during migration and winter.

Red-headed Woodpeckers (*Melanerpes erythrocephalus*) are found in oak savannas on the Refuge. Northern Flickers (*Colaptes auratus*) frequently forage in prairies but use trees for nesting. Eastern Towhees and Field Sparrows use shrubs in oak savanna areas.

Waterfowl may occur on the Refuge more frequently as habitat conditions in sedge meadows and savannas improve.

Mammals

By the end of the 19th century at least 13 mammals were extirpated from Iowa including bison, pronghorn (*Antilocapra americana*), elk, mountain lion (*Felis concolor*), porcupine (*Erethizon dorsatum*), gray wolf (*Canis lupus*), wolverine (*Gulo luscus*), lynx (*Lynx canadensis*), fisher (*Martes pennant*), black bear (*Ursus americanus*), beaver (*Castor canadensis*), river otter (*Lutra canadensis*), and white-tailed deer (*Odocoileus virginianus*). The last three have been reintroduced into the state and the populations are rebounding. Black bears are sighted occasionally in Iowa but have not shown a substantial comeback, which is likely the result of a lack of suitable habitat.

More than 40 mammal species, including the federally endangered Indiana bat (*Myotis sodalis*) have been documented on the Refuge. White-tailed deer, eastern cottontail (*Sylvilagus floridanus*), thirteen-lined ground squirrel (*Citellus tridecemlineatus*), and raccoon (*Procyon lotor*) are the most frequently seen mammals on the Refuge. Badgers (*Taxidea taxus*) and bobcats (*Lynx rufus*) have also been found. Bison and elk have been reintroduced to a 700-acre fenced enclosure. The Refuge has suitable habitat to support the spotted skunk (*Spilogale putorius*), although the species is thought to be extirpated from the state. Although somewhat outside its present range, the white-tailed jack rabbit (*Lepus townsendii*) could potentially occupy grazed areas of the Refuge in the future. Franklin's ground squirrel (*C. franklini*) is another species formerly occurring in the area that could be re-established on the Refuge.

Reptiles and Amphibians

The 1992 Master Plan appendices list four turtles and 15 snakes likely to occur on the Refuge. Most of these species have broad distributions and are common in Iowa. At least three species of grassland-associated reptiles might reoccupy the area if suitable habitat were available. Two of these species [western slender glass lizard (*Ophisarius attenuates*) and speckled kingsnake (*Lampropeltis getula holbrooki*)] are currently listed as endangered in Iowa. The ranges of both species extend to near the Refuge. The other, the northern prairie skink (*Eumeces septentrionalis*), is reasonably common in suitable habitat (sand prairies) in Iowa, but such habitat currently is greatly restricted and not present on the Refuge. All three of these species might naturally recolonize the Refuge if suitable habitat is available. Fox (*Elaphe vulpine*) and bull snakes (*Pituophis catenifer*) (as well as many others) are also declining and are present in suitable habitat on the Refuge.

Amphibian surveys documented nine species on the Refuge in 2004 including the tiger salamander (*Ambystoma*

tigrinum), eastern gray treefrog (*Hyla versacolor*) and Cope's gray treefrog (*H. chrysoscelis*), American toad (*Anaxyrus americanus*), American bullfrog (*Ranus catesbeiana*), Blanchard's cricket frog (*Acris crepitans blanchardi*), western chorus frog (*Pseudacris triseriata*), northern leopard frog (*Rana pipiens*), and pickerel frog (*R. palustris*). A narrow-mouthed salamander (*Ambystoma texanum*) was captured in a pitfall trap as part of a ground invertebrate sampling project in 1994. The most common frogs and toads detected on annual nocturnal call surveys are eastern gray tree frog, American toad, Blanchard's cricket frog, and western chorus frog. None of the amphibians present on the Refuge are on the federal or Iowa lists of threatened or endangered species, although Blanchard's cricket frog is listed as a species of greatest conservation need in the Iowa Wildlife Action Plan. Additional species that may occur include the plains leopard frog and green frog (*R. clamitans*). The spring peeper (*P. crucifer*) is found in nearby counties and its range is expanding in Iowa.

Invertebrates

Nearly 90 butterfly species have been documented on the Refuge, including the regal fritillary (*Speyeria idalia*), which has been the subject of Refuge reintroduction and research efforts. Baseline sampling in remnants on the Refuge identified 426 moth species. At least 29 species of ants have been documented from the Refuge, including *Formica montana* and *Formica exsectoides*, two species that build large mounds. Five species of native earthworms have been documented on the Refuge. Prairie crayfish (*Procambarus gracilis*), which engineers the prairie by building burrows, is found throughout the Refuge.

Fish

Thirty-one species of fish from eight families were collected from Walnut Creek between 1995 and 2005, but the overall number of fish collected was low. The fish community was dominated by minnows (Cyprinidae), most of which are considered abundant-to-common in Iowa streams. Sunfishes (Centrarchidae) were often found in Walnut Creek, but in small numbers. Seven species of suckers (Catostomidae) were collected, generally in fairly low numbers. Gizzard shad comprised a large proportion of the Walnut Creek fish population in 1998 and 1999 but were found in relatively low numbers in other years. During all years, species tolerant of degraded environmental conditions made up a large proportion of the Walnut Creek fish community. Less tolerant species were sporadically found. The diversity of fish collected from Walnut Creek can vary dramatically and is heavily influenced by its proximity to the Des Moines River. The dominant resident fish species are likely populations that have relied historically on Walnut Creek for shelter and food while the infrequent species are likely just transients (Schilling et al., 2006).

Little is known about the historic fish assemblage of Walnut Creek. At least two species listed as threatened in Iowa [western sand darter (*Ammocrypta clara*) and blacknose shiner (*Notropis heterolepis*)] once were found in this region, although Walnut Creek does not appear to have suitable habitat for either. The Refuge is within the historic range of the endangered Topeka shiner (*N. Topeka*), but the species has not been found in Walnut Creek, and the Refuge does not contain designated critical habitat. The damming of the Des Moines River to create Red Rock Lake influences habitat in Walnut Creek and allows access to the creek by warm-water species that would not be present otherwise.

Threatened and Endangered Species

Federally endangered Indiana bats (*Myotis sodalis*) migrate from central Missouri to southern Iowa during the spring months to raise their young. Jasper County is near the northwestern edge of the species' range. Two monitoring seasons (1992 and 1993) on the Refuge resulted in successful mist-netting of lactating females and juveniles from one localized area just north of Thorn Valley Savanna. A third monitoring season resulted in capture of one adult male. The Refuge follows Service guidelines for

tree-cutting and burning to protect roosting Indiana bats. Savanna restoration will likely improve Indiana bat habitat by developing more desirable flyways and thus, better forage conditions under an open canopy. The species prefers large dead trees with loose bark during breeding season.

In 1994, seeds of the federally threatened prairie bush clover (*Lespedeza leptostachya*) were sown on the Refuge. No plants have been observed as yet on this 35-acre site. Seeds and/or seedlings may have perished, but it is also possible that the seeds are still lying dormant in the soil. Some species of the genus Lespedeza require seed scarification to begin the germination process, but it is uncertain whether or not prairie bush clover is one of those species.

In 2001, seedlings of the federally threatened western prairie fringed orchid (*Platanthera praeclara*) were transplanted to two sites on the Refuge. The plants were the result of a project instigated by Dr. Margaret Fromm, the only individual who had successfully propagated the species from seed in the lab. Seedlings existed as a single green shoot or leaf per plant. Though the shoot stayed green on some orchid plants, others could not be found again later in the year. In subsequent years the plants have not been observed in the area where transplanting took place.

3.1.4 Socioeconomic Environment

Population, Income, Employment, and Demographics

The Refuge lies in the southwest quadrant of Jasper County. Jasper County is primarily rural in nature. Polk County includes the city of Des Moines, located about 18 miles west of the Refuge. The Des Moines metropolitan area (population 500,000) is one of the fastest growing regions of the state. The town of Prairie City (population 1,400) lies just northeast of the Refuge boundary.

The area population increased by 12.8 percent from 1995 to 2005, compared with a 3.4 percent increase for the State of Iowa and an 11.4 percent increase for the United States as a whole. Per capita income in the area increased by 8.6 percent over the 1995-2005 period, while the State of Iowa and the United States increased by 14.6 and 13.2 percent respectively (Carver and Caudhill, 2007).

Table 3-2: Changes in population, employment, and income 1995-2005

County	Population		Employment		Per Capita Income	
	2005	*% change 1995-2005*	*2005*	*% change 1995-2005*	*2005*	*% change 1995-2005*
Jasper	37,500	6.0%	18,700	1.4%	$28,622	1.5%
Polk	401,800	13.5%	323,300	12.5%	$39,215	14.5%
Area Total	**439,300**	**12.8%**	**342,000**	**11.8%**	**$33,919**	**8.6%**
Iowa	2,965,500	3.4%	1,968,200	9.6%	$31,670	14.6%
United States	266,278,400	11.4%	174,249,600	17.0%	$34,471	13.2%

(From: Carver E. and J. Caudill, 2007)

The median household income in Jasper County in 2009 was $48,439 with ten percent of residents living below the poverty level. The population is about 97 percent white (U.S. Census Bureau *Quick Facts*). Manufacturing is the largest category of private sector employment in Jasper County, followed by retail trade, leisure/hospitality, and education/health services (Iowa Workforce Development http://iwin.iwd.state.ia.us/iowa).

Refuge Economics
Neal Smith NWR affects the local economy through the visitor spending it generates and the employment it supports. The Refuge currently supports 10.5 full-time permanent employees and receives about 160,000 visitors each year, many of whom visit the Refuge multiple times during the year. About 14 percent of visitors come from Jasper County, 24 percent from the Des Moines metropolitan area, 36 percent from other parts of Iowa, and 22 percent from other parts of the United States. Neal Smith NWR was one of the sample refuges investigated in a national study of the economic benefits to local communities of national wildlife refuge visitation (Carver and Caudill, 2007). This study found that, in 2006, resident and non-resident visitors to Neal Smith NWR spent about $2.3 million with non-residents accounting for about 90 percent of total expenditures. When this spending had cycled through the economy, Refuge visitation had generated $982,200 in job income, 36 jobs, and about $325,400 in total tax revenue for local communities.

3.1.5 Cultural Resources

Area History (from Hudak et al., 1991)
Pre-History
Archeological records show evidence that nomadic hunter-gatherers were present in Iowa from the earliest generally accepted cultural period, the Paleo-Indian tradition, that began about 12,000 years before present (yrs BP). Archeologists hypothesize that these hunter-gatherers roamed widely through the post-glacial boreal forest of the Midwest in search of mastodon, wooly mammoth, and other resources.

The Archaic tradition evolved as the climate grew warmer and drier, and the cool moist boreal forest gave way to deciduous forest and savanna. People became more sedentary, exploiting deer, elk, and smaller mammals for food, as well as birds and plant resources. There is consistent evidence of ongoing trade and other forms of interaction during this period. Prairie vegetation moved into the region during the middle Archaic (8,000–5,000 yrs BP), and bison became a dependable resource. Late Archaic sites are well represented in central Iowa, including sites in Saylorville Reservoir.

Cooler moister conditions subsequently re-emerged. As deciduous forest expanded once again, bison herds likely moved farther west, although other resources were still plentiful. During this time, people of the Woodland tradition developed pottery manufacture, construction of burial mounds, experimentation with cultivated plants, and habitation in small villages. The middle Woodland tradition (2,500–1,500 yrs BP) is well represented in the archeological record of central Iowa.

Several new cultural traditions emerged in the Midwest as shorter climatic intervals (~400 years) oscillated between wet and dry periods. The people of the Oneota tradition (950–200 yrs BP) were the primary inhabitants of the tallgrass prairie. Archeological sites west of the Mississippi River generally offer large numbers of bison bone, suggesting that the animals were located nearby and were intensively sought by these people. Almost all Oneota villages offer evidence for intensive gardening of corn, beans, and squash. The Oneota culture is regarded as the traditional culture of the Winnebago, Ioway, Oto, and Missouri Indians. Oneota cultural remains from central Iowa are sufficiently distinctive that they are referred to in the literature as the Moingona phase.

Native American History
Prior to 1821, the Ioways and Missouris were in control of the lower and central Des Moines River Valley. The prehistoric remains of these tribes are well represented in the nearby Red Rock Reservoir

area. It is possible that the ancestral Ioway, Missouri, and/or Oto lived in large villages very near the Refuge area as early as A.D. 1000. Their hunting grounds, collecting locations, campsites, and gardens were probably located in the Walnut Creek drainage although there is little specific documentation in the historic record.

The Sauk Indians, led by the famous warrior Black Hawk, soundly defeated the Ioways in a battle fought near Iowaville in 1821. The Ioways vacated the area soon thereafter and ceded all their Iowa lands to the U.S. Government in the early 1830s. Shortly after the battle, the Sauk and Fox moved into the central Des Moines valley and became the principal Native Americans in residence there until they ceded all Iowa territory and left for reservations to the west.

The Sauk and Fox lived in several villages simultaneously that fluctuated in size depending upon the fortunes of the village leader. In the early 1840s Poweshiek's village was located less than 20 miles north of the Refuge on the South Skunk River, and Keokuk's village was located immediately south of the Refuge along the Des Moines River (now Lake Red Rock).

The Sauk and Fox were involved in numerous treaties with the U.S. Government to cede their lands. In an 1842 treaty, they ceded their last claim to Iowa land in exchange for a reservation in Kansas, then to the present-day reserve in Oklahoma. Part of the Meskwaki tribe, however, separated from the larger group, returned to Iowa, and purchased land in Tama County where they still maintain the Meskwaki Settlement today.

The historic record contains few specific references to Native American use of the Walnut Creek drainage but one early settler, William Edward Pulver, told the story of the "Johnnie Green Indians" in a 1935 article in the Newton Daily News. Johnnie Green was a Potawatomi, yet he was the leader of a band of Meskwaki. Pulver probably saw Green and his band along Walnut Creek in the early 1860s when he was a small boy:

> *"I remember seeing the Indians ride past our house wrapped in their bright blankets and I have been with Lute Hayes in their camp about two miles east of here, where they built a dam in the creek to wash their clothes, in the Dan Hayes timber. They were called the Johnnie Green Indians as that was the name of their chief. They left here and went to Kansas, then later moved to Tama. It was their custom to return each year to camp for a time in the timbers near their graveyard on the Billy Hayes farm. There are some fourteen or more graves that lay on a hillside just east of a small creek east and a little north of the barn as it now stands, the location being R 21 W, Township 78 N, Section 21. There are also several Indian graves just south of the school house."*

Euro-American Settlement

Jasper County was created in 1840 even before there were any permanent residents. Settlement began in 1843, and by 1846 permanent white settlement was sufficient to merit establishment of formal county government. Newton City (later shortened to Newton) was named county seat.

With rapid increased settlement in the interior of Iowa came calls for a state capital that was more centrally located than Iowa City. Many frontier communities dreamed of capturing the prize, and the political pressure was intense. A three-man commission examined a series of locations in 1847 before settling on an uninhabited site two miles south and east of present-day Prairie City. Word of the selection touched off a frenzy of speculative lands sales, and central Iowa suddenly was *the* place to be. However, legislators in Iowa City were less than thrilled with the location, so in 1848 they repealed the

earlier act that provided for a new capital location. Eventually, in 1876, the capital was moved to Des Moines.

By the summer of 1847, there was evidence of various settlement activities in southwest Jasper County. The map prepared by surveyor Samuel Jacobs showed four sets of cultivated fields, what may have been an Indian trail running east-west across the center, and a portion of the old Territorial Road from Oskaloosa to Fort Des Moines crossing the northeast corner of the township. Jacobs described the landscape:

> *"Township 78 Range 21 W 5th Meridian has a rolling surface and a good second rate soil. In the southwestern part of the township there is a body of generally good timber, about equal in area to ten sections, consisting of oak, hickory, elm, lind, walnut, etc. The remainder of the township is rolling prairie. It is well watered and being rapidly settled."*

Prairie City was founded in 1851 and soon became a stop along the old Territorial Road. Jasper County acquired rail service in 1865 when the Des Moines Valley Railroad reached Monroe. Prairie City emerged as the dominant community in the Walnut Creek area when it gained rail service in 1866.

Farms and communities developed rapidly, fueled by the developing agricultural economy. In Jasper County and elsewhere, settlers initially favored farm sites combining timberland and open prairie land, preferably near a stream. Such sites offered wood for fuel and building purposes, a water source, and prairie for pasture and (relatively) easy planting. But as settlement increased, virtually all available land was soon snapped up without regard for the proportions of timber and prairie on them.

Livestock and corn were dominant in Iowa, but some areas developed additional agricultural specialties. In the Prairie City area, commercial potato production was very important during the late 19th century. The area was termed the "Potato Metropolis," and one 1891 account estimated that the total harvest that year alone would easily reach 100,000 bushels. The Dowden potato digger was invented and manufactured in Prairie City, and the company touted its "potato harvesters, shoveling boards, potato cutters, potato sorters, etc." Many prominent root cellars on area farmsteads persist as a visual reminder of this era.

Refuge Cultural Resources

In 1991, the Service sponsored a cultural resources investigation of the Refuge to guide development of the 1992 Master Plan and to formulate a predictive model to identify areas of high cultural resources potential for use in future planning (Hudak et al., 1991).

The investigation team identified and evaluated seven prehistoric sites, two reported historic Indian burial locations, a reported Indian camp area, and all standing farmsteads located on the Refuge. None of the prehistoric sites were considered significant. No surface evidence of the reported burial areas or camping site was found, probably due to the effects of cultivation and erosion. Additional non-destructive testing was recommended should ground-disturbing activities become necessary. The farmsteads have been greatly altered over the years and it is unclear at present whether any are eligible for the National Register of Historic Places.

Two soil groups found in alluvial fans and valley bottoms were identified as having the potential to contain additional cultural resources. Cultural resources in the lowlands may now be deeply buried.

Uplands on the Refuge show little or no promise for either surficial or buried archaeological sites because of extensive erosion.

Cultural Resources Management
Cultural resources (archaeological sites, historic structures, and Native American traditional cultural properties) are important parts of the nation's heritage. The Service strives to preserve evidence of these human occupations, which can provide valuable information regarding not only human interactions with each other, but also with the natural environment. Protection of cultural resources is accomplished in conjunction with the Service's mandate to protect fish, wildlife, and plant resources.

The Service is charged with the responsibility, under Section 106 of the National Historic Preservation Act of 1966, of identifying historic properties (cultural resources that are eligible for listing on the National Register of Historic Places) that may be affected by our actions. The Service is also required to coordinate these actions with the State Historic Preservation Office, Native American tribal governments, local governments, and other interested parties. Cultural resource management in the Service is the responsibility of the Regional Director and is not delegated for the Section 106 process when historic properties could be affected by Service undertakings, for issuing archaeological permits, and for Indian tribal involvement.

The Archaeological Resources Protection Act of 1979 (ARPA), Section 14 requires plans to survey lands and a schedule for surveying lands with "the most scientifically valuable archaeological resources." This Act also affords protection to all archeological and historic sites more than 100 years old (not just sites meeting the criteria for the National Register) on federal land and requires archeological investigations on federal land be performed in the public interest by qualified persons.

The Regional Historic Preservation Officer (RHPO) advises the Regional Director about procedures, compliance, and implementation of these and other cultural resource laws. The actual determinations relating to cultural resources are to be made by the RHPO for undertakings on Service fee title lands and for undertakings funded in whole or in part under the direct or indirect jurisdiction of the Service, including those carried out by or on behalf of the Service; those carried out with federal financial assistance; and those requiring a federal permit, license, or approval.

The responsibility of the Refuge Manager is to identify undertakings that could affect cultural resources and coordinate the subsequent review process as early as possible with the RHPO and state, tribal, and local officials. Also, the Refuge Manager assists the RHPO by protecting archeological sites and historic properties on Service managed and administered lands, by monitoring archaeological investigations by contractors and permittees, and by reporting ARPA violations.

3.2 Refuge Management

3.2.1 Biological Program

Introduction
At Neal Smith NWR, management emphasis is placed on restoring the tallgrass prairie ecosystem, including native wildlife, plants, and ecological processes. Tallgrass prairie, oak savanna, and sedge meadow vegetation communities are being restored or reconstructed. The prescribed fire program is approximating a historic burn regime. Bison, elk, and the regal fritillary have been reintroduced on the

Refuge. Many grassland bird species and other wildlife have returned to the Refuge as habitat conditions have improved.

The benchmark reference period for ecosystem restoration on the Refuge is the 1840s when permanent European settlement was beginning in central Iowa. This period was chosen because GLO survey notes and maps from that era provide one of the earliest detailed records of landscape conditions in central Iowa. However, it is understood that some of the flora and fauna of that time period may no longer exist today, and other irreversible changes have occurred so that it will be impossible to restore the entire historic conditions. We also are faced with the effects of climate change creating uncertainty about future precipitation and temperature patterns. Habitat restoration to date has focused on reconstructing native prairie plant communities on former agricultural lands and restoring biological diversity on prairie and savanna remnants according to the best science available.

Refuge staff developed an ecosystem summary table for Neal Smith NWR (Appendix F: Summary of Refuge Ecosystems); three vegetation communities are named: tallgrass prairie, oak savanna, and sedge meadow. Also included are aquatic and aerial ecosystems. Table columns list characteristic plant species, wildlife species, natural processes, and limiting factors/threats. Plant and wildlife species listed aren't considered more "important" than other species, but they are considered representatives of a high quality ecosystem, specializing in those communities. It is considered that if these species are present, then other more generalist species should be present, too.

Vegetation

Tallgrass Prairie Reconstruction

Habitat work in the early years following Refuge establishment focused on planting and maintaining native prairie species on former agricultural fields. The new Refuge was controversial, and quickly, planting many fields was perceived to be critical in gaining credibility and support at all levels both within and outside the Service. About 1,100 acres were planted from 1993 to 1995. Today that total is about 3,400 acres (Figure 3-6). Each planting is a unique prescription derived for the specific site conditions using the plant species available at the time.

Seed sources and mixes

Development of seed sources was a complicated business when the Refuge began. Only seed from a 38-county "local ecotype zone" was to be used for Refuge plantings in order to maintain a high degree of ecological integrity. By using local ecotype seed, the environmental pressures that influenced presence and development of species, genetic, and community characteristics would most effectively be captured. The local ecotype zone lies primarily within the Southern Iowa Drift Plain, but because the Refuge lies near the northern end of the landform, additional counties were added that were likely to have contributed to plant genetic exchange via wind, water, or animal movement.

The Refuge had a large and immediate need for native prairie seed in the early years, but local remnant prairie seed sources were small, scattered, and mostly unknown to the conservation community. Businesses supplying an appropriate seed product did not exist. Over time a greater diversity and quality of seed became available as suppliers adapted to this new market and as Refuge plantings began producing harvestable seed, but in the initial years the majority of seed available was big bluestem (*Andropogon gerardii*), and Indian grass (*Sorghastrum nutans*). Now volunteers, school groups, interns, and staff collect a wide diversity of native seeds on the Refuge. Species not present in high quantities or difficult to collect on the Refuge can be purchased from several local seed vendors.

Early plantings included some areas with concentrations of highly diverse seed mixes, some areas with good diversity in a matrix primarily of available grass, and some plantings that were admittedly dominated by big bluestem and Indian grass, with the intent of future species enrichment. To date, such enrichment has been minimal due to time and funding constraints.

Meanwhile, Refuge staff began using Canada wild rye as a nurse crop for prairie plantings, because it establishes easily, competing with weeds as other native species become established but declines in vigor within five years. This built-in obsolescence holds the place for future infusion of diversity without the intense competition of warm season grass species. Inclusion of Canada wild rye as a native nurse crop became standard practice relatively early in Refuge development. Canada wild rye is still used on the Refuge in this way and the practice has been widely adopted by other prairie restoration programs.

Refuge greenhouse facilities and production plots provide the opportunity to establish plants without competition before planting them out. Plant species diversity has been increased by transplanting plugs into specific areas. Certain seed is hard to obtain and/or very expensive, so the greenhouse is used to provide better germination success. Some plants do not establish easily or quickly from seed but do so from a greenhouse started plant. Other species are grown in the greenhouse, so they can be planted in specific areas where seeding hasn't been very successful, such as near the Visitor Center. The greenhouse is used for environmental education and stewardship activities in addition to improving plant diversity.

With more options for obtaining greater quantities of seed of specific species, planting prescriptions no longer need to be dominated by warm season grasses. Current plantings may contain 250 or more species, although the precise number of total species planted is difficult to assess. Small samples of each lot of machine-harvested seed are tested to provide an idea of at least the most abundant species in the mix for development of reasonable planting prescriptions.

Site selection

A variety of factors are considered when selecting planting sites in any given year. A priority in the early years of reconstruction was to concentrate plantings in the core of the Refuge to serve a two-part goal of ecological restoration and development of an area near the Visitor Center where visitors could experience prairie and that was convenient for Refuge interpretive and education programs. Similarly, a high priority was placed on planting near the location of the entry road. When roads or buildings were constructed, planting the area of disturbance was of utmost importance.

Planting crop fields has been a higher priority than planting areas with existing perennial vegetation, such as former CRP lands and pastures. The Refuge has attempted to take proportionate amounts of cropland from each cooperating farmer in any given year, which was a big influence in the early years when many acres were planted. The relationship of a site to remnant natural communities or high

densities of invasive species like reed canarygrass has been considered. Later priorities included seeding along drainage areas, roadsides, and smoothed fencerows that had been included in the initial plantings.

Site preparation and planting

In general, agricultural fields are kept in Roundup Ready® crops until Refuge staff is ready to plant them with prairie seed. This reduces invasive species problems. Crop fields are rotated annually between corn and soybeans, with the final crop usually consisting of soybeans. The presence of terraces and trees in a unit requires more preparatory work and has delayed planting in some areas more recently. Subsurface drain tiles were not removed in most areas that have been planted to native species.

Early plantings were experimental and included several methods of seed delivery using drills and various broadcast seeders, but the most common method was a no-till drill. Later, broadcast seeding became a routine practice. Observations and research indicate better results using broadcast seeding in terms of invasive species suppression, forb establishment and earlier blooming, establishment of relatively more conservative species, and more even species distribution, so that is the approach now used. Broadcast seeding is also esthetically more pleasing, because it does not result in obvious rows of plants as drilling does.

Generally for the first two years after planting, the field is mowed two to three times during the growing season to prevent early successional non-native species from going to seed. After three or four years the planting may be burned. It typically takes at least three years for a prairie planting to develop a fuel matrix sufficient to carry fire.

Results

Since the Refuge was established, almost 3,600 acres of prairie has been planted into former agricultural land. Tallgrass prairie reconstruction at this scale had never been done previously. Returning perennial vegetation to the land has provided benefits to the wildlife and hydrology on the Refuge. Native warm season grasses and many native forb species established readily. Other species have been slow or difficult to establish. Prairie reconstructions on the Refuge vary in diversity of vegetation, from highly diverse to those dominated by a few species that are primarily native warm season grasses. Native cool season graminoids (grasses and sedges) and forbs are under-represented throughout the Refuge. Some units have low densities of forbs, and most units would benefit from the addition of more species. Non-native invasive species are present in many locations. Terraces, gullies, trees, roads, fences, and drain tiles should be removed before planting. This has not always happened; removal is still needed on some previously planted sites.

Many factors affect the outcome of prairie reconstruction efforts on the Refuge. Differences in diversity and development of planted sites can reflect differences in seed mixes; timing and method of planting; frequency and seasonality of burning, mowing, and spraying; and effects of bison and elk in the fenced enclosure. The large-scale spraying of herbicides to treat invasive species, particularly Canada thistle, has probably contributed to the low diversity of native plants in some areas. Weather patterns such as temperature and rainfall are very important in determining what species and how many seeds will survive, and which invasive species might become a problem. Sorting out the nuances that result in a particular planting outcome at any given time is difficult. However, research efforts on the Refuge are addressing some of these issues.

Restoration of Remnant Habitats

In the first 15 years or so after Refuge establishment, the focus of habitat work was on planting native prairie vegetation on former cropland. Work on most remnants was deferred. On those remnants that did receive attention, it was minimal. Prioritization of restoration on remnants was focused primarily on degree of visibility to the public and on public use. Thus, Thorn Valley and Buzzard Head savannas were selected early-on for restoration activities, because both have foot trails and are used for interpretive and environmental education activities.

In general, remnant native vegetation communities on the Refuge (Figure 3-6) are in a degraded condition as evidenced by relatively low native species diversity compared to historic conditions and/or the presence of non-native plants. Nevertheless, they are notable for their wildlife benefits, seed source potential, and as focal points for native community reconstruction and restoration. Several of the remnants contain species unique to that site, so taken together the diversity of remnants is higher. Development and maintenance of these sites is accomplished by prescribed burning, planting, grazing, and mechanical and chemical control of undesirable plant species.

Most remnants don't have the more aggressive invasive plants that are targeted for eradication by the Refuge and there has been tolerance for many non-aggressive invasive species, knowing most will succumb through time to good management including prescribed fire. Also, there is a difference between invasive species and opportunistic native species. Some tree species are not invasive but need to be removed if they are not appropriate in fire-dependent systems like prairie or savanna. Black locust and European silver poplar, however, are non-native and aggressively invasive so require more intensive and focused control efforts.

Tallgrass prairie

There are 12 known prairie remnants on the Refuge, totaling about 90 acres. Each of the remnants is unique, composed of different sets of plant and animal species. The degree of degradation is also unique with some sites being overgrown with woody vegetation and others more open but threatened with invasive forbs and grasses. Most remnants have had little management except for burning. Remnants are usually burned at the same time as the burn unit that surrounds them, if there is enough fuel to carry fire.

Some tree removal has occurred on the Dogleg (15.7 acres) and Coneflower (11 acres) remnants. Trees are cut, stumps are treated with herbicide to prevent re-sprouting, and felled trees are moved outside the remnants to a designated area. Heavy equipment is used only when the ground is frozen and snow-covered to prevent damage to understory plants, root systems, and soil structure. Some woody species have been mowed using a brush cutter. In Coneflower, sweet clover has been mowed and hand-pulled and, in June 1994, fifty-three species of native grasses and forbs were sown there. Downy gentian (*Gentiana puberulenta*) and prairie phlox (*Phlox pilosa*), among others, are now thriving and are indicators of increasing natural community quality.

Oak Savanna

About 150 acres of remnant oak savanna remain on the Refuge, with additional remnants within the Refuge acquisition boundary. Fire-intolerant woody species have been removed in portions of the Thorn Valley, Old Game Farm, and Buzzard Head savannas to begin opening up the canopy. Fire has been attempted in these and other savannas with some success.

Most of the savanna restoration work has been focused in Thorn Valley (39 acres) where results have been encouraging. Fire has been attempted here most years and in some years has been quite successful but is restricted to the period between September 15 and April 15 due to the possible presence of Indiana bats. Oak seedlings are now scattered throughout the areas where the canopy has opened up and saplings are found around the southern and western edges. The understory is recovering and herbaceous savanna species are now present. Invasive bush honeysuckle (*Lonicera* sp.) is present. Black locust (*Robinia pseudoacacia*) along the west edge has been sporadically treated with herbicide.

In Old Game Farm savanna (22 acres), in the southwest corner of the Refuge, resprouting of cut woody vegetation has created a dense thicket in one area. Prescribed fire is not always successful due to tree density and difficulty in getting a fire to carry under typical conditions. Due to its history as a game farm, this savanna includes invasive species that are not found in most areas of the Refuge, including Japanese raspberry (*Rubus parvifolius*), autumn olive (*Elaeagnus umbellata*), Russian olive (*Elaeagnus angustifolia*), and black locust. They persist despite sporadic herbicide treatment.

Buzzard Head savanna (11 acres), located inside the loop of the Tallgrass Trail, has young oak trees and many larger fire-intolerant woody species. Tree and brush clearing was not always followed up with stump treatments, resulting in dense shrub thickets. The most recent efforts have concentrated on removing brush and trees on the west end of the remnant. Hoary puccoon (*Lithospermum canescens*) was recently discovered here, making it the only known population on the Refuge, and indicating sun-loving native species still persist in these remnants despite neglect.

Sedge Meadow

Sedge meadow remnants are found in several small areas on the Refuge. Many are surrounded by prairie plantings or prairie remnants and are generally burned with the unit. One area near Thorn Valley savanna has been the focus of a reconstruction effort. This area was formerly dominated by reed canarygrass. It was burned and sprayed, and planted with sedge meadow seeds, greenhouse-grown plants, and plants rescued from a bulldozed fen. Burning has continued almost annually. The area is also the site of a hydrology research project. Research results indicate three zones of vegetation that correspond to three hydrologic zones.

Research indicates that the zone next to the stream supports a few forbs, a tallgrass component, and reed canarygrass. Soil moisture in this zone is affected by stream elevation. Hydrologic study revealed that the near-stream floodplain groundwater drains into the deeply incised stream and creates dry soil conditions adjacent to the channel. Until stream hydrology is normalized, this zone will remain drier than it was historically and drier than other parts of present-day sedge meadows.

Soil moisture in the middle zone is affected both by upland groundwater tables and stream elevation. Reed canarygrass is especially dense and tenacious here. Data indicate wide fluctuation in groundwater

in response to rainfall with a rapid rise followed by a rapid fall. Water is poorly drained in the middle zone until the near zone has sufficiently drained into the incised stream.

The zone farthest from the stream has the most stable groundwater table during rain events and excellent restoration potential. It supports a diversity of sedge meadow species with some reed canarygrass mixed in. Groundwater fluctuation in this zone is buffered by distance from the incised stream and proximity to the savanna. A fair amount of water is thought to enter the sedge meadow from the adjacent savanna.

Management Tools

Prescribed Fire

Fire has shaped prairies for centuries and is critical to restoration of the ecosystem. Prairie and savanna species evolved with fire, and it is crucial to their long-term survival. Prescribed fire is used to prevent woody species from overtaking the prairie and to reduce invasive species. Fire removes dead plant material, allowing additional heat and light to reach the soil and stimulating the growth of native prairie and savanna plant species. Fire is also used in cool season non-native grasslands to prepare the site for prairie reconstruction. Frequent-to-annual burns are most effective in increasing overall plant diversity and in gaining control of woody and invasive species.

Fire improves habitat for many species of wildlife by maintaining grassland vegetation and allowing easier access to forage or prey. Some grassland species prefer recently burned areas that begin the season with little above-ground vegetation or litter, and plant height changes dramatically during the growing season. Others prefer standing dead plant material in the spring. The downside of prescribed fire is that it may have detrimental effects on some invertebrate populations, destroys early nests of ground-nesting birds, and temporarily reduces cover for some wildlife species. Frequent fire eliminates the litter layer that is important to some wildlife such as small mammals. Careful use of prescribed fire includes leaving unburned refugia for vulnerable species and those species requiring a litter layer.

The Refuge has been using prescribed fire as a management tool since 1993 to emulate historic disturbance regimes. Refuge files from 1993-2000 document 5,452 acres that were burned during 69 prescribed burns (Table 3-3). In recent years the Refuge typically has burned 2,000 acres or more per year. Factors that influence which units are burned each year include presence of certain invasive species, time since last burn, management or research activities, and condition of the planting.

Table 3-3: Prescribed burn history 1993–2010

Year	Number of Burns	Acres Burned
1993	3	58
1994	6	280
1995	2	218
1996	5	805
1997	6	268
1998	10	356
1999	6	868
2000	21	2453
2001	7	813
2001	8	1717
2003	8	854
2004	12	2018
2005	15	3130
2006	14	2738
2007	7	1342
2008	21	2977
2009	17	1878
2010	20	2721

Variability in timing of prescribed fire promotes diversity of plant species. Fall burning promotes forbs and favors a more competitive prairie community, and spring burning can be very effective in controlling certain invasive species. Weather and vegetation conditions generally allow for a longer burn window in spring than in fall or summer. Although summer burning requires specific weather conditions that do not commonly occur, it may promote forbs over warm season grasses and can be useful in controlling some invasive species. Suppression of cool season invasives can be achieved by spring burning and woody species can be effectively limited by summer burns. Invigoration of natural communities resulting from frequent fall burns can also suppress invasives.

The majority of burns on the Refuge to date have been in spring, though a limited fall burn program was initiated in 1999, and summer burns have been conducted recently in the bison and elk enclosure as part of the patch burn grazing regime. More extensive summer and fall burn seasons are difficult to implement due to staffing shortages and weather conditions. However, intensive use of an expanded burn season is especially important at Neal Smith NWR because of many abnormally wet springs in recent years, often prolonged and cool. Such conditions favor rampant expansion of cool season invasive species and encroachment of trees, especially in a landscape in the early stages of ecological recovery. Creative and persistent use of prescribed fire in spring, summer, fall, and even winter if conditions permit, would enhance the ability to achieve habitat goals and objectives on the Refuge.

Grazing

Bison and elk have been reintroduced to emulate the role of grazers in the pre-settlement ecosystem. Grazing by native ungulates undoubtedly played an important role in maintaining the tallgrass prairie. Bison grazing has been correlated with increased plant species diversity and richness in prairies. Removal of dead plant material through burning and grazing increases primary productivity in prairie (Knapp et al., 1999). Grazing is an important ecological process in prairies but little is known about its effects on reconstructed prairies.

Most of the 700-acre bison/elk enclosure was planted between 1992 and 1996, at which time the first bison were reintroduced to the Refuge. The vegetation had little time to become established and was in a state of change. Some areas were planted after bison and elk were present and other areas still have not been planted with native prairie species and are dominated by non-native smooth brome (*Bromus intermis*). Until 2007, about half of the enclosure was burned each spring, alternating halves between years.

In 2007, the Refuge began using more varied patch burn grazing to manage the prairie in the enclosure. Patch burn grazing uses prescribed fire in widely spaced small patches to create shifting areas of intense bison grazing rotated across the landscape over several years (Fuhlendorf and Engle; 2001, 2004). This regime is thought to emulate the patchy mosaic of evolutionary grazing distribution across the tallgrass

prairie. Under patch burn grazing, the enclosure is divided into twelve burn patches, but the bison still have access to the entire enclosure. About one-third to one-half of the enclosure is burned each year, with two to six different patches burned in different seasons each year depending on burning conditions and vegetation condition.

Patch burn grazing is used on the Refuge to stimulate native vegetation and reduce non-native invasives and residual standing dry matter. Bison prefer to graze in recently-burned areas, attracted to the nutritionally high-quality new growth. Research on the Refuge (Kagima, 2008) provided evidence that the spatial distribution of the mixed sex/age bison group is positively correlated with fire and higher proportions of native plants, despite the abundance of exotic plant species in the landscape. They also have a strong preference for grasses over forbs (Plumb and Dodd, 1993), so intensive grazing in the burned areas reduces competition from the dominant grasses, giving forbs a better chance at survival.

Patch burn grazing is expected to increase plant diversity in the enclosure as well. Grazing creates microsites throughout the bison and elk enclosure that, when coupled with seed additions, increases diversity and the presence of rare forb and grass species (Martin and Wilsey, 2006). In general, the more time that has passed since burning, the more detritus is present, and the less grazing occurs. Plants that thrive with fire and grazing grow well in the more recently burned patches, and plants that take longer to recover grow more successfully in the patches with the longest time since burning. Grazing is dispersed throughout the enclosure over several years but concentrated within individual seasons. This creates more spatial and temporal heterogeneity on the prairie.

Bison stocking rate is important in a patch burn grazing regime. Too many bison will overgraze burned patches while too few will allow grasses to grow beyond the stage of high quality forage. An optimum bison herd size to promote native vegetation under the current program has not been established. Ongoing monitoring of the effects of the Refuge patch burn grazing program will continue.

Bison affect the prairie in other ways, creating bare areas by rubbing and wallowing. Their grazing and rolling also may affect seed dispersal of native plant species; ongoing research is investigating.

The effects of elk grazing on tallgrass prairie are not well-understood, although their foraging habits are different from bison so their effects are expected to be different as well. The Refuge elk herd spends noticeably less time out on the prairie and more time in wooded areas than the bison. Elk consume more woody vegetation, so they may be important in controlling woody species. Although there are very few studies of elk food habits in prairie systems, the limited information that exists indicates that forbs and browse play an important role in Great Plains elk diets during the fall and winter (Wydeven and Dahlgren, 1983). Due to the small number of elk relative to bison in the enclosure, they have less impact on the vegetation.

Use of grazing as a management tool is currently limited to the 700-acre fenced enclosure. Doubling the size of the enclosure would be possible based on the current land ownership pattern; the 1992 Master Plan recommended a 2000-acre enclosure when land acquisition is complete. Non-native grazers such as cattle, sheep, and goats have not been used to manage prairie on Neal Smith NWR.

Farming

Farming is used as a tool to manage the land until sufficient quantities of native local ecotype seed can be secured and staff is available to plant and maintain a new planting. Currently there are 543 acres in

six management units being farmed on the Refuge by three farmers. In any given year, about 50 percent of the farmed area is planted to corn and about 50 percent is planted to soybeans.

Only "no till" farming practices are allowed. Planting of genetically-modified corn is allowed on Refuge cropland tracts as a place holder to reduce weed infestations until the site is planted to prairie. Under current FWS Region 3 policy, use of glyphosate-tolerant crops is allowed for a maximum of five years after a site is acquired by the Service. Application of anhydrous ammonia is allowed in the spring; no fertilizer application is permitted in the fall. All fields with streams and/or gullies are required to have a 100-foot-wide buffer strip on each side planted with perennial vegetation.

Only glyphosate (Roundup®) herbicide has been allowed without first obtaining written permission from the Refuge. Other herbicides may be permitted under the following conditions:

- There is a documented need from a crop scout;
- the herbicide is listed on the Region 3 Herbicides List; and
- the farmer obtains written permission from the Refuge.

A Special Use Permit that defines terms and conditions is issued to each farmer annually. Farmers pay rent each year and provide pesticide use data and crop yield information to Refuge staff. Pesticide data are used to insure appropriate use and efficacy and in preparation of the Refuge Pesticide Use Report. Crop yield data are compared to the Cash Rental Rates Survey prepared by Iowa State University Extension and is used to set the rental rates for the next crop year. The Refuge may remove tracts from the farm program prior to drafting the next year's agreements.

Invasive Plants

Invasive plants can out-compete native species and cause their displacement, sometimes altering habitat structure and ecosystem processes. Even if the native species are not completely eliminated, the ecosystem often becomes much less diverse. A less diverse ecosystem is more susceptible to further disturbances such as diseases and natural disasters. Invasive plants degrade, change, or displace native habitats and thus are harmful to fish, wildlife, and plant resources. Wildlife species are adapted to the native plants of an area and are much better served by them for food and cover than by most introduced plants. Control of invasive plant species on the Refuge can be time-intensive. Methods include herbicides, mowing, prescribed burning, and hand cutting or pulling.

Sericea lespedeza

Considerable effort was invested in avoiding introduction of the biggest invasive plant threats such as spotted knapweed (*Centaurea* sp.), sericea lespedeza (*Lespedeza cuneata*), purple loosestrife (*Lythrum salicaria*), garlic mustard (*Alliaria petiolata*), and leafy spurge (*Euphorbia esula*). Nevertheless, two sericea lespedeza plants were found within a few years of the initial prairie plantings on the Refuge. One plant, located within the bison and elk enclosure, was thought to have been eliminated by bison grazing. Since then, however, sericea lespedeza has been found to be widespread in the enclosure, so grazing apparently does not eliminate it. The other initial sighting, outside the bison and elk enclosure, could not be relocated later for chemical treatment, and sericea lespedeza has since become widespread in that area. In 2006, sericea lespedeza was discovered again in several more plantings. The practice of harvesting areas of the Refuge and planting the seed in newly retired crop fields exacerbated spread of this species.

Sericea lespedeza can quickly change a landscape by displacing native vegetation. It is a deep-rooted perennial that cannot be pulled out of the ground once it is established. Even young seedlings may have deep roots before they are of noticeable size. Mature plants can reach five feet or more in height, producing large quantities of seed that can remain viable for 20 or more years. Sericea lespedeza is also known to produce chemicals that inhibit the growth of neighboring plants.

The species generally emerges on the Refuge in late May, blooms in September, and sets seed in October. Plants stay green later in the season than native warm season grasses, making it easier to detect in the fall. However, fall herbicide treatment is less effective than earlier treatments, and seed may already be viable by the time plants are easiest to see. Summer mowing may reduce seed production but does not affect the plant's survival. Because of its high tannin content, the plant is not very palatable, so livestock and native ungulates avoid it if possible. The species is adapted to fire. Seed scarification stimulates germination, and fire does not damage established plants. Chemicals are the only effective method of killing sericea lespedeza.

Sericea lespedeza has been promoted for use in wildlife food plots and for cover. However, its negative attributes overwhelm its few benefits. The exclusion of other plant species by sericea can result in monocultures, reducing the diversity of plant foods and cover needed to support a variety of wildlife. Northern Bobwhites occasionally consume the seeds, but they obtain little nutrition from them. Cover provided by sericea in the summer can be beneficial to Northern Bobwhites, but this benefit is eliminated when sericea is dormant.

For the past several years, interns, volunteers, and staff have been walking a grid pattern through management units, locating sericea lespedeza plants, marking them with GPS, and spot spraying them. Because most of the plants are isolated individuals or small patches, broadcast spraying has not been used. Larger patches are sprayed with a UTV-mounted sprayer. Marked locations are re-visited in following years to re-spray if necessary. Plants found after seed set are clipped and removed if possible. Sericea lespedeza has been found at low levels in most plantings that have been searched.

More recently, dogs have been used to locate sericea lespedeza plants in management units that have not yet been searched. Using smell, the dogs have a high success rate in locating low densities of the plant in a relatively short period of time, freeing the use of interns, volunteers, and staff to direct their efforts toward more treatment. Repeated use of dogs over time will assist the Refuge in quickly determining the success of treatments, locate new infestations, and identify areas without sericea lespedeza for harvest sites.

Because of the severity of the threat this species presents, staff is identifying sites on the Refuge that show no sign of sericea lespedeza. Seed will either be hand-collected or machine-harvested on sites believed to be sericea-free. As planting efforts increase, the Refuge must work to clear more areas of sericea for seed harvest or else purchase additional seed.

Other Invasive Species

White and yellow sweet clovers (*Melilotus* spp.) are mowed while blooming, generally in June. These biennial species can be controlled by preventing seed production through early season mowing. Eventually the seed bank can be depleted if the plants are consistently mowed every year. The seeds respond to fire by germinating, so burning is often followed by a flush of sweet clovers. Although they are not as much of a biological threat to the prairie as sericea lespedeza is, sweet clovers are widespread and very visible so are also an aesthetic issue.

Refuge staff also puts considerable time into spraying Canada thistle (*Cirsium arvense*), usually during bud stage. Currently, large patches are treated using a Patriot sprayer to apply the herbicide Milestone®. The operator locates the patches from the spray rig, but locations are not tracked from year-to-year to determine success. This method undoubtedly kills many of the native forbs, too, though it is more selective than some other herbicides. Research is underway on the Refuge to determine which native species might be resistant to some of the more selective herbicides. In 2009, smaller patches of Canada thistle in some of the most diverse plantings were sprayed using a smaller spray rig mounted on a UTV. These patches were marked into GPS and will be re-visited for further treatment if necessary. Some patches of Canada thistle have also been mowed prior to seed set.

Black locust (*Robinia pseudoacacia*) is present on the Refuge in several of the plantings and has invaded some remnants. Many of the locations are former home sites or along the edge of the Refuge near neighboring residences. Black locust is a clonal species, so the entire clone must be killed. Attempts to control it have been sporadic, but much has been learned and efforts are more consistent with added interns in recent years. In some years black locust was mowed, followed by treatment of resprouts with a bud inhibitor, hand cut followed by stump treatment with triclopyr, or basal bark treatment with triclopyr. However, if the entire clone was not treated the roots would survive.

A more complete table of invasive species that have been managed on the Refuge is included in Appendix H. Most of the species not already mentioned above are small or isolated populations that do not take as much time to manage, or they are widespread persistent species that are kept in check with prescribed fire. There are many other non-native species on the Refuge that do not pose much of a threat and have not had nor are likely to receive much management. A prioritized list of invasive plants that need management attention on Neal Smith NWR will be developed in a step-down management plan following approval of the CCP.

Wildlife

Birds

Grassland-dependent birds are adapted to the diverse vegetation structure that historically was maintained by frequent disturbances from fire and grazing. Habitat needs vary by species. Some prefer tall vegetation with a dense litter layer, while others prefer shorter patchier vegetation. Most grassland birds prefer areas with little to no woody vegetation and at least low to moderate forb cover. Reestablishing diverse native plant communities and historic fire, grazing, and hydrologic regimes on the Refuge will create a sustainable mosaic of habitat types that meets the needs of grassland birds and other wildlife. Many birds of the tallgrass prairie ecosystem have returned to the Refuge in response to restoration efforts.

Henslow's Sparrow was first detected on the Refuge in 1999 and is now quite common in prairie units that have not been burned for one year or more. Other grassland birds present during breeding season include Sedge Wren, Dickcissel, Eastern Meadowlark, and Bobolink. Sedge Wren prefers tall grass, especially in low wet areas of the Refuge. Dickcissel and Eastern Meadowlark are found in all types of grassland. Upland Sandpiper and Grasshopper Sparrow use the short vegetation found in areas that are grazed or dominated by shorter grass species such as little bluestem or smooth brome. Management for more areas of short vegetation likely would increase numbers of these species but would also reduce habitat for birds such as Henslow's Sparrow that prefer taller vegetation.

Northern Harrier usually is present fall through spring, with an occasional bird seen during the summer. Short-eared Owl also is present in small numbers from fall through spring. Both require large areas of grassland. Expanding the area of prairie and removing trees may provide sufficient habitat for these species to nest. Smith's Longspur is a migrant found for brief periods in spring and fall using short, sparse vegetation in recently burned areas and newly planted prairie that has been mowed. Le Conte's Sparrow is present on the Refuge in tall grass during migration, particularly in the fall.

The Greater Prairie-Chicken (*Tympanuchus cupido*) requires a large home range and a variety of grassland habitat conditions to meet its life cycle needs. The Iowa DNR has had some success in reintroducing Greater Prairie-Chicken on grasslands in southern Iowa. Both Missouri and Illinois have been able to maintain small populations on fairly small isolated grasslands although they have required intensive management including additional reintroductions to maintain genetic diversity. Greater Prairie-Chicken populations in some locations have experienced declines associated with competition from Ring-necked Pheasants (*Phasianus colchicus*). The sizeable Ring-necked Pheasant population found on Neal Smith NWR and adjacent lands may limit success in reestablishing this species. The Refuge is working with Iowa DNR to determine if reintroduction is feasible and, if so, to develop a strategy for success through partnerships.

The Northern Bobwhite needs sparse vegetation with some tall grasses and shrubs. The Refuge is in the northern edge of its range and the habitat looks suitable throughout portions of the Refuge. Intensive agriculture on the surrounding landscape may prevent movement of these birds into the area, so reintroduction may be necessary to restore a viable population. Other birds that use Refuge habitats with a shrub component include Bell's Vireo, Gray Catbird, Brown Thrasher, Yellow-breasted Chat, Orchard Oriole, Loggerhead Shrike, Willow Flycatcher, Eastern Kingbird, Vesper Sparrow (*Pooecetes graminius*), Field Sparrow, Lark Sparrow (*Chondestes grammucus*), and American Goldfinch. Species that benefit from Refuge savannas include Red-headed Woodpecker, Northern Flicker, Eastern Towhee, and Field Sparrow.

The Service developed *Birds of Conservation Concern 2008* to identify species that represent the Service's highest conservation priorities because they are rare or declining. The list encompasses three geographic scales— The North American Bird Conservation Initiative (NABCI) Bird Conservation Regions (BCR), FWS Regions, and National—and uses assessment scores from the North American Landbird Conservation Plan, the U.S. Shorebird Conservation Plan, and the North American Waterbird Conservation Plan. Eleven species of the tallgrass prairie ecosystem are considered Birds of Conservation Concern for the portion of BCR 22 that lies within the Service's Midwest Region, where Neal Smith NWR is located: Upland Sandpiper (*Bartramia longicauda*) Short-eared Owl, Red-headed Woodpecker, Northern Flicker, Loggerhead Shrike, Bell's Vireo, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Smith's Longspur, and Dickcissel. The species that Neal Smith NWR could be the most influential in meeting regional population objectives are Red-headed Woodpecker, Henslow's Sparrow, and Dickcissel (Will, 2012; personal communication). Appendix G contains a table that summarizes the current status of species selected as Birds of Special Consideration for Neal Smith NWR.

Restoration activities consider potential negative impacts to birds and avoid them, if possible. Tree cutting and brush clearing take place outside of the nesting season, between September 15 and March 30. Most spring burning takes place before May 1 to minimize destruction of grassland bird nests.

Bison and Elk

The historic ecological role of bison and elk cannot be fully replicated on the Refuge. Herds historically were free-ranging and migratory, for example, but now must be confined within Refuge boundaries and carefully managed. The appropriate role of captive bison and elk on national wildlife refuges is still evolving and has been discussed within the Service since before the Refuge was established. Ultimately, the 1992 Final Environmental Impact Statement and Master Plan did support bison and elk reintroduction at Neal Smith NWR (then known as Walnut Creek NWR) "to best achieve the biodiversity, environmental education, and interpretation and recreation goals" of the new Refuge.

In August 1996, new Service policy (Service Manual, 701 FW 8 Fenced Animal Management) specifically authorized five Refuges to "preserve and promulgate" remnant herds of nationally and/or historically significant animals. Walnut Creek NWR was approved for reintroduction of bison and Rocky Mountain elk. The policy requires each Refuge to develop a herd management plan that describes objectives relating to the specific population(s) and the relationship of the management of the species with other objectives.

The Fenced Animal Management Plan (FWS, 2002) for Neal Smith NWR outlined a program designed to restore Refuge bison and elk herds as nearly as possible to the condition that existed prior to Euro-American settlement. Neal Smith NWR was described as unique in managing its herds to perpetuate habitat, rather than using habitat management to perpetuate the species. The bison and elk are limited to a 700-acre fenced enclosure but are treated as wild animals as much as possible and managed with minimal interference.

Bison

The Fenced Animal Management Plan recommended an "ecological" carrying capacity of 35 animal units for bison (based on a conservative estimate of 1,500–2,000 pounds/acre of available forage, a moderate grazing rate of 35 percent, and a correction factor of 30 percent for soil/slope conditions). This carrying capacity was thought to ensure a herd size that would survive drought or severe winter conditions without overgrazing the prairie. Herd reductions would be made each year as needed to prevent habitat damage while allowing the bison to continue playing a vital role in prairie establishment and ecology.

Bison were introduced to the Refuge between 1996 and 1998. During that time, 30 bison were transferred to the Refuge from Fort Niobrara NWR, Wichita Mountains NWR, and the National Bison Range. By the end of the spring 2001 calving season, the Neal Smith herd numbered 68. In October 2001, the herd size was reduced to 33 by donating animals to other programs. Additional bison were culled in 2003 and 2004 to maintain population numbers between 35 and 40 animals.

Meanwhile, the U.S. Department of the Interior and the Service began moving toward more cohesive management of federal bison herds as one resource to better conserve and protect the genetic diversity of the wild species on a national scale. The majority of bison in the United States currently exist in private herds that often have high rates of hybridization with domestic cattle. This makes Service bison herds with low hybridization especially valuable for long-term conservation of the species. As part of this program, the existing Neal Smith bison were transferred to Native American tribes in Iowa and North Dakota, because they represented a gene pool well established in other Service herds. In December 2006, a herd of 39 animals with high genetic uniqueness was brought in.

By November 2010, the herd had grown to 85 animals. Thirteen bison were relocated, bringing the herd size down to 72 animals as of March 2011. After another year of births and deaths in the herd, in

November 2011, another 16 bison were relocated to bring the population down to 71 animals. While the current herd size is being held at approximately 70 animals, the optimum herd size has not been determined, but is one that will promote the growth and diversity of the prairie and maintain bison body condition and health without supplemental food. Monitoring of plant biomass is not currently occurring within the enclosure, although one study in 2002-2003 calculated above-ground productivity at 4,000 to 7,000 pounds/acre/year, depending on the year and the calculation method used (Martin et al., 2005). This production rate is much higher than the estimate used to develop the Fenced Animal Management Plan in 2002.

Seven national wildlife refuges participate in the national FWS bison genetics program. These seven smaller herds are managed genetically as a single large metapopulation of about 1,400 animals total. Each animal undergoes genetic testing and receives a microchip implant for identification. Maintaining the genetic foundation broadly across several locations reduces the risk of total loss of genetic resources from a natural event or other disaster. In addition, exchange of animals between the participating Refuges ensures that the diversity of the metapopulation is maintained.

The genetics program does not affect habitat management within the bison/elk enclosure. Refuge staff decides how many animals to transfer based on habitat quality. Selection of which animals to excess or move to other Refuges is done by the FWS Wildlife Health Office in Bozeman, Montana and is based on presence of rare alleles and other genetic factors, sex, and age class. Herd management includes an annual roundup to take genetic samples and microchip calves, do health screenings on a random sample of adults, assess condition of animals, and remove or exchange animals.

The bison get their water from streams running through the enclosure, and mineral blocks are provided primarily to prevent bison from being attracted to road salt on vehicles. Domestic animal practices such as vaccination, feeding, and individual animal treatment are avoided. However, confinement to small areas, dense animal aggregation, and repetitive use of select forage all enhance transmissible parasites and diseases so in addition to disease testing during the roundup, occasional testing for parasites is done and herd treatment takes place if necessary. Additional actions are taken to inhibit the spread of parasites within the enclosure. Refuge staff monitors the herd weekly (when conditions permit) to assess herd health and condition. In isolated cases when an animal is determined to be suffering, it is euthanized. Dr. Tom Roffe of the Wildlife Health Office advises Refuge staff on herd health issues.

Routine supplies cost about $2,000-$3,000 annually for mineral blocks, biological sampling, microchips, and other supplies. Roundups involve considerable staff time for one day each year and some preparation time to maintain the handling facility. Regular monitoring and occasional maintenance of water gaps and cattle guards is necessary to prevent escape.

Elk

Elk were introduced onto the Refuge in 1998 and 1999 by transferring ten Rocky Mountain elk from Fort Niobrara NWR. No additional animals have been brought in since then. Because of difficulties in managing elk in captivity, the target herd size is 15. Five animals were culled in 2006 when numbers had grown to 21. Since then, elk have died at about the same rate that calves are born. Herd size in spring of 2011 was 16.

Inbreeding is a concern with such a small number of animals and the benefits of their grazing on overall habitat diversity in the enclosure are probably small due to the small number of elk. Refuge staff conducts weekly health monitoring, but because of their habits the elk are difficult to observe. A study

of habitat use and diet of bison and elk in the enclosure was conducted in 2006-2007 (Kagima, 2008). Tranquilizers are necessary to handle them, and darting is difficult and dangerous for staff and could be fatal for the elk, so research involving marking or tracking animals is not conducted. Live elk are not handled, and management focuses on morbidity and mortality.

Chronic Wasting Disease (CWD) is a significant threat to the long-term viability of elk on the Refuge. Deer are free-ranging on the Refuge, so if CWD shows up in Iowa's deer population it could be transmitted to the elk herd. If CWD were found on or near the Refuge, the elk would likely need to be eliminated. Elk are regulated through the Iowa Department of Agriculture and cannot be transported on or off the Refuge unless they are in the Iowa CWD program. Neal Smith NWR does not participate in this program because of its intensive livestock approach and lack of deer-proof fencing on the Refuge.

The Refuge adopted a CWD contingency plan in 2005. The Refuge plan accepts many measures identified in the state plan, which includes strategies for 1) surveillance and detection, 2) communication and education, and 3) containment and eradication; and includes provisions for destroying the elk herd upon request by the Iowa DNR if CWD is found on or near the Refuge. As of January 2012, all states bordering Iowa had found at least one CWD-infected animal, but no cases have yet been documented in Iowa.

Indiana bat

The Indiana bat, a federally listed endangered species, was first documented on the Refuge in 1992 through a bat mist-netting project. Indiana bats were found to be present in the Thorn Valley savanna and north along Walnut Creek. In 1992 and 1993 there was evidence of a maternity colony (adult female with enlarged mammae and juveniles). In 1995, the last time Indiana bat surveys were conducted, only a single adult male was captured. This male was radio-tagged and found to be using red elm snags and live shagbark hickory trees as roost sites. Roost surveys found up to two to three bats emerging from these trees, consistent with a male Indiana bat roost. The Refuge has conducted Endangered Species Act Section 7 consultation with Ecological Services and follows seasonal tree clearing and burning restrictions to protect any maternity roosts that may be present.

Regal Fritillary

The regal fritillary is a rare butterfly closely associated with high quality prairies whose obligate larval host plants are prairie violet (*Viola pedatifida*) and bird-foot violet (*Viola pedata*) (Shepherd and Debinski, 2005). Iowa State University was the principal investigator in a research project designed to reintroduce the regal fritillary to the Refuge and to explore certain relationships that this species has to fire including success of its host food.

Prairie violet plots have been established in each of four areas on the Refuge to provide larval food. In the summer of 2000, gravid female regal fritillaries were introduced in cages over prairie violets to maximize probability of successful egg-laying. Independent of reintroduction attempts, two wild butterflies (one male and one female) were observed on the Refuge in 2000. Adult regal fritillaries were sighted across the Refuge during the summers of 2002–2010. Though the butterfly is vulnerable to fire, especially during the larval period, the prairie violet is invigorated by fire and tends to decline in periods when fire is absent from the landscape. Regal fritillaries continue to persist on the Refuge as do the violets where they were planted.

Monitoring and Research

Monitoring

Twenty-five permanent plant transects were established on prairie and savanna remnants throughout the Refuge in 1994 under the direction of Dr. Darryl Smith. Fifty randomly located 0.1-meter plots were surveyed along each transect. Species diversity, cover, and frequency data were recorded in each plot. Transects were permanently marked using metal conduit and drawn on a topographic map. More than sixty vegetation survey transects were established on planted prairie sites in late summer of 1997 using the same methods. These data have not yet been analyzed. Follow-up monitoring began in 2008, with a few different transects sampled each year. Data will be analyzed using the Floristic Quality Assessment technique (Swink and Wilhelm, 1994).

The Refuge has conducted breeding season bird point counts almost every year since 1994. Over 120 randomly selected points were established and almost evenly divided between riparian, crop, woody, and grassland sites. Eighteen of the points are in the bison and elk enclosure. The observer stands at each point for ten minutes and documents birds heard and seen within 0–25, 25–50, and >50 meter distances of the point. Recently this was modified to include distance bands of 50–100 meters and > 100 meters. The observer also records whether the birds were first detected in the first five minutes or the last five minutes. Recently this was modified to record the minute the bird was first detected. Each point is surveyed once per year. The surveys were originally conducted to collect baseline data on birds and look for population trends during the early stages of prairie reconstruction (Thomas, 1999). This study found increases in grassland birds such as Dickcissel and Grasshopper Sparrow during the first few years after Refuge establishment.

In 1998, a recommendation was made to change the protocol to conduct the counts only one time at each point, rather than three times as the original protocol established. This recommendation was followed. Another recommendation was made to continue conducting point counts in crop fields, despite changes in vegetation from crop to grassland. For unknown reasons this recommendation was not carried out, and the number of points in each vegetation type was kept fairly constant, with points dropped as crops were planted to prairie vegetation and new points added in crop fields. This has made it difficult to detect changes in the bird populations on the Refuge in a straightforward manner. Analysis of data is being initiated to try to detect population trends. Recently an analysis was carried out examining the bird species composition in prairie plantings of different ages (Olechnowski et al., 2009). This study found that the bird species found in certain areas of the Refuge were related to the age of the planting. For example, Henslow's Sparrows were found in more established plantings, while Killdeer, Horned Lark, and Vesper Sparrow were most abundant in the first year after planting. Dickcissels peaked in abundance the second year after planting.

A Christmas Bird Count circle includes the entire Refuge and the count is conducted annually to monitor winter bird populations. This count has not occurred long enough to get trend data, but data are submitted to National Audubon Society to contribute to the national database. Some monitoring of birds has also been carried out during spring and fall migration. Smith's Longspurs have been detected during spring and fall using Refuge areas that were recently burned or planted and mowed.

Nocturnal frog and toad call surveys are done in coordination with the Iowa DNR's wildlife diversity program and contribute to monitoring long-term trends state-wide. The surveys were originally conducted by volunteers between 1997 and 1999. Since 2006, the surveys have been conducted annually by the Refuge biologist. The most common frogs and toads detected on annual nocturnal call surveys are eastern gray tree frog, American toad, Blanchard's cricket frog, and western chorus frog. The

northern leopard frog has rarely been detected. Bullfrogs were detected in areas that are no longer monitored, and no suitable habitat occurs on the current survey route.

In 1994, baseline surveys were conducted across the Refuge on birds, medium-sized mammals, and Orthoptera (grasshoppers and katydids). Remnants were surveyed for butterflies, moths, ants, and ground-dwelling invertebrates (Klaas and Bishop, 1995).

The National Oceanic and Atmospheric Administration operates a meteorological station on the Refuge as part of the U.S. Climate Reference Network (USCRN). The USCRN consists of more than 100 stations in the United States installed for the express purpose of detecting climate change. In addition to temperature and precipitation, these stations also monitor solar radiation, surface temperature, and surface winds. Data is transmitted hourly via satellite to the National Climate Data Center. Measured elements are being expanded to include soil moisture, soil temperature, and relative humidity.

Research

Neal Smith NWR was home to the Service's Land Management Research and Demonstration Program (LRMD) for over ten years. The LMRD supported research to increase understanding of effective prairie, savanna, and sedge meadow restoration techniques. Major studies in 2009 included use of herbicides to control Canada thistle and the relationship of avian diversity to changes in vegetative structure in restored tallgrass prairie and savanna. Additional studies relate to climate change, carbon sequestration, and impacts to vegetation and hydrology due to changes in weather patterns. Outreach programs on the Refuge included: research symposia, field days, brown bag specials, student science innovations, interpretive and environmental education programs, and volunteer involvement in science.

While the program has been beneficial, regional reorganization has caused the Tallgrass Prairie and Savanna LMRD site to be phased out in 2012. Some research pertaining specifically to Neal Smith NWR prairie and savanna restoration and bison/elk management will continue through the Refuge biological program. A list of LMRD-related publications from 2001 through 2011 is included in Appendix J.

3.2.2 Visitor Services Program

The Visitor Services program has been a significant component of management since the Refuge was established. Early planning documents all described the importance of the new Refuge as a major center for environmental education, interpretation, and wildlife-oriented recreation in central Iowa. To enhance the program, state-of-the-art facilities were constructed. The entire Refuge was intended to serve as an outdoor laboratory and classroom; it was designed to impart an awareness and appreciation of "the value of wildlife and wildlands" and to teach visitors about the natural and cultural history of the ecosystem and the process of native habitat reconstruction. Much of that original vision has now been implemented.

In 2010 and 2011, a National Visitor Survey was conducted by the FWS Division of Visitor Services and Communications and the U.S. Geological Survey's Fort Collins Science Center. The goal was to provide refuge managers, planners, and visitor services specialists with reliable baseline data about refuge visitors and their experiences, both at a national level and at a field station level. Neal Smith NWR was one of the participating field stations. The data provides insight into visitor characteristics, primary activities, and average expenditures. Visitor satisfaction was measured in four categories: recreational activities and opportunities, information and education provided at the Refuge, services provided by employees or volunteers, and how well the Refuge was conserving fish, wildlife, and their habitats. In

each category, more than 90 percent of visitors expressed satisfaction with Neal Smith NWR (Sexton et al., 2011).

Neal Smith NWR has been known as the Neal Smith National Wildlife Refuge and Prairie Learning Center since building construction was completed in 1996. The use of the name Prairie Learning Center has been confusing to many visitors who are not certain they are at the Refuge when visiting, or ask directions to the Prairie Learning Center. This confusion also has affected public understanding of Refuge purposes, so "Prairie Learning Center" is being dropped from the name. The large building that houses the exhibits, bookstore, and administrative areas is now referred to as the Neal Smith National Wildlife Refuge Visitor Center.

Guidance for authorizing public uses on national wildlife refuges is provided in the Improvement Act, which states that "Compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System . . . through which the American public can develop an appreciation for fish and wildlife." The Improvement Act specifies hunting, fishing, wildlife observation and photography, and environmental education and interpretation as priority public uses. These six activities, when determined to be compatible, are considered legitimate and appropriate uses of Refuge System lands that should receive priority consideration in refuge planning and management. Compatibility determinations are the responsibility of the Refuge Manager with concurrence by the regional office supervisor. Compatible uses are those that will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the Refuge.

Welcome and Orientation

Refuge visitation has averaged about 160,000 people annually during the years 2007 through 2009. For most, the visit begins with a drive along the winding entrance road that meanders through the rolling topography (Figure 3-7) and is designed to provide a sense of immersion in the landscape. The experience provides a dramatic contrast to the agricultural lands surrounding the Refuge and visually introduces visitors to the beauty and diversity of prairie, savanna, and riparian plants and wildlife.

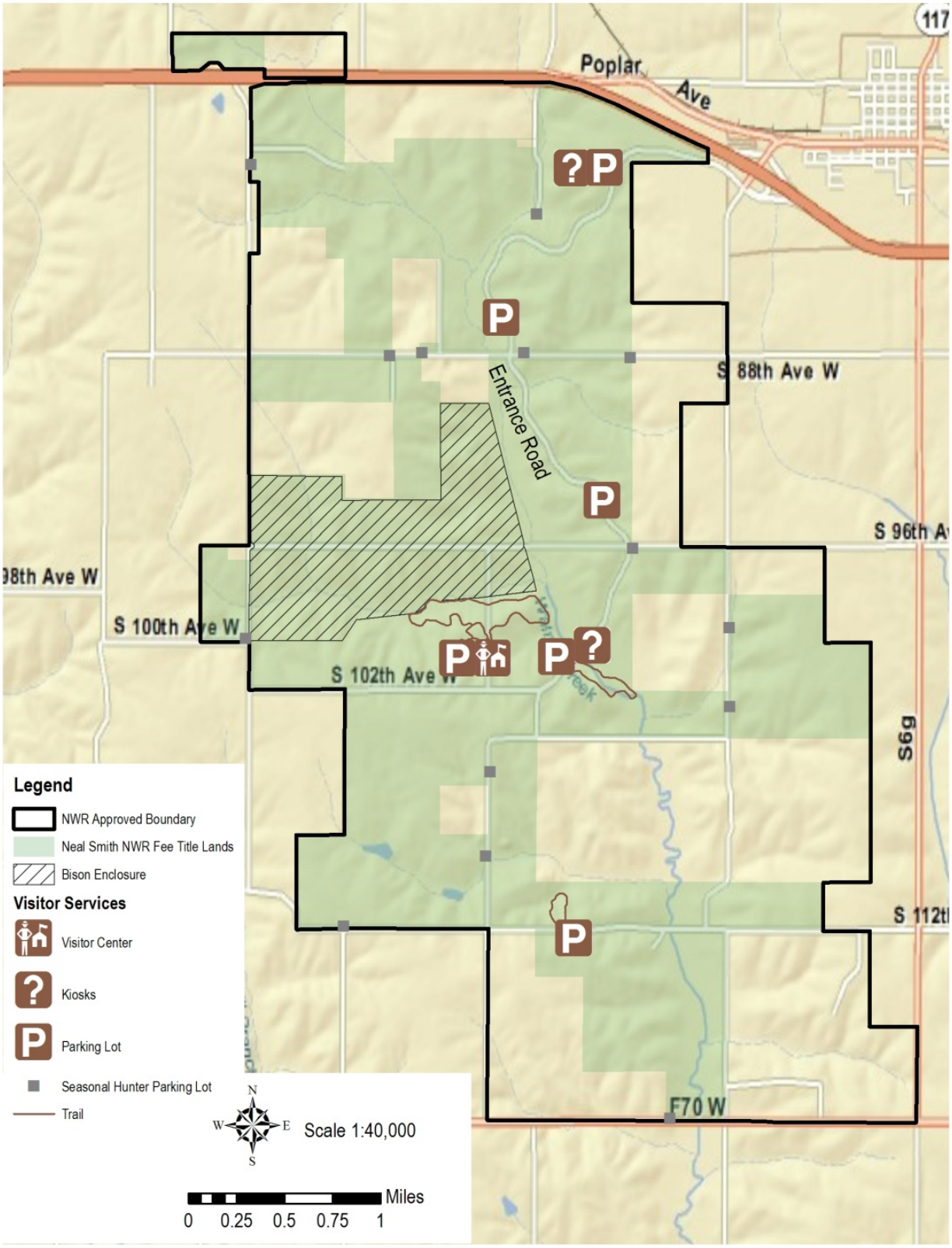
Table 3-4: Visitor numbers

	2009	2008	2007
Trails	44,000	18,000	19,500
Visitor Center	25,000	22,500	24,000
Bison and Elk Enclosure	88,500	105,500	149,500

Table 3-5: Where do visitors come from?

Locations	Percentage of Visitors
Jasper County	14%
Des Moines + suburbs	24%
Other Iowa	36%
Other United States	22%
Other countries	3%
Unknown	1%

Figure 3-7: Current Visitor Services Facilities, Neal Smith NWR



The 4.5-mile entrance road leads to the Visitor Center. The site of the Visitor Center provides good views of the Refuge and offers the opportunity to explore and discover the incredible diversity of the tallgrass prairie ecosystem firsthand. The building itself is designed to blend unobtrusively into the surrounding landscape. The 40,000 square foot Visitor Center includes 13,000 square feet of exhibits, multi-purpose meeting rooms, theater, laboratory-classroom, and bookstore, as well as Refuge offices and research facilities. The Visitor Center desk is staffed seven days/week by volunteers who are available to welcome and orient visitors to the Refuge.

Wildlife Observation and Photography

The opportunity for wildlife observation and photography are huge draws for visitors. The bison and elk are very popular with visitors and are the primary reason many people come to the Refuge; they are also a critical component of Refuge biological and environmental education programs. Birding also is popular, although most birders come from outside the local area. Five trails and an auto tour loop are available for exploration, and all are open from daylight to dusk.

Foot Trails

Overlook Trail is a short, quarter mile paved loop adjacent to the Visitor Center. It has interpretive signs and is accessible under the Americans with Disabilities Act. It passes through prairie plantings and offers panoramic views of the Refuge. Portions of prairie along the trail have been adopted and are maintained by volunteers from the community. Bison and elk can sometimes be spotted in the distance.

Tallgrass Trail is two-mile asphalt loop that branches off from the Overlook Trail. Its long gradual slopes pass through reconstructed prairie, along a prairie/savanna remnant in the process of being restored, and down to the lowlands along the creek. This trail has an interpretive brochure and benches about every third of a mile. Like the Overlook Trail, it offers scenic views and occasional sightings of bison and elk. Since this trail parallels the south fence of the bison enclosure, it provides one of the best chances to see bison close up while travelling by foot.

Savanna Trail is a half-mile gravel loop that allows visitors to meander through a mature oak savanna that is in the process of being restored and to view a sedge meadow under restoration near Walnut Creek. The Savanna Trail is located east of the Visitor Center near the main entrance road. The site includes a visitor parking lot.

Basswood Trail, located in the southern end of the Refuge, has a mowed grass surface. The half-mile trail is mostly wooded and located in the open hunting zone. The site includes a hunter and visitor parking lot.

Native Trails are mowed firebreaks that allow the visitor opportunities to walk along the perimeter of the Refuge to view the prairie from other vantage points. Over 49 miles of firebreak are available on the Refuge, outside the bison enclosure.

Volkssport Trail is an officially designated ten-kilometer trail listed with the American Volkssport Association that incorporates some trails, firebreaks, and county roads.

Auto Tour Route

The four-mile Auto Tour Route is the most popular visitor attraction. Its gravel surface mostly follows county roads and passes through the 700-acre bison/elk enclosure. Many visitors come to the Refuge just to see the herds. For safety reasons, visitors are asked to remain in their vehicles at all times inside the bison/elk enclosure. An interpretive audio CD is available for loan or purchase when the Visitor Center is open.

Bicycle Trail

Visitors enjoy bicycling along the entry road, but there is no shoulder so safety has been a concern. In 2010, the Refuge received a grant from the Paul S. Sarbanes Transit in Parks Projects (a Federal Transit Authority program) to engineer and design a bike/pedestrian trail that will connect Prairie City with the Neal Smith NWR Visitor Center. The trail will follow the entry road, reducing habitat fragmentation while safely allowing visitors the opportunity to reduce their carbon footprint, exercise, and experience the prairie outside of their vehicles. Prairie City currently has a one-mile bike/pedestrian trail that includes a parking lot, restroom, and kiosk just to the northeast of the Refuge. Jasper County Conservation Board has completed more than half of a trail connecting Prairie City and Monroe Iowa. When completed, this trail will add access by bicycle to the Refuge from the town of Monroe.

There are plans for a 100-mile loop trail from Des Moines to Lake Red Rock (a U.S. Army Corps of Engineers facility), with the Refuge trail being a spur. In the future, there is a possibility of extending the Refuge trail to the south, creating two 50-mile loop trails for those desiring a shorter excursion.

Other Access

Some visitors explore the Refuge away from the designated roads and trails. Although demand for such experiences is low at present, this activity is expected to increase. Some visitors walk along fire breaks while others (mostly hunters and birders) venture off into the unbroken prairie. Snowshoeing and cross-country skiing are allowed on- and off-trail in winter; snowshoes in adult and child sizes are available for loan when snow depth is six inches or more. Foot access to the bison/elk enclosure is not allowed. Horses are allowed on county roads only. Other requests for off-trail access are handled on a case-by-case basis with consideration for visitor safety and wildlife disturbance.

Environmental Education and Interpretation

The Refuge provides a wide variety of environmental education and interpretation programs for a wide range of audiences. Teacher training, the Partner Schools program, and ranger-led stewardship activities are the heart of the environmental education program. New twice-monthly interpretive programs are now being developed and presented by staff in an effort to provide more opportunities for visitors to explore the tallgrass prairie and oak savanna ecosystem.

Since 2007, the Visitor Services program has focused more effort on training teachers to lead their own groups and less on ranger-led environmental education programs. Teacher training is an effective way to reach more students when Refuge staff time is limited. A 200-unit teacher-training curriculum on prairie and oak savanna—called Project Bluestem—has been developed by Refuge staff, the Friends of Neal Smith NWR, and educators from around the state. The K–12 interdisciplinary program is available electronically and is designed for Refuge or school-site learning. The original authors of the Project

Bluestem Curriculum (PBS) wrote in their introduction that the PBS curriculum should be constantly "changing, improving, and growing." Neal Smith NWR recognizes the importance of these commands and has worked to uphold them by reviewing and revising the curriculum with the most current philosophies and methods of environmental education. Recently, Neal Smith NWR has adapted and created six new lessons for each grade level K–5; three for the fall season and three for the spring season. These new lessons will be added to the original Project Bluestem Curriculum. Teacher workshops are held at the Refuge in the summer and are usually well-attended. A new rotation of teacher workshops is currently being developed.

The Partner Schools program uses the environment and the outdoors to teach science, math, social studies, English, and art. It provides a multidisciplinary standards-based curriculum that includes hands-on experiences with plants and wildlife to immerse students in nature throughout the seasons. The program typically involves the entire student body. Ideally, Refuge staff visits each school three to four times per year and each class visits the Refuge three to four times per year. While the program reaches a wide audience of students, the emphasis is on diverse youth. The Refuge currently partners with five area schools; additional schools would like to participate and will be accommodated when and if staffing and resource levels are able to meet the requests.

Through this interaction, students are able to gain both hands-on and minds-on learning experiences on a repetitive basis, allowing more in-depth understanding of America's wildlife resources and the role that the Service plays in their management and protection. A growing volume of new research may be accessed at http://www.peecworks.org, the Place-Based Education Evaluation Collaborative website. Previous research and the findings from the Prairie Science Class (Prairie Wetlands Learning Center in Fergus Falls, Minnesota) evaluations demonstrate that integrated learning using authentic field-based experiences makes sense, with positive outcomes for both students and partnering organizations such as the Service.

Research also substantiates that maintaining a smaller teacher to student ratio is one of the most effective ways to increase academic achievement. For this reason, Neal Smith NWR has recently moved from having 100 students on a field trip at time to usually 50 students at a time. Even with these restrictions, staff still lead nearly 5,000 students in environmental education and stewardship programs at the Refuge each year and teach another 2,500 students during off-Refuge programs. The Refuge is also involving teachers and students in research-based programs such as hands-on field work, monitoring, and data collection, and designing their own research proposals. Neal Smith NWR partners with many surrounding institutions of higher learning including Central College, Des Moines Area Community College, Simpson College, Wartburg College, and Iowa State University to provide their students with hands-on, career-related work. School groups are at the Refuge every weekday in September, October, April, and May and most weekdays the rest of the year.

The Refuge sponsors eight special events each year including celebrations for Earth Day, International Migratory Bird Day, National Wildlife Refuge Week (Ding Darling Day), Monarch Madness, Public Lands/Buffalo Day, stewardship days, butterfly counts, and the Christmas bird count. Other interpretive programs include prairie walks, winter adaptation hikes with snowshoes, beginning birding classes, and preschool and family programs. Most activities are scheduled on Saturdays and Sundays. Public interest in these events and programs is strong. An activity guide is made in-house and distributed each season and includes information about interpretive programs and special events. On the weekends, Neal Smith NWR also offers ranger-led badge programs for Boy Scouts and Girl Scouts of various ages.

Non-personal interpretation on the Refuge includes the Visitor Center exhibits, multi-media presentation, trail brochures, interpretive signs and kiosks, and an interpretive audio CD for the auto tour route. A butterfly garden with walkways has been established next to the Visitor Center.

Hunting and Fishing

About two-thirds of the Refuge is open for deer, squirrel, rabbit, pheasant, and quail hunting. The bison/elk enclosure and the area surrounding the Visitor Center are closed to all hunting. Shotgun, bow, and muzzleloader deer hunts are available. Drive hunting for deer is also currently allowed. Special youth and disabled hunter deer seasons are currently not open on the Refuge. There are 15 temporary parking areas available on the Refuge during hunting season. Non-toxic shot is mandatory. The use of dogs is allowed only for upland game birds during the state-approved season. Hunter registration is not required.

Walnut Creek and a few tributaries are the only areas within the Refuge with perennial waters. Even so, water depths are very shallow in the summer and winter months, supporting minnows and other small fish not suitable for angling. Peak waterflows occur after spring rains when flood conditions sometimes make Walnut Creek inaccessible. Therefore, fishing is not a recreational activity that is conducted on Neal Smith NWR.

Other Recreational Uses

Other recreational activities include:

- Horseback riding is allowed on county roads only.
- Dogs allowed for pheasant hunting only.
- Berry and morel collecting are allowed.

Activities not allowed on the Refuge include:

- No shed antler collection.
- No ATVs or snowmobiles.
- No camping/picnicking/fires, but lunchroom and outdoor lunch area are available for visitor use.

Volunteers, Partnerships, and Community Outreach

Refuge programs are supported by many dedicated volunteers. They staff the Visitor Center and bookstore, lead environmental education and interpretive programs, and assist with special events. Volunteers help with invasive species control, greenhouse operations, hand harvest of seed, the prescribed fire program, and many other activities. In 2010, volunteers contributed more than 13,000 hours to the Refuge.

The volunteer group Friends of Neal Smith NWR (Friends) was established in 1993. In addition to supporting the activities listed above, the Friends group pays for the quarterly *Prairie Wind* newsletter and maintains the *tallgrass.org* website to communicate current news and event information. The Friends group has joined the local business association and provides up to four annual $1,000 college scholarships to local graduating high school seniors who are pursuing a higher degree in a natural resources field. The group also provides funding for a 12-week Prairie Builder intern program. Since 1999, over 65 interns have received a combined total of more than $150,000 in stipends.

In 2008, the Friends group and the Iowa Natural Heritage Foundation (INHF) acquired 840 acres of land within the Refuge acquisition boundary. Of particular importance was a large tract of land containing remnant oak savanna and the only remaining unchannelized section of Walnut Creek. The Friends and INHF jointly committed $2.7 million to purchase and hold the land until Service acquisition funds become available.

In 2004, Refuge staff assisted Prairie City with a successful $600,000 grant application that included construction of a bike trail, entry plaza with native plantings, and a bison sculpture. Another $10,000 grant for interpretive kiosks was funded with assistance from Refuge staff. The Refuge was a partner in developing interpretive panels for the kiosks that were installed in 2009. The Refuge continues to be an active member of the Prairie City Business Association.

3.2.3 Special Management Areas

Conservation Easements

When the Farm Services Agency (FSA), formerly known as the Farmers Home Administration, acquires property through default on loans, it is required to protect wetland and floodplain resources on the property prior to public resale. The Service assists the FSA in identifying important floodplain and wetland resources on these properties. Once identified, the FSA assigns a perpetual conservation easement to the property and transfers management responsibility to the Service as part of the Refuge System.

Neal Smith NWR manages 21 FSA conservation easements located in 10 central Iowa counties and totaling approximately 700 acres. All easement properties are inspected, have management plans, and are posted with signs indicating the properties are under conservation easements. Widely dispersed easements have proven difficult to adequately manage with limited Refuge staff. Easements need regular inspection and management to prevent encroachment and resource degradation. The Refuge visits and inspects easements each year, notifying the owners of the upcoming visit as well as any violations that may be found afterwards.

3.2.4 Administrative Facilities

The 40,000 square-foot Visitor Center was built in the mid-1990s using existing green technology (including geothermal heating and cooling). The building serves as Refuge headquarters and includes offices, exhibits, bookstore, research lab, greenhouse, and meeting rooms. A maintenance shop, vehicle and seed storage buildings, greenhouse, and small outdoor amphitheater are located nearby.

The Refuge uses a constructed subsurface flow wetland to treat effluent leaving the septic tank. This system offers an environmentally compatible alternative to a septic drain field, which studies had shown to have severe limitations in the area proposed for the Visitor Center. Through a series of physical, chemical, and biological processes, the three-cell wetland naturally breaks down the effluent as it passes through the porous rock medium and over plant roots and stems on which bacteria, algae, microflora, and fauna are present. The wetland is monitored and operated by Refuge staff to meet permit discharge requirements. Weekly inspections and monthly water sample testing are required. Frequent vegetation control within the cells and surrounding area is necessary to keep the wetland functioning properly. The water quality of the wetland discharge has consistently been better than the permit requires.

A 4.5-mile paved entry road leads from Highway 163 to the Visitor Center, and a paved parking lot is available for visitors and staff. The Refuge is crisscrossed by county roads, both paved and unpaved. About 30,000 linear feet of eight-foot-high, high-tensile woven wire fence surround the bison and elk enclosure, and two cattle grates have been installed, one at each end of the enclosure.

Chapter 4: Future Management Direction

In this chapter

4.1 Introduction
4.2 Goals, Objectives, Strategies, and Rationales

4.1 Introduction

The Environmental Assessment in Appendix A describes and analyzes four management alternatives for Neal Smith National Wildlife Refuge (NWR, Refuge). The U.S. Fish and Wildlife Service (FWS, Service) identifies one as its preferred alternative, and it is described in this chapter as the proposed management direction, defined by a series of goals, objectives, and strategies.

Goals are broad descriptive statements of desired future conditions. There are three goals for Neal Smith NWR. Each goal is followed by a series of objectives, which are specific statements describing management intent. Beneath each objective is a list of strategies—the specific actions, tools, and techniques needed to meet the objective. Finally, rationale statements describe background, history, assumptions, and/or technical details of the objectives and strategies. Unless otherwise noted, the Service intends to meet these objectives within the next 15 years.

4.2 Goals, Objectives, Strategies, and Rationales

4.2.1 Habitat

***Goal*: The Refuge will actively protect, restore, reconstruct, and manage diverse native communities of tallgrass prairie, oak savanna, sedge meadow, and aquatic ecosystems and the natural processes essential to these ecosystems to enhance the vitality and health of the natural prairie environment.**

Objective 1-1: Agriculture
Within five years, plant all remaining agricultural fields (540 acres) with diverse native prairie or savanna seed mix to include no more than 20 percent warm season grass seed, at least 30 percent cool season grass and sedge seed, and approximately 50 percent forb seed (by seeds/ft^2). Initiate restoration of newly-acquired agricultural lands within three years of acquisition. Maintain all sites for continued dominance of at least 75 percent native species.

Strategies

- Remove all terraces, fencelines, and woody vegetation; and re-contour if necessary prior to planting.
- Evaluate whether removing, breaking, or blocking drain tiles is desirable in each management unit and if so, implement actions prior to planting.
- Use local ecotype seed mix appropriate to soil type and hydrology of each site.
- Plant appropriate buffer strips on farm sites to reduce erosion if not converted to prairie within one year of acquisition.
- Mow as necessary during early establishment to prevent competition from early successional weedy species.

- After plantings have been established for three to five years, conduct prescribed burns on a variable schedule every one to five years and within different seasons, if feasible, to invigorate natural communities, limit woody plants, and suppress invasive species.
- Use Integrated Pest Management (IPM) measures including physical, mechanical, grazing, prescribed fire, and/or chemical treatments to reduce, control, or eliminate high-priority invasive plants.
- Experiment with oak tree planting in appropriate areas. Plant acorns directly in the ground in oak savanna reconstruction areas and grow seedlings for future planting in these areas.
- Ensure that all Refuge farming is consistent with FWS Region 3 policy, including limits on the use of genetically-modified crops.

Rationale

Tallgrass prairie and savanna have been reduced to less than one percent of their former presence east of the Missouri River and less than 0.1 percent in Iowa making them critically endangered ecosystems. According to 1846 General Land Office (GLO) survey records, the land cover of the current Neal Smith NWR was primarily prairie and oak savanna at the time of European settlement, but most has been converted to agriculture. Reconstructing prairie or savanna on agricultural fields serves to reverse that statistic, buffers prairie and savanna remnants, and creates habitat for indigenous plant and animal species. Increasing the expanse of prairie and savanna not only benefits wildlife but also creates a more resilient landscape that can persist through perturbations such as climate change.

The acquisition of farmland provides an opportunity to reverse the trend of prairie and savanna loss in Iowa and the Midwest. The Refuge continues farming each site for a period of three to five years from acquisition while the treatment of tile systems, terraces, or other site-related problems are addressed. The ability to meet planting schedules is dependent upon seed availability from vendors, funding to purchase seed, and Refuge harvest.

In many areas, failing to remove drain tiles could increase erosion and have undesirable effects on native vegetation. In some cases, breaking, plugging, or complete removal of tile lines could have undesired effects, so careful evaluation of each site is important. Plugs might create overly wet conditions in adjacent areas as water continues to discharge above the plug, breaking tiles could allow some continued drainage and potential headcutting at break points, and full removal has the potential to increase erosion in some areas.

Prescribed burning is a critical management tool for all habitat reconstruction and restoration objectives in this Comprehensive Conservation Plan (CCP). Tallgrass prairie, oak savanna, and sedge meadow systems all evolved with and adapted to frequent fire. Some fires were caused by lightning, while most were ignited by Native Americans to ease travel, provide safety from wildfires, and provide forage for game species. Fire stimulates growth of many native plants and eliminates competition from species not adapted to fire, and in some species fire is required to break seed dormancy.

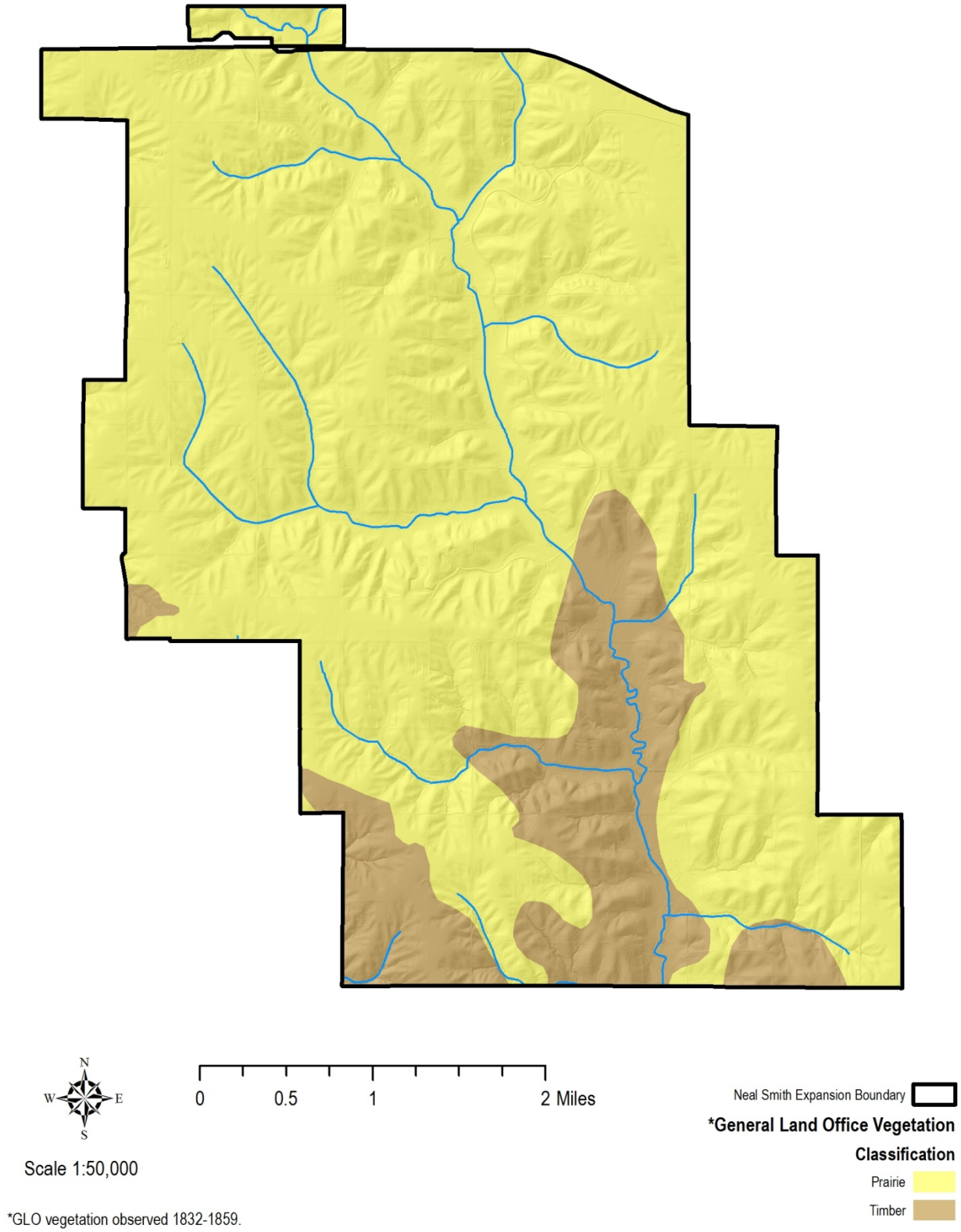
Prior to European settlement, prairie and savanna fires occurred primarily during the fall. Spring burns are most effective at controlling cool season invasive species but can have detrimental effects on native cool season species. Variability in timing of fires promotes plant diversity. Decisions about which areas to burn each year and timing of the burn are based on the condition of the prairie, time since last burn, presence of certain invasive species, management or research activities, available resources, and weather conditions. Practically speaking, spring offers the most opportunities for prescribed burning on the Refuge because of weather and fuel conditions.

IPM is “a sustainable approach to managing pests by combining biological, cultural, physical, and chemical tools in a way that minimizes economic, health, and environmental risks” (U.S. Code Title 7 Section 136r-1). It is a long-standing, science-based, decision-making process that identifies and reduces risks from pests and pest management related strategies. Steps in the IPM process include monitoring and identifying organisms that require action, setting thresholds for action, and managing land and water in a way that prevents organisms from becoming a threat. If preventive measures are not working and the IPM process indicates that pest control is required, then effective less-risky controls are chosen first. Broadcast spraying of non-specific pesticides is a last resort. High-priority invasive plants that require action on Neal Smith NWR will be determined in a step-down management plan following approval of the CCP.

Oak savanna reconstruction will be initiated on some agricultural lands near existing oak savanna remnants. Soil types, historic land cover maps, and field observation will be used to determine other suitable locations. In those sites, a less aggressive seed mix of species commonly found in savanna understory will be planted that will not compete with oak and hickory seedling recruitment. These plantings will be allowed to establish themselves for several years before tree planting begins. Oak savanna reconstruction has not been attempted at Neal Smith NWR, and few attempts have been made at other sites, so this approach will be experimental to determine the best techniques.

Figure 4-1 shows the pattern of prairie and savanna distribution in the early 1800s. The long-term vision for the Refuge includes restoration of prairie and savanna as nearly as possible to this historic pattern, given the dramatic changes that have occurred on the landscape since then.

Figure 4-1: Neal Smith NWR Generalized Future Land Cover (50 to 100 years)



Objective 1-2: Tallgrass Prairie Remnants
Restore vegetation on all prairie remnants (90 acres) to the following conditions: greater than 70 percent canopy cover of native species, less than 20 percent canopy cover of woody vegetation, and combined Floristic Quality Index (FQI) of 35 or higher.

Strategies

- Conduct prescribed burns on a variable schedule every one to five years and within different seasons to invigorate natural communities, limit woody plants, and suppress invasive species. If necessary, plant graminoids (grasses and sedges) to provide a fine-fuel matrix to carry fire through the remnant.
- Remove fire-intolerant woody vegetation using physical (e.g., hand removal), chemical, or mechanical methods to facilitate the use of prescribed fire and increase exposure of prairie plants to sunlight.
- Use IPM measures including physical, mechanical, and/or chemical treatment to reduce, control, or eliminate high-priority invasive plants.
- If tiles, ditches, or terraces are present in areas adjacent to remnants, evaluate whether removing, breaking, or blocking drain tiles; or removing ditches or terraces is necessary, and if so, implement necessary actions.

Rationale
According to 1846 GLO survey records, the land cover of the current Neal Smith NWR was primarily prairie and oak savanna at the time of European settlement. Although much of this area has been in agricultural production since that time, there are still patches of degraded prairie and oak savanna remnants throughout the Refuge. Many of these remnants still hold high potential for restoration but they could be lost to invasive species and woody vegetation if not restored soon. Each is unique in species composition and other characteristics and, when taken together, they could provide important seed sources and valuable genetic diversity adapted to local conditions. Conservative species are present in some of the remnants that have not been established elsewhere on the Refuge.

Prescribed burning is critical to restoration of tallgrass prairie remnants. It promotes native plant diversity, which benefits grassland birds, invertebrates and other wildlife. Prairie plants and wildlife are adapted to the open sunny conditions maintained by frequent fire. Since European settlement of the Midwest, fire has been suppressed, allowing woody vegetation to grow in areas where it wouldn't be present under a natural fire regime. Woody vegetation inhibits growth of native prairie plants and degrades wildlife habitat. Removal of trees from prairie remnants can immediately improve habitat for grassland birds by creating larger areas of grassland and increasing distance to the nearest tree edge. Grassland bird abundance and nest density is lower near woody edges, and grassland birds experience lower nest success near woody edges (Askins et al., 2007).

The FQI is a standardized method to objectively assess the quality of a natural area based on its plant community. It can be used to compare a site to other sites or to determine changes in the same site through time. Intact natural communities have higher FQI scores than disturbed areas. Areas with little ecological value have an FQI of less than 20, areas rating more than 35 are important ecologically, and areas with an FQI in the 50s are extremely important (Wilhelm and Ladd, 1988; Swink and Wilhelm, 1994). Increasing the FQI also is expected to increase the structural diversity of a prairie, providing habitat for a variety of grassland birds and other prairie-dependent species.

Reconstructed Tallgrass Prairie

Objective 1-3

Manage 2,500 acres classified on the 2010 land cover map as *Warm Season (Planted)* vegetation and 675 acres classified as *Cool/Warm Season* vegetation toward the following conditions: at least 70 percent overall native species comprised of approximately 10 percent cool season grasses, 60 percent warm season grasses, 30 percent forbs, and less than 20 percent woody vegetation.

Objective 1-4

Manage 700 acres classified as *Brome (Cool Season)* vegetation to contain at least 40 percent overall cover of native grasses and forbs.

Objective 1-5

Manage reconstructed tallgrass prairie vegetation throughout the Refuge so that in any given year approximately 20 percent will be low stature (less than two-feet tall), 20 percent mid stature (two to four feet), and 60 percent tall stature (greater than four feet) achieved through management strategies to benefit grassland birds and other prairie-dependent wildlife.

Strategies (for objectives 1-3, 1-4, and 1-5)

- Conduct prescribed burns on a variable schedule every one to five years and within different seasons to invigorate natural plant communities, provide diverse habitat for grassland birds and other wildlife, and limit undesirable vegetation.
- Use bison and elk grazing within the enclosure to meet habitat objectives. If fire or grazing by native herbivores cannot meet wildlife and habitat objectives, implement grazing with cattle, sheep, and/or goats in selected units outside the enclosure. Evaluate success of grazing program and modify if necessary, including changes to the bison and elk enclosure size and herd size.
- Evaluate whether removing, breaking, or blocking drain tiles or removing terraces or ditches is necessary in each management unit and, if so, implement necessary actions. Reconfigure enclosure fence away from highly erodible stream sites to reduce degradation of riparian areas.
- Use IPM measures including physical, mechanical, and/or chemical treatment to reduce, control, or eliminate high-priority invasive plants.
- Increase diversity of native plants, including cool season and other conservative species, by interseeding or planting plugs in select areas.
- Work with Inventory and Monitoring Program biologists to develop a simple and effective monitoring protocol and database. Use this protocol and database to collect and enter baseline data on a representative sample of reconstructed prairie units within two years of CCP approval.
- Develop Habitat Management Plan further detailing the activities described.

Rationale

Prairie reconstructions on the Refuge are of varying quality, from very diverse to those dominated by warm season grasses having low plant diversity, and therefore little structural diversity (lower quality). Although the long-term vision is to develop all reconstructions into highly diverse prairies with varying species composition and structure, the short-term objectives (15 years) are more limited because reconstructed sites take time to develop and mature. The 2010 land cover map (Figure 3-6) defines the three general vegetation classes based on aerial photography:

Warm Season (Planted): Dominated by native warm season grasses (big bluestem, Indian grass, little bluestem, etc.) and native forbs; may contain greater than 25 percent relative cover of cool season grasses (mostly non-native smooth brome) and non-native forbs.

Cool/Warm Season: Also planted with native warm season grasses, but still has greater than 50 percent relative cover of non-native cool season grasses (mostly non-native smooth brome). This category is typical of younger plantings and areas that have been grazed or mowed so that cool season grasses are expressed.

Brome (Cool Season): Dominated by greater than 50 percent relative cover of smooth brome and other non-native cool season grasses (timothy, Kentucky bluegrass, etc.); also usually contains non-native forbs, such as clover and wild parsnip; relative cover of native grasses and forbs is less than ten percent. Most of these units were planted for pasture or through the Conservation Reserve Program (CRP) prior to Refuge ownership. This vegetation class provides low-stature vegetation on the Refuge. Reconstruction of some of these areas to native tallgrass prairie will be conducted using low-growing species to contribute to this habitat type.

The interaction of fire and grazing was important in the evolution of the tallgrass prairie ecosystem. Both dramatically reduced vegetative cover in tallgrass prairie, but the effects were temporary, allowing plant species to adapt to the periodic disturbance. Grazing by bison and elk are essential to the control of woody or tree species on the prairie. Removal of dead plant material through burning and grazing increases primary productivity in prairie (Knapp et al., 1999). Both of these management tools, as well as mowing, are used on the Refuge to mimic disturbance regimes that maintained the historic tallgrass prairie ecosystem.

Burning in the spring for several consecutive years will reduce cool season invasive plants including reed canarygrass and smooth brome. Fall burning promotes forbs and cool season species. Native cool season grasses and forbs are extremely under-represented in prairie plantings on the Refuge. Increasing the cover of cool season natives will make these sites more resistant to cool season invasives such as smooth brome and Canada thistle and will increase floristic quality. Planting additional cool season plants also will provide better habitat for native pollinators by providing an increased season of bloom.

Bison and elk graze freely within the 700-acre fenced enclosure. Patch burn grazing encourages the bison to concentrate in different areas of the enclosure each season, creating a mosaic of vegetation structure. Burning is used to stimulate native vegetation and reduce non-native invasives and residual standing dry matter. This encourages bison to graze these areas, creating areas with short vegetation. Unburned areas are grazed less frequently, resulting in taller vegetation and greater litter depth. Together these areas create more diversity in vegetation structure. By rotating the burns throughout the enclosure, the areas that are grazed most frequently also rotate. Each area is allowed periods of “rest” where it receives little grazing, and the residual standing dry matter is able to build up, facilitating prescribed fire. The cycle is then repeated. It is intended that some areas are allowed to grow rank. Expansion of the enclosure area would increase management capabilities to manipulate grazing with bison and elk to best meet wildlife and habitat objectives.

Cattle, sheep, and/or goats can provide grazing disturbance outside the enclosure if it is necessary to meet wildlife or habitat objectives. Cows and sheep can reduce vegetation height or density in prairie reconstructions. Goats can be used in both prairie and savanna sites to target woody plant species. These animals would need to be confined using temporary fencing that can be moved from place to

place, and measures would need to be taken to minimize the introduction of new invasive species via grazers onto the Refuge.

Vegetation structure significantly affects habitat suitability for grassland birds. For example, Henslow's Sparrow, Le Conte's Sparrow, and Sedge Wren prefer tall vegetation with high litter layers. Dickcissels, Bobolinks, and Eastern Meadowlarks use medium to tall vegetation. Upland Sandpiper, Grasshopper Sparrow, and Western Meadowlark prefer areas with shorter vegetation. Northern Harrier and Short-eared Owl require large areas that may include a mix of vegetation heights. Most species prefer areas with little to no woody vegetation and at least low to moderate forb cover, which provides habitat components such as song perches and above-ground nesting substrates.

Restoring a high FQI on tallgrass prairie remnants and reconstructions will provide appropriate habitat diversity for grassland birds but will require many years to accomplish over large areas of the Refuge. In the shorter term, strategic use of mowing, haying, grazing, or burning on reconstructed prairie units can provide varied habitat by creating shorter vegetation and removing litter even where the number of different native plant species is low. This provides better habitat for certain species such as Grasshopper Sparrow. These actions can also be used along with interseeding and herbicides to promote native plant diversity. Mowing, haying, or burning during the growing season will keep vegetation short, but will also destroy nests of grassland birds. These measures would provide benefits to some grassland birds but will reduce habitat suitability for others. The Refuge will play an important role in ensuring that grassland birds and other prairie wildlife have the varied habitat structure necessary to meet their life cycle needs while minimizing damage to nests.

Objective 1-6: Oak Savanna Remnants

Restore vegetation on all oak savanna remnants (150 acres) to the following conditions: canopy cover of 10 to 80 percent and stem density of 1 to 25 trees per acre, less than 30 percent cover of fire-intolerant trees, 70 percent cover of native savanna understory species, and an FQI of 35 or greater.

Strategies

- Remove fire intolerant woody vegetation using methods including physical (e.g., hand removal), chemical (herbicide), mechanical, or livestock browsing to facilitate the use of prescribed fire and increase exposure of savanna understory plants to sunlight.
- Conduct prescribed burns to stimulate growth of native savanna plants, remove litter, and reduce fire-intolerant woody vegetation and invasive species. Burning should be conducted annually for the first ten years if resources allow. If necessary, plant graminoids to provide a fine-fuel matrix.
- Use IPM measures including physical and mechanical treatments, herbicide application, and prescribed fire to reduce, control, or eliminate high-priority invasive plants.
- If tiles, terraces, or ditches are present in areas adjacent to remnants, evaluate whether removing, breaking, or blocking drain tiles or removing terraces or ditches is necessary, and if so, implement actions.

Rationale

At the time of European settlement, oak savannas covered 11 to 13 million acres in the Midwest (Nuzzo, 1985) and about 2.4 million acres in Iowa (Smith, 1998). Only 0.02 percent of midwestern savannas remain, with the rest destroyed or degraded. There are still patches of oak savanna throughout its historic range on the Refuge. These remnants are in varying stages of degradation but still hold potential for restoration. They provide valuable genetic diversity that is adapted to the local conditions, providing

the necessary seed sources for restoring savanna within the Refuge boundary. The metrics for canopy cover and tree density described in this objective represent the definition of oak savanna. The cover of fire intolerant species and native species are metrics that will help the Refuge move towards complete savanna restoration. By achieving this target, we will have restored the oak savanna remnants to a level that is low maintenance, requiring only regular prescribed burning and invasive species management. The strategies listed mimic natural ecological processes and will benefit all savanna-adapted species.

Because oak savannas have characteristics of both grasslands and forests, they are used by more bird species than either of these vegetation types. More bird species are found at higher densities in savannas than in grasslands, shrublands, or forests (Grundel and Pavlovic, 2007). These birds are most likely attracted to one or more of the distinctive habitat features of savannas including scattered mature trees, standing dead trees and snags, and presence of both shrubby and grassland vegetation (Davis et al., 2000). Species that have been found to reach higher densities in oak savanna compared to closed-canopy forests included Red-headed Woodpecker (Grundel and Pavlovic, 2007; Brawn, 2006), Northern Bobwhite, Indigo Bunting, Summer Tanager, and Baltimore Oriole (Brawn, 1998). Rose-breasted Grosbeak, Indigo Bunting, and Blue Jay experienced significantly higher nest success in savannas and woodlands with fire and disturbance compared to closed-canopy forest (Brawn, 1998). Field Sparrow was favored by restoration including fire. Another aspect of oak savanna restoration is that small patches of overgrown, degraded savannas act as sinks for forest bird species. Restoring these oak savannas will provide habitat for source populations of birds adapted to savanna conditions (Brawn, 2006).

Sedge Meadow

Objective 1-7

Manage 330 acres of vegetation classified as *Phalaris (Reed Canarygrass)* to contain at least 25 percent overall cover of native grasses, sedges, and forbs.

Objective 1-8

Within two years of CCP approval, examine soils, topography, slope, aspect, vegetation, and hydrology to identify appropriate sites where wet sedge meadows could be developed or restored. Within five years, develop site-specific plans to create or enhance wet sedge meadows on the Refuge.

Strategies (for objectives 1-7 and 1-8)

- Conduct frequent prescribed burns on sedge meadow sites currently dominated by reed canarygrass to invigorate natural plant communities, limit undesirable vegetation, and provide diverse habitat for sedge meadow birds and other wildlife.
- Increase diversity of native sedge meadow plants by interseeding or planting plugs in select areas.
- Use IPM measures including physical and mechanical treatments, herbicide application, and prescribed fire to reduce, control, or eliminate reed canarygrass and high-priority invasive plants.
- Use 2011 aerial photography, topographic and soils maps, and past vegetation records to identify current and potential sedge meadow sites.
- With regional office assistance, survey each unit to locate sedge meadows or sites where they would have potentially formed before tiling was implemented.
- Determine where removing, breaking, or blocking drain tiles would benefit sedge meadow restoration; implement necessary actions in highest priority locations.

- Establish partnerships with non-profit groups to assist with restoration of sedge meadow sites.

Rationale
A diverse tallgrass prairie ecosystem would necessarily have sedge meadows within the landscape. Sedge meadows occur along a gradient from mesic tallgrass prairie to wet prairie to sedge meadow to wetland. They have hydric soils and require moisture close to the surface for an extended period during the growing season. The plants require full sun and frequent fire. Dominant native plants found in healthy sedge meadows include many species of sedges, prairie cordgrass, rushes, and some forbs. Sedges often form tussocks, creating unique habitat for wildlife. Sedge meadows are a unique mix of aquatic and terrestrial ecosystems.

The Refuge has approximately 370 acres of sedge meadow in mostly poor condition. Much of it has been subject to hydrologic alteration, siltation, and reed canarygrass invasion. Sedge meadows are located in floodplain depressions associated with Walnut Creek and its tributaries as well as in upland seeps and ravines. The 2010 land cover map (Figure 3-6) defines two relevant vegetation classes, based on aerial photography:

- *Phalaris (Reed Canarygrass)*: Invasive reed canarygrass is greater than 75 percent of the relative cover; this category dominates many wet areas that could support sedge meadows (330 acres).
- *Wet Meadow*: Areas with a mix of reed canarygrass, sedges, and forbs, with reed canarygrass normally dominant; typically in wetter settings (40 acres).

In the floodplain, reed canarygrass has become a tenacious competitor due to hydrologic alteration of Walnut Creek and its tributaries. In the uplands, sedge meadows near seeps and ravines often still retain some diversity, although subsurface drain tiles have reduced the level of soil saturation and the quality and diversity of sedge meadows found there. Many ravines probably contained seeps prior to being tiled. Sedges sometimes still survive in these areas, but not all have been located and mapped. One ten-acre sedge meadow near Savanna Trail is the subject of an ongoing reconstruction and research program.

Sedge meadows provide habitat for Service priority wildlife species including Northern Harrier, Short-eared Owl, Sedge Wren, and Bobolink. Waterfowl and other water birds may occur on the Refuge more frequently as habitat conditions in sedge meadows and savannas improve. Sedge meadow restoration also will reduce runoff and erosion by slowing the flow of water across the landscape, allowing it to settle temporarily in wet zones.

Objective 1-9: Habitat Reconstruction and Restoration Research
Develop and implement a Refuge research and monitoring program to evaluate the effects of management actions (grazing, fire, mowing, planting, etc.) on restoring and reconstructing prairies and savannas. Within one year of CCP approval, clearly define three or four of the highest priority management-relevant questions and the data needed to answer them. Within two years, solicit researchers to implement highest priority studies. Meet annually with research team(s) to discuss results, evaluate progress, review priorities, and make plans for the next year.

Strategies
- Continue to collaborate with the Region 3 Prairie Biology Network and other agencies and organizations conducting prairie restoration. Investigate research and monitoring protocols used in other locations to evaluate their potential usefulness at Neal Smith NWR.

- Conduct a structured decision-making workshop with land managers, biologists, researchers, and statisticians with relevant experience from both inside and outside the Service to develop specific science-based management questions and data needs.
- Seek funding assistance for management-relevant studies.
- Incorporate the principles of adaptive management (AM) into all management-related monitoring and research activities.
- Strengthen partnerships with academic institutions to coordinate research needs and activities.

Rationale

Although knowledge of complex ecological systems will always be incomplete, refuges must make management decisions using the best available information to guide their actions. The Service cannot afford to undertake large-scale habitat protection, restoration, or enhancement endeavors only to discover after years of management that actions were ineffective. In the absence of perfect knowledge, biologists are forced to make assumptions, but they can treat these assumptions as testable hypotheses using an AM approach. AM focuses on deliberately designing management to enhance learning and improve subsequent decision-making (Williams et al., 2007).

Studies should be targeted to provide the highest value to resource management; questions having the greatest impact on management decisions should be the highest priorities. Re-creating the tallgrass prairie ecosystem from scratch on Neal Smith NWR is an experimental process, so problems, questions, and hypotheses are complex and wide-ranging. The effect of the grazing and prescribed fire programs on vegetative composition and structure has been a high-priority topic of interest. Others that have been considered to date include control of invasive plants, altered hydrology in the Walnut Creek watershed, the effects of management on priority wildlife species, and appropriate future vegetation types under a changing climate scenario.

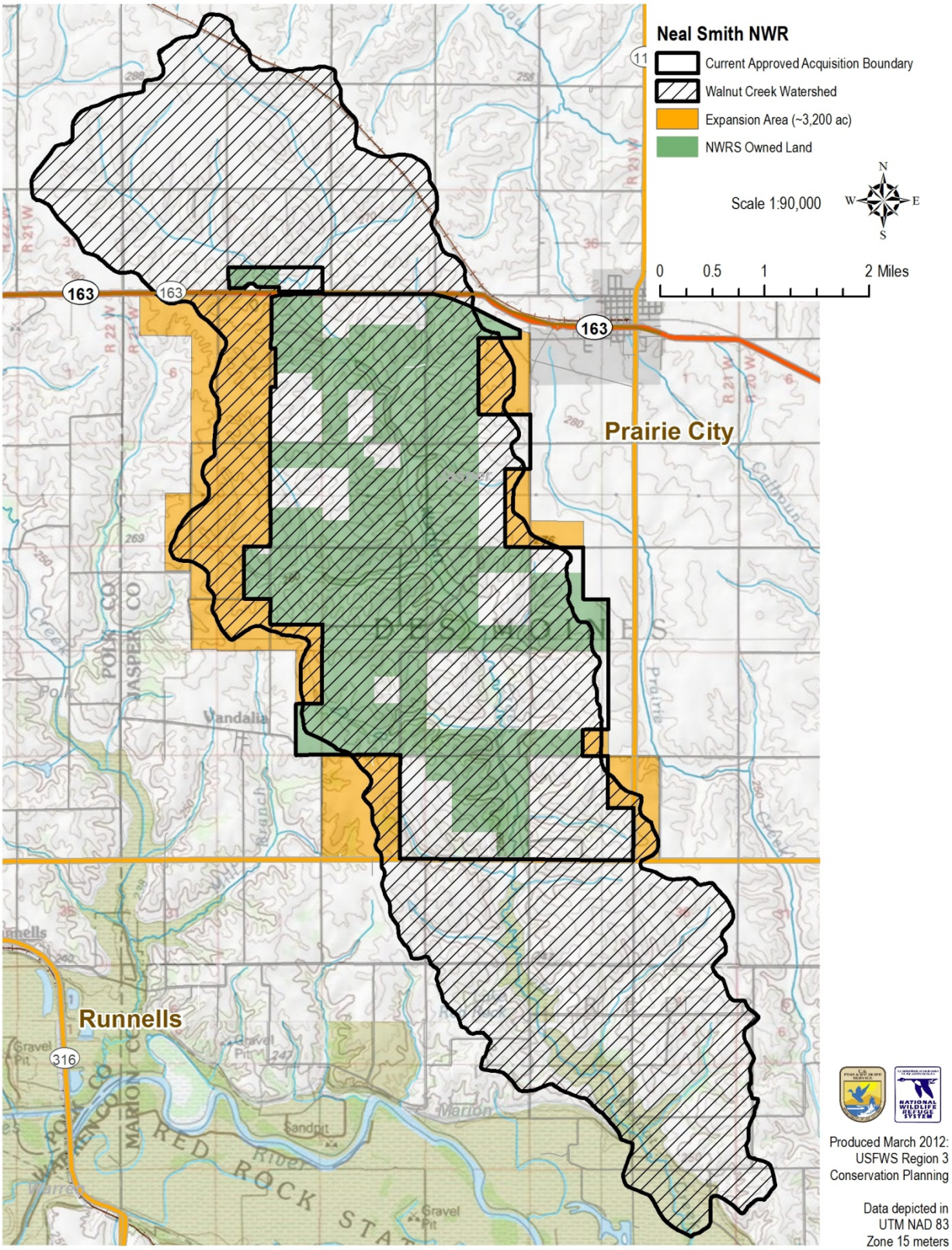
Structured decision-making is an organized approach to identifying and evaluating options and making choices in complex decision situations. It will help Refuge staff to clearly define the most pressing management questions and to direct limited resources toward obtaining scientifically sound answers (FWS, 2008b). New information from research and monitoring only becomes useful if it influences future management decisions and actions. Thus two important steps in the AM loop are analyzing study data and incorporating the results into future actions (Williams et al., 2007).

Refuge staff will promote specific studies designed to evaluate management practices at Neal Smith NWR. This work could be conducted in-house or through college and university partners. Partnerships with academic institutions are critical to successful design, implementation, and evaluation of AM studies on the Refuge.

Objective 1-10: Landscape-Scale Development and Habitat Loss

Reduce the effects of urban development, wildlife habitat loss, and climate change by continued conservation partnerships, and by expanding the Refuge boundary to include 3,200 additional acres of the Walnut Creek watershed that lie to the east and west of the current boundary (Figure 4-2).

Figure 4-2: Proposed Refuge Boundary Expansion



Strategies

- Partner with neighboring landowners and the Iowa Private Lands Office to increase use of available conservation programs and tools.
- Work with partners to further reduce erosion and improve water quality in the Walnut Creek watershed.
- Work with partners to establish wildlife habitat corridors between the Refuge, Lake Red Rock, and Chichaqua Bottoms Greenbelt.
- Work with partners to protect and restore high-value prairie remnants within the 38-county local ecotype zone, especially those that can provide rare plant seeds that are hard to acquire elsewhere.
- Encourage better local zoning regulations and lower-impact development.
- Reduce impacts of subsurface drainage on Refuge habitats.

Rationale

The Refuge is located in a primarily rural area just 20 miles east of Des Moines. Over 99 percent of the historic tallgrass prairie ecosystem has been lost to agricultural and urban development, and pressure on remaining wildlife habitat is increasing as the city and suburbs expand. Protected areas such as Neal Smith NWR, Lake Red Rock, and Chichaqua Bottoms Greenbelt are isolated islands of conservation surrounded primarily by croplands. As a result, the ability of many wildlife species to move across the landscape is limited. Off-Refuge land use patterns also can affect the Service's ability to restore and manage lands and waters on the Refuge.

Diverse partnerships are important in meeting Refuge purposes, National Wildlife Refuge System (NWRS, Refuge System) goals, and the mission of the Service. Neal Smith NWR partners include individual landowners; federal, state, and local government agencies; non-governmental organizations, and other stakeholders.

Lands within the proposed Refuge boundary expansion are located within the Walnut Creek watershed and include the headwaters of those tributaries that flow through the Refuge. The expansion area lies south of State Highway 163 and north of County Road 70. The expanded boundary generally follows roads and/or quarter-section lines adjacent to the watershed boundary, which provides a clearly defined acquisition boundary while also limiting the expansion only to those lands of greatest conservation value in meeting Refuge purposes and objectives.

The expanded boundary will help buffer Refuge wildlife and habitat from the increasing pressures of urban expansion, habitat fragmentation, and climate change, and improve habitat for migratory grassland bird species that require large tracts of prairie for successful nesting. Habitat quality on existing Refuge uplands will increase by restoring more natural subsurface drainage patterns.

Drainage tiles under the Refuge reduce the amount of water in the soil above, so many sites are drier than they would be without tiles. Reducing or eliminating the drainage system under the Refuge would restore the natural soil moisture regimes needed for more diverse and sustainable habitat restoration. Breaking, plugging, or removing tiles only within the current Refuge boundary, however, is not enough. Sections of tile line that lie up-gradient of the Refuge on private lands would remain intact, continuing to discharge groundwater onto Refuge lands and increasing the threat of severe headcutting.

Private landowners are unlikely to break, plug, or remove tiles because wetter soil would significantly reduce agricultural productivity. Consequently, fee title acquisition by the Service is likely to be the most viable option for meeting Refuge objectives, although easements or cooperative agreements also may be feasible in some locations. Land acquisition is proposed on a willing-seller-only basis, which means that any acquisition would occur only when landowners choose to sell. Additional information about this proposal can be found in the Land Protection Plan in Appendix B of this CCP.

Drainage tiles north of State Highway 163 do not flow under the Refuge, so these northernmost watershed reaches do not affect the soil moisture of most Refuge prairies, savannas, and upland sedge meadows. These northern reaches, however, do affect the Walnut Creek floodplain. Service land acquisition north of the highway would facilitate efforts to restore the natural hydrology of the creek, but attempting to engineer this restoration would take many years at a very high cost and is unlikely to be successful. Active channel restoration involving strategies such as armoring streambanks or installing channel meanders is not likely to work until water balance and hydrology are restored (Schilling et al., 2012). In addition, the creek already is moving slowly toward a new state of equilibrium and will eventually restore many of its historic functions if allowed to evolve naturally. Allowing natural processes to occur in the stream network (beaver dams, debris dams, etc.) do not cost anything and encourage stream evolution and readjustment (Schilling et al., 2012). Therefore, the Walnut Creek watershed north of Highway 163 is not included within the expanded Refuge land acquisition boundary. These lands, however, are a high priority for Service partnerships aimed at increasing the conservation value of private lands near the Refuge.

Refuge staff will assist agency partners, landowners, and other stakeholders in their efforts to restore and protect habitat and wildlife outside the expanded Refuge boundary. Priority areas for such assistance include the Walnut Creek watershed north and south of the Refuge, the Chichaqua Bottoms Greenbelt corridor, and habitat remnants determined to be of highest conservation value. Refuge staff may provide technical assistance and other support as requested, but any fee-title acquisition, easements, and ongoing management responsibility in these areas would be provided by others.

The Service's Partners for Fish and Wildlife Program (Partners Program) will be a key partner in meeting this objective. The Partners Program works beyond the boundaries of refuges with landowners and other partners to improve habitat on private lands for fish and wildlife. Neal Smith NWR, Lake Red Rock, and Chichaqua Bottoms Greenbelt lie within the Lower Des Moines River Corridor, a primary focus area of the Partners Program in Iowa. This focus area was established to help improve connectivity between Iowa's major habitat units.

Ultimately, restoring ecological functions and values in the tallgrass prairie ecosystem in central Iowa will require conservation and restoration of both public and private lands. Neal Smith NWR, Chichaqua Bottoms Greenbelt, and Lake Red Rock would serve as core areas of permanently protected and restored habitat connected by a matrix of public and private conservation lands.

4.2.2 Wildlife

***Goal*: The Refuge will protect, restore, reconstruct, and maintain biologically diverse populations of native wildlife associated with healthy prairie, savanna, sedge meadow, and aquatic ecosystems.**

Objective 2-1: Grassland and Savanna Birds

Increase or maintain the populations of native grassland and savanna birds of Service concern that occur on the Refuge. Increase Red-headed Woodpecker populations by five to ten percent over 15 years, Henslow's Sparrow population by 20 percent over 15 years, and maintain Grasshopper Sparrow and Dickcissel populations (currently at 88 and 661 singing males, respectively).

Strategies

- Through management actions, restore and reconstruct tallgrass prairie and oak savannas to benefit bird species that are in decline including Northern Harrier, Upland Sandpiper, Short-eared Owl, Red-headed Woodpecker, Northern Flicker, Sedge Wren, Eastern Towhee, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Le Conte's Sparrow, Smith's Longspur, Dickcissel, Bobolink, Eastern Meadowlark, and Western Meadowlark.
- Conduct prescribed burns on a variable schedule every one to five years and in different seasons to prevent spread of woody vegetation within savanna and prairie habitats and provide structural diversity.
- Continue bird monitoring to determine populations of grassland and savanna bird species and their relationship to Refuge management.
- Analyze point count data collected since 1994 to determine population trends of grassland birds on the Refuge in relation to prairie restoration and Refuge management.
- Promote research on breeding and nest success of grassland birds using the Refuge.
- Promote research to determine the relationship between grassland birds and prairie conditions such as floristic quality.
- Evaluate conditions necessary to introduce Greater Prairie-Chicken to the Refuge. Continue partnership with Iowa Department of Natural Resources (DNR); encourage the DNR to take the lead on reintroduction.

Rationale

Widespread declines of many species of grassland and savanna birds are occurring throughout North America (Sauer et al., 2011). In the Midwest, this loss is primarily due to the conversion of prairie to cropland, resulting in both habitat loss and fragmentation (Brennan and Kuvlesky, 2005). The tallgrass prairie ecosystem has been reduced to less than one percent of its former extent east of the Missouri River and less than 0.1 percent in Iowa. Of the bird species listed in Appendix G: Birds of Special Consideration, Neal Smith NWR could have the most influence on regional populations of Henslow's Sparrow, Dickcissel, and Red-headed Woodpecker because central Iowa is an important part of the breeding range of all three, and they are highly associated with tallgrass prairie and oak savanna habitats. Table 4-1 shows current and future Refuge population estimates.

Table 4-1: Bird populations on Neal Smith NWR

Species	Current Population Estimate	Long-term Population Estimate*
Henslow's Sparrow	317	745
Dickcissel	661	1,553
Red-headed Woodpecker	11	99

*When all Refuge land acquisition/restoration is complete within expanded Refuge boundary

When the habitat objectives in this CCP are achieved, the population of Henslow's Sparrows on currently owned Refuge land could potentially increase to about 500 singing males (based on 2011 densities of 9.2 singing males/100 acres of Refuge grasslands). Over the longer term, when all lands within the

expanded Refuge boundary are acquired and restored, the Henslow's Sparrow population could reach 745 singing males.

Dickcissels populations fluctuate and densities in 2011 were 19.1 birds/100 acres of grassland. The current population estimate is 661 birds on 3,457 grassland acres. If suitable grassland habitat were established on all appropriate soils throughout the current Refuge boundary, the population could reach 1,032 birds. However, since their populations peak two years after planting, it is doubtful that number could be maintained. Maintaining a population of 661 singing males would meet the 15-year objective. Over the longer term, full land acquisition and restoration within the expanded Refuge boundary would result in an estimated population of 1,553 breeding male Dickcissels.

The current estimate for Red-headed Woodpeckers on the Refuge is 11individuals. Over the long term, when savanna has been restored on all suitable soils within the expanded Refuge boundary, the population could potentially reach 99 individuals (based on 2011 densities of 2.9 birds/100 acres).

The current population estimate for Grasshopper Sparrows is 88 singing males on the Refuge, primarily inhabiting the bison enclosure. There they are found at a density of 2.5 singing males/100 acres of grassland. Since they are associated with grazed or shorter grasses their population should remain stable unless grazed areas are increased or decreased. Estimates are based on numbers of birds within 50 meters of point transects conducted in 2011 and the amount of suitable cover that the points were located in.

Bird populations vary from year-to-year and season-to-season. Numbers indicate estimates of breeding birds. For most breeding songbirds, numbers indicate primarily singing males, the most commonly recorded individuals on point counts. For Red-headed Woodpeckers, males and females could not be distinguished for most observations. It is unknown whether these birds have mates or successfully fledge young. Density does not necessarily indicate habitat quality or nest success, and in some species intermediate densities may have higher rates of nest success.

Each species of grassland bird has specific habitat requirements. Many species, such as Killdeer (*Charadrius vociferus*), Horned Lark (*Eremophila alpestris*), and Smith's Longspur, are able to use short sparse grasslands such as agricultural fields and pastures. This habitat type is abundant throughout the region in which the Refuge is located. Some short-grass prairie species, such as Upland Sandpiper, Grasshopper Sparrow, and Western Meadowlark, are found in drier prairies on sandy soils, brome fields, and pastures in Iowa but are more abundant in the core of their range west of Iowa. Tallgrass prairie is important habitat for Sedge Wren, Henslow's Sparrow, Le Conte's Sparrow, Eastern Meadowlark, Bobolink, and Dickcissel. Birds requiring large tracts of grassland include Greater Prairie-Chicken, Northern Harrier (*Circus cyaneus*), and Short-eared Owl.

Henslow's Sparrow is a species of particular concern to the Service. Historically a tallgrass prairie species, it has a relatively small range and is limited to areas of tall grasslands. Dickcissel is another tallgrass prairie species, although more widespread and less specific in its habitat requirements. Other than prairie found on Refuge lands, most tallgrass prairie in Iowa is found on private lands enrolled in the CRP or along roadsides. Since the early 1990s, populations have increased as enrollment in CRP has increased.

In recent years, many CRP plantings are rapidly being converted back to agricultural fields. By restoring and reconstructing tallgrass prairie and sedge meadow at Neal Smith NWR, the Refuge will continue to

create habitat for a diversity of grassland birds that are dependent on these plant communities. In general, it is these prairie-dependent species that are experiencing declines due to loss of these plant communities.

Red-headed Woodpecker is another species experiencing steady declines. Savanna restoration will create larger areas of suitable habitat for this species. Red-headed Woodpecker populations respond well to savanna restoration, so populations are expected to increase on the Refuge.

The Refuge has conducted breeding season bird point counts almost every year since 1994. The surveys were originally conducted to collect baseline data on birds and look for population trends during the early stages of prairie reconstruction (Thomas, 1999). This study found increases in grassland birds such as Dickcissel and Grasshopper Sparrow during the first few years after Refuge establishment. Since then an analysis was carried out examining the bird species composition in prairie plantings of different ages (Olechnowski et al., 2009). This study found that the bird species found in a certain areas of the Refuge were related to the age of the planting. For example, Henslow's Sparrows were found in more established plantings, while Killdeer, Horned Lark, and Vesper Sparrow were most abundant in the first year after planting. Dickcissels peaked in abundance the second year after planting.

Objective 2-2: Bison Genetics
Participate in the U.S. Department of the Interior's (DOI) program to conserve bison genetics.

Strategies

- Maintain an optimum herd size that will not compromise habitat quality or other wildlife populations within the bison and elk enclosure.
- Selectively exchange bison with other herds on other refuges as needed to maintain widespread genetic diversity based on data developed by the FWS Wildlife Health Office (WHO) in Bozeman, Montana.
- Expand and reconfigure bison enclosure to minimize parasite problems associated with repeated use of the same area.

Rationale
The primary purpose of the bison and elk herds on Neal Smith NWR is to establish native wildlife species to the tallgrass prairie reconstruction that played key roles in the ecology of the natural prairie ecosystem. Bison and elk were the dominant native grazers on the tallgrass prairie; and, as such, they shaped the vegetative communities and had direct impacts on other prairie-dependent species such as insects, mammals, and birds. These animals graze the reconstructed prairie within the enclosure to approximate as closely as possible the movements and other behaviors that would have been found in the wild.

Since December 2006, the Neal Smith NWR bison herd has been part of a Service program established to help conserve the genetic diversity of the species. Modeling suggests that a herd size of 1,000–2,000 animals is necessary for high confidence of genetic conservation. The seven Refuges participating in the program have about 1,400 bison in total, with each at or near its preferred carrying capacity. Therefore, the seven small herds are managed genetically as a single large metapopulation. Exchange of animals between the participating Refuges ensures that the genetic diversity of the metapopulation is maintained. In addition, maintaining the genetic foundation broadly across several locations reduces the risk of total loss of genetic resources at a single location from a natural event or other disaster.

The DOI has made a commitment to manage and maintain bison on its lands by chartering the Bison Conservation and Management Working Group to guide management of DOI bison herds (DOI, 2008). The Working Group coordinates opportunities to increase existing DOI herds to 1,000 or more bison or establish new herds as parts of a metapopulation that can reach that size, without impacts from non-native diseases and with minimal cattle allele introgression.

Objective 2-3: Bison and Elk Herd Health

Promote bison and elk herd health at Neal Smith NWR with the following measures:

- In November of each year, at least 90 percent of individuals in bison and elk herds are in good-to-excellent condition based on body condition charts. In March at least 90 percent of animals are in fair or better condition.
- At least 90 percent of tested bison have normal blood panel results, and remaining abnormalities are minor and without herd significance.
- Elk are monitored and show no signs of Chronic Wasting Disease (CWD) and samples test negative.

Strategies

- Conduct regular visual assessments of health of at least 80 percent of the animals in the bison and elk herds every one to two weeks (when travel conditions within the enclosure allow) to monitor population and determine body condition, injuries, abnormal behavior, or other signs of disease.
- In cooperation with the FWS WHO, conduct bison health assessments during annual roundup, sample sizes determined by WHO as appropriate for disease and needed sensitivity. Collect fecal samples when advised by WHO for assessing parasite trends and management effectiveness.
- Euthanize moribund animals, and conduct postmortem exams of all euthanatized animals and of found carcasses in suitable postmortem condition.
- Comply with the Refuge's Chronic Wasting Disease Surveillance and Management Plan, which addresses surveillance/detection, communication/education, and containment/eradication. Refuge staff will confer with the Iowa DNR if CWD appears in the State of Iowa.
- Continue to coordinate with the DOI, Intertribal Bison Cooperative, and Native American tribes to donate excess bison to maintain an appropriate herd size. Manage the elk herd toward maintaining a 50/50 sex ratio of no more than 20 adult animals.
- Continue minimal interference with herds, handling bison only once per year as needed to manage herd size and genetics, and not handling elk at all if possible.
- Avoid domestic animal practices such as vaccination, feeding, and individual animal treatment with exception of herd management practices that include parasite treatment.

Rationale

Bison and elk are nomadic/migratory animals. However, Neal Smith bison and elk herds are confined to a 700-acre enclosure. Confinement to small areas, dense animal aggregation, and repetitive use of select forage all enhance spread of transmissible diseases and parasites. Direct life cycle parasites are a known problem in Neal Smith NWR bison.

Currently the bison herd size is being maintained at approximately 70 head, but appropriate herd size may change with new information derived from research, changes in the size of the enclosure, parasitic loads, as well as vegetative and wildlife response to grazing benefits. The 700-acre enclosure currently

produces enough forage to maintain approximately 70 head of bison with healthy body condition and weight and no evident damage to the prairie based on visual observations of the vegetation.

Objective 2-4: Regal Fritillary Butterfly
Increase the prairie violet (*Viola pedatifida*) population on the Refuge to provide larval food source for the regal fritillary butterfly by establishing at least 500 violet plants in ten additional burn units within ten years.

Strategies

- Purchase or collect local ecotype prairie violet seeds and grow in the greenhouse for planting out.
- Plant prairie violet seeds and plants throughout different burn units of the Refuge, including the bison enclosure where disturbance is beneficial.
- Monitor violet and butterfly populations.

Rationale
The regal fritillary, a species of concern in Iowa, was re-introduced to Neal Smith NWR in 2000. The species was not found when initial butterfly surveys were conducted on the Refuge in 1994 (Klaas and Bishop, 1995). The larval host plant consists of only a few species of violets. Prairie violet is one of the primary host plants and is appropriate for the soil types found on Neal Smith NWR. Before and after reintroduction of the butterflies, prairie violet plugs were planted in several units on the Refuge. Regal fritillary butterflies continue to persist on the Refuge as do the violets where they were planted.

More prairie violets across the Refuge would increase habitat for regal fritillary butterflies and increase their likelihood of locating a patch of violets on which to lay eggs. Increasing the number of burn units on the Refuge that support prairie violets would also reduce the percentage of prairie violet patches burned, and thereby the number of regal fritillary larvae destroyed, in a given year. Prairie violets are conservative plants (coefficient of conservatism for Iowa is 8 on a scale of 0 to 10, with 10 being the highest) making their presence an indication of high quality prairie. Establishing more prairie violets on the Refuge would increase the floristic quality of the prairie and increase the cover of cool season native species, which could make the prairie plant community better able to compete with invasive plant species.

Monitoring of the violets and regal fritillaries is needed to measure success.

Objective 2-5: Indiana Bat
Within three years, initiate Indiana bat monitoring to determine if the species is still present on the Refuge; and, if so, determine locations and whether there is evidence of reproduction.

Strategies

- Conduct baseline inventory of bats within oak savanna habitat across the Refuge.
- Map areas where the Indiana bats are located.
- Continue to monitor every five years in sites known to contain the Indiana bat.

Rationale
Several endangered Indiana bats were found on the Refuge between 1992 and 1995, but no surveys have been conducted since then. Savanna sites will be restored and reconstructed throughout the

Refuge over the next 15 years, and it is important to know whether Indiana bats are currently present in these areas or in other areas of the Refuge where restoration work may take place. Bats may begin to occur here in higher numbers as ecosystem restoration continues. Monitoring to determine presence or absence of Indiana bats will provide a better understanding of what, if any, measures should be taken to avoid negatively impacting the population. At a minimum, restoration work such as tree removal and prescribed burning in occupied Indiana bat habitat should occur only between September 15 and April 15. Mist-net surveys will follow guidelines described in the Indiana Bat recovery plan (FWS, 2007).

4.2.3 People

***Goal*: The Refuge will provide a variety of wildlife-dependent recreational and educational opportunities for visitors to experience and develop an appreciation for the native tallgrass prairie heritage, ecological processes, and cultural resources while participating in ecological restoration efforts or enjoying other activities on the Refuge.**

Objective 3-1: Welcome and Orient Visitors
Provide a welcoming, safe, accessible experience for at least 200,000 visitors each year. Provide clear information in multiple formats so visitors can easily determine where they can go, what they can do, and how they can safely and ethically engage in recreational and educational activities. At least 90 percent of visitors will report a satisfactory overall experience on the Refuge each year.

Strategies

- Within two years of CCP approval, review and update website(s) to provide clear, dynamic information about research, biology, visitor services (to include upcoming events, education, volunteer opportunities), and timely flora and fauna updates (i.e., what's blooming or migrating through). Review and update all other website information at least annually.
- Within five years, review and revise if needed, all informational brochures, directional signs, maps, and other welcoming/orienting publications to ensure that they are current, accurate, and in compliance with Service standards. Thereafter, review brochures annually and update if needed.
- Determine measures of visitor satisfaction, and begin collecting data within one year of completing a Visitor Services step-down plan.
- Move current kiosk closer to the beginning of the entry road; move kiosk on hill by Visitor Center to parking lot.
- Expand length of the Savanna Trail to approximately one mile incorporating savanna/prairie edge.
- Add a southern extension to the Savanna Trail that will eventually connect to the Basswood Trail when the property between is acquired.
- Realign a portion of the lower section of the Tallgrass Trail and place it farther up onto the hillside. The current location is frequently flooded and difficult to maintain.
- Add accessible after-hours restrooms and drinking water.
- Within five years, update Visitor Center display theme and exhibits.
- Develop new introduction movie, and update the theatre configuration.
- Increase Visitor Center hours Memorial Day through Labor Day (hours would be 9:00 AM – 8:00PM) to allow for more interpretive programing and provide evening visitors an opportunity to experience the Visitor Center.

Rationale
Welcoming and orienting Refuge visitors contributes to the criteria that defines a quality wildlife-dependent recreation program as identified in the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) and defined in the Service Manual (Service Manual, 605 FW 1). The number of visitors has stabilized at 140,000 visitors annually. Clear signage and adequate visitor information are essential. The ease with which the public can navigate to visitor use areas on the Refuge, understand guidelines for appropriate conduct and safety, have basic needs met (parking, restrooms, maps, etc.), and fully engage in wildlife-related activities directly translates to a quality recreational experience, a positive impression of the Service, and an identification with the mission and goals of the agency.

Objective 3-2: Hunting
Develop a Refuge hunting program that provides the public with safe and enjoyable hunting opportunities, increases understanding and appreciation of tallgrass prairie and oak savanna ecosystems and associated wildlife, minimizes conflict with other compatible public uses, and is consistent with sound wildlife and resource management practices.

Strategies
- Complete a Refuge hunting plan within one year of CCP approval.
- Add hunting opportunities for youth and people with disabilities.
- Consider changes to Refuge hunt program that would align more closely with the State hunt program.
- Monitor hunter satisfaction by including a space on the hunting brochure for comments along with an email address to encourage a response.
- Host Iowa DNR hunter education courses at the Refuge.
- Review hunting program annually, updating as needed based on wildlife monitoring findings.
- Coordinate and consult with Iowa DNR on all changes to the Refuge hunting program.
- Coordinate with biological program to monitor population numbers of hunted species on the Refuge, and monitor effects on non-hunted species such as Short-eared Owl.

Rationale
Hunting is one of six wildlife-dependent recreational uses that receives priority consideration in Refuge planning and management under the Improvement Act. The Improvement Act states that “Compatible wildlife-dependent recreation is a legitimate and appropriate general public use of the System . . . through which the American public can develop an appreciation for fish and wildlife.”

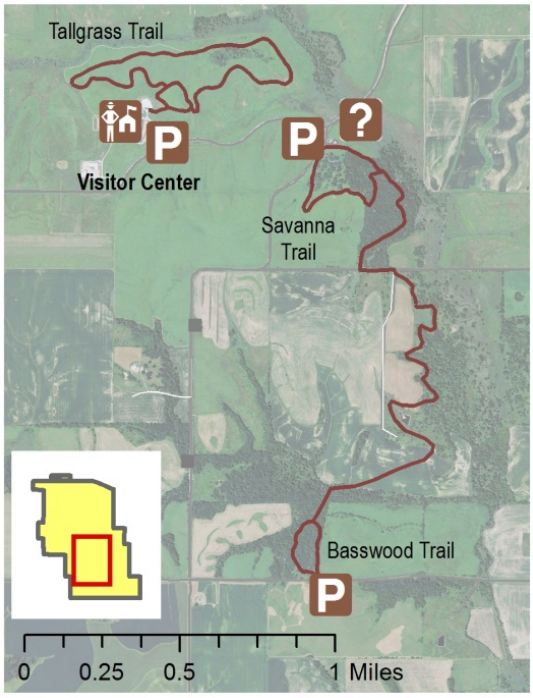
Hunting on Neal Smith NWR will allow Refuge staff to provide wildlife-dependent recreational opportunities for the public, promote a better understanding and appreciation of tallgrass prairie and oak savanna ecosystems and their associated wildlife resources, and manage game populations at acceptable levels. The Service will coordinate and consult with the Iowa DNR on all changes to the Refuge hunt program.

Objective 3-3: Wildlife Observation and Photography
Provide year round opportunities for at least 150,000 visitors to safely observe and photograph wildlife and plants on the Refuge. Offer a range of visitor access experiences appropriate to each activity, location, vegetation type, and time of year.

Strategies

- Continue to maintain current trails and auto tour route to meet FWS standards.
- Provide new trail connecting the existing Basswood and Savanna trails (Figure 4-3) within ten years of acquiring the necessary land (Rothinghouse property). Upgrade the surface of the Basswood trail when connection is complete.
- Reconfigure the layout of the Savanna trail to comply with Americans with Disabilities Act regulations.
- Slightly reconfigure the Tallgrass Trail to elevate it out of the creek floodplain and to allow better visibility into the bison enclosure.
- Allow off-trail foot access year round throughout the Refuge except within and next to the bison and elk enclosure. The Refuge reserves the right to close specific units throughout the year for management or safety purposes.
- Assist with the completion of the bicycle trail adjacent to the entry road.
- Install spotting scopes on pullouts adjacent to bicycle trail and at the Visitor Center to improve viewing of bison and elk.
- Continue to allow cross-country skiing and snowshoeing in designated areas.
- Develop new amphitheater outside the bison viewing window next to the Visitor Center to provide seating for programs or viewing of bison and elk.
- Continue to limit horseback riding on the Refuge to only county roads to prevent the spread of noxious and invasive weeds, and eliminate maintenance issues created by traffic other than foot traffic.
- Increase birding opportunities and activities to meet many of the "birder-friendly" standards of the Refuge System without incorporating feeders, nest boxes, or artificial devices. (http://www.fws.gov/refuges/pdfs/a%20birder%20friendly%20refuge7.08.pdf)
- Continue to provide opportunities for the visiting public to view bison and elk grazing within the relatively natural landscape of the enclosure.

Figure 4-3: Future Configuration of Hiking Trails



Rationale
Wildlife observation and photography are priority wildlife-dependent recreation activities listed in the Improvement Act. They are important and valuable activities that promote understanding and appreciation of natural resources and their management. If properly managed, these uses provide invaluable opportunities for interaction between people and the natural environment with little or no detrimental effects to wildlife or vegetation.

Objective 3-4: Environmental Education
Provide quality environmental education programs to at least 15,000 students each year. Emphasize curriculum-based packages based on national and state education standards, training of teachers to lead their own educational experiences (e.g., Partner Teachers), and repeat student visits that include hands-on outdoor experiences (e.g., Partner Schools). At least 90 percent of teachers will report that Refuge environmental education programs support their curriculum and help to promote resource stewardship and conservation.

Strategies
- Within five years of CCP approval, develop and implement activities to evaluate student learning and teacher satisfaction.
- Within five years, review and update Project Bluestem lesson plans to meet new Iowa educational standards, as well as Refuge and teacher needs and teaching philosophies. These will be reviewed and updated every three years.
- Within five years, all lessons taught as part of the Partner Schools program will reinforce classroom lessons to assist teachers in meeting state standards.
- Increase number of teachers participating in the Partner Teacher program.
- Increase annual number of teacher workshops from one to at least three.
- Develop three to five core themes. Incorporate them into all environmental education programs within two years after completion of the Visitor Services step-down plan.
- Provide educational programs that explain the historic role of bison in the native ecosystems, the relationship between native cultures and bison, the role of bison on the Refuge today, and the management of the FWS bison metapopulation.

Rationale
Through repeated hands-on and minds-on learning experiences, students gain a more in-depth understanding of the value of America's unique wildlife resources and the role that the Service plays in their management and protection. Recent studies indicate that environmental education increases student engagement, academic achievement, leadership skills, critical thinking skills, overall health, and reduces discipline problems. These studies include findings from evaluations conducted at the Prairie Science Class (Prairie Wetlands Learning Center in Fergus Falls, Minnesota); research by the Place-Based Education Evaluation Collaborative; and research by the National Association of Environmental Educators; their work can be accessed at http://www.fws.gov/midwest/pwlc/prairie_school.html, http://www.peecworks.org/ and http://www.eeweek.org/pdf/EE_Benefits.pdf respectively.

Expanding the Partner Schools and Project Bluestem programs are high priorities for the Visitor Services program at the Refuge. These programs build on the "No Child Left Indoors" goal of the Service, as well as building skills for the future workforce (critical thinking), connecting people with nature, instilling civic responsibility, and increasing environmental literacy.

Objective 3-5: Interpretation
Provide quality interpretive experiences for at least 100,000 visitors annually. Identify three to five core themes that will make Refuge issues relevant to everyday lives. Select delivery methods, locations and target audiences to reach people of diverse age, ability, and background. At least 90 percent of people participating in interpretive activities will report learning and understanding the core messages developed in the Visitor Services step-down plan and a satisfaction with their experience.

Strategies

- Within 15 years of CCP approval, update all interpretive programs, signs, brochures, and exhibits to reflect new core themes.
- Continue to offer at least eight special events per year. Work to increase participation and update/revise programs as needed.
- Expand interpretive program offerings.
- Update interpretive CD for auto tour route, and offer it in MP3, podcast format or other current media.
- Develop interpretative resources that encourage native gardens for the benefit for wildlife and people.
- Provide interpretive programs, brochures, and signs that explain the historic role of bison in the native ecosystems, the relationship between native cultures and bison, the role of bison on the Refuge today, and the management of the bison metapopulation.

Rationale
Interpretation is a priority wildlife-dependent recreational use listed in the Improvement Act. Well-designed interpretation can be an effective management tool and provide the opportunity to influence visitor attitudes about natural resources, refuges, the Refuge System, and the Service. They can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively towards the conservation of our nation's environmental resources. They can also influence visitor behavior when visiting units of the Refuge System. Future efforts will be directed toward on- and off-Refuge programs with a goal of increasing the knowledge of, and appreciation for, the Refuge and its resources.

Objective 3-6: Other Recreational Uses
Continue to provide opportunities for berry and mushroom collecting for personal consumption. Continue to allow firewood gathering in designated areas with a Special Use Permit.

Strategy

- Develop an informational sheet (or rack card) concerning berry and mushroom collecting regulations on the Refuge. The brochure will be reviewed annually and updated if necessary.

Rationale
These allowed activities promote historical uses on the Refuge while instilling a land use ethic. Visitor participation can develop a connection and appreciation for non-commercially grown foods and other consumable resources. Human populations have become more and more removed from tasting wild foods that do not require chemicals or other unnatural means to grow. This disconnect is counter to human needs.

Camping and campfires are sometimes requested by visitors, but these uses introduce a potential for increased litter, wildlife feeding issues, and wildfire, so they will not be allowed on the Refuge. Hotels and campgrounds are located within 20 miles of the Refuge allowing these uses to be accommodated by the local community, bolstering the economy, which benefits the Refuge and neighboring towns.

Objective 3-7: Outreach

Increase awareness of and support for Refuge issues in the local community and the Des Moines metropolitan area by participation in community events. Develop messages and delivery techniques that make Refuge issues relevant to everyday lives.

Strategies

- Incorporate core themes and messages into all outreach activities.
- Provide local media with news releases, television/radio spots, interviews, newsletter articles, etc. a minimum of 12 times per year.
- Develop relationships with three key reporters in the surrounding area within two years.
- Increase the frequency of community group presentations.
- Increase opportunities to interact with and listen to local residents and landowners.
- Maintain regular contact with community leaders, agencies, and organizations.
- Enlist the assistance of the Refuge Friends Group in conducting outreach activities.
- Utilize social media including Facebook, Twitter, Flickr, and YouTube, as well as any future sites approved by the Service.

Rationale

It is critical to the mission of the Refuge System and to Neal Smith NWR that the neighbors, citizens, organizations, and agencies in the surrounding landscape know about the Refuge and support it as a valuable and contributing part of the community. The Refuge is an asset to the local community and continued support is essential for the success of the Refuge and its long-term viability. Also, building support for land and water conservation among Refuge neighbors is essential in protecting the natural resources in the area over the long term.

Effective outreach depends on open and continuing communication and collaboration between the Refuge and its many publics. Outreach can foster a sense of ownership in the greater community and contribute to achievement of Refuge purposes and the Refuge System mission.

Objective 3-8: Volunteers and Community Partnerships

Provide quality volunteer opportunities that total at least 20,000 hours annually; and recruit, orient, and train new volunteers each year. Develop community partnerships with local cities and towns.

Strategies

- Recruit new volunteers from the local community and the Des Moines metropolitan area.
- Explore new opportunities for Refuge involvement in the community.
- Explore new opportunities for the community to become involved with the Refuge.
- Construct bunkhouse and RV pads for use by out-of-town volunteers, interns, and researchers.
- Continue to support the Friends Group in providing quality interpretive and educational material offered for sale in the Refuge bookstore.

Rationale

The human resource hours required to effectively manage a national wildlife refuge often exceeds that which can be provided by staff alone. The accomplishments of any refuge, especially the exemplary work above and beyond the day-to-day management needs are often the result of joint public and private teamwork and the collective interests and enthusiasm of the multitude of individuals that benefit from the Refuge. As public servants, Service staff manages a public resource owned by the citizens of this nation. The greater the involvement of the public, the more successfully the mission of the Service is met: " . . . working with others . . . for the continuing benefit of the American people."

Whether through volunteers, support groups, or other important partnerships in the community, Refuge personnel seek to make the Refuge an integral part of the community. Volunteers and partner organizations of Neal Smith NWR become advocates for Refuge management activities and provide vital assistance in fulfilling Refuge purposes and goals. They are integral to the future of the Refuge System. Congress reauthorized the Volunteer and Community Partnership Enhancement Act in 2004, affirming its desire to involve Americans as stewards of our nation's natural resources and wildlife.

Friends of Neal Smith NWR and other volunteers will continue to be important partners in restoring the biological integrity of Refuge lands.

Developing relationships with other conservation agencies and organizations is mutually beneficial in conducting efficient and effective natural resource work. It is important that the Refuge continue efforts to build and maintain open communication, informing partners and the public about the successes, opportunities, and challenges involved in conservation and wildlife-dependent recreation.

Chapter 5: Plan Implementation

In this chapter

5.1 Introduction
5.2 Funding
5.3 Staffing
5.4 Partnership Opportunities
5.5 Step-Down Management Plans
5.6 Monitoring and Evaluation
5.7 Plan Review and Revision

5.1 Introduction

This chapter summarizes the actions, funding, coordination, and monitoring needed to implement the Comprehensive Conservation Plan (CCP). As noted in the inside cover of this document, this plan does not constitute a commitment for staffing increases or operational and maintenance increases. These decisions are at the discretion of Congress in overall appropriations and in budget allocation decisions made at the Washington and Regional levels of the U.S. Fish and Wildlife Service (FWS, Service).

5.2 Funding

This CCP outlines an ambitious course of action for the future management of Neal Smith National Wildlife Refuge (NWR, Refuge). The ability to enhance wildlife habitats and to develop and maintain quality public use facilities will require a significant commitment of staff and funding from the Service. The Refuge will continually need appropriate operational and maintenance funding to implement the objectives of this plan. This section provides a brief description of the highest priority Neal Smith NWR projects as chosen by the Refuge staff.

Expansion of Bison Fence
The existing enclosure is approximately 700 acres and supports approximately 70 bison and 20 elk. The 8-foot tall woven wire fence with wooden posts will be reconfigured. This project would enlarge the size of the enclosure to as much as 1,500 acres, and could allow a doubling of the size of the bison herd. This will allow Neal Smith NWR to better manage for a more botanically and structurally diverse prairie and support the Service's bison genetics conservation efforts by moving to expand and protect bison genetic material that lacks evidence of cattle gene introgression and by expanding the unique genetics represented in the National Bison Range herd through relocation. Reconfiguring the enclosure is needed to maintain adequate space and forage for the existing herd of elk and bison. In addition, through more aggressive grassland management practices, the Refuge may be in a better position to eventually reintroduce the Greater Prairie-Chicken.

Estimated Cost $105,000

Repair Deteriorated Bison Containment Fence
This asset consists of 30,000 linear feet of 8-foot tall by 6-inch diameter (exposed, 12 feet total) posts that are about ten-feet apart with wire containment fencing. Most of the fenceline is in good condition but approximately five to ten percent of posts are damaged and/or degraded and require replacement in order to prevent wildlife from breaching the containment area.

Estimated Cost $20,000

Building Visitor Center and Office Rehabilitation
General rehabilitation work is required as follows:

- The security system is inadequate due to inadequate materials for the size and commercial function of the building. Remove and replace with commercial grade security system. There are 12 air handlers for the building with carbon dioxide (CO2) monitors. The air handlers and sensors are failing and must be replaced. Eighteen of the 20 compressors and five of the six geothermal pumps are failing and must be replaced. Abandoned conduit through the concrete into the HVAC room needs to be fire caulked/sealed.
- The roof was replaced five years ago, but interior damage has not been repaired. Remove and replace 15,000 square feet ceiling tile. Remove and replace 500 board feet of interior window trim, and refinish an additional 1,000 board feet. Replace 2,500 square feet water-damaged wall coverings with sheetrock. Replace electrical circuits damaged during the roof replacement. This will require 1,000 linear feet of #12 stranded and 100 linear feet of ¾-inch electrical metallic tubing. Exterior windows and casings need existing caulking removed and replaced, as it is weathered and failed.
- Replace 15,000 square feet of carpet in the Visitor Center due to mildew and potential mold caused by inadequate drainage beneath the floor. No water barrier was installed beneath the concrete flooring when the building was originally constructed. To correct this structural problem, an electric osmotic pulse system was installed to stop water percolation through the floor. The system has failed causing chemical reactions to occur at cathode/diode sites creating a leachate to stain carpet. Leaky roof drains, leaking roof, thermal expansion, and differential settling have caused damage and cracking to drywall in office area. Five thousand square feet of drywall needs to be replaced, taped and repainted; install ten expansion joints, and repaint 10,000 square feet sheetrock. The building's 119-gallon gas water heater does not meet current energy efficiency standards (built in 1990, installed in 1996) and must be replaced. Fifteen thousand square feet of soffits, fascia, and wood timber exterior needs pressure washing and resealing.
- Integrated neon lighting in the theater does not function properly and must be replaced with more energy efficient lighting. Fifty emergency battery back-up lamps are failing and must be replaced. Four dome skylights in the gift shop have failed and must be replaced. Drains in greenhouse, planting room, and men's shower floors are not graded to drain. Remove and replace 1,000 square feet tile, and mill 100 square feet concrete floor for adequate slope to drain.
- Foundation waterproofing on the building exterior has delaminated and must be replaced. Apply three-ply waterproofing to perimeter of entire building. Erosion, settling, and animal burrows are apparent around the perimeter of the building. Re-grade, compact, and seed. A 15 by 20 foot false ceiling in the loading dock platform of the Visitor Center needs to be installed to prevent bird access to the roof interior where they have nested and caused damage to the ceiling insulation. A workroom used for soldering and brazing does not have adequate ventilation. Install an exhaust hood. A large floor crack runs through several rooms and on a west-side exterior foundation wall. Interior floor cracks have been ground and grouted, but the floor must now be covered with 4,000 square feet tile, and epoxy grout ½-inch by 6-foot crack in foundation wall. Re-caulk all windows, and replace lighting with more efficient models.

Estimated Cost $671,840

Realignment and Expansion of Savanna Trail
This gravel surface trail will be expanded from ½ mile to 1 mile in length and will better meet Americans with Disabilities Act requirements by more closely following the contours of the landscape.

Estimated Cost $75,000

Realignment of Tallgrass Trail
Approximately ½ mile of this trail will be re-surveyed and moved farther up the hill to elevate it out of the floodplain and allow better visibility of the bison enclosure.

Estimated Cost $100,000

Construction of Connector Trail between Savanna and Basswood Trails (including Bridge Construction over Creek)
The three-mile Connector Trail will follow the contours of the landscape and will highlight the transitional zone between prairie and savanna habitats. Construction of a foot bridge capable of weight loads equivalent to UTVs will be built.

Estimated Cost $400,000

Resurface Basswood Trail
This ½ mile long trail will be resurfaced to gravel but will continue the same route as currently exists.

Estimated Cost $50,000

Redesign, Construction, and Installation of Exhibits in Visitor Center
A plan and cost estimate is being prepared for redesign, construction, and installation of new exhibits as well as new color scheme and finishes for the Visitor Center and administrative areas of the building. Current exhibits are out of date, technology is obsolete (unable to be repaired), and some exhibits are broken. The current theme will be updated. Old exhibits will be recycled where possible either in the Visitor Center or will be donated to other conservation entities if possible.

Estimated Cost $2,000,000

5.3 Staffing

Currently, Neal Smith NWR has a staff of 10.5 full-time employees. The following table lists current staff. Additional positions will likely be needed for full implementation of this CCP. However, future funding is uncertain, and new staff positions cannot be guaranteed.

Table 5-1: Current and proposed Neal Smith NWR staffing

	Current Staffing	Proposed Additions
Management	Wildlife Refuge Manager, GS-13 Assistant Refuge Manager, GS-11/12 Wildlife Refuge Specialist, GS-07/09	
Biological	Wildlife Biologist, GS-11	Wildlife Biologist, GS-0486-07
Visitor Services	Park Ranger, GS-07/09 Park Ranger, GS-07/09	Park Ranger, GS-05/07
Administrative	Administrative Officer, GS-09 Office Assistant, GS-05 (0.5 FTE)	
Maintenance	Maintenance Mechanic, WG-09 Maintenance Worker, WG-07	
Fire Management	Fire Management Specialist, GS-09	
Law Enforcement	*None*	LE Officer, GS-07/09

5.4 Partnership Opportunities

Partnerships are an essential element for the successful accomplishment of goals, objectives, and strategies at Neal Smith NWR. The objectives outlined in this CCP need the support and the partnerships of federal, state, and local agencies; non-governmental organizations, and individual citizens. Refuge staff will continue to seek creative partnership opportunities to achieve the vision of the Refuge.

We expect to continue to work with the following notable partners, while also developing new partnerships:

- Iowa Department of Natural Resources
- Friends of Neal Smith National Wildlife Refuge
- Iowa Natural Heritage Foundation
- Jasper County Conservation Board
- Polk County Conservation Board
- Dallas County Conservation Board
- Prairie City Business Association
- U.S. Army Corps of Engineers
- Local and Des Moines area partner schools
- Iowa Prairie Network
- Iowa State University
- Iowa Natural Heritage Foundation
- Iowa Audubon
- Des Moines Audubon Society
- Iowa Ornithologists' Union
- Iowa Native Plant Society

5.5 Step-Down Management Plans

The CCP for Neal Smith NWR is intended to be a broad umbrella plan that 1) outlines general concepts and objectives for habitat, wildlife, visitor services, cultural resources, and partnerships; and 2) guides Refuge management for the next 15 years. Step-down management plans provide greater detail for carrying out specific actions authorized by this CCP. The table below presents step-down management plans that are anticipated to be needed, along with their current status and next revision date. Some of

these plans logically suggest an integrated approach and, where appropriate, may be combined into a single integrated step-down management plan.

Table 5-2: Step-down management plans

Step-down Management Plan	Existing Plan Year Approved	New or Revised Plan
Habitat Management	--	2014
Fenced Animal Management	2002	2015
Integrated Pest Management	--	2014
Inventory and Monitoring	--	2014
Fire Management	2009	Updated Annually
Chronic Wasting Disease	2005	2020
Visitor Services	--	2014
Hunting	1992	2012

5.6 Monitoring and Evaluation

The direction set forth in this CCP and specifically-identified strategies and projects will be monitored throughout the life of the plan. Many actions inherent in the plan are new directions, and monitoring will help understand the effects of the actions on habitat, wildlife, and public use patterns. In addition, the Refuge and its watershed will certainly change, and likely in ways unforeseen. Land use changes, invasive species, floods and droughts, disease outbreaks, and climate may alter expected outcomes. Monitoring will be critical to detecting and reacting to such change.

5.7 Plan Review and Revision

The CCP is intended to be a dynamic plan based on the concept of adaptive management. Since the CCP will be a constant reference and guide for Refuge staff, internal review will be continuous. In addition, it is expected that the public and partners will offer continuous feedback. The Service will document minor plan modifications when monitoring and evaluating to determine that changes are needed to achieve Refuge goals and objectives. There will be opportunity for public review and comment before making any substantive amendments or revisions. A major plan review and re-write will occur after 15 years.

Appendix A: Environmental Assessment

In this appendix

A.1 Purpose and Need
A.2 Description of Alternatives
- Figure A-1: Potential Boundary Expansion
- Table A-1: Summary of Actions by Alternative

A3 Affected Environment
A4 Environmental Consequences
- Table A-3: Summary of Impacts by Alternative

A.1 Purpose and Need for the Proposed Action

A.1.1 Purpose

The purpose of this Environmental Assessment (EA) is to adopt and implement a Comprehensive Conservation Plan (CCP) for Neal Smith National Wildlife Refuge (NWR, Refuge) as mandated in the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) and that the CCP meets the purposes for which the Refuge was established, contributes to the overall mission of the National Wildlife Refuge System (NWRS, Refuge System), and adheres to U.S. Fish and Wildlife Service (FWS, Service) policies and mandates.

Refuge purposes are derived from the legislative authority used to acquire specific refuge lands and are, along with Refuge System goals, the basis on which primary management activities are determined. Purposes for Neal Smith NWR:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources…"16 U.S.C. §742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) (*Fish and Wildlife Act of 1956*)

" . . . for the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) (*Emergency Wetland Resources Act of 1986*)

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans..." 16 U.S.C. § 668dd(a)(2) (*National Wildlife Refuge System Administration Act*)

The mission of the National Wildlife Refuge set forth in the Improvement Act of 1997 is:

"To administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans."

The appendices of the Draft CCP contain a list of key laws, orders, and regulations that provide a

framework for the proposed action.

A.1.2 Need for Action

This EA addresses the need to adopt a 15-year management plan for Neal Smith NWR in order to provide guidance for future Refuge management, address significant issues, identify priorities, ensure consistent and integrated management, protect the biological integrity, diversity, and environmental health of the Refuge; evaluate the appropriateness and compatibility of public uses, and meet other requirements of the Improvement Act.

The CCP is needed because adequate, long-term management direction does not currently exist for the Refuge. Management is now guided by an outdated Master Plan that was published in 1992 and by various general policies and short-term plans. The 1992 Master Plan provided initial guidance for the newly established Refuge and recognized that management programs would need to adapt over time as experimental approaches were tested—large-scale reconstruction of the tallgrass prairie ecosystem had never before been attempted. In addition, the landscape has undergone changes that affect the Refuge, new threats to wildlife and habitat are emerging, new laws and policies are in place, and new scientific information is available.

The plan is needed to help achieve Refuge goals for habitat, wildlife, and people:

Goal 1: Habitat – The Refuge will actively restore, reconstruct, and manage diverse native communities of tallgrass prairie, oak savanna, sedge meadow, and aquatic ecosystems and the natural processes essential to these ecosystems to enhance the vitality and health of the native prairie environment.

Goal 2: Wildlife – The Refuge will protect, restore, and maintain biologically diverse populations of native wildlife associated with healthy prairie, savanna, sedge meadow, and aquatic ecosystems, with an emphasis on grassland and savanna bird species including Greater Prairie-Chicken, Northern Bobwhite, Northern Harrier, Upland Sandpiper, Short-eared Owl, Red-headed Woodpecker, Northern Flicker, Loggerhead Shrike, Bell's Vireo, Sedge Wren, Eastern Bluebird, Eastern Towhee, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Le Conte’s Sparrow, Smith’s Longspur, Orchard Oriole, Dickcissel, Bobolink, Eastern Meadowlark, and Western Meadowlark.

Goal 3: People – The Refuge will provide a variety of wildlife-dependent recreational and educational opportunities for visitors to experience and develop an appreciation for the native tallgrass prairie heritage, ecological processes, and cultural resources while participating in ecological restoration efforts or enjoying other activities on the Refuge.

Significant issues that need to be addressed are summarized in section A.1.3.1 below. More detail about these issues can be found in chapter 2 of the Draft CCP.

A.1.3 Scoping of the Issues

Internal scoping began in April 2009 when Service planning staff and Neal Smith NWR staff developed a preliminary list of issues, concerns, and opportunities associated with management of the Refuge. A second internal scoping session was held with the Service’s Regional Office staff at Fort Snelling, Minnesota, in October 2009 to get input on issues from regional supervisors, biologists, planners, and other program specialists.

Public scoping began in June 2009 when Refuge staff hosted two open house events in Des Moines and Prairie City, Iowa, to inform the public of the planning process and to solicit their input on issues of concern. About 15 people attended. In addition, CCP information and comment sheets were available in the Visitor Center and were sent to the several hundred stakeholders on the Refuge mailing list. Written and e-mailed comments were received from a total of 24 people.

In August 2009, the Refuge convened a team of resource professionals to share their perspectives on the biological and visitor services programs at Neal Smith NWR. Participants included partner agencies, researchers, educators, and Refuge volunteers. Purposes of the workshop were to review the draft list of issues, to begin discussing options for addressing them, and to ensure that the best-available scientific and socioeconomic information was being considered.

A.1.3.1 Neal Smith NWR Issues, Concerns, and Opportunities

This section summarizes the major issues that were identified and analyzed as part of the CCP process. The issues were critical in framing the objectives for the various alternatives considered and formed the basis for evaluating environmental effects. More detailed description of the issues can be found in chapter 2 of the Draft CCP.

Restoration of Native Plant Communities
Individual tracts of land are in different stages of reconstruction/restoration so management needs vary, but several main issues predominate:

- Enhancement of native plant diversity
- Control of non-native invasive plants
- Effects of subsurface drainage and other watershed alterations
- Disruption of historic fire and grazing regimes

Tallgrass Prairie Reconstruction
Plant diversity varies, but all reconstructed prairie sites need more native cool season grasses and forbs. All contain non-native invasive plants, and control of these invasives is one of the most time-intensive management activities on the Refuge. Terraces, gullies, trees, roads, fences, and drain tiles need to be removed on some previously planted sites. Some farm fields and pastures have not yet been planted with native prairie species.

Remnant Prairie, Savanna, and Sedge Meadow
The few remaining remnants of native tallgrass prairie and oak savanna have low native plant diversity, include many non-native plants, and/or are overgrown with trees and woody shrubs. They need to be rescued soon before their integrity is completely lost. Reed canarygrass has invaded sedge meadows in low-lying areas of the Refuge, primarily due to hydrologic alteration of the floodplain. Sedge meadows in upland seeps and ravines are degraded due to reduced soil moisture caused by subsurface drain tiles.

Grazing
Grazing by bison and elk is limited to a small fenced enclosure. An eventual enclosure size of 2,000 acres has been recommended, but that size still would limit grazing to about one-fourth of the Refuge. Adding cattle, sheep, and/or goat grazing as options would increase flexibility and facilitate expansion of the

grazing program, but feasibility and potential program design have not been evaluated in detail. Decisions on whether and how to expand grazing on the Refuge is a primary focus of current research on the Refuge to evaluate effects of the current program.

Wildlife Management

Grassland Birds

Grassland bird populations have exhibited steeper, more consistent declines than any other group of North American birds. Many species largely disappeared from central Iowa due to habitat loss, but many now are returning to the Refuge as restoration continues. Further habitat improvements are expected to increase the number, diversity, and productivity of grassland birds that the Refuge can support. Some, such as Greater Prairie-Chicken, are unlikely to recolonize on their own due to distance from the nearest population. Management strategies for conservation of grassland-nesting birds usually include establishing large contiguous grassland blocks, providing structurally diverse habitat, eliminating mid-season grassland mowing, and controlling woody encroachment.

Bison and Elk

The optimum enclosure size and configuration of the bison and elk enclosure to best meet multiple Refuge needs has not been determined. The optimum bison herd size under the current management program has been determined to be no more than 70 animals. Doubling the size of the enclosure is feasible given the current Refuge boundary. A larger enclosure would expand the grazing program allowing a more proactive management strategy involving patch burn grazing and other manipulations. Concerns among staff are that enlarging the enclosure could reduce the visibility of the animals to visitors and increase erosion if bison are allowed access to the creek and tributaries. The concerns are being considered and addressed in the planning process. The desired number of elk on the Refuge is twenty. Inbreeding is a concern with such a small number of animals. Monitoring, management, and study of the herd are difficult. Chronic Wasting Disease (CWD) is a potential threat to the long-term viability of elk on the Refuge.

Visitor Services

Environmental Education and Interpretation

Current program offerings are in high demand, and many new ideas have been proposed. The potential for program expansion is much greater than staff and volunteers can meet, so priorities need to be set. More interpreted sites on the Refuge are desired, and the Visitor Center exhibits need updating.

Wildlife Observation and Photography

Most visitors come to see wildlife. Many drive the tour route without leaving their vehicles. Foot trails are available, but some visitors also want to walk the mowed fire breaks or explore off-trail. Close visitor connection to the Refuge ecosystem is a meaningful experience to be encouraged, although safety is a concern. Current demand for off-trail access is low but may increase over time.

Hunting

About two-thirds of the Refuge is open for deer, squirrel, rabbit, pheasant, and quail hunting. Shotgun, archery, and muzzleloader hunting are allowed. Drive hunting for deer is allowed, but there are safety concerns and potential conflict with other recreational uses. There have been requests by the public for turkey and furbearer hunting. No special disabled or youth hunts are offered. No on-refuge registration is required, so accurate assessments of hunter use are not available. There is no regular law enforcement presence. An environmental assessment for a new hunt plan is currently in preparation.

Other Recreational Opportunities
Additional horseback riding opportunities are desired by some visitors. Other requested uses have included camping, picnicking, snowmobiling, antler collecting, and creation of potholes for winter ice fishing and for wildlife. Some visitors would like to bring their dogs on the Refuge.

Communication and Community Outreach
Continued development of strong community outreach and partnerships was a frequent theme during the scoping period. The Refuge should promote and publicize its activities at every opportunity, increase outreach in metropolitan Des Moines and the Midwest, and increase collaboration with other local organizations. Recruitment of additional volunteers is desired, including more volunteers from the Prairie City area.

Urban Development and Habitat Fragmentation
Development is increasing rapidly near the Refuge as metropolitan Des Moines expands. Wildlife movement between the Refuge and other protected areas will decrease. The long-term ability to sustain native vegetation and wildlife on Refuge lands depends in part on the integrity of the surrounding landscape. As more agricultural areas are developed, opportunities for the Service to influence land use decisions and reduce habitat fragmentation will become increasingly rare.

A.1.4 Decision Framework

This Environmental Assessment describes four alternatives for future Refuge management and the environmental consequences of each alternative. Each alternative has a reasonable mix of wildlife habitat prescriptions and wildlife-dependent recreational opportunities.

This EA is an important step in the Service's formal decision-making process. In compliance with the National Environmental Policy Act of 1969 (NEPA), the Regional Director of the Midwest Region (Region 3 of the Service) will consider the information presented in this document to select the preferred management alternative. Selection of the preferred alternative is based on its environmental consequences and ability to achieve Refuge purposes and goals. The planning team has recommended Alternative B to the Regional Director. The Draft CCP was developed for implementation based on this recommendation.

The Regional Director will determine whether the preferred alternative is a major federal action, which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of NEPA. If it is determined not to be a major federal action, a Finding of No Significant Impact (FONSI) will be issued. A FONSI means that the preferred alternative is selected and can be implemented in accordance with other laws and regulations. A Decision of Significant Impact would indicate the need to conduct more detailed environmental analysis in an Environmental Impact Statement.

A.2 Description of Alternatives

A.2.1 Alternatives Development

Alternatives are different approaches or combinations of management objectives and strategies designed to achieve the Refuge's purposes, the vision and goals identified in the CCP, and the mission and goals of the Refuge System and the Service. Alternatives are formulated to address the significant issues, concerns, and opportunities identified by the Service and by the public during the scoping period.

The four alternatives identified and evaluated represent different approaches to providing permanent protection, restoration, and management of the Refuge's fish, wildlife, plants, habitats, and other resources as well as compatible wildlife-dependent recreation. The planning team assessed the existing biological conditions and external relationships affecting the Refuge. This information contributed to the development of Refuge goals and, in turn, helped to formulate the alternatives.

A.2. 2 Alternatives Considered but not Analyzed in Detail

The CCP planning team considered expanding the Refuge boundary to include prairie remnants that lie within the 38-county local ecotype seed collection zone but eliminated the option from further consideration in the Draft CCP. Additional detail can be found in Appendix B Land Protection Plan under the Alternative E discussion.

The planning team also considered adding the Walnut Creek watershed north of State Highway 163 to the preferred alternative to facilitate efforts to restore the natural hydrology of the creek and its tributary streams. Attempting to engineer this restoration, however, would take many years at a very high cost and is unlikely to be successful. Active channel restoration involving strategies such as armoring streambanks or installing channel meanders is not likely to work until water balance and hydrology are restored (Schilling et al., 2012). In addition, the creek already is moving slowly toward a new state of equilibrium and will eventually restore many of its historic functions if allowed to evolve naturally. Allowing natural processes to occur in the stream network (beaver dams, debris dams, etc.) do not cost anything and encourage stream evolution and readjustment (Schilling et al., 2012). This alternative was eliminated from further consideration.

A.2.3 Elements Common to All Alternatives

Although the alternatives differ in many ways, there are similarities as well. These common features are listed below to reduce the length and redundancy of the individual alternative descriptions.

- All alternatives, including the no-action alternative, emphasize the same priority wildlife and vegetation communities.
- The Service would ensure that Refuge management complies with all federal laws and regulations that provide direction for managing units of the Refuge System.
- No adjacent landowners would be adversely impacted by any action taken by the Service without a mutual agreement and adequate compensation.
- All alternatives would provide equal protection and management of cultural resources.

A.2.4 Description of Alternatives

This section summarizes the alternatives considered by the planning team to achieve the proposed vision and goals and to address the issues. These alternatives include continuation of current management (Alternative A) and the planning team's proposed action (Alternative B).

Alternative A: Current Management (No Action)

Alternative A, the no-action alternative, reflects the current management of Neal Smith NWR. It provides the baseline against which to compare other alternatives. It is also a requirement of NEPA that a no-action alternative is addressed in the planning process. A detailed description of the existing programs and uses contained in this alternative is found in chapter 3 of the Draft CCP.

These are key elements of Alternative A:

- Manage prairie reconstruction sites to promote diverse tallgrass prairie species and control invasive species by burning, mowing, and spraying. Continue current patch burn grazing program and research in the bison enclosure. Slowly phase out the cooperative farming program on Refuge crop fields.
- Continue current limited efforts to restore prairie, savanna, and sedge meadow remnants.
- Acquire land from willing sellers within the existing approved Refuge boundary.
- Continue current conservation partnerships with federal and state agencies, landowners, universities, and other organizations.
- Bison and elk numbers would not change significantly unless herd health becomes an issue; current enclosure size and configuration would remain.
- Outreach, community involvement, and priority public uses that are compatible and wildlife-dependent would continue at present levels. Visitor numbers likely would remain stable at about 140,000 per year.

Alternative B: Refuge Grassland Bird Focus (Preferred Alternative)

Alternative B would focus on increasing the amount and diversity of native vegetation on the Refuge, and providing the varied habitat structure needed to support wildlife, especially declining populations of migratory grassland birds. Additional effort would be directed toward restoring floristic quality on prairie and savanna remnants. Additional effort would be directed toward monitoring and learning from the results of management actions. The Refuge boundary would expand to the east and west by 3,210 acres to include all tributaries of Walnut Creek that flow through the Refuge (Figure A-1). Detailed objectives, strategies, and rationales associated with this alternative are provided in chapter 4 of the Draft CCP.

These are key elements of Alternative B:

- Convert all Refuge crop fields to native vegetation within five years. Direct management actions (such as burning, mowing, and grazing) on reconstructed prairie sites toward meeting specific measurable objectives for vegetation composition and structural diversity of habitat.
- Increase floristic quality of all prairie and savanna remnants. Begin experimental reconstruction of additional savanna acreage.

- Restore Refuge floodplains and riparian areas dominated by invasive reed canarygrass (330 acres) to at least 25 percent cover of native grasses, sedges, and forbs.
- Evaluate the effects of grazing on Refuge habitat. Modify the program if necessary to meet objectives, including possible changes to enclosure size and/or animal numbers. Use grazing by cattle, sheep, and/or goats as a habitat management tool outside the bison enclosure.
- Assess progress toward meeting habitat objectives; implement vegetation monitoring; continue bird monitoring; develop studies using adaptive management principles to evaluate the effectiveness of management actions.
- Expand Refuge boundary to allow restoration of more natural waterflow on Refuge lands.
- Focus partnership efforts on improving water quality and reducing the effects of development and habitat loss outside the Refuge boundary through existing programs.
- Expand environmental education, interpretation, volunteer, and community outreach programs. Regularly review and update exhibits, brochures, signs, and websites. Update the hunting plan, possibly to align more closely with the State hunting plan. Focus public messages on issues that face the rural landscape, their relevance to everyday life, and the values of conservation partnerships in addressing them. Increase visitor numbers to at least 200,000 per year.

Alternative C: Watershed Focus

Alternative C would emphasize restoration of hydrologic function and native vegetation to the entire Walnut Creek watershed. Refuge staff would build and lead a new public/private partnership to develop and begin implementation of a long-term restoration plan for the watershed. The Refuge land acquisition boundary would expand by 14,600 acres to include all lands within the watershed (Table A-1). Restoration of the southernmost reaches of the watershed would create a contiguous habitat connection between Neal Smith NWR and Lake Red Rock.

These are key elements of Alternative C:

- Work in partnership with private landowners, other agencies, non-governmental organizations, and other stakeholders to restore the Walnut Creek watershed.
- Begin major restoration efforts to re-create creek meanders, restore natural waterflow, reduce erosion, re-connect the creek to its floodplain, and improve water quality.
- Work with landowners and the Partners for Fish and Wildlife Program through existing programs to implement additional conservation measures on private lands within the watershed.
- Expand the Refuge land acquisition boundary to include willing sellers throughout the Walnut Creek watershed. Plant waterways within agricultural fields to native prairie within five years of acquisition.
- Manage reconstructed prairie sites to increase native plant diversity, control the highest priority invasives (especially sericea lespedeza), and restore natural soil moisture patterns.
- Increase efforts to restore and manage riparian and floodplain sedge meadow habitat. Restore Refuge floodplains to at least 50 percent cover of native grasses, sedges, and forbs.
- Focus monitoring and research programs on the effects of hydrologic restoration on Refuge prairie, savanna, and sedge meadow habitats.
- Expand environmental education, interpretation, volunteer, and community outreach programs. Regularly review and update exhibits, brochures, signs, and websites. Update the hunting plan, possibly to align more closely with the State hunting program. Focus public messages on watershed issues and climate change. Increase visitor numbers to at least 200,000 per year.

Alternative D: Corridor Focus

Alternative D would emphasize creation of a permanent wildlife habitat corridor connecting Neal Smith NWR with Chichaqua Bottoms Greenbelt to the north and Lake Red Rock to the south. Refuge staff would build and lead a new public/private partnership focused on increasing the wildlife value of lands within the corridor and supporting environmentally sound development. The Refuge land acquisition boundary would expand by 20,550 acres to include the entire corridor area (Figure A-1). Prairie restoration and management would focus on creation of large connected tracts of diverse habitat structure for wildlife, especially declining populations of grassland birds.

These are key elements of Alternative D:

- Work in partnership with private landowners, other agencies, non-governmental organizations, and other stakeholders to develop and begin implementation of a strategic plan for the long-term conservation of lands within the Neal Smith – Chichaqua – Red Rock corridor.
- Work with landowners and the Partners for Fish and Wildlife Program to implement additional conservation measures on private lands within the corridor.
- Expand the Refuge land acquisition boundary to include willing sellers throughout the Neal Smith – Chichaqua – Red Rock corridor. Plant agricultural fields to native prairie within five years of acquisition.
- Focus monitoring and research programs on evaluating the response of bird, mammal, reptile, amphibian, and invertebrate populations to corridor expansion and habitat restoration.
- Work with the Iowa Department of Natural Resources and other partners to restore and reintroduce native wildlife species as the habitat corridor becomes established.
- Expand environmental education, interpretation, volunteer, and community outreach programs. Regularly review and update exhibits, brochures, signs, and websites. Update the hunting plan, possibly to align more closely with the State hunting program. Focus public messages on building local understanding and support for the wildlife habitat corridor and sustainable development. Increase visitor numbers to at least 200,000 per year.

Figure A-1: Potential Boundary Expansion, Neal Smith NWR

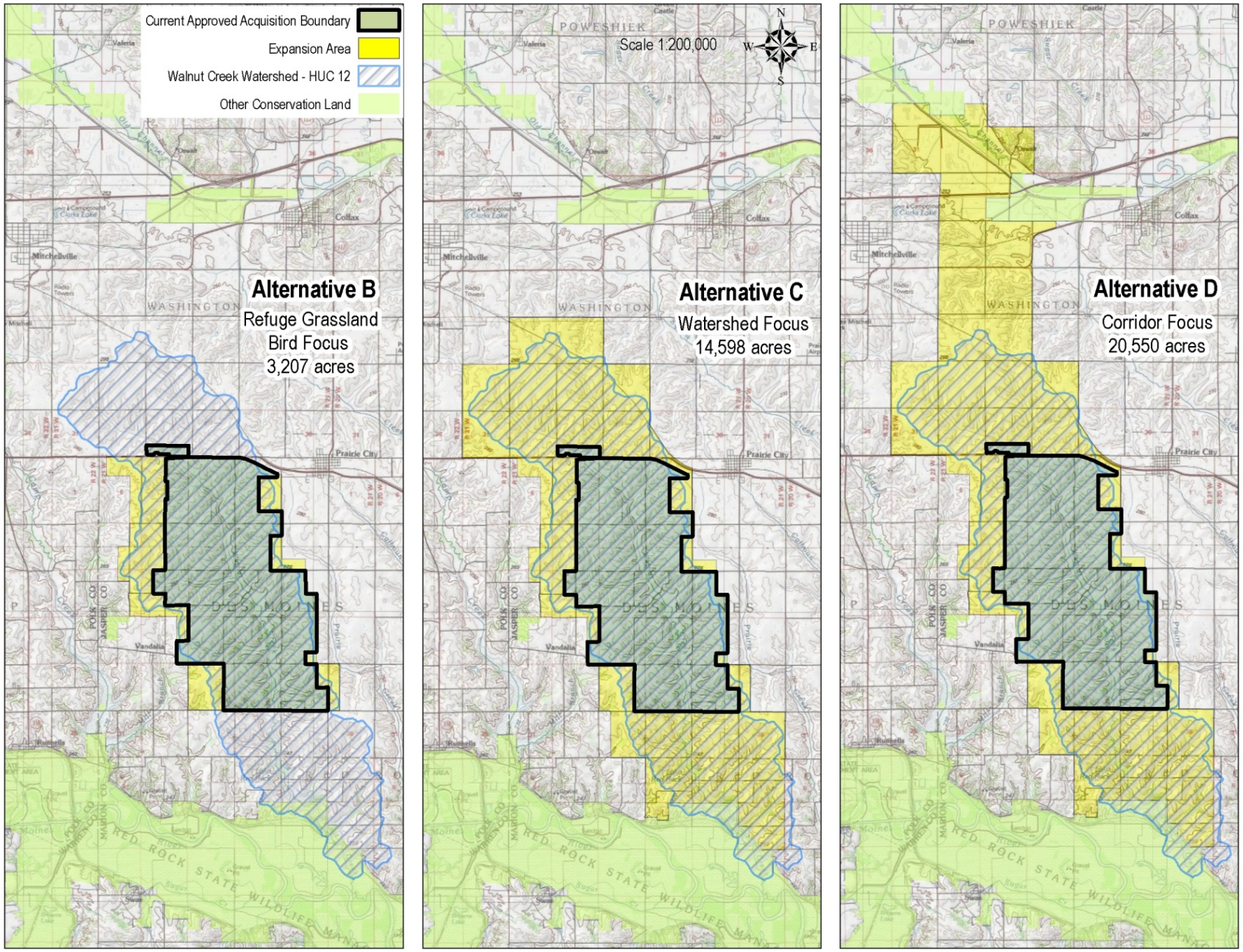


Table A-1: Summary of Actions by Alternative

Theme/Issue	Alternative A (No Action) Current Management	Alternative B (Preferred) Refuge Grassland Bird Focus	Alternative C Watershed Focus	Alternative D Corridor Focus
HABITAT				
Tallgrass prairie reconstruction	Manage reconstructed prairie to promote native plants and control invasives. Gradually convert cropland to prairie. Current grazing program continues. Increase diversity of existing plantings by overseeding.	Manage 3,175 acres to at least 70% native cover with about 10% cool season grass, 60% warm season grass, 30% forbs, and <20% woody vegetation. Manage 700 acres dominated by non-native brome to at least 40% cover of native grasses and forbs. Manage all reconstructed prairie to include about 20% low (<2 feet), 20% mid (2–4 feet), and 60% tall (>4 feet) vegetation for habitat structure needed by grassland birds and other wildlife. Convert all cropland to prairie in 10 years. Evaluate habitat and wildlife effects of grazing program; modify if needed. Use non-native grazers for habitat management at appropriate sites outside the bison enclosure.	Manage reconstructed prairie to promote native plants and control invasives. Restore natural soil moisture patterns on reconstructed prairie; eliminate all drain tiles where feasible; convert waterways in cropland to prairie within 10 years. Evaluate habitat effects of grazing program; modify if needed.	Manage all reconstructed prairie to include about 20% low (<2 feet), 20% mid (2–4 feet), and 60% tall (>4 feet) vegetation for habitat structure needed by grassland birds and other wildlife. Convert all cropland to prairie in five years. Evaluate habitat effects of grazing program; modify if needed.
Tallgrass prairie remnants	Limited prairie remnant restoration with primary focus on Coneflower and Dogleg (26 acres).	All prairie remnants (90 acres) restored to >70% native plant cover, <20% woody vegetation, and combined Floristic Quality Index of 35 or greater.	Same as Alternative A.	Same as Alternative A.
Oak savanna	Limited savanna remnant restoration with primary focus on Thorn Valley, Buzzard Head, and Old Game Farm units (72 acres).	All savanna remnants (150 acres) restored to 10–80% canopy cover, one to 25 trees/acre, <30% cover of fire-intolerant trees, 70% native understory, and Floristic Quality Index of 35 or greater. Experimental reconstruction of additional savanna acreage.	Same as Alternative A.	Same as Alternative A.
Sedge meadow	Manage reed canarygrass and plant natives on one 10-acre sedge meadow site.	Manage floodplain dominated by reed canarygrass (330 acres) to include 25% native vegetation. Evaluate seeps and ravines for potential sedge meadow restoration. Eliminate tile drainage where appropriate.	Manage riparian and floodplain dominated by reed canarygrass to include 50% cover of native vegetation. Evaluate seeps and ravines for potential sedge meadow restoration. Eliminate tile drainage where appropriate.	Same as Alternative A.

Theme/Issue	Alternative A (No Action) Current Management	Alternative B (Preferred) Refuge Grassland Bird Focus	Alternative C Watershed Focus	Alternative D Corridor Focus
Landscape-scale issues: **Development, habitat loss, and altered watershed**	Acquire land from willing sellers within the 8,600-acre approved Refuge boundary. Work with partners through existing programs to improve water quality and reduce the effects of development and habitat loss outside the Refuge boundary.	Expand land acquisition to the east and west within the watershed (3,210 additional acres). Work with partners through existing programs to improve water quality and reduce the effects of development and habitat loss outside the Refuge boundary. Eliminate tile drainage that causes erosion, infrastructure damage, or measurable negative changes in habitat condition or wildlife use on Refuge lands.	Expand land acquisition to include the entire watershed (14,600 additional acres). Build and lead new public/private watershed partnership to develop and implement a long-term restoration plan for the Walnut Creek watershed. Begin major restoration efforts to re-create creek meanders, restore natural waterflow, and improve water quality throughout the watershed.	Expand land acquisition to include lands between the Refuge, Chichaqua, and Red Rock (20,550 additional acres). Build and lead new public/private partnership to create wildlife habitat corridors between the Refuge, Chichaqua, and Red Rock. Support and promote environmentally sound development.
Habitat monitoring and research	Limited vegetation monitoring. Accept research proposals that meet Refuge needs.	Evaluate effectiveness of management actions in meeting habitat and wildlife objectives: • Define highest priority management questions and data needs; establish vegetation and wildlife monitoring protocol(s); solicit researchers for highest priority studies. • Incorporate the principles of adaptive management into all activities.	Evaluate the effects of hydrologic restoration on water quality, erosion, wildlife use, and habitat quality throughout the watershed: • Define highest priority questions and data needs; establish monitoring protocol(s); solicit researchers for highest priority studies. • Incorporate the principles of adaptive management into all activities.	Same as Alternative B.
WILDLIFE				
Grassland birds	Increase cover and diversity of native plants which benefits grassland birds and other prairie wildlife. Continue annual point count monitoring.	Increase cover and diversity of native plants and provide varied habitat structure needed by grassland birds. Continue point counts; analyze data to determine bird response to management. Increase Henslow's Sparrow population by 20%, Red-headed Woodpecker by 5–10%.	Same as Alternative A.	Provide varied habitat structure needed by breeding grassland birds and other prairie wildlife; expand acreage of prairie and reduce habitat fragmentation in the Neal Smith - Chichaqua – Red Rock corridor. Expand point counts to include corridor lands; determine bird response to management and corridor expansion.
Bison	Maintain herd size of about 70 animals. Maintain 700-acre enclosure in current configuration. Participate in national bison genetics program.	Determine optimum herd and enclosure size needed to meet habitat objectives; reconfigure enclosure fence to reduce erosion. Participate in national bison genetics program.	Same as Alternative B.	Same as Alternative B.
Elk	Maximum herd size of 20 animals. Minimal herd management, monitoring, and research; follow CWD contingency plan guidelines.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

Theme/Issue	Alternative A (No Action) Current Management	Alternative B (Preferred) Refuge Grassland Bird Focus	Alternative C Watershed Focus	Alternative D Corridor Focus
Other wildlife reintroductions	No new wildlife reintroductions during the life of the plan.	Explore long-range options with Iowa DNR for Greater Prairie-Chicken reintroduction as habitat on and near the Refuge continues to improve. Increase prairie violet population to increase larval food source for the regal fritillary butterfly.	Same as Alternative A.	Explore options with Iowa DNR for reintroduction of Greater Prairie-Chicken and other species as the Chichaqua – Red Rock corridor becomes established. Monitor mammals, reptiles, amphibians, invertebrates; determine candidates for reintroduction; evaluate population responses to corridor creation.
Indiana bat	No Indiana bat monitoring.	Design and implement monitoring program for Indiana bats on the Refuge.	Same as Alternative B.	Same as Alternative B.
PEOPLE				
Welcome and orient visitors	Provide a welcoming, safe, accessible experience for 140,000 visitors each year. Maintain current signs, maps, kiosks, website, and other visitor information. Maintain current facilities and Visitor Center hours.	Provide a welcoming, safe, accessible experience for at least 200,000 visitors each year. Review/update all visitor information for clarity, accuracy, and compliance with Service standards. Open Visitor Center on summer evenings. Add after-hours restrooms and drinking water.	Same as Alternative B.	Same as Alternative B.
Environmental education and interpretation	Teacher training and Partner Schools programs remain at 2011 levels. Maintain current exhibits, brochures, and interpretive programs.	Expand teacher training and partner schools; emphasize curriculum-based packages; measure student learning and teacher satisfaction. Enhance exhibits, brochures; expand interpretive program offerings. Develop core themes tied to issues that face the rural landscape, their relevance to everyday life, and the value of conservation partnerships in addressing them.	Expand teacher training and partner schools; emphasize curriculum-based packages; measure student learning and teacher satisfaction. Enhance exhibits, brochures; expand interpretive program offerings. Develop core themes tied to watershed issues such as water quality, soil erosion, and hydrologic changes.	Expand teacher training and partner schools; emphasize curriculum-based packages; measure student learning and teacher satisfaction. Enhance exhibits, brochures; expand interpretive program offerings. Develop core themes tied to connected natural landscapes and conservation partnerships. Coordinate programs and messages with partners in the Chichaqua – Red Rock corridor.
Wildlife observation and photography	Four foot trails and an auto tour route. Bicycle trail under construction. Cross-country skiing and snowshoeing. Horseback riding on county roads only.	Add new trail to connect Basswood and Savanna trails as needed land is acquired. Allow off-trail foot access except in bison enclosure; designate temporary restrictions when needed for management or safety. Continue current policies on bicycles, cross-country skiing, snowshoeing, and horses. Increase birding opportunities.	Same as Alternative B.	Same as Alternative B.

Theme/Issue	Alternative A (No Action) Current Management	Alternative B (Preferred) Refuge Grassland Bird Focus	Alternative C Watershed Focus	Alternative D Corridor Focus
Hunting	About 2/3 of Refuge open for deer, squirrel, rabbit, pheasant, and quail hunting. Shotgun, bow, and muzzleloader deer hunting allowed.	Review current program and develop Refuge hunting plan within one year or concurrent with this plan. Consider changes that would align Refuge hunt program more closely with the state hunt program.	Same as Alternative B.	Same as Alternative B.
Other recreation	Berry and mushroom collecting allowed; firewood gathering by permit only.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Communicate key issues with offsite audiences	Continue current outreach programs and current messages.	Increase outreach in the local community and the Des Moines metropolitan area; use social media. Involve Friends of the Neal Smith NWR. Develop core themes to incorporate into all activities.	Same as Alternative B.	Same as Alternative B.
Volunteer programs and community partnerships	Volunteer hours total about 15,000/year. Community partnership programs remain at current level.	Volunteer hours total at least 20,000/year. Recruit new volunteers from local community and Des Moines metropolitan area. Construct bunkhouse and RV pads for out-of-town volunteers, interns, and researchers. Develop and expand community partnerships.	Same as Alternative B.	Same as Alternative B.

A.3 Affected Environment

This section is a brief overview of the affected environment of Neal Smith NWR. Additional detail is contained in chapter 3 of the Draft CCP.

Neal Smith NWR is located in Jasper County in central Iowa, about 20 miles east of Des Moines. The Refuge currently encompasses about 5,400 acres. It was established in 1991 to restore up to 8,600 acres of the tallgrass prairie ecosystem "from scratch" on former farmland. The Refuge is also responsible for some Service activities on private lands in eleven Iowa counties. Currently administered within this area are 21 Farmers Home Administration easements totaling approximately 700 acres.

A.3.1 Physical Environment

Geology
Neal Smith NWR lies in the southern Iowa Drift Plain landform region, which covers most of the southern half of Iowa. This region was created by repeated glacial expansion and retreat, wind-deposited loess, and erosion. The region is characterized by steeply rolling hills interspersed with more level hilltops and valley bottoms and is heavily dissected by drainage systems such as the Walnut Creek basin.

Hydrology
The Refuge is located within the 20-square-mile Walnut Creek watershed, which lies within the Des Moines River drainage basin. From its headwaters located two to three miles north of the Refuge boundary, Walnut Creek flows south about ten miles to its confluence with the Des Moines River just northwest of the Red Rock Reservoir. The approximately 6.5-mile stretch of Walnut Creek within the Refuge boundary bisects the Refuge from north to south and is fed by numerous tributary streams, which generally flow in an east-west direction.

As tallgrass prairie was converted to agriculture, most of the natural meanders in Walnut Creek were straightened and deepened, and subsurface drainage tiles were installed throughout the watershed. These measures had the desired effect of moving water off crop fields and down Walnut Creek more efficiently, thereby increasing farm productivity. However, the increased volume and velocity of water in the straightened creek also caused significant channel scouring. Today the channel is incised as much as ten feet in many places, the groundwater table is lowered near the channel, and Walnut Creek is disconnected from its historic floodplain. As a result, floodplain soils are drier and native vegetation has been overtaken in many locations by a monoculture of invasive reed canarygrass.

The creek has benefitted from reduced human disturbance and is slowly moving toward a new state of equilibrium as it attempts to balance parameters such as slope, sediment loads, water volume, and channel geometry. The incision of the creek bed has largely stabilized and the channel is gradually widening as the stream banks collapse. This is a natural process. As the channel widens, slope of banks will decrease, terraces and channel meanders will begin to emerge, and new floodplain vegetation communities will become established. The time needed for these changes to occur naturally is unknown, but would be on the order of decades to centuries (Schilling et al., 2012).

Soils
Refuge soils formed as a result of the interaction of climate with the growth of tallgrass prairie and deciduous trees in loess, glacial till, and alluvial deposits. Soils in the upper end of the Refuge are loess

formations and are poorly-to-moderately drained. Soils in the lower end of the Refuge are formed of glacial till and are generally well-drained. There are approximately 1,644 acres of hydric soils along Walnut Creek and its tributaries; another 740 acres contain soils with hydric inclusions.

About 60 percent of soils on the Refuge are subject to moderate erosion. Agricultural development during the last 150 years may have resulted in the erosion of up to five to six feet of topsoil from some uplands. Approximately 10,000 to 20,000 tons of sediment is transported downstream each year in the Walnut Creek channel.

Climate

The climate of central Iowa, classified as humid continental, is characterized by warm, humid summers and cold, relatively dry winters. Temperatures typically range from 72 °F in the summer to 22 °F in the winter. Approximately 70 percent of the average annual rainfall (32 inches in Jasper County) falls between April and September. The amount of precipitation is the primary factor in the historic dominance of tallgrass prairie in the region: drier areas to the west support midgrass or shortgrass prairie, while deciduous forest is the native vegetation typically occurring in moister regions to the east.

Precipitation in Iowa has gradually increased over the last 100 years, although year-to-year variability is high. Most of the precipitation increase has come in the first half of the year and less in the second half leading to wetter springs and drier autumns. Growing evidence points to stronger summer storm systems in the Midwest due to warming temperatures and increasing humidity levels.

Iowa's annual average temperature has increased since 1873 at a modest rate, but seasonal and day-night changes have been proportionately larger. Temperatures have increased six times more in winter (0.18 °F/decade) than in summer (0.03 °F/decade), and nighttime temperatures have been increasing more than daytime temperatures. Iowa now has a statewide average of five more frost-free days per year than 50 years ago, and eight to nine more than at the beginning of the 20th century. Higher winter and spring temperatures seem to be causing earlier and more protracted snowmelt and a reduced probability of spring flooding. The increased number of large summertime rain events, increased soil moisture, and other factors seem to be leading to increased summer flooding.

A.3.2 Vegetation and Wildlife

Historic Habitat Conditions

According to 1846 General Land Office survey records, the land cover of the current Neal Smith NWR at the time of European settlement consisted of tallgrass prairie in the northern half, extending into the southwestern portion of the Refuge; the rest of the Refuge consisted of a mix of tallgrass prairie and oak savanna.

The pattern of vegetation across the landscape was dependent on a complex combination of environmental factors such as climate, topography, hydrology, grazing, and soils, combined with the effects of fire, which was caused naturally by lightning or deliberately set by humans. Fire was an important factor in the ecology of the ecosystem, reducing litter build-up and suppressing the growth of woody vegetation. Bison and elk provided essential functions such as grazing and other disturbances that, together with fire, maintained the diverse and dynamic nature of the system. As these environmental factors varied over time and space, so too did the distribution of vegetation communities.

The tallgrass prairie ecosystem was quickly settled and cleared as European-Americans arrived in the Midwest in the mid-1800s. The entire Walnut Creek watershed and surrounding area was heavily impacted by agriculture. Most prairie and savanna was converted to croplands; lands less suitable for agriculture were used for grazing livestock or logging. Fire was actively suppressed. Consequently, all of the pre-settlement natural communities were eliminated, severely degraded, or considerably disturbed.

Current Habitat Conditions

Reconstructed Prairie

About 3,400 acres of former cropland have been planted with native prairie species. Prairie reconstructions on the Refuge are of varying quality, from very diverse to those dominated by a few species, primarily warm season grasses. The 2,500 acres of reconstructed prairie classified as *"Warm Season"* on the 2010 vegetation map (Figure 3-6) are dominated by warm season grasses and native forbs but may contain up to 20 percent cover of non-native grasses (mostly brome) and non-native forbs. Units classified as *"Cool/Warm Season"* (675 acres) have more than 50 percent cover of non-native grasses, especially brome. This category is typical of younger plantings and areas that have been grazed or hayed.

Crop Fields and Old Pasture

About 540 acres of Refuge land are still being farmed to prevent weed encroachment until they can be planted to prairie. Another 700 acres are categorized as *"Brome (Cool Season)."* Most of these units were planted for pasture or through the Conservation Reserve Program (CRP) prior to Refuge ownership. They are dominated by smooth brome and other non-native cool season grasses (timothy, Kentucky bluegrass, etc.).

Prairie and Savanna Remnants

About 90 acres of remnant tallgrass prairie and 150 acres of oak savanna remnants are found on the Refuge. When fire was suppressed, non-fire-tolerant woody species began encroaching, eventually forming an overly dense canopy that favors shade-tolerant understory species at the expense of prairie and savanna specialists. Native herbaceous plants that remain often are limited to spring-blooming species that complete much of their life cycle before the trees leaf out. Non-native plant species, both woody and herbaceous, are invading many remnants.

Sedge Meadow

Dominant native plants found in healthy sedge meadows include prairie cordgrass, sedges, rushes, and occasional forbs. Sedge meadows are located in floodplain depressions associated with Walnut Creek and its tributaries as well as in upland seeps and ravines. In the floodplain, invasive reed canarygrass has become a tenacious competitor due to hydrologic alteration. About 330 acres of low-lying Refuge land are classified as *"Phalaris (Reed Canarygrass)."* These areas are dominated by greater than 75 percent reed canarygrass.

Sedge meadows on upland areas near seeps and ravines often still retain some native plant diversity, although subsurface drain tiles have reduced the level of soil saturation in these areas and reduced the quality and diversity of the sedge meadows found there.

Volunteer Woodland

About 220 acres, primarily along the creek, have grown up into woodlands. Although the trees are primarily native species, they did not occur in these locations in the 1840s. Woodland did exist in some parts of southern and eastern Iowa prior to European settlement, but probably not on the Refuge.

Evidence indicates that current-day Refuge woodlands are actually overgrown savanna or prairie, the result of fire suppression not historic ecological processes.

Wildlife and Fish

Birds

More than 200 species of birds now use the Refuge, including more than 80 species during breeding season. Many bird species that had been extirpated from the area due to habitat loss have returned as the ecosystem undergoes restoration.

Henslow's Sparrow is now ubiquitous in unburned prairies and grasslands. Sedge Wren, Field Sparrow, Grasshopper Sparrow, Dickcissel, Bobolink, and Eastern Meadowlark also are common on the Refuge during the breeding season. Western Meadowlark, Sandpiper, and Northern Bobwhite are present in small numbers. Short-eared Owl and Northern Harrier are now consistently seen during winter and migration. Le Conte's and Savanna Sparrow use the Refuge regularly during migration.

Bell's Vireo, Gray Catbird, Brown Thrasher, Yellow-breasted Chat, and Orchard Oriole use shrubs for feeding and nesting. Others—such as Loggerhead Shrike, Willow Flycatcher, Eastern Kingbird, Vesper Sparrow, Field Sparrow, Lark Sparrow, and American Goldfinch—use scattered shrubs surrounded by grasslands. Red-headed Woodpeckers are found in oak savannas on the Refuge. Northern Flickers frequently forage in prairies but use trees for nesting. Eastern Towhees and Field Sparrows use shrubs in oak savanna areas.

Waterfowl may occur on the Refuge more frequently as habitat conditions in sedge meadows and savannas (for Wood Duck nesting) improve.

Mammals

More than 40 mammal species, including the federally endangered Indiana bat, have been documented on the Refuge. White-tailed deer, eastern cottontail, thirteen-lined ground squirrel, plains pocket gopher, and raccoon are the most frequently seen mammals on the Refuge. Badgers, coyotes, and bobcats have also been found. Bison and elk have been reintroduced to a 700-acre fenced enclosure.

Reptiles and Amphibians

The 1992 Master Plan appendices list four turtles and 15 snakes likely to occur on the Refuge. Most of these species have broad distributions and are common in Iowa.

Amphibian surveys documented nine species on the Refuge in 2004 including the tiger salamander, eastern gray treefrog and Cope's gray treefrog, American toad, American bullfrog, Blanchard's cricket frog, western chorus frog, northern leopard frog, and pickerel frog. The small-mouthed salamander was found in 1994.

Invertebrates

Nearly 90 butterfly species have been documented on the Refuge, including the regal fritillary, which has been the subject of Refuge reintroduction and research efforts. At least 29 species of ants have been documented, including two species that build large mounds. Prairie crayfish is another species that engineers the prairie by building burrows.

Fish

Thirty-one species of fish were collected from Walnut Creek between 1995 and 2005, but the overall

number of fish collected was low. Species tolerant of degraded environmental conditions made up a large proportion of the fish community. The collections were dominated by minnows, most of which are considered abundant to common in Iowa streams. Sunfishes and suckers were collected in fairly low numbers. Gizzard shad comprised a large proportion of the population in 1998 and 1999, but were found in relatively low numbers in other years. Species diversity can vary dramatically and is heavily influenced by proximity of the creek to the Des Moines River.

Threatened and Endangered Species
Federally endangered Indiana bats migrate from central Missouri to southern Iowa in the spring to raise their young. Jasper County is at the northern edge of the species' range. Monitoring on the Refuge in 1992 and 1993 resulted in successful mist-netting of lactating females and juveniles from one localized area just north of Thorn Valley Savanna. A third monitoring season resulted in capture of one adult male. Current species status on the Refuge is unknown. Savanna restoration will likely improve Indiana bat habitat by developing more desirable flyways and thus better forage conditions under an open canopy.

The Refuge is within the historic range of the endangered Topeka shiner, but the species has not been found in Walnut Creek, and the Refuge does not contain designated critical habitat.

A.3.3 Public Use

The 1997 Improvement Act gives priority to six wildlife-dependent recreational uses of national wildlife refuges when these uses are compatible with the purposes for which the refuge was established. These uses are hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

Hunting and Fishing
About two-thirds of the Refuge is open for deer, squirrel, rabbit, pheasant, and quail hunting during part of the state season. The bison/elk enclosure and the area surrounding the Prairie Learning Center are closed to all hunting, and no shooting is allowed within 200 yards of buildings inhabited by people or livestock.

Thirteen temporary parking areas are available on the Refuge during hunting season. Non-toxic shot is mandatory. The use of dogs is allowed only for pheasants during the state-approved season. Hunter registration is not required. Shotgun, bow, and muzzleloader deer hunts are available. Drive hunting for deer is also allowed.

There are no fishable waters on the Refuge.

Wildlife Observation and Photography
Facilities to aid wildlife observation and photography include four pedestrian trails and an auto tour route that passes through the 700-acre fenced bison and elk enclosure. Numerous county roads also crisscross the Refuge. Some visitors explore the unbroken prairie away from designated roads and trails, although demand for such experiences has been low. Foot access to the bison/elk enclosure is not allowed.

Environmental Education and Interpretation
Teacher training, the Partner Schools program, and ranger-led stewardship activities are the heart of the

environmental education program. A teacher-training curriculum on prairie and oak savanna (Project Bluestem) has been developed, and workshops are held at the Refuge throughout the year. The Partner Schools program uses the environment and the outdoors to teach science, math, social studies, English, and art by immersing students in nature throughout the seasons. In addition, about 5,000 students participate in other ranger-led programs at the Refuge each year and another 1,500 attend off-Refuge programs.

The Refuge sponsors eight events each year including Migratory Bird Day and National Wildlife Refuge Week, as well as other interpretive programs. A variety of trail brochures, interpretive signs, and kiosks are available, as well as an interpretive audio CD for the auto tour route. Facilities include a 13,000 square foot Visitor Center with exhibits, theater, classrooms, and bookstore.

A.3.4 Socioeconomics

The Refuge is located in the southwest quadrant of Jasper County, Iowa, which is primarily rural in nature. The town of Prairie City (population 1,400) lies just northeast of the Refuge boundary. Polk County includes the city of Des Moines, which is located about 18 miles west of the Refuge. The Des Moines metropolitan area (population 500,000) is one of the fastest growing regions of the state.

The area population (Jasper and Polk counties) increased by 12.8 percent from 1995 to 2005, compared with a 3.4 percent increase for the State of Iowa and an 11.4 percent increase for the United States as a whole. The median household income in Jasper County in 2008 was $48,734 with about 10.4 percent of residents living below the poverty level. Manufacturing was the largest category of private sector employment in Jasper County, followed by retail trade, leisure/hospitality, and education/health services.

A.3.5 Archeological and Cultural Values

Native American History

It is possible that the ancestral Ioway, Missouri and/or Oto lived in large villages very near the area that is now the Refuge as early as A.D. 1000. Their hunting grounds, collecting locations, campsites, and gardens were probably located in the Walnut Creek drainage, although there is little specific documentation in the historic record.

Prior to 1821, the Ioways and Missouris were in control of the lower and central Des Moines River Valley. The Sauk Indians defeated the Ioways in 1821, and the Ioways left the area soon thereafter. The Sauk and Fox became the principal Native Americans in residence. They lived in several villages simultaneously that fluctuated in size depending upon the fortunes of the village leader. In the early 1840s Poweshiek's village was located less than 20 miles north of the Refuge on the South Skunk River and Keokuk's village was located immediately south of the Refuge along the Des Moines River (now Red Rock Reservoir).

In an 1842 treaty, the Sauk and Fox ceded their last claim to Iowa land in exchange for a reservation in Kansas, then to the present-day reserve in Oklahoma. Part of the Meskwaki tribe, however, separated from the larger group, returned to Iowa, and purchased land in Tama County where they still maintain the Meskwaki Settlement today.

Euro-American Settlement

Jasper County was created in 1840 and by 1846 permanent white settlement was sufficient to merit establishment of formal county government. Prairie City was founded in 1851 and soon became a stop along the old Territorial Road. Prairie City emerged as the dominant community in the Walnut Creek area when it gained rail service in 1866.

Farms and communities developed rapidly. In Jasper County and elsewhere, settlers initially favored farm sites combining timberland and open prairie land, preferably near a stream. Such sites offered wood for fuel and building purposes, a water source, and prairie for pasture and (relatively) easy planting. As settlement increased, virtually all available land was soon claimed without regard for the proportions of timber and prairie on them. Livestock and corn became dominant throughout Iowa, but in the Prairie City area commercial potato production also was important during the late 19th century.

Refuge Cultural Resources
A 1991 cultural resources investigation of the Refuge located seven previously unrecorded prehistoric sites within the project boundaries. Also identified within the Refuge were two reported Indian burial areas, an Indian camp site, and two types of historic properties. Two soil groups found in alluvial fans and valley bottoms were identified as having the potential to contain additional cultural resources. Cultural resources in the lowlands may now be deeply buried. Uplands on the Refuge show little or no promise for either surficial or buried archeological sites because of extensive erosion.

No surface evidence of the reported burial areas or camping site was found, probably due to the effects of cultivation and erosion. Additional non-destructive testing is recommended should ground-disturbing activities become necessary. Farmsteads on the Refuge have been greatly altered over the years, and it is unclear at present whether any are eligible for the National Register of Historic Places.

A.4 Environmental Consequences

A.4.1 Effects Common to All Alternatives

Air Quality
None of the management alternatives would have appreciable, long-term impacts on ambient air quality conditions in the area. Habitat management involving prescribed fire would occur under each alternative, but prescribed fire would be used only under ideal weather conditions. Approved smoke management practices developed by state and federal land management agencies would be implemented in all burning events. Nevertheless, under each alternative there would be some potential for temporary air quality impacts from smoke in areas near the Refuge.

Actions to manage smoke include altering ignition techniques and sequence, halting ignition, suppressing the fire, use of local law enforcement as traffic control, and roadway signs. Burning will be done only on days that the smoke will not be blown across nearby communities and/or Refuge neighbors or when the wind is sufficient as not to cause heavy concentrations. The Annual Prescribed Fire Plan for each unit will have specific mitigation measures to deal with unexpected smoke management problems. Refuge staff will work with neighboring agencies and in consultation with Iowa air quality personnel to address smoke issues that require additional mitigation.

Environmental Justice
Executive Order 12898 “Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations” was signed by President Bill Clinton on February 11, 1994, to focus federal

attention on the environmental and human health conditions of minority and low-income populations with the goal of achieving environmental protection for all communities. The Order directed federal agencies to develop environmental justice strategies to aid in identifying and addressing disproportionately high and adverse human health or environmental effects of their program, policies, and activities on minority and low-income populations. The Order is also intended to promote nondiscrimination in federal programs substantially affecting human health and the environment and to provide minority and low-income communities with access to public information and participation in matters relating to human health or the environment.

None of the alternatives described in this EA will disproportionately place any adverse environmental, economic, social, or health impacts on minority and low-income populations. Public use activities that would be offered under each of the alternatives would be available to any visitor regardless of race, ethnicity, or income level.

Cultural Resources

The Service is responsible for managing archaeological and historic sites found on national wildlife refuges. Known cultural resources occur at Neal Smith NWR, and there may be undiscovered sites. Under each of the alternatives evaluated in this EA, Refuge management would ensure compliance with relevant federal laws and regulations, particularly Section 106 of the National Historic Preservation Act. Prior to all habitat and facility projects, appropriate efforts will be made to identify and protect cultural resources within the area of potential impact by contacting the Regional Historic Preservation Officer for project review.

Climate Change

The U.S. Department of the Interior issued an order in January 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change impacts as part of long-range planning endeavors. Some potential impacts of climate change on the tallgrass prairie ecosystem in Iowa have been identified that may need to be considered and addressed in the future. For example:

- Accelerated growth of woody vegetation could allow oak savanna to expand into non-wooded areas (if they are not cropped), and non-fire-tolerant woody vegetation could more rapidly invade prairie and savanna remnants.
- Plant and animal communities may change as species' ranges shift northward; with less-adaptable species becoming threatened by the changing conditions, and other more tolerable species moving in to take their place.
- Plant species that are most tolerant to variable environmental conditions and are often invasive in nature (sometimes exotic) will likely out-compete native plants for resources.
- Higher winter and spring temperatures may cause earlier and more protracted snow melt and a reduced probability of spring flooding. Stronger summer storm systems may lead to increased summer flooding.
- Prescribed fire may become more difficult to implement.

Managers and resource specialists on the Refuge need to be aware of the potential effects of climate change. When feasible, documenting long-term vegetation, wildlife, and hydrologic changes should become a part of research and monitoring programs. Adjustments in management direction may be necessary over time to adapt to a changing climate.

Carbon Sequestration
Increased carbon dioxide in the atmosphere has been linked to global climate change. In relation to comprehensive conservation planning for national wildlife refuges, carbon sequestration is one of the primary climate-related management strategies that can be considered despite uncertainty surrounding site-specific climate change effects. The U.S. Department of Energy (USDOE, 1999) defines carbon sequestration as " . . . the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

Terrestrial vegetation is an important factor in global carbon sequestration. Terrestrial biomes of all sorts—grasslands, forests, wetlands, tundra and desert—capture and store carbon, thereby removing a portion of the atmospheric carbon dioxide. The USDOE report notes that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere.

One Refuge activity in particular, prescribed burning, releases carbon dioxide directly to the atmosphere from plants consumed during combustion. However, new vegetation quickly replaces the burned vegetation and, over multiple years of burns, an increasing root network develops below the soil surface in prairies, effectively capturing large quantities of carbon. No net decrease in the amount of carbon sequestered on the Refuge will occur due to prescribed burning. Restoration of lands previously cleared for agriculture will increase the total quantity of sequestered carbon on the Refuge under all alternatives. Alternative A would result in the smallest increase in carbon storage; Alternative D would result in the largest increase in carbon storage due to increased land acquisition and restoration. Grasses, forbs, and trees characteristic of the Refuge ecosystem are effective at capturing and storing carbon both above and below the ground.

A.4.2 Summary of Effects by Alternative

Specific impacts of implementing each alternative are examined in this section under three broad categories: habitat, wildlife, and socioeconomics. A summary table of impacts is included at the end of this section (Table A-3).

Habitat
All alternatives would have a positive net effect on quantity and quality of native tallgrass prairie and oak savanna, although acreage and plant diversity achieved over the next 15 years would vary by alternative. Under all alternatives, Service-owned agricultural fields would be converted to native vegetation, although rate of conversion would be slower under Alternative A. Alternatives B, C, and D would increase the efficiency and success of Refuge management actions compared to Alternative A due to more targeted monitoring and evaluation of the effectiveness of management actions and implementation of the principles of adaptive management.

The amount of land permanently protected as part of the Refuge would vary according to alternative. Resource threats outside the Refuge boundary—habitat loss, fragmentation, and urban development—would be addressed to different degrees in each alternative.

All alternatives would reduce erosion in the local watershed by converting crop fields to native prairie and encouraging adoption of additional conservation measures on privately-owned agricultural land. Alternative B includes measures to restore more natural waterflow patterns on the Refuge by reducing subsurface drainage tiles. Alternative C proposes major hydrologic restoration of the watershed, the

creek channel, and the floodplain.

Alternative A: Current Direction

Prairie, savanna, sedge meadow

Alternative A provides the smallest increase in amount and diversity of prairie, savanna, and sedge meadow vegetation communities. Existing agricultural fields (540 acres) would be planted gradually with native prairie plants. Additional acreage acquired by the Service within the existing Refuge boundary also would be planted to appropriate native vegetation over time as resources allow. About 3,000 acres remain to be acquired, but how much of that total could be purchased and converted to prairie during the 15-year life of this plan is unknown and is dependent on landowner willingness to sell and availability of Service land acquisition funding.

The current approach to management of reconstructed prairie would continue, so native plant diversity and quality of wildlife habitat would remain stable or improve slowly. Limited efforts to restore a few tallgrass prairie and oak savanna remnants would continue, so the biological condition of most remnants would continue to decline (including encroachment by non-native plants, inappropriate woody vegetation, and low diversity of native plants), and some could be lost altogether. Sedge meadow habitat in the Walnut Creek floodplain would continue to be dominated by invasive reed canarygrass.

Resource threats

Urban development and habitat fragmentation outside the Refuge boundary would remain mostly unaddressed by current Refuge programs. Negative impacts of altered hydrology on Refuge restoration (erosion, soil moisture loss, spread of non-native plants, etc.) would remain fairly stable.

Alternative B: Refuge Grassland Bird Focus

Prairie, savanna, sedge meadow

Under Alternative B, all existing agricultural fields would be converted to native prairie plants within ten years. Any additional acreage acquired by the Service would be planted to native vegetation within three years of purchase. The Refuge boundary would expand to include an additional 3,210 acres compared to Alternative A, but how much of that total could be purchased and converted to prairie during the 15-year life of this plan is unknown and is dependent on landowner willingness to sell and availability of Service land acquisition funding.

Management of all reconstructed prairie sites [3,875 acres with vegetation classified as "*Warm Season (Planted),"* "*Cool Season,"* or "*Brome (Cool Season)"*] would focus on increasing native plant diversity and creating the habitat structure needed by breeding grassland birds and other prairie wildlife. Biological condition of all prairie and savanna remnants would improve, preventing further degradation or loss of these irreplaceable sites. All would be restored to a Floristic Quality Index of 35 or higher, which indicates "ecologically important" sites. The quality of Refuge prairies and savannas would show the most improvement under this alternative.

Floodplain sedge meadow (300 acres) currently dominated by invasive reed canarygrass would be managed to include at least 25 percent native grasses, sedges, and forbs over the next 15 years.

Resource threats

Threats to resources caused by urban development, habitat fragmentation, and climate change would be reduced on the Refuge compared to Alternative A due to increased Refuge size and more focused conservation partnership efforts outside the Refuge boundary. Lands acquired by the Service would be

protected from future development.

Refuge boundary expansion would allow reduction or elimination of subsurface drainage tile lines that flow under the Refuge. Negative impacts to upland vegetation would be reduced. Many prairie, savanna, and upland sedge meadow sites are drier than they would be without tiles. Reducing or eliminating the drainage system under the Refuge would restore the natural soil moisture regimes needed for more diverse and sustainable habitat restoration.

Alternative C: Watershed Focus

Prairie, savanna, sedge meadow

Under Alternative C, the current approach to managing reconstructed prairie units would continue, so native plant diversity and quality of wildlife habitat would remain stable or possibly improve slowly as effects of subsurface drainage are reduced. Prairie acreage would increase more than it would under Alternatives A or B, because the Refuge boundary would expand to include the entire Walnut Creek watershed (an additional 14,600 acres compared to Alternative A). How much of that land could be purchased and converted to prairie during the 15-year life of this plan is unknown and is dependent on landowner willingness to sell, availability of Service land acquisition funding, and availability of Refuge funding for habitat restoration and management.

Limited efforts to restore a few tallgrass prairie and oak savanna remnants would continue, so the biological condition of most remnants would continue to decline (including encroachment by non-native plants, inappropriate woody vegetation, and low diversity of native plants). The quality of Refuge sedge meadows would show the most improvement under this alternative due to greater emphasis on hydrologic restoration of the Walnut Creek watershed.

Resource threats

Threats to resources caused by urban development, habitat fragmentation, and climate change would be reduced over time in the entire Walnut Creek watershed due to the larger Refuge land acquisition boundary and creation of a new conservation partnership. Lands acquired by the Service would be protected from future development.

The boundary expansion and strong emphasis on hydrologic restoration would allow reduction or elimination of subsurface drainage tile lines that flow under the Refuge. Negative impacts to upland vegetation would be reduced. Many prairie, savanna, and upland sedge meadow sites are drier than they would be without tiles. Reducing or eliminating the drainage system under the Refuge would restore the natural soil moisture regimes needed for more diverse and sustainable habitat restoration.

Under this alternative a major program to engineer the restoration of Walnut Creek would be planned and implemented. If funding were acquired and results proved to be successful, then native vegetation communities on the Refuge floodplain might become re-established more quickly than if the creek were allowed to find its own new equilibrium over several decades or longer. However, a successful outcome to major Walnut Creek restoration efforts cannot be assured.

Alternative D: Corridor Focus

Prairie, savanna, sedge meadow

The acreage of reconstructed prairie would increase the most over time under Alternative D because the Refuge land acquisition boundary would expand by 20,550 acres to include the Neal Smith – Chichaqua – Red Rock corridor. How much of that land could be purchased and converted to prairie during the 15-

year life of this plan is unknown and is dependent on landowner willingness to sell and availability of Service land acquisition funding and Refuge management funding. Management of reconstructed prairie would focus on creating habitat conditions that benefit breeding grassland birds and other prairie wildlife.

Resource threats
Threats to resources caused by urban development, habitat fragmentation, and climate change would be reduced over time in the entire corridor due to the larger Refuge land acquisition boundary and creation of a new conservation partnership. Lands acquired by the Service would be protected from future development. Outside threats to Refuge resources would be reduced the most under this alternative.

Wildlife
Bison and elk
Bison and elk herds will continue to be maintained on the Refuge, although changes to bison herd size, enclosure size, and grazing protocols may occur under Alternatives B, C, and D depending on results of new evaluation program. Under Alternative B, non-native grazers (cattle, sheep, and/or goats) may be used on the Refuge for management purposes outside the bison and elk enclosure, which would improve habitat quality for native wildlife.

Indiana bat
All alternatives would improve savanna habitat used by the endangered Indiana bat. Although several Indiana bats were mist-netted on Refuge savannas in the early 1990s, their current status is unknown. Alternatives B, C, and D would implement regular monitoring for the species.

Grassland Birds
Grassland-dependent bird populations have declined from historic levels far more than any other group of birds. Neal Smith NWR can play an important role in recovering and sustaining many of these species. Each alternative will increase quantity and quality of available habitat for declining populations of grassland birds. A few species such as Upland Sandpiper, Northern Bobwhite, and Loggerhead Shrike are sometimes present on the Refuge or nearby in small numbers. They are expected to establish a regular presence on the Refuge as habitat conditions continue to improve under Alternatives B, C, and D. The Greater Prairie-Chicken has been proposed for reintroduction, but this species has a large home range and requires a variety of habitat conditions to meet its life cycle needs. Alternative D would provide the highest likelihood of establishing a self-sustaining Greater Prairie-Chicken population in central Iowa.

Birds of Conservation Concern 2008 identifies species of highest conservation concern to the Service. Eleven bird species that use the tallgrass prairie ecosystem are considered high priorities for the portion of Iowa that includes Neal Smith NWR. All are found on the Refuge. Of these eleven species of concern, Neal Smith NWR could have the most influence on regional populations of Henslow's Sparrow, Dickcissel, and Red-headed Woodpecker. Central Iowa is an important part of the breeding range for all three and they are highly associated with tallgrass prairie and oak savanna. Refuge point count data were used to quantify the potential population benefits of each alternative to these species. Potential acreage of restored prairie and savanna habitat was calculated for each alternative based on soils data; bird numbers were calculated based on current densities on Refuge prairies and savannas. All numbers are estimates. Table A-2 summarizes the results.

Table A-2: Estimated Refuge bird numbers under each alternative for three high-priority species

Species	Current population estimate	Alt A	Alt B	Alt C	Alt D
Henslow's Sparrow	317	495	745	1,534	1,961
Dickcissel	661	1,032	1,553	3,199	4,088
Red-headed Woodpecker	11	85	99	177	201
Grassland acres	*3,457*	*5,397*	*8,118*	*16,723*	*21,375*
Savanna acres	*374*	*3,007*	*3,489*	*6,238*	*7,080*

Suitable breeding habitat for Henslow's Sparrow generally has tall dense grass, a well-developed litter layer, and sparse woody vegetation. Based on point count data, the current population estimate of Henslow's Sparrows on the Refuge is 317 birds on 3,457 acres of grassland. Recent increases in Henslow's Sparrow numbers in many areas are associated with creation of grassland habitat on private land by the CRP. CRP is a short-term program that faces an uncertain future with changing agricultural policies and dynamic commodity markets. Loss of considerable CRP acreage could result in steep population declines for this species (Cooper, 2010). Acquisition and restoration of land by the Service would ensure permanent protection of restored habitat for Henslow's Sparrow and many other grassland bird species.

Dickcissels prefer dense moderate-to-tall prairie vegetation with some forbs and moderately deep litter. Based on point count data, the number of Dickcissels on the Refuge is 661 birds on 3,457 grassland acres during breeding season.

Breeding Red-headed Woodpeckers occupy a range of habitats including savannas, woodland edges, and overgrown pastures; most are characterized by open areas for feeding, snags for roosting, and a secure food supply. Red-headed Woodpeckers use oak savannas on the Refuge. The Refuge currently includes about 374 acres of suitable habitat, and the estimated number of Red-Headed Woodpeckers is 11 individuals.

Socioeconomics

Each alternative could potentially result in both positive and negative economic and social effects on the local community primarily related to acquisition of private property by the Service and the subsequent conversion of agricultural land to native vegetation. Potential positive effects include an increase in operation expenditure and employment, an increase in visitor expenditures, and an increase in opportunities for wildlife-dependent recreation. Potential negative effects include loss of agricultural employment and production and loss of county property tax revenues. The magnitude of these effects would vary under each alternative.

Landowners

Expansion of the Refuge would affect to some degree the current lifestyles of individuals in and around the proposed boundary expansion. Landowners who choose to sell their land to the Service would be most affected. Land transactions would be purely voluntary in keeping with Service policy to purchase lands or rights from willing sellers. Type of transactions could include fee-title acquisition, lease, or easement and would be determined on an individual basis by the type of management or land use planned for the site and landowner preference. All acquisition would be conducted in accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646),

which provides reimbursement of certain expenses in relocating landowners that are displaced from their property by federal acquisition.

Owning land within the Refuge boundary would not mean a restriction of property rights. Private land uses would remain under the control of the owner until the landowner decided to sell and the title passed to the federal government. Service-owned lands would be removed from agricultural production and planted to native vegetation. Some subsurface drainage tiles would be plugged, broken, or removed on Refuge land, but only if drainage on private land is not negatively affected.

Expansion of the Refuge would increase acreage available for compatible wildlife-dependent recreation and, along with expanded program offerings, would likely increase Refuge visitation. This increased use may be noticeable to some landowners. Visitor patterns will be considered and managed to minimize any disturbance to landowners adjacent to Refuge lands.

Local Community

When land is purchased, it becomes the property of the U.S. Government and is exempt from taxation. The Refuge Revenue Sharing Act authorizes annual in-lieu-of-taxes payments to counties based on ¾ of 1 percent of the appraised value of Refuge land acquired in fee. However, in recent years Congressional appropriations have been insufficient to pay the full amount authorized, and the shortfall has been increasing during the past five years. Revenue sharing payments made to Jasper County in 2011 for 5,580 acres of Refuge land totaled $32,954.

Lands purchased would be removed from agricultural production but would be protected from many of the effects of urban development. More lands would be open to public hunting, wildlife observation, environmental education, and other compatible Refuge uses thereby enhancing local and regional opportunities for wildlife-dependent recreational activities and increasing Refuge visitation. Increased Refuge visitation would increase spending in the local community. The 2006 Banking on Nature study (Carver and Caudill, 2007) estimated that 67 percent of visitors to Neal Smith NWR came from outside the local area. According to the study, visitor spending in 2006 totaled $2.3 million with non-residents accounting for $2.1 million or 90 percent of total expenditures. The Refuge also supports the local economy through employment it generates and through operational expenditures. Staffing and budget would be expected to increase slowly as the Refuge expands.

Under all alternatives, any economic gain or loss due to Refuge expansion would be gradual. All land acquisition would occur over an extended period of time that would depend both on landowner willingness to sell and the availability of Service funds for acquisition.

Alternative A: Current Direction

Current Refuge size is approximately 5,600 acres. Under Alternative A, the Service would continue to purchase and restore up to 3,000 additional acres that have not yet been acquired within the current 8,600-acre Refuge boundary. Farmland in Jasper County totaled 430,000 acres in 2010 (U.S. Department of Agriculture). If every acre purchased by the Service was classified as farmland, converting those 3,000 acres to native vegetation would reduce the county farmland total by 0.70 percent.

Opportunities for wildlife-oriented public recreation would remain largely stable. Visitor numbers also would be expected to remain stable.

Alternative B: Refuge Grassland Bird Focus
Under Alternative B, the Refuge boundary would expand by an additional 3,210 acres compared to Alternative A. If all of this land was acquired by the Service and restored to native vegetation, total farmland in Jasper County would be reduced by an additional 0.74 percent compared to Alternative A.

Opportunities for environmental education, interpretation, wildlife observation, and photography would increase. Hunting opportunities could change depending on the outcome of the step-down hunting plan. Annual visitor numbers would be expected to increase by 25 percent over the next 15 years.

Alternative C: Watershed Focus
Under Alternative C, the Refuge boundary would expand by an additional 14,600 acres compared to Alternative A. If all of this land was acquired by the Service and restored to native vegetation, total farmland in Jasper County would be reduced by an additional 3.40 percent.

Opportunities for environmental education, interpretation, wildlife observation, and photography would increase. Hunting opportunities could change depending on the outcome of the step-down hunting plan. Annual visitor numbers would be expected to increase by 25 percent over the next 15 years.

Alternative D: Corridor Focus
Under Alternative D, the Refuge boundary would expand by an additional 20,550 acres compared to Alternative A. If all of this land was acquired by the Service and restored to native vegetation, total farmland in Jasper County would be reduced by an additional 4.78 percent.

Opportunities for environmental education, interpretation, wildlife observation, and photography would increase. Hunting opportunities could change depending on the outcome of the step-down hunting plan. Annual visitor numbers would be expected to increase by 25 percent over the next 15 years.

A.4.3 Cumulative Impacts

Cumulative impacts are effects that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The Council on Environmental Quality, which ensures that federal agencies meet their obligations under NEPA, requires mitigation measures when the environmental analysis process detects possible significant negative impacts on habitat, wildlife, or the human environment. None of the activities proposed are expected or intended to produce significant levels of cumulative environmental impacts that would require mitigation measures.

Biological Resources
All four alternatives are intended to maintain or improve biological resources on the Refuge. All alternatives would increase the acreage of restored Refuge prairie. All include working with partners to increase the conservation value of adjacent lands and to create habitat connections with other nearby conservation areas. The combination of our proposed management actions with those of other organizations could result in substantial beneficial cumulative impacts through restoration and protection of tallgrass prairie plant communities and wildlife habitats that are declining nationwide.

Water Resources

All alternatives would reduce erosion in the local watershed by converting crop fields to native prairie and encouraging adoption of additional conservation measures on privately-owned agricultural land. Alternatives B, C, and D also include measures to restore more natural waterflow patterns by reducing subsurface drainage tiles. In addition, Alternative C proposes major restoration of the straightened creek channel and reconnection of the creek with its historic floodplain.

Each alternative would benefit restoration of Refuge habitat and would reduce sediment and contaminants delivered downstream to the Des Moines River, Mississippi River, and Gulf of Mexico. However, Walnut Creek is a very small part of the Des Moines River Basin (approximately 0.2 percent). It is also less disrupted than most Iowa watersheds due to the presence of Neal Smith NWR, extensive use of no-till farming on privately-owned lands, and a branched system of tile lines that has less dramatic effects on natural waterflow than the pattern tile systems found in many other places. Therefore, cumulative benefits of additional hydrologic restoration in the Walnut Creek watershed would be minimal when considered at the scale of the Des Moines River, Mississippi River, and Gulf of Mexico.

Over the much-longer term, the altered hydrology of the Walnut Creek watershed will move gradually to a new state of hydrologic equilibrium at the same time ongoing climate change is altering historical precipitation and temperature patterns. How the interaction of these two long-term changes will impact Refuge resources is unknown at this time.

Table A-3: Summary of impacts by alternative

Issues	Alternative A (No Action) Current Direction	Alternative B (Preferred) Refuge Grassland Bird Focus	Alternative C Watershed Focus	Alternative D Corridor Focus
		HABITAT		
Prairie reconstruction	Increased prairie acreage. Stable native plant diversity. Stable habitat structure for wildlife.	Increased prairie acreage. Increased native plant diversity. More diverse habitat structure for wildlife.	Increased prairie acreage. Stable native plant diversity. Stable habitat structure for wildlife.	Increased prairie acreage. Stable native plant diversity. More diverse habitat structure for wildlife.
Prairie remnants	Stable or declining biological condition of most remnants.	Improved condition of all remnants.	Same as Alternative A.	Same as Alternative A.
Oak savanna	Stable or declining in biological condition of most remnants.	Improved condition of all remnants. Experimental reconstruction of additional savanna acreage.	Same as Alternative A.	Same as Alternative A.
Sedge meadow	Stable or declining biological condition.	Improved condition of floodplain and upland sedge meadows.	Same as Alternative B.	Same as Alternative A.
Effectiveness of management actions	Minimal monitoring; informal learning from management actions.	Improved habitat restoration due to formal monitoring protocols and adaptive management studies.	Same as Alternative B.	Same as Alternative B.
Land protection	Stable. Acquire lands only within existing Refuge acquisition boundary.	Increased. Add 3,210 acres to the Refuge acquisition boundary.	Increased. Add 14,600 acres to the Refuge acquisition boundary.	Increased. Add 20,550 acres to the Refuge acquisition boundary.
RESOURCE THREATS				
Development and habitat fragmentation	Increased threat as urban development continues.	Reduced threat to Refuge due to expanded partnerships, increased land conservation, and restoration.	Reduced threat throughout Walnut Creek watershed due to major new watershed partnership, expanded land conservation, and restoration.	Reduced threat throughout Neal Smith – Chichaqua – Red Rock corridor due to new partnership effort focused on land conservation and restoration.
Water quantity and quality	Fairly stable.	Improved on Refuge due to reduced subsurface drainage and more restored prairie acreage.	Improved throughout watershed if major hydrologic restoration projects can be successfully implemented.	Some improvement throughout watershed due to more restored prairie acreage.
		WILDLIFE		
Grassland birds	Small increase in numbers as more acres are acquired and restored.	Medium increase due to more acres and more habitat diversity.	Medium increase due to more acres.	Large increase due to more acres and more habitat diversity.
Bison	Stable herd size. Stable enclosure size.	Evaluate effects on habitat; determine optimum herd size and enclosure size and configuration.	Same as Alternative B.	Same as Alternative B.

Issues	Alternative A (No Action) Current Direction	Alternative B (Preferred) Refuge Grassland Bird Focus	Alternative C Watershed Focus	Alternative D Corridor Focus
Elk	Stable herd size.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Indiana bat	Current status on Refuge unknown.	Initiate Indiana bat monitoring program.	Same as Alternative B	Same as Alternative B
		PEOPLE		
Hunting	Stable opportunities. No program changes.	Hunt program and effects might change based on results of step-down hunting plan.	Same as Alternative B.	Same as Alternative B.
Wildlife observation opportunities	Stable.	Increased due to new foot trail and enhanced birding opportunities.	Same as Alternative B.	Same as Alternative B.
Quality of environmental education and interpretation	Slight increase. Occasional improvements.	Increased due to expanded programs, development of core themes, and measurement of student learning and visitor satisfaction.	Same as Alternative B.	Same as Alternative B.
Quality of exhibits, signs, brochures, website	Slight increase. Occasional improvements.	Increased due to regular reviews and updates.	Same as Alternative B.	Same as Alternative B.
Public awareness and support	Stable.	Increased due to new outreach techniques, more volunteers, and expanded community partnerships. Probable 25 % increase in visitor use.	Same as Alternative B.	Same as Alternative B.

Appendix B: Land Protection Plan

In this appendix

B.1 Introduction
B.2 Threats to Resources
B.3 Proposed Action
B.4 Other Land Protection Alternatives Considered
B.5 Land Acquisition Funding
B.6 Sociocultural Impacts
B.7 Map

B.1 Introduction

Project Description
Neal Smith National Wildlife Refuge (NWR, Refuge) was established in 1991 to reconstruct about 8,600 acres of the tallgrass prairie ecosystem "from scratch" on former farmland in central Iowa. Although tallgrass prairie once covered much of the central United States and Canada, the ecosystem is now globally endangered. Less than one percent of this historic mosaic of prairie, savanna, and wetland remains today, and many prairie-dependent wildlife species are declining range-wide.

Priorities for the Refuge include restoration and reconstruction of native plant and wildlife diversity and the ecological functions and processes that sustain them. About 5,500 acres within the approved boundary have been acquired from willing sellers. Several thousand acres of farmland have been seeded with tallgrass prairie plants, resulting in a 100 percent conversion to wildlife habitat. The few remaining remnants of native prairie and savanna, degraded by fire suppression, are under restoration.

This portion of Iowa is characterized by heavily dissected drainage systems such as the Walnut Creek basin. The current Refuge boundary includes about 6.5 miles of 10-mile-long Walnut Creek and 45 percent of its watershed. The headwaters of Walnut Creek and its tributaries lie mainly outside the Refuge boundary to the north, east, and west. Walnut Creek empties into the Des Moines River at Lake Red Rock about three miles south of the Refuge. Although farm fields dominate the landscape surrounding the Refuge, Chichaqua Bottoms Greenbelt to the north (8,600 acres) and Lake Red Rock to the south (52,800 acres) provide additional protected wildlife habitat.

Study Area
During the process of developing the Comprehensive Conservation Plan (CCP) for Neal Smith NWR, the U.S. Fish and Wildlife Service (FWS, Service) evaluated land protection and restoration options for a 20,550-acre study area outside the existing approved Refuge boundary. The study area encompasses lands that connect the Refuge to Chichaqua Bottoms Greenbelt and Lake Red Rock and includes the entire Walnut Creek watershed. The evaluation also considered options for conserving remnant prairies in surrounding counties that might provide seed sources for Refuge restoration.

B.2 Threats to Resources

Grassland bird population declines
More than 97 percent of the native grasslands of the United States have been lost, mostly because of conversion to agriculture. As a result, grassland bird populations nationwide have declined from historic

levels far more than any other group of birds. However, many species that had been largely extirpated from central Iowa, such as Henslow's Sparrow, Dickcissel, and Upland Sandpiper, are beginning to return to the Refuge as the integrity of its ecosystem improves and as additional habitat is created. More than 200 bird species now use the Refuge, including more than 80 species during breeding season. Avian diversity is complemented by more than 40 mammal species including the endangered Indiana bat, 28 species of reptiles and amphibians, and nearly 60 butterfly species including the rare regal fritillary.

Watershed alteration

Hydrologic changes in the Walnut Creek watershed affect the Service's ability to restore Refuge lands. In the uplands, subsurface drainage tiles on and near the Refuge cause drier soils, making sustainable reconstruction of prairie, savanna, and upland sedge meadow habitat more difficult. In the floodplain, straightening and down-cutting of the creek bed has increased erosion and waterflow through the Refuge and degraded floodplain habitat; invasive reed canarygrass has overtaken many locations. Sediment and contaminants end up in Lake Red Rock.

However, the creek is slowly moving toward a new state of equilibrium. This is a natural process, probably aided by conversion of agricultural fields to prairie on the Refuge and widespread use of conservation tillage on farmland upstream. The creek bed down-cutting has largely stabilized, and the channel is gradually widening again as the stream banks collapse (Schilling et al., 2011). Given current trends, the creek will eventually restore many of its natural functions. Slope of banks will decrease, terraces and channel meanders will begin to emerge, and floodplain vegetation communities will become established. The time needed for these changes to occur naturally is on the order of decades to centuries.

Habitat loss and urban development

Neal Smith NWR, Chichaqua Bottoms, and Lake Red Rock each provide diverse habitat for wildlife but are separated by large expanses of farmland. Some prairie wildlife such as reptiles, amphibians, small mammals, and butterflies have difficulty crossing agricultural areas so may be unable to move between the Refuge and other protected areas. State highway 163 and Interstate 80 provide additional barriers to terrestrial wildlife movement within the study area.

The Refuge is located in Jasper County, a primarily rural area just 20 miles east of Des Moines. Development pressure is increasing around the Refuge as the city and suburbs expand. The metropolitan area has a population of more than 500,000 people and recent highway improvements have made commuting from Jasper County to Des Moines much easier. If land surrounding the Refuge is subdivided and houses built, the possibility of restoring it to tallgrass prairie sometime in the future would be lost.

B.3 Proposed Action

The Environmental Assessment (Appendix A) includes evaluation of four options for future management direction on Neal Smith NWR. Table B-1 below summarizes Refuge boundary expansion recommendations under each of the four alternatives.

Table B-1: Summary of land protection by environmental assessment alternative on Neal Smith NWR

Alternative A Current Direction (No Action)	Alternative B Refuge Grassland Bird Focus (Preferred Alternative)	Alternative C Watershed Focus	Alternative D Corridor Focus
Acquire and manage lands only within existing Refuge boundary (8,600 acres total).	Acquire and/or protect an additional 3,210 acres to include tributaries of Walnut Creek that flow through the Refuge.	Acquire and/or protect an additional 14,600 acres to include the entire Walnut Creek watershed.	Acquire and/or protect an additional 20,550 acres that connect the Refuge to Chichaqua Bottoms Greenbelt and Lake Red Rock.

Alternative B (Refuge Grassland Bird Focus) has been selected as the preferred alternative and is the basis for the CCP. The preferred alternative includes expansion of the Refuge boundary by 3,210 acres to the east and west of the current boundary to encompass the headwaters of all Walnut Creek tributaries that flow through the Refuge. The expansion area lies south of Highway 163 and north of County Road 70. Fee title acquisition from willing sellers within the Refuge boundary is likely to be the most viable option for meeting objectives, although easements or cooperative agreements also may be feasible in some locations.

Objectives of the proposed action are to:

- Increase populations of grassland bird species of concern on the Refuge.
- Improve the quality and sustainability of habitat for tallgrass prairie wildlife on the Refuge by reestablishing more natural soil moisture and waterflow patterns.
- Work with partners to increase the conservation value of lands that connect the Refuge to Chichaqua Bottoms Greenbelt and Lake Red Rock.

This Land Protection Plan proposes acquiring only those lands of highest conservation value to Neal Smith NWR and to the National Wildlife Refuge System (NWRS, Refuge System) and is the most cost-effective means of achieving Refuge objectives. The proposed action would ensure a net increase in the biological integrity and diversity of the Refuge. Declining populations of grassland birds and other native wildlife will benefit from increased habitat acreage and improved quality of habitat on the Refuge. An intact, resilient ecosystem will be better able to withstand outside pressures including urban development and climate change.

Service lands will be managed to reconstruct and restore the tallgrass prairie ecosystem. Agricultural fields will be planted to native vegetation and managed to increase wildlife and plant diversity and to improve habitat for declining populations of grassland birds and other wildlife. As far as possible, ecosystem processes that historically sustained the system (such as hydrology, fire, and grazing), will be restored.

The boundary expansion will permit restoration of more natural hydrology on Refuge prairies, savannas, and upland sedge meadows by reducing or eliminating the subsurface drainage system. More natural water flow will help native vegetation outcompete invasive plant species while reducing the threat of erosion and headcutting. Walnut Creek will be allowed to reach a new equilibrium on its own over time.

Service acquisition priorities within the proposed Refuge boundary are:

- Lands facing imminent threat of development that would irreparably destroy wildlife values.

- Lands important for reduction of subsurface drainage and restoration of more natural soil moisture regimes on the Refuge.
- Lands that will reduce habitat fragmentation and help consolidate the Refuge into manageable units.

Refuge staff will assist agency partners, landowners, and other stakeholders in their efforts to restore and protect habitat and wildlife outside the expanded Refuge boundary. Priority areas for such assistance include the Walnut Creek watershed north and south of the Refuge, connections with Chichaqua Bottoms Greenbelt, and prairie remnants of high conservation value. Refuge staff may provide technical assistance and other support as requested, but any fee-title acquisition, easements, and on-going management responsibility in these areas would be provided by others.

Ultimately, restoring ecological functions and values in the tallgrass prairie ecosystem in central Iowa will require conservation and restoration of both public and private lands. Neal Smith, Chichaqua Bottoms Greenbelt, and Lake Red Rock could serve as core areas of permanently protected and restored habitat connected by a matrix of public and private conservation lands.

Estimated Initial Costs:
Purchase 3,210 acres of agricultural land @ $6,000/acre = $19.3 million
Prepare sites and plant native prairie species @ $1,000/acre = $3.2 million

B.4 Other Land Protection Alternatives Considered

Current Direction (Alternative A)
Land acquisition would continue within the current approved Refuge boundary, but the boundary would not be expanded to include any additional lands. Reliance would be on existing federal, state, and local programs and authorities to address threats to Refuge resources.

Watershed Focus (Alternative C)
Under Alternative C, the Refuge boundary would expand by 14,600 acres to include the entire Walnut Creek watershed. Service land ownership would facilitate major efforts to restore the hydrology of Walnut Creek. Small-scale measures (such as grade control structures and silt fences) might help somewhat but are expensive and unlikely to be successful in the long term. Any serious attempt to engineer the restoration of Walnut Creek would require moving massive amounts of dirt, require fee title acquisition by the Service or buy-in from private landowners upstream, and take many years with a low likelihood of success at a very high monetary cost.

However, given current trends, the creek and its floodplain will return to a more natural equilibrium and water quality will continue to improve, although it will be a very long-term process. If this long-term approach is acceptable, then Service investment in the restoration of Walnut Creek would not be needed to meet Refuge objectives.

Increased acreage of restored tallgrass prairie within the watershed would provide additional habitat for migratory grassland birds and other native wildlife. Restoration of the southern reaches of the watershed would create a three-mile-wide habitat corridor linking the Refuge and Lake Red Rock. Most bird species, of course, can fly between nearby protected areas without the need for connecting corridors, but this connection could benefit reptiles, amphibians, small mammals, and invertebrates that have trouble crossing agricultural areas. In the northern reaches, however, Highway 163 would continue

to be a hazard to wildlife trying to cross it.

Alternative C would provide increased ecosystem resilience in the face of stressors such as urbanization and climate change and Service-owned lands would be permanently protected from development.

Estimated Initial Costs
Purchase 14,600 acres of agricultural land @ $6,000/acre = $87.6 million
Prepare sites and plant native prairie species @ $1,000/acre = $14.6 million

The cost of attempting an engineered restoration of Walnut Creek hydrology is unknown, but would be many millions of dollars.

Corridor Focus (Alternative D)
Under Alternative D, Refuge land acquisition would expand by 20,550 acres to allow establishment of a permanent wildlife habitat corridor connecting the Refuge with Chichaqua Bottoms Greenbelt to the north and Lake Red Rock to the south. These connections could benefit reptiles, amphibians, small mammals, and invertebrates that have trouble crossing agricultural areas. Highway 163 and Interstate 80, however, would pass through the Neal Smith – Chichaqua portion of the habitat corridor and would continue to be hazardous to wildlife trying to cross.

Increased acreage of restored tallgrass prairie within the watershed would provide additional habitat for declining populations of migratory grassland birds. The Greater Prairie-Chicken has been proposed for reintroduction but currently would be difficult to manage successfully on the Refuge due to the limited land base. This species has a large home range and requires a variety of grassland habitat conditions to meet its life cycle needs. Establishment of a habitat connection between the Refuge and Chichaqua would increase the probability of developing a self-sustaining Greater Prairie-Chicken population in central Iowa.

Some habitat improvement could continue to be accomplished without Service land acquisition through existing programs and the committed efforts of the many conservation partners working in the Chichaqua – Neal Smith – Red Rock corridor. Pooling of resources by federal, state, and local agencies; private landowners, and other conservation groups would facilitate accomplishment of mutual goals. Service land acquisition and restoration, however, would provide permanent protection from development and increased ecosystem resilience in the face of long-term stressors such as climate change.

Estimated Initial Costs
Purchase 20,550 acres of agricultural land @ $6,000/acre = $123.3 million.
Prepare sites and plant native prairie species @ $1,000/acre = $20.6 million

Prairie Remnants (Alternative E)
The Refuge only uses native prairie seed from sources originating within about 100 miles of the Refuge. These “local ecotype” seeds are adapted to local climate and soil conditions and have a better chance of survival than seeds grown farther away. In the early years of Refuge restoration, seed was primarily collected on small pieces of native prairie that had never been cleared for agriculture.

The need to include some or all of these prairie remnants as part of Neal Smith NWR was evaluated as part of this Land Protection Plan. The focus was on areas east, south, and west of the Refuge that are

not included within the boundary of Northern Tallgrass Prairie NWR (where the Service already has acquisition authority). The Iowa Department of Natural Resources' 2003 Statewide Prairie Inventory identified more than 700 remnants within this zone, ranging in size from less than 0.1 acre to more than 200 acres. The average (mean) size is 7.3 acres.

Most of these remnants would benefit from restoration efforts to address problems such as non-native plant invasion and encroachment of trees. Many have not been inventoried so their species composition and conservation value are poorly known. Most are on private land, although some are owned and managed by state or local agencies.

Service acquisition of remnants would protect them in perpetuity and facilitate their restoration and management. However, off-Refuge remnants, although worth protecting, are no longer essential to Refuge restoration, because local ecotype seed now can be purchased from local suppliers or collected from restored sites on-Refuge. Management of many small tracts of land scattered over a multiple county area would be logistically difficult.

Many private landowners recognize the value of their remnants and are working to protect and enhance them. If additional public ownership becomes desirable, acquisition by state or local agencies could be financially feasible due to the small size and proportionally lower cost of the remnants compared to larger tracts of high-quality agricultural land. Refuge staff could provide technical assistance to state, local, and private efforts, if needed.

Alternative E was eliminated from further consideration in the Draft CCP.

B.5 Land Acquisition Funding

Funding to buy land for Neal Smith NWR comes primarily from the Land and Water Conservation Fund, which derives from certain user fees, proceeds from the disposal of surplus federal property, federal tax on motor boat fuels, and oil and gas lease revenues. About 90 percent of that fund now derives from Outer Continental Shelf oil and gas leases. The federal government receives about 40 percent of that fund to acquire and develop nationally significant conservations lands.

B.6 Sociocultural Impacts

Landowners

Expansion of the Refuge would affect to some degree the current lifestyles of individuals in and around the proposed boundary expansion. Landowners who choose to sell their land to the Service would be most affected. Landowners who choose not to sell their land would probably not be directly affected by purchases around them since they would retain all ownership rights such as hunting, control of trespass, farming, drainage, and pesticide use. If Service activity inadvertently created a water-related problem (flooding, soil saturation, deleterious increases in water table height, etc.) for any private landowner, the problem would be corrected at Service expense.

The Service's policy is to acquire land from willing sellers and only when other protective means, such as local zoning restrictions or regulations, are not appropriate, available, or effective. When land is needed to achieve fish and wildlife conservation objectives, the Service seeks to acquire the minimum interest necessary to reach those objectives. If fee title acquisition is required, the Service gives full consideration to extended use reservations, exchanges, or other alternatives that will lessen the impact

on the owner and the community. Donations of desired lands or interests are encouraged.

Although the Service has a long-standing policy of willing-seller-only acquisitions, it also has the power of eminent domain as do other federal, state, and local government agencies. This federal power, however, requires congressional approval and is rarely used by the Service. When acquiring lands, the Service is required by law to offer 100 percent of the property's appraised market value as established by an approved appraisal that meets professional standards and federal requirements.

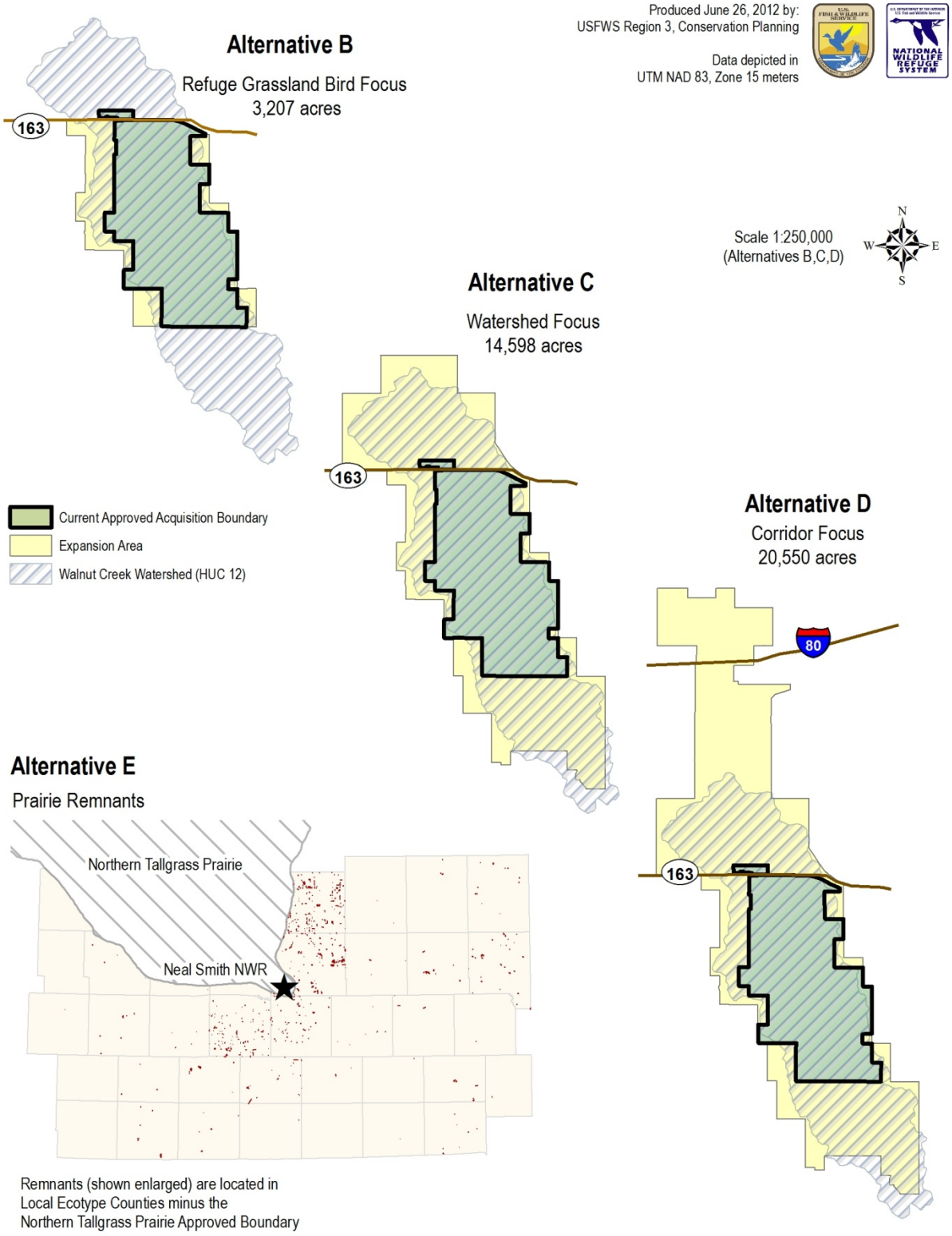
Local Community

When land is purchased, it becomes the property of the U. S. Government and is exempt from taxation. The Refuge Revenue Sharing Act authorizes annual in-lieu-of-taxes payments to counties based on ¾ of 1 percent of the appraised value of Refuge land acquired in fee. In recent years, however, Congressional appropriations have been insufficient to pay the full amount authorized.

Lands purchased would be removed from agricultural production but would be protected from many of the effects of urban development. Refuge expansion would likely open more lands to public hunting, wildlife observation, photography, environmental education, and other compatible Refuge uses thereby enhancing local and regional opportunities for wildlife-dependent recreational activities, increasing Refuge visitation, and having a positive effect on the local economy.

B.7 Map

(see next page)


Produced June 26, 2012 by:
USFWS Region 3, Conservation Planning
Data depicted in
UTM NAD 83, Zone 15 meters
Alternative B
Refuge Grassland Bird Focus
3,207 acres
163
Scale 1:250,000
(Alternatives B,C,D)
N
W
E
S
Alternative C
Watershed Focus
14,598 acres
163
Current Approved Acquisition Boundary
Expansion Area
Walnut Creek Watershed (HUC 12)
Alternative D
Corridor Focus
20,550 acres
80
163
Alternative E
Prairie Remnants
Northern Tallgrass Prairie
Neal Smith NWR
Remnants (shown enlarged) are located in
Local Ecotype Counties minus the
Northern Tallgrass Prairie Approved Boundary

Appendix C: Compatibility Determinations

In this appendix:

Bicycling
Hunting
Wildlife Observation and Photography
Wildlife Interpretation and Outreach, Environmental Education
Jogging
Haying
Mushroom and Berry Picking
Firewood Cutting and Collection
Farming
Grazing
Research and Monitoring

Compatibility Determination

Use: Bicycling

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

“ . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . ”16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

" . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) **(Emergency Wetland Resources Act of 1986)**

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) **(National Wildlife Refuge Administration Act)**

The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer “*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now*

scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Use
What is the use? Bicycling

Where is the use conducted? Bicycling will be permitted on the entry road where bicycle trails will be constructed to flow with traffic, and in the parking lots associated with the entry road.

When is the use conducted? Bicycling will occur throughout the year from sunrise to sunset.

How is the use conducted? The public will be able to park their vehicle near the entry of the Refuge on the entry road and bicycle in and out of the Refuge. Citizens in the nearby community of Prairie City may bicycle their way to the Refuge from their homes. Future trail plans in Jasper County include connecting with the Refuge allowing long distance bicyclers to visit the Refuge.

Why is the use being proposed? Bicycling is a current activity on the county roads around the Refuge. To increase safety of bicyclers, a bicycle trail is being added to the existing entry road in 2013. Bicycling is a healthy way to enjoy the outdoors and view wildlife without the interference of vehicle noise or containment. Bicycling may provide additional opportunities to interpret and educate the public about the tallgrass prairie.

Availability of Resources
The entry road is currently undergoing a renovation. Funding from Federal Highways, Refuge Roads, and the Sarbanes Transportation Grant will finance the repaving of the entry road to include widening to accommodate a bicycle trail. While additional interpretive signage is going to be included in the renovation, it is not specific to bicyclers. Some regulatory signage will be added to the bicycle trail, which will be maintained with other signage. Resources needed to administer the bicycle trail will be negligible.

Anticipated Impacts of the Use
It is expected that some bicycling will replace the current traffic that comes to the Refuge from Prairie City. A small increase in bicycle traffic may occur initially, increasing over time as news spreads that the trail is available. No negative impacts are expected from allowing bicycling to occur along the entry road and parking areas of the refuge.

<u>Wildlife Response to Bicycling</u>
Rapid movement directly toward wildlife frightens them, while movement away from or at an oblique angle to the animal is less disturbing (Knight and Cole, 1995). Road noise has been shown to negatively affect birds (Bowles, 1995), although the response is often difficult to assess, because it may be confounded by responses to visual stimulus. Knight and Cole (1991) suggest that sound may elicit a much milder response from wildlife if animals are visually buffered from the disturbance.

Bicycles, motorcycles, and vehicles currently travel through the Refuge on the entry and county roads. The addition of a bicycle trail along the entry road will not increase wildlife disturbance or noise on the Refuge.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith National Wildlife Refuge Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of

availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Bicycling

_____ Use is Not Compatible

__X__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
Bicycles must be ridden at safe speeds and yield to pedestrians. Signs would be placed on the bicycle trail and parking areas to reflect that requirement. Use of the trail will be restricted to areas within the 3-foot symbolic fence located on both sides of the trail.

Justification
Bicycling is not one of the Priority Public Uses of the Refuge System under the National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. 668dd-668ee), as amended by the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). However, the refuge manager believes by allowing this use, more people will be exposed to the importance of habitat and wildlife to people, as well as the benefits the National Wildlife Refuge System has to wildlife in their communities. Further, bicycling allows access to the Refuge and reduces the carbon footprint of visitors to the Refuge. Bicycling may provide alternatives to motor vehicle transportation for enjoying the Refuge and are often necessary to allow the public to get away from the urban landscape. The educational possibilities provided by this opportunity would outweigh anticipated impacts associated with implementation.

Literature Cited
Bowles, A. 1995. Responses of wildlife to noise. Pf 109-156 in K.D. Frederick and R. A. Sedgo, eds, America's Renewable Resources: Historical and Current Challenges. *Resources for the Future*, Washington, D.C.

Knight, R. L. and D. N. Cole. 1995. Effects of recreational activity on wildlife in wildlands in Transactions of the North American Wildlife and Natural Resources Conference. 56:238-247.

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Use: Hunting

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

" . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) **(Emergency Wetland Resources Act of 1986)**

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) **(National Wildlife Refuge Administration Act)**

The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Use
What is the use? Hunting of game as an activity conducted by the general public under regulation authority of the National Wildlife Refuge System Improvement Act of 1997. Hunting is currently allowed for small game (squirrel and cottontail rabbit), upland game birds (bobwhite quail and rooster pheasant) and whitetail deer.

Where is the use conducted? The entire Refuge is open to all hunting with the exception of the bison enclosure and the area immediately adjacent to the Neal Smith NWR Visitor Center. Units of the Northern Tallgrass Prairie NWR that are administered by the Neal Smith NWR will be open to hunting and will be managed in a seamless manner, as if it were a part of the Neal Smith NWR, beginning in 2013.

When is the use conducted? Hunting of small game generally begins during the first week of September; upland game bird hunting begins at the end of October with Deer season opening late September or early October. All hunting on the Refuge ceases on January 31 of each year. This use is conducted during daylight hours only with the exception of deer hunting, which will begin one-half hour before sunrise and close one-half hour after sunset.

How is the use conducted?
Hunting is conducted according to the regulations of the Neal Smith NWR and consistent with regulations of the Iowa Department of Natural Resources. The Refuge requires that shot are of non-toxic materials. Please refer to the State of Iowa Hunting Regulations for clothing requirements, definition of approved weapons, bag limits, license requirements, and other important information. Hunters are required to acquire a special hunting brochure that serves as a hunting permit on the Refuge. These brochures are located at the Neal Smith NWR Prairie Visitor Center as well as at all hunt parking locations. All hunters must have this "permit" with them at all times while hunting.

Why is the use being proposed? Hunting is a priority public use identified in the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) and it has traditionally occurred at the Refuge without adverse impacts to the purpose for which the Refuge was established. The Refuge is surrounded by farm fields and, as such, provides some of the best habitat for many species to concentrate. A hunt program is needed to maintain game populations in balance with prairie and savanna reconstruction activities. The hunt program is administered in accordance with sound wildlife management principles and the utmost concern for public safety.

Availability of Resources
The Refuge is assisted by state law enforcement officers in patrolling during the hunting season. In addition the Refuge is the location for one of the Zone Law Enforcement offices in Region 3. An additional $25,000 is required annually to support and administer this program including Refuge staff time to prepare parking sites, install signage, prepare brochures/permits, coordinate with local law enforcement, and provide information to interested public.

Anticipated Impacts of the Use
This activity is an existing use on the Refuge and has shown no assessable environmental impact to the Refuge, its habitats, or wildlife species; but the activity is monitored closely for any signs of change. Hunting does cause mortality and disturbance to those species hunted, but bag limits, season dates, and other regulations are set to protect the long-term health of populations.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Hunting

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility

1. This use must be conducted in accordance with state and federal regulations and special Refuge regulations published in the Code of Federal Regulations (CFR).
2. Dogs may only be used to hunt pheasant and quail.
3. Snowmobiles and ATVs are prohibited on Refuge lands.
4. Hunters must possess non-toxic shot for upland game and bird species.

5. Parking, blocking, or in any manner restricting access to roads and gates is prohibited.
6. All personal property must be removed from the Refuge at the end of each hunt day.
7. Annually evaluate hunting methods to ensure safety.
8. Annually review all hunting activities and operations to ensure compliance with all applicable laws, regulations, and policies.

Justification

This use has been determined compatible provided the above stipulations are implemented. This use is being permitted as it is a priority public use and will not diminish the primary purposes of the Refuge. This use will meet the mission of the Refuge System by providing renewable resources for the benefit of the American public while conserving wildlife and plant resources on these lands.

This activity is an existing use on the Refuge and has shown no assessable environmental impact to the Refuge, its habitats, or wildlife species. It is a valuable tool in controlling deer and small game species on the Refuge that have direct negative impacts to the process of habitat reconstruction and restoration.

Mandatory 15-year Re-evaluation Date: 2027

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Uses: Wildlife Observation and Photography (including means of access)

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

" . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) **(Emergency Wetland Resources Act of 1986)**

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) **(National Wildlife Refuge Administration Act)**

The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Uses
What is the use? General public access to observe and/or photograph wildlife and Refuge habitats including the means of access such as automobile, hiking, bicycling, snowshoeing, cross-country skiing, and jogging. Under the National Wildlife Improvement Act, of 1997, wildlife observation and photography are priority public uses.

Where is the use conducted? These activities may occur anywhere on the Refuge but most often occur in the vicinity of roads and visitor use facilities. The Refuge has an auto tour route, paved and gravel walking trails, and grass mowed (native) trails that total more than 50 miles of access. A bicycle trail is being planned as part of an improvement to the five mile entry road and bicycling will be limited on the Refuge to that trail when it is

completed. For their safety, the public is not permitted to enter the bison enclosure by any other means than an automobile. The native trail system totals over forty miles around the perimeter of the Refuge. The distances and lengths of these trails provide an excellent opportunity for visitors to get away from the main Visitor Center area and truly enjoy the wide expanses of prairie and open space. These native trails are very amenable to optional access modes including snow shoeing, cross-country skiing, and jogging. These additional modes of access will allow a diverse public more opportunity to enjoy the outdoors without creating adverse impacts to habitat or wildlife. These modes of access will increase opportunities for wildlife viewing and photography on the Refuge.

When is the use conducted? The Visitor Center is open seven days a week except Thanksgiving Day, Christmas Day, and New Year's Day. The Refuge hosts approximately 140,000 people per year. Wildlife observation and photography occurs throughout the year, from dawn to dusk.

How is the use conducted? The use is conducted whenever a visitor drives the roads of the Refuge or accesses the trails. Many of the roads that cross through the Refuge are county roads affording wildlife observation and photography twenty four hours per day. Trails within the Refuge are open from dawn to dusk.

Why is the use being proposed? These activities are consistent with the National Wildlife Refuge System Improvement Act of 1997 that promotes wildlife observation and photography as one of six primary uses considered appropriate for national wildlife refuges. These activities accomplish Refuge goals and promote understanding, appreciation, and support for national wildlife refuges.

Availability of Resources
Approximately $74,000 is required annually to maintain Refuge roads, trails, and facilities used by the public engaged in wildlife observation and photography. The current Refuge budget allows for this level of maintenance.

Anticipated Impacts of the Uses
Wildlife observation and photography are not expected to have measurable environmental impacts on the Refuge, its habitats, or wildlife. These activities follow all applicable laws, regulations, and policies including: Migratory Bird Conservation Act, Title 5 Code of Federal Regulations, Service Manual; Refuge System mission, goals, and objectives; and the Refuge goals and objectives.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Wildlife Observation and Photography (including means of access)

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
All users must comply with Refuge-specific regulations.

Justification
Wildlife observation and photography are priority public uses for the Refuge System as outlined in the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). By facilitating these uses on the Refuge, we will increase visitor's knowledge and appreciation of fish and wildlife, which will lead to increased public stewardship of fish and wildlife resources and fulfillment of the mission of the Refuge System.

Mandatory 15-year Re-evaluation Date: 2027

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Uses: Wildlife Interpretation and Outreach, Environmental Education

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

" . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) **(Emergency Wetland Resources Act of 1986)**

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) **(National Wildlife Refuge Administration Act)**

The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Uses
What is the use? Environmental education is a process designed to develop a citizenry that has the awareness, concern, knowledge, attitudes, skills, motivations, and commitment to work toward solutions of current environmental problems and the prevention of new problems. Environmental education that is conducted within the Refuge System incorporates onsite, offsite, and distance learning activities and programs that address the audience's course of study, the mission of the Refuge System, and the management purposes of the specific field station. Environmental education integrates the field station messages with the audience's program such as school curriculums. Environmental education tends to be longer in duration than interpretation and often involves pre- and post-visit discussions and multiple field station visits.

Interpretation is a communication process that forges emotional and intellectual connections between the interests of the audience and the inherent meanings in the resource (i.e., more than information). Interpretation occurs in less formal activities with Refuge staff and volunteers or through exhibits, signs, brochures, elements of special events, and tours.

Outreach is a two-way communication between the Service and the public to establish understanding and promote involvement or influence attitudes and actions, with the goal of improving joint stewardship of our natural resources. Examples of outreach include news releases, newsletters, websites, offsite displays, and participation in community partnerships.

The 20,000 square foot Neal Smith NWR Visitor Center was built specifically to accommodate environmental education, interpretation, and outreach.

Where is the use conducted? These activities may occur on or off the Refuge but most are likely to occur within the Visitor Center, wildlife auto tour, trails, and roads. The Refuge also maintains a website that provides interpretive information. Environmental education and interpretive programs are given upon request to schools and other groups visiting the Refuge. The Refuge also has a Partner School program, which actively engages teachers and specific schools with more specialized environmental education activities. Additional recreational and outreach programs will include winter wildlife observation tours, theatre programs, and some night time activities.

When is the use conducted? The Visitor Center is open seven days a week except Thanksgiving Day, Christmas Day, and New Year's Day. The Refuge hosts approximately 140,000 people per year. Interpretation occurs throughout the year whenever a visitor reads a sign, brochure, or the Refuge website or talks to Visitor Services staff and volunteers. Environmental education activities typically occur when school is in session, concentrated in the spring and fall months. Most activities occur during daylight hours with some scheduled evening or night events.

How is the use conducted? All environmental education and interpretation activities are conducted under the guiding principles of the Refuge's primary mission, goals, objectives, and habitat management requirements. These activities allow the Refuge to accomplish its management goals and provide for the safety of visitors. All programs include a description of the Service and the Refuge System. All of the interpretive programs address at least one of a number of wildlife conservations issues relating to management, habitat, watershed, wildlife endangered species, invasive species, etc.

Why is the use being proposed? These activities are consistent with the National Wildlife Refuge System Improvement Act of 1997 that promotes environmental education and interpretation as two of six primary uses considered appropriate for national wildlife refuges. These activities accomplish Refuge goals and promote understanding, appreciation, and support for national wildlife refuges.

Availability of Resources

Approximately $320,000 is required to administer this program at current staffing levels, which include a half-time Visitor Services Manager and two full-time, permanent Visitor Services Specialists. In addition, staff time is required for periodic maintenance and improvement of interpretive signs, trails, observation platforms, and exhibits. Shortfalls in permanent Visitor Services staffing are sometimes remedied through hiring Student Temporary Employment Program (STEP) students on a seasonal basis and recruiting volunteers. The Regional Office periodically uses this Refuge as a training detail for Student Career Experience Program (SCEP) students in the Visitor Services program. Volunteers are an integral and vital part of the Refuge's environmental education and interpretation program, staffing the Visitor Center and bookstore, hosting special events, leading or co-leading programs, and assisting Refuge staff with a variety of other needs.

Every effort is made to meet each request for environmental education and interpretive programs. However, staff and funding shortages have curtailed programs and the number of requests often exceeds our resources. Based

on a review of the current Refuge budget, there is enough funding to administer this program at its current reduced level to ensure compatibility with the purposes for which the Refuge was established. Strategies to improve the environmental education and interpretive program have been identified in the Comprehensive Conservation Plan (CCP). These strategies include hiring another park ranger and maintenance person. Facility improvements in the form of digital equipment and products, as well as replacement and redesign of displays are needed. Construction of a bunkhouse for the Refuge would assist the Visitor Services program by providing housing for volunteers and interns.

Anticipated Impacts of the Uses
Environmental education and interpretation are not expected to have measurable environmental impacts on the Refuge, its habitats, or wildlife. Activities are designed to have no impact while providing interpretation and education about the work that is done on the Refuge. These activities follow all applicable laws, regulations, and policies including: Migratory Bird Conservation Act, Title 5 Code of Federal Regulations, Service Manual; Refuge System mission, goals, and objectives; and the Refuge goals and objectives.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR CCP and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Wildlife Interpretation and Outreach, Environmental Education

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
All users must comply with Refuge-specific regulations.

Justification
Environmental education and interpretation are priority public uses for the Refuge System as outlined in the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57). By facilitating these uses on the Refuge, we will increase visitor's knowledge and appreciation of fish and wildlife, which will lead to increased public stewardship of fish and wildlife resources and fulfillment of the mission of the Refuge System.

Mandatory 15-year Re-evaluation Date: 2027

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Use: Jogging

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

" . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) **(Emergency Wetland Resources Act of 1986)**

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) **(National Wildlife Refuge Administration Act)**

The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Use
What is the use? Jogging

Where is the use conducted? Jogging will be permitted on entry road bicycle path, Tallgrass Trail, Overlook Trail, Savanna Trail, Basswood Trail, and all native trails (mowed trails). In addition, this activity will be permitted on the proposed trail that will connect the Savanna Trail and the Basswood Trail via a connector through the Rothinghouse property when it is acquired.

When is the use conducted? Jogging could occur throughout the year on any open trail.

How is the use conducted? No special conditions or efforts are required beyond normal maintenance of trails. Trails will not be maintained in winter.

Why is the use being proposed? Jogging is a preferred mode of travel for individuals who are interested in outdoor exercise in areas with good opportunities for wildlife observation and clean air.

Availability of Resources
The Neal Smith NWR has a variety of trails and locations available for this activity. No additional resources are needed to administer or regulate this use.

Anticipated Impacts of the Use
Rapid movement by joggers is more disturbing to wildlife than slower moving hikers (Bennett and Zuelke, 1999). However, joggers tend to spend less time in a particular area than pedestrians and are less likely to directly approach or otherwise disturb wildlife. The effects of human disturbance can be reduced by restricting human activity to an established trail. Animals show greater flight response to humans moving unpredictably than to humans following a distinct path (Gabrielsen and Smith, 1995). Neal Smith NWR has public use trails where walking is allowed. Disturbance by joggers on these trails to feeding or nesting passerines is not expected to increase.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Jogging

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
Joggers would be restricted to established, well-defined trails.

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Use: Haying

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities:
Congress established the refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purpose(s):
" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) (National Wildlife Refuge Administration Act)

“. . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . ”16 U.S.C. § 742f(a)(4) " . . .for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) (Fish and Wildlife Act of 1956)

" . . .the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) (Emergency Wetland Resources Act of 1986)

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is “to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans.” (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee.]

Description of Use
What is the use? Haying is the cutting, baling, and removal of vegetation for purposes of reinvigorating established grassland habitat on refuge lands as well as to establish and maintain firebreaks. Haying is primarily conducted to create and maintain firebreaks for prescribed fire operations or to remove vegetation from refuge units that cannot be burned for any reason. Haying is conducted through a Special Use Permit issued by the Refuge Manager to members of the public through a bid process. The bid process will be conducted annually and a minimum bid per acre will be established each year.

Where is the use conducted? Haying will occur on various grassland units throughout the refuge and along outer boundaries of the refuge. Units hayed each year vary in size from 20 to 80 acres and the total area hayed each year will vary from 200 to 600 acres depending on management needs and prescribed fire planning.

When is the use conducted? Haying for the purpose of fire break establishment and maintenance may occur anytime from May through late September. When haying is utilized as a tool to enhance established grasslands within units, cutting will begin after July 15 into late September when most ground nests, particularly grassland bird species, have hatched or ceased nesting activity.

How is the use conducted? Haying is carried out by cooperative farmers with standard agricultural tractors and implements and through Special Use Permits. Special Conditions will apply with the Permit (see Stipulations below). Each year a bid process may be announced, maps of the haying areas will be created and the sites will be open for inspection. The bidding process will be announced each year.

Why is the use being proposed? Haying is an effective, often crucial tool for grassland management and restoration. Construction of fire breaks, free of fuels in the form of duff, is essential to controlling prescribed fire operations. Haying is a viable alternative to rejuvenating and maintaining decadent grassland communities when treatments such as burning or grazing are infeasible or impractical.

Haying is not a priority public use, as defined by the National Wildlife Refuge System Improvement Act of 1997, but rather serves as a management instrument for ensuring priority habitat objectives are being addressed.

Availability of Resources
No additional fiscal resources are needed to conduct this use. Needed management staff time is already committed and available. Most of the work needed to prepare for this use would be done during habitat management planning. The bid process would require some additional staff time to develop and oversee Special Use Permits but would be relatively minor and within existing resources. Costs would be off-set by the benefits of restoration and fire break maintenance without using staff time or equipment to conduct the activity.

Anticipated Impacts of the Use
In units where haying is used in place of prescribed fire, short-term impacts include disturbance and temporary displacement caused by noisy heavy equipment and temporary removal of cover. In these same areas, long term impacts will be beneficial by helping to restore and reinvigorate native prairie cover needed by these same species. Units selected for haying will rotate throughout the refuge each year so that it does not occur in the same unit consecutively year after year.

In firebreaks, the impacts will be short term and long term as these areas will be hayed several times throughout the year, every year, to protect habitats and neighboring landowners from wildfire.

Public Review and Comment
Public notification and review includes a notice of availability through the local media and a 15-day comment period. Copies of this Compatibility Determination will be available at the Neal Smith National Wildlife Refuge Visitor Center front desk and at the Prairie City Public Library. Comments and suggestions should be directed to the Refuge Manager at 515-994-3400 before close of business on August 17, 2012.

Determination: Haying

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility:

1. This activity is a year by year opportunity. Continued haying on the refuge depends on refuge needs and may be stopped at any time by the Refuge Manager.
2. Equipment must be cleaned and be free of vegetation, seeds, mud, and soil before mowing/baling operations begin on the Refuge. Notify Refuge 24 hours before you plan to begin. The Refuge reserves the right to inspect equipment prior to the onset of work.
3. All equipment must be removed from the field directly after its use. Storage of equipment is not allowed on Refuge property.
4. Hay bales must be removed from the Refuge prior to September 15 each year.

5. Fields must be mowed between July 15 and August 31 each year. Firebreaks must be mowed as soon as vegetation reaches a height of one foot, probably May of each year, and repeated throughout year when necessary to maintain a firebreak of 8 inches or less.
6. In case of rain, sufficient drying time must be allowed so that equipment does not leave ruts.

Justification
Haying will not materially interfere with or detract from the purpose of the National Wildlife Refuge System when carried out under the required stipulations. Haying is a valuable management tool that provides greater long-term habitat benefits for reestablished and existing grasslands. The productivity and abundance of grassland dependent bird and other wildlife species would slowly decline in the absence of haying or similar treatments on the refuge. Grasslands are a disturbance-dependent ecosystem that requires periodic haying, mowing or burning to maintain their vigor, diversity and the structure necessary for wildlife use. Haying is an effective alternative when other management methods are infeasible.

Literature Cited: N/A

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Uses: Mushroom and Berry Picking

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

" . . . the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations contained in various migratory bird treaties and conventions . . . " 16 U.S.C. § 3901(b) **(Emergency Wetland Resources Act of 1986)**

" . . . conservation, management, and . . . restoration of the fish, wildlife, and plant resources and their habitats . . . for the benefit of present and future generations of Americans . . . " 16 U.S.C. § 668dd(a)(2) **(National Wildlife Refuge Administration Act)**

The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Use
What is the use? Non-commercial harvest of mushrooms and berries (chokecherries, raspberries, blackberries) for human consumption.

Where is the use conducted? These activities may occur throughout the Refuge in wooded areas. Approximately ten to fifty people participate in this activity annually, and most people tend to access areas adjacent to existing roads and trails.

When is the use conducted? Mushroom and berry picking are authorized year round in the Refuge areas outside

the bison enclosure. However, most of the activity is conducted during the few weeks when the fruits ripen.

How is the use conducted? This is an activity that is often done in conjunction with other activities that are wildlife-dependent, such as wildlife observation and photography. Access to harvest sites is accomplished by walking from a designated parking area, public roadway, or trail. All harvesting is done by hand.

Why is the use being proposed? Mushroom and berry picking are traditional outdoor activities that bring families to the Refuge. It allows them to collect wholesome, healthy foods while enjoying the natural environment.

Availability of Resources
There is little to no cost to administer this program. It occurs in conjunction with other public uses, and participation is low.

Anticipated Impacts of the Use
Historically public participation in mushroom and berry picking has been low, and future participation is expected to remain low. Most activity occurs adjacent to existing roads and trails causing minimal disturbance to wildlife or habitat. No mushroom or berry picking will be permitted within the bison enclosure for the safety of the public. The relatively few mushrooms and berries harvested will not significantly reduce the food source for wildlife.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Mushroom and Berry Picking

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
All users must comply with Refuge-specific regulations.

Justification
This use has little negative impact to wildlife or habitat since few people participate, no machinery is allowed, and most activity occurs along designated foot trails.

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Use: Firewood Cutting and Collection

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

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The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

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Description of Use
What is the use? Non-commercial harvest of downed wood for use as fire fuel.

Where is the use conducted? These activities may occur throughout the Refuge. Approximately five to 15 people participate in this activity annually, and most access areas adjacent to existing roads and trails.

When is the use conducted? This activity is authorized year round in the Refuge areas outside the bison enclosure, when wood is available. Only downed trees are authorized for take.

How is the use conducted? This is an activity that is permitted along road ditches and in areas where the Refuge has cleared trees for prairie or savanna reconstruction or restoration. Trees that have already been cut down along road ditches and on prairie locations may be cut into smaller pieces and retrieved by individuals or groups who have acquired a Special Use Permit (SUP) from the Refuge. When Refuge staff clears trees from an area, wood is generally available on a first come, first served basis to persons who acquire an SUP from the Refuge. No individual will be permitted to cut down a standing tree; they will only be permitted to cut a downed tree to smaller sizes in order to transport.

Why is the use being proposed? Removal of trees from the Refuge for reconstruction and restoration is an on-going management activity. The cost of removing the wood from sites or the staff time needed to conduct and monitor burn piles can be prohibitive. Burning of wood piles is limited to winter when snow is on the ground. This use allows the Refuge to remove wood from reconstruction/restoration sites throughout the year and provide fuel wood to the general public.

Availability of Resources
There is little to no cost to administer this program.

Anticipated Impacts of the Use
Historically public participation in woodcutting activities has been low, and future participation is expected to remain low. Most activity occurs adjacent to existing roads and trails causing minimal disturbance to wildlife. No woodcutting will be permitted within the bison enclosure for the safety of the public.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Firewood Cutting and Collection

_____ Use is Not Compatible

__**X**__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
All users must comply with Refuge-specific regulations. Only trees that have already been cut down will be permitted to be taken from the Refuge.

Justification
This use has little negative impact to wildlife or habitat since it is linked to beneficial habitat enhancement and restoration management activities.

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Use: Farming (with Genetically Modified Crops [GMCs])

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
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Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

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National Wildlife Refuge System Mission
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Description of Use
What is the use? Row crop farming using genetically modified crops, specifically glyphosate tolerant soybean and corn.

Where is the use conducted? The use is conducted on agricultural lands purchased by the Service for the purpose of tallgrass prairie reconstruction.

When is the use conducted? In the long term, not to exceed five years, the use is conducted until such time the Refuge is able to begin tallgrass prairie reconstruction/restoration efforts on newly acquired lands, not to exceed

five years from year of purchase. Seasonally, the use would be conducted between April and November with a one year Special Use Permit (SUP) beginning January 1st of each year and ending December 31st.

How is the use conducted? The land is rented through an SUP. The land would be farmed under typical farming practices for the area but would be restricted to no-till, Service-approved pesticides and their application, no fall fertilization, and maintenance of grassed waterways and buffer strips.

Why is the use being proposed? This is an existing economic use that is useful in managing land in a weed-free state until such time the Refuge can begin the reconstruction/restoration effort. The use of GMCs is necessary to reduce the quantity and use of pesticides on the Refuge, reduce weed infestations from crops to restored areas of the Refuge, and to maintain a farming program with local farmers. There are no native corn species on the Refuge and no endangered species utilize areas where farming occurs. Farming is not used as a food crop for wildlife but is simply a place holder until restoration activities can begin.

Availability of Resources
Resources involved in the administration and management of the use are approximately $6,000 for staff time and overhead. No special equipment or facilities are needed to support this use.

Anticipated Impacts of the Use
Temporary continuation of the loss of ground cover, increased erosion, and use of pesticides will be some of the direct and indirect short term impacts. Pesticide use is expected to be minimal due to the use of GMCs. Glyphosate applications can be made early in the season when they are most effective. Loss of viable soil for restoration and gully erosion are potential impacts, but since all farm ground will be restored to tallgrass prairie the impacts will be short term. Cumulative impacts, if farming were to be maintained on each site, would include depleted soil microbes and soil fertility. Cumulative impacts under eventual reconstruction or restoration would be minimal.

Public Review and Comment
Public notification and review includes a notice of availability, 15-day comment period and local media announcements. Copies of this compatibility determination were made available at the Neal Smith NWR Visitor Center as well as the public library in Prairie City, Iowa. Comments received and agency responses will be included in the final Comprehensive Conservation Plan that is currently in progress.

Determination: Farming (with GMCs)

_____ Use is Not Compatible

__X__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
Farmers who lease land on the Refuge must adhere to strict regulations to comply with the "Special Use Permit." Some related special conditions that farmers must adhere to in order to farm on the Refuge include the following:

1. Only "no till" farming practices are allowed.
2. Planting of Bt corn is not allowed.
3. Application of anhydrous ammonia is only allowed in the spring. Application of any fertilizer is not permitted in the fall.
4. All fields with streams and/or gullies will be required to have a buffer strip planted 100 feet wide on each side. The Refuge will provide the seed to plant strips. Operator will mow buffer strips and field borders at least once between July 15 and August 15 and as needed or as directed by Refuge staff for weed control.
5. Only glyphosate herbicides are allowed to be sprayed on Refuge cropland without first obtaining written permission. Application rates on are not to exceed the recommended label rate for each growing season.
6. Other herbicides may be used if all the following three conditions are met: 1) there is documented need from a crop scout, 2) the herbicide is listed on the FWS Region 3 Herbicides List, and 3) the farmer

requests and obtains written permission from the Refuge. Requests for herbicide use must be received at least 72 hours prior to the planned application time.

7. By December 15th the operator is required to provide a pesticide use report to the Refuge.
8. Use of genetically-modified, glyphosate-tolerant crops is limited to corn and soybeans.
9. Beginning in calendar year 2012, the use of genetically-modified, glyphosate-tolerant corn and soybeans will be used only for the purpose of habitat restoration.

Justification

This is an existing economic use that is useful in managing land in a weed-free state until such time the Refuge can begin the reconstruction/restoration effort. The use of GMCs is necessary to reduce the quantity and variety of use of pesticides on the Refuge, reduce weed infestations from crops to restored areas of the Refuge, and to maintain a farm program with local farmers. There are no native corn species on the Refuge, and no endangered species utilize areas where farming occurs. Farming is not used as a food crop for wildlife but is simply a place holder until restoration activities can begin.

Mandatory 10-year Re-evaluation Date: 2021

Refuge Manager: /s/ Christy Smith 9/15/2011

Regional Chief Concurrence: /s/ Rick Schultz 9/15/2011

Compatibility Determination

Use: Grazing (other than bison and elk)

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities
Congress established the Refuge on May 25, 1990 by appropriating $6 million for land acquisition through the Emergency Supplemental Appropriations Act (Public Law 101-302). The first major parcel of land (about 3,600 acres) was purchased by the U.S. Fish and Wildlife Service from the Redlands Corporation, a subsidiary of Iowa Power in April 1991. Previously, this property had been targeted for a nuclear power generating station. A total of 8,655 acres of land south and west of Prairie City, Iowa, are included within the approved acquisition boundary. About 5,580 acres have been acquired so far.

Refuge Purposes
Public Law 101-302 did not describe specific purposes for the Refuge, so its legal purposes are derived from the following broad authorities:

" . . . for the development, advancement, management, conservation, and protection of fish and wildlife resources . . . "16 U.S.C. § 742f(a)(4) " . . . for the benefit of the United States Fish and Wildlife Service, in performing its activities and services. Such acceptance may be subject to the terms of any restrictive or affirmative covenant, or condition of servitude . . . " 16 U.S.C. § 742f(b)(1) **(Fish and Wildlife Act of 1956)**

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The intent of Congressman Neal Smith in working to establish the Refuge was clear. He stated in the Congressional Record (H2727) that the proposed Refuge would offer "*an unusual opportunity for interpretive programs, wetlands, a habitat for some 300 species of indigenous and migratory birds, the regrowth of many acres of now scarce species of trees, buffalo and elk which were indigenous to the area, and the largest native prairie grass fields in Iowa*" and that "*tens of thousands of school children . . . could use the area as an outdoor study area*."

National Wildlife Refuge System Mission
The mission of the National Wildlife Refuge System is "to administer a national network of lands and waters for the conservation, management, and where appropriate, restoration of the fish, wildlife, and plant resources and their habitats within the United States for the benefit of present and future generations of Americans." (National Wildlife Refuge System Administration Act of 1966, as amended [16 U.S.C. 668dd - 668ee])

Description of Use
What is the use? The use is grazing by domestic livestock to include cows, goats, and sheep, or other herbivores to manipulate or remove unwanted vegetation, create disturbance, or achieve a specific habitat management goal or objective.

Where is the use conducted? The use would be conducted throughout the Refuge where needed.

When is the use conducted? Grazing could occur within any season on the Refuge depending on the target species and desired outcome to achieve habitat management goals.

How is the use conducted? Agreements or contracts with livestock owners can be established on short- or long-term basis. The Refuge would lease land to or pay a contractor to graze a specified area of land for a specific time frame or series of time frames to meet a desired habitat goal or objective.

Why is the use being proposed? In order to manage the Refuge landscape successfully, methods should be available to the Refuge to allow flexibility so that when one method is not feasible another can be employed. In many instances grazing may achieve specific results that cannot be achieved through any other means due to the selective feeding preferences of different livestock.

Availability of Resources
Neal Smith NWR is located in an agricultural landscape where many land owners own various domestic livestock and may be interested in working with the Refuge. Some biological staff time and expertise will be required to permit and monitor the activity.

Anticipated Impacts of the Use
Grazing would be used as a habitat management tool to achieve specific goals and objectives. The anticipated impacts to the landscape should be positive or, if not, will be discontinued. Other impacts could be perceptions from visitors who perceive domestic livestock in a negative light. Environmental education and interpretation measures would be conducted to reduce negative visitor impacts.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR Comprehensive Conservation Plan (CCP) and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Grazing (other than bison and elk)

_____ Use is Not Compatible

__X__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
Grazing (non-bison/elk) would be permitted on the Refuge as part of a habitat management plan to manipulate or control habitat to a desired outcome. Grazing would particularly be used where mowing or prescribed burning is not feasible. Consideration of animal species will be considered for each habitat type and desired outcome. Grazing will not be permitted in areas where it will directly conflict or compete with bison or elk.

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Compatibility Determination

Uses: Research and Monitoring

Refuge Name: Neal Smith National Wildlife Refuge

Establishing and Acquisition Authorities:
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Description of Use
What is the use? Research and monitoring of vegetation, hydrology, geology, wildlife, and public uses will be conducted to provide information that will form the basis for management decisions. Priority would be given to research and monitoring that contributes to the enhancement, reconstruction, protection, preservation, and management of prairie, savanna, and related habitats as well as migratory birds, bison, elk, bats, and other wildlife on the Refuge.

Research proposals would be assessed based on criteria including, but not limited to, research that will contribute to specific Refuge or regional management challenges, Comprehensive Conservation Plan (CCP) goals, or purposes

for which the Refuge was established; and research designed to minimize disturbance to the wildlife and habitat on the Refuge as well as the surrounding human environment. Research projects should incorporate the principles of adaptive management.

Where is the use conducted? Research will be conducted throughout the Refuge within the variety of habitats found there depending on the purpose and need.

When is the use conducted? Research can be conducted throughout the year, day or night and depending on the purpose and need.

How is the use conducted? Research proposals would be reviewed by Refuge staff and conservation partners, as appropriate. If the proposal is approved, a Special Use Permit would be issued by the Refuge Manager. Research that will conflict with other ongoing research, monitoring, or management programs will not be granted. Research that can be accomplished off-Refuge is less likely to be approved. Research that causes exceptional disturbance to wildlife or undue habitat degradation will not be granted. If staffing or logistics make it impossible for the Refuge staff to monitor research activity in sensitive areas, the proposal will not be granted; and the length of proposed research will not be allowed to be conducted with an open-ended time frame. Research and monitoring SUPs will be reviewed annually before renewal.

Why is the use being proposed? Research and monitoring are integral parts of national wildlife refuge management. Two provisions of the National Wildlife Refuge System Improvement Act of 1997 are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Plans and actions based on research and monitoring provide an informed approach, which analyzes the management effects on Refuge wildlife.

Availability of Resources
Some staff time would be required to review research requests and manage research activities. However, Refuge staff would not be expected to commit weekly staff time to managing this use. Approving proposals will also be based upon available staff to monitor the research. Currently, limited staffing exists to monitor projects and compliance of research projects. Other than staff time, no special equipment, facilities, or improvements are necessary to support this proposed use.

Anticipated Impacts of the Use
Expected short-term benefits to conducting research activities at the Refuge would include improvement of habitat and wildlife populations. Monitoring of wildlife and habitat on the Refuge would provide feedback on the effectiveness of activities taking place. The possibility exists of disturbing wildlife. In addition, if research is expected to take place, rare plants and newly planted native seedlings may be trampled. Non-native plants may also be introduced through researchers' clothing and footwear.

Long-term effects could include expanding the knowledge base of the habitat and wildlife of the larger tallgrass prairie ecosystem. Moreover, natural resources inventory, monitoring, and research are provisions in the National Wildlife Refuge System Improvement Act of 1997. Overall, proper review and approval of appropriate research proposals should result in limited disturbance to wildlife and habitat, while resulting in maximum benefit to Refuge management and scientific data within the tallgrass prairie ecosystem.

Public Review and Comment
This compatibility determination was part of the Draft Neal Smith NWR CCP and Environmental Assessment. Public notification and review includes a notice of availability published in the *Federal Register*, 30-day comment period, local media announcements, and a public meeting at the Refuge. Comments received and agency responses will be included in the final CCP.

Determination: Research and Monitoring

_____ Use is Not Compatible

__X__ Use is Compatible with Stipulations

Stipulations Necessary to Ensure Compatibility
Each research project will be evaluated, and special requirements will be determined for each project and included with the Refuge SUP. All researchers must comply with the additional requirements or the research project will be stopped or discontinued until compliance measures are met.

Justification
There is much to be learned about tallgrass prairie and savanna ecosystems. Research and monitoring are integral parts of national wildlife refuge management. Two provisions of the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57) are to "maintain biological integrity, diversity and environmental health" and to conduct "inventory and monitoring." Plans and actions based on research and monitoring provide an informed approach, which analyzes the management effects on Refuge wildlife.

Mandatory 10-year Re-evaluation Date: 2022

Refuge Manager: _____
(Signature and Date)

Regional Chief Concurrence: _____
(Signature and Date)

Appendix D: Appropriate Use Determinations

In this appendix:

Bicycling (means of access)
Farming for Invasive Weed Management and Future Restoration Preparation
Firewood Cutting and Collecting
Prescribed Grazing (other than bison and elk)
Jogging
Haying
Mushroom, Nut, and Berry Picking
Research
Snow Shoeing/Cross Country Skiing (means of access)

Appropriate Refuge Uses

The U.S. Fish and Wildlife Service's (FWS, Service) Appropriate Use policy describes the initial decision process a Refuge Manager follows when first considering whether or not to allow a proposed use on a refuge. The Refuge Manager must first find a use to be appropriate before undertaking a compatibility review of the use and outlining the stipulations of the use.

This policy clarifies and expands on the compatibility policy (Service Manual, 603 FW 2.10D(1)), which describes when Refuge Managers should deny a proposed use without determining compatibility. If we find a proposed use is not appropriate, we will not allow the use and will not prepare a compatibility determination. By screening out proposed uses not appropriate to the refuge, the Refuge Manager avoids unnecessary compatibility reviews. By following the process for finding the appropriateness of a use, we strengthen and fulfill the National Wildlife Refuge System (NWRS, Refuge System) mission. Although a refuge use may be both appropriate and compatible, the Refuge Manager retains the authority to not allow the use or modify the use.

Background for this policy as it applies to Neal Smith National Wildlife Refuge (NWR, Refuge) is found in the following statutory authorities:

(A) *National Wildlife Refuge System Administration Act of 1966*, as amended by the *National Wildlife Refuge System Improvement Act of 1997* (16 U.S.C. 668dd-668ee) (Improvement Act). This law provides the authority for establishing policies and regulations governing refuge uses, including the authority to prohibit certain harmful activities. The Administration Act does not authorize any particular use but, rather, authorizes the Secretary of the Interior to allow uses only when they are compatible. The Improvement Act provides the Refuge System mission and includes specific directives and a clear hierarchy of public uses on the Refuge System.
(B) *Refuge Recreation Act of 1962*, (16 U.S.C. 460k). This law authorizes the Secretary of the Interior to allow public recreation in areas of the Refuge System when the use is an "appropriate incidental or secondary use."

This policy does NOT apply to:

(A) *Situations Where Reserved Rights or Legal Mandates Provide We Must Allow Certain Uses.*

(B) *Refuge Management Activities.* Refuge management activities conducted by the Refuge System or a Refuge System-authorized agent are designed to conserve fish, wildlife, and plants and their habitats. These activities are used to fulfill a refuge purpose(s) or the Refuge System mission, and are based on sound professional judgment.

Uses that have been administratively determined to be appropriate are:

(C) *Six wildlife-dependent recreational uses.* As defined by the Improvement Act, the six wildlife-dependent recreational uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation) are determined to be appropriate. However, the Refuge Manager must still determine if these uses are compatible.

(D) *Take of fish and wildlife under state regulations.* States have regulations concerning take of wildlife that includes hunting, fishing, and trapping. We consider take of wildlife under such regulations appropriate. However, the Refuge Manager must determine if the activity is compatible before allowing it on a refuge.

Refuge uses must meet at least one of the following four conditions to be deemed appropriate:

(1) It is a wildlife-dependent recreational use of a refuge as identified in the Improvement Act.
(2) It contributes to fulfilling the refuge purpose(s), the Refuge System mission, or goals or objectives described in a refuge management plan approved after the Improvement Act was signed into law.
(3) The use involves the take of fish and wildlife under state regulations.
(4) The Refuge Manager has evaluated the use following the guidelines in this policy and found that it is appropriate. The criteria used by the manager to evaluate appropriateness can be found on each of the appropriate use forms included in this appendix. Also included under this condition are “specialized uses,” or uses that require specific authorization from the Refuge System, often in the form of a Special Use Permit, letter of authorization, or other permit document. These uses do not include uses already granted by a prior existing right. We make appropriateness findings for specialized uses on a case-by-case basis.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Bicycling (means of access)

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No _x_

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date: _____12/14/2011_____

Justification: This use will provide the public an alternative conveyance to automobiles to view and observe wildlife on the Refuge as well as promote fitness and wellness of visitors. This use reduces the carbon footprint for the visiting public. This use will be allowed on existing or proposed public use trails outside the bison enclosure.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Farming for Invasive Weed Management and Future Restoration Preparation

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(k) Do we have jurisdiction over the use?	X	
(l) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(m) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(n) Is the use consistent with public safety?	X	
(o) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(p) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(q) Is the use manageable within available budget and staff?	X	
(r) Will this be manageable in the future within existing resources?	X	
(s) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(t) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date: _____12/14/2011_____

Justification: Farming is used on the Refuge as a place holder to maximize the destruction of seeds from invasive or unwanted plant species and to create less competition when lands are converted to prairie. Typically cooperators use glyphosate tolerant corn and soybeans prior to reconstruction activities.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date: _____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Firewood Cutting and Collection

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date:_____12/14/2011_____

Justification: Trees have invaded areas where prairie and savanna reconstruction and restoration will occur. Removal of trees that have been cut down by Refuge staff by the public under a Special Use Permit helps to reduce fire fuel loads and aids in the restoration of prairie habitats. The public may obtain a Special Use Permit at no cost to remove wood from specific areas of the Refuge. The person will be issued a Special Use Permit and directed to an area where they can collect wood from previously downed trees and/or they may cut downed trees to a size that can be transported. Under no circumstance is the public permitted to cut standing trees.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.
If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Prescribed Grazing (other than bison and elk)

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date:_____12/14/2011_____

Justification: Prescribed grazing may be used in areas where mowing or burning is not feasible to remove woody vegetation or other unwanted vegetative cover. Grazing may also be used to enhance specific attributes in any habitat to achieve disturbance or vegetative manipulation. Species considered for management include non-native ungulates such as cattle, goats, and/or sheep.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Jogging

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date:_____12/14/2011_____

Justification: This activity provides a means of access for wildlife observation as well as an opportunity to maintain fitness/wellness. The use is wildlife-dependent in that it requires fresh air and open spaces. The jogging public will appreciate the experience of being in the tallgrass prairie and viewing the open vistas and wildlife. The use will be allowed on existing trails and any new proposed trails.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Haying

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	**YES**	**NO**
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No _x_

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager:_____ Date:_____

Justification: Haying is an effective, often crucial tool for grassland management and restoration. Construction of fire breaks, free of fuels in the form of duff, is essential to controlling prescribed fire operations. Haying is a viable alteranative for rejuvenating and maintaining decadent grassland communities when treatments such as burning or grazing are infeasible or impractical.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Mushroom, Nut, and Berry Picking

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date:_____12/14/2011_____

Justification: For a small number of people, this is a traditional, family oriented activity that provides an opportunity for those participating to collect wholesome, healthy foods while enjoying the beauty of the natural environment. The foods are a renewable resource and the use does not compete with wildlife needs. The use will not require additional Refuge resources to manage.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Research

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date: _____12/14/2011_____

Justification: Research is conducted by universities and other academic institutions; government agencies, and consultants hired by the Service as well as non-profit organizations. Research projects focus on better understanding Refuge wildlife and habitat resources in relation to construction and restoration activities; provide information to improve adaptive management decisions; and increase of life history information on wildlife species, invasive plants, and tallgrass prairie habitats.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

Finding of Appropriateness of a Refuge Use

Refuge Name: Neal Smith National Wildlife Refuge

Use: Snow Shoeing/Cross Country Skiing (means of access)

This exhibit is not required for wildlife-dependent recreational uses, forms of take regulated by the State, or uses already described in a refuge CCP or step-down management plan approved after October 9, 1997.

Decision Criteria:	YES	NO
(a) Do we have jurisdiction over the use?	X	
(b) Does the use comply with applicable laws and regulations (federal, state, tribal, and local)?	X	
(c) Is the use consistent with applicable Executive Orders and Department and Service policies?	X	
(d) Is the use consistent with public safety?	X	
(e) Is the use consistent with goals and objectives in an approved management plan or other document?	X	
(f) Has an earlier documented analysis not denied the use or is this the first time the use has been proposed?	X	
(g) Is the use manageable within available budget and staff?	X	
(h) Will this be manageable in the future within existing resources?	X	
(i) Does the use contribute to the public's understanding and appreciation of the Refuge's natural or cultural resources, or is the use beneficial to the Refuge's s natural or cultural resources?	X	
(j) Can the use be accommodated without impairing existing wildlife-dependent recreational uses or reducing the potential to provide quality (see section 1.6D. for description), compatible, wildlife-dependent recreation into the future?	X	

Where we do not have jurisdiction over the use ("no" to (a)), there is no need to evaluate it further as we cannot control the use. Uses that are illegal, inconsistent with existing policy, or unsafe ("no" to (b), (c), or (d)) may not be found appropriate. If the answer is "no" to any of the other questions above, we will generally not allow the use.

If indicated, the Refuge Manager has consulted with state fish and wildlife agencies. Yes ___ No ___

When the Refuge Manager finds the use appropriate based on sound professional judgment, the Refuge Manager must justify the use in writing on an attached sheet and obtain the Refuge Supervisor's concurrence.

Based on an overall assessment of these factors, my summary conclusion is that the proposed use is:

Not Appropriate _____ Appropriate __X__

Refuge Manager: _____/s/ Christy Smith_____ Date:_____12/14/2011_____

Justification: Neal Smith NWR is located in Iowa where high levels of snow fall through the winter months. Wildlife observation, photography, interpretation, and environmental education programs conducted throughout the winter months can be accommodated with snow shoeing and cross country skiing as a means of access.

If found to be Not Appropriate, the Refuge Supervisor does not need to sign concurrence if the use is a new use.

If an existing use is found Not Appropriate outside the CCP process, the Refuge Supervisor must sign concurrence.

If found to be Appropriate, the Refuge Supervisor must sign concurrence.

Refuge Supervisor: _____ Date:_____

A compatibility determination is required before the use may be allowed.

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Appendix F: Summary of Refuge Ecosystems

Ecosystems	Characteristic plant species	Characteristic wildlife species	Natural processes responsible for these conditions	Limiting factors/threats
Tallgrass Prairie	**Dry**: Yellow Star Grass, Fringed Puccoon, Creamy Indigo, Little Bluestem, Rough Dropseed, Prairie Dropseed, Side Oats Grama, Downy Gentian, Sand Milkweed. **Mesic**: Lead Plant, Big Bluestem, Indian Grass, Hoary Puccoon, Butterfly Milkweed, Switch Grass, Rough Blazingstar, White Prairie Clover, Downy Gentian, Prairie Lily, Alum Root, Prairie Potentilla, Prairie Violet.	**Birds**: Northern Harrier, Upland Sandpiper, Short-eared Owl, Sedge Wren, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Dickcissel, Bobolink, Eastern and Western Meadowlarks. **Mammals**: Short-tailed Shrew, Thirteen-lined Ground Squirrel, Plains Pocket Gopher, Prairie Vole, Meadow Vole, Badger, Bobcat, Elk, Bison. **Reptiles**: Western Smooth Green Snake, Bull snake. **Butterflies**: Regal Fritillary, Monarch, Wild Indigo Duskywing, Arogos Skipper, Byssus Skipper. **Crustacea**: Prairie Crayfish (Procambarus gracilis).	Frequent fire, grazing, pollination, seed dispersal, hydrologic process, migration, nutrient cycling, carbon cycling, reproduction.	Invasive species; invasion by fire intolerant woody vegetation; altered hydrology; erosion; climate change.
Oak Savanna	Bur Oak, Blue-eyed Grass, Leather Flower, Creamy Gentian, Downy Brome, Wood Reed Grass, Yellow False Foxglove, Violet Wood Sorrel, Dutchman's Breeches, Bloodroot, Lead Plant, Culver's Root, Purple Milkweed, Elm-leaved Goldenrod.	**Birds**: Ruby-throated Hummingbird, Red-headed Woodpecker, Northern Flicker, Loggerhead Shrike, Bell's Vireo, Tufted Titmouse, Blue Jay, Eastern Bluebird, Eastern Towhee, Field Sparrow, Orchard Oriole, Baltimore Oriole. **Mammals**: Indiana Bat, Evening Bat, Southern Flying Squirrel, Fox Squirrel, Bobcat, Elk. **Reptiles**: Bull snake, Fox Snake. **Butterflies**: Hickory Hairstreak, Monarch.	Frequent fire, grazing, pollination, seed dispersal, hydrologic process, migration, nutrient cycling, carbon cycling, reproduction.	Invasive species; invasion by fire intolerant woody vegetation due to lack of fire; lack of fine fuel matrix; lack of sunlight penetrating to understory; climate change.
Sedge Meadow	Blue Flag Iris, Prairie Milkweed, Marsh Milkweed, Bottle Gentian, Prairie Cord Grass, Tussock Sedge, Michigan lily, New England Aster, Great Blue Lobelia, Rattlesnake master, Giant St. John's Wort, Mad Dog Skullcap.	**Birds**: Northern Harrier, Short-eared Owl, Sedge Wren. **Mammals**: Masked Shrew, Indiana Bat, Meadow Jumping Mouse. **Amphibians**: Tiger Salamander, Blanchard's Cricket Frog. **Reptiles**: Western Smooth Green Snake. **Butterflies**: Monarch, Dion Skipper, Two-spotted Skipper. **Crustacea**: Prairie Crayfish (*Procambarus gracilis*).	Frequent fire, grazing, pollination, seed dispersal, hydrologic process, migration, nutrient cycling, carbon cycling, reproduction.	Invasive species; invasion by fire intolerant woody vegetation; altered hydrology including drain tiles, erosion; climate change.
Aquatic Systems	?	**Birds:** Wood Duck, Great Blue Heron, Belted Kingfisher. **Mammals:** River Otter, Beaver. **Reptiles:** Common Snapping Turtle **Amphibians:** Tiger Salamander, Blanchard's Cricket Frog. **Fish:** Northern hog sucker, Slenderhead darter. **Insects:** Odonata: Dragonflies and damselflies.	Hydrologic process, migration, nutrient cycling, carbon cycling, reproduction.	Hydrologic alteration including drain tiles, erosion, siltation; pollution from agricultural runoff; climate change.
Aerial Ecosystem	Aerially dispersing and wind pollinated plants (grasses, oaks).	Aerial feeders (Tree Swallow, Cliff Swallow, Barn Swallow, Purple Martin, Chimney Swift, Common Nighthawk, bats), migratory birds and bats, grassland birds, flying insects	Pollination, migration, nutrient cycling, carbon cycling, reproduction.	Air pollution, wind turbines, power lines, light pollution, communication towers.

Appendix G: Birds of Special Consideration

Species	Breeding	Sp	S	F	W	Federal Status	USFWS Focal Species	State Status	Region 3 Priority Species (MSH/UMR)	BCR 22 (Eastern Tallgrass Prairie) BCC 2008 List, USFWS	Iowa DNR SGCN	Shortgrass Prairie	Tallgrass Prairie	Sedge Meadow	Oak Savanna	Shrubland	Habitat preference
Wood Duck	x	u	u	u			FS		x						x		Water with trees and nest cavities nearby
Greater Prairie-Chicken											x		x				Large grassland tracts with varying vegetation heights
Northern Bobwhite	x	o	o	o	o						x		x		x		Medium height grasslands w/shrubs & forbs
Northern Harrier	x	u	r	u	u			E	x		x		x	x			Large grassland tracts
Swainson's Hawk		o		r					x		x		x		x		Savanna (breeding) or grassland (foraging)
American Kestrel	x	u	u	u	u										x		Savanna (breeding) or grassland (foraging)
Upland Sandpiper	x	o	o	r			FS		x	x	x	x	x	x	x		Short-to-medium height grasslands w/forbs
Barn Owl		x						E	x				x		x		Savanna (breeding) or grassland (foraging)
Short-eared Owl	x	u	r	u	u			E	x	x	x		x	x			Large grassland tracts
Red-headed Woodpecker	x	u	u	r	r				x	x	x		x		x		Oak savanna
Northern Flicker	x	c	c	c	u				x	x			x		x		Oak savanna
Willow Flycatcher	x	u	c								x		x	x	x	x	Shrubs or thickets in grasslands
Eastern Kingbird	x	c	c	u									x		x	x	Shrubs or thickets in grasslands or savannas
Loggerhead Shrike	x	o	r	o	r	S			x	x	x		x		x	x	Thorny shrubs/trees in savanna/grasslands
Bell's Vireo	x	u	c	o					x	x	x		x		x	x	Thickets in savanna/grasslands
Sedge Wren	x	a	a	c					x		x		x	x			Tall grass infrequently disturbed
Eastern Bluebird	x	u	u	u	r								x		x		Oak savanna
Brown Thrasher	x	c	c	u									x	x	x	x	Shrubs or thickets in grasslands or savannas
Smith's Longspur		o		o						x		x	x				Short, sparse vegetation
Yellow-breasted Chat	x	o	o								x		x	x	x	x	Dense, overgrown, brushy grasslands
Eastern Towhee	x	u	u	o	r						x				x	x	Brushy wooded edge or savanna
Clay-colored Sparrow		o		o								x	x		x	x	Grassland w/shrubs
Field Sparrow	x	a	a	c					x	x	x		x		x	x	Grassland w/shrubs
Savannah Sparrow		c		c								x	x				Short to medium height grass
Grasshopper Sparrow	x	a	a	u					x	x	x	x	x				Short grass (arid grasslands) w/forbs
Henslow's Sparrow	x	c	c	o		S	FS	T	x	x	x		x				Tall grass and infrequent disturbance
Le Conte's Sparrow		r		u					x		x		x	x			Tall grass, wetlands
Dickcissel	x	a	a	u					x	x	x		x				Medium height or tall grass w/forbs
Bobolink	x	u	u	r					x		x		x	x			Medium height grass w/forbs
Eastern Meadowlark	x	a	a	c					x		x		x				Grassland or open savanna
Western Meadowlark	x	u	u	u	o				x			x	x				Short grass w/forbs
Orchard Oriole	x	u	u						x				x		x		Thickets in savanna/grasslands
Baltimore Oriole	x	c	c	u											x		Oak savanna

Appendix H: Invasive Plants

Common name	Scientific name	Biological characteristics	Response to fire	Control method	Extent on Refuge
Russian olive/autumn olive	*Elaeagnus angustifolia, E. umbellata*	Woody; perennial; nitrogen-fixing; seeds spread by birds; shade-tolerant	Mature trees tolerant	Herbicide treatment—basal bark or cut stump	Small, isolated populations. Present in Savanna Reconstruction Unit, Rothinghouse property
Shrub lespedeza	*Lespedeza bicolor*	Herbaceous/semi-woody; perennial; clonal	Fire-adapted	Herbicide treatment	Dense population present in one unit (Old Game Farm)
Sericea lespedeza	*Lespedeza cuneata*	Herbaceous forb; perennial; clonal; warm season; allelopathic*	Fire-adapted	Chemical treatment—Triclopyr (Garlon 4)	Widespread small populations, isolated individuals or small clumps
Bush honeysuckle	*Lonicera sp.*	Woody; perennial; shade-tolerant; seeds spread by birds	Intolerant	Herbicide treatment—cut stump	Primarily in oak savannas
White poplar	*Populus alba*	Woody; perennial; clonal	Fire may increase suckering	Girdling, herbicide treatment—basal bark or cut stump	Isolated in Dogleg unit in about three patches
Black locust	*Robinia pseudoacacia*	Woody; perennial; clonal	Fire increases suckering	Herbicide treatment—basal bark or cut stump	Small clumps in several plantings, one large area in Highpoint along both sides of the Refuge boundary; primarily associated with former home sites
Japanese raspberry	*Rubus parvifolius*	Woody; perennial; clonal; Shade-tolerant	Intolerant	Herbicide treatment	Only known to be in one isolated population on the Refuge; small population on roadside near Refuge
Garlic mustard	*Alliaria petiolata*	Herbaceous forb; biennial; cool season; shade-tolerant	Intolerant	Early detection/rapid response -- hand pulling, cool season burning	Present in central Iowa, but not found on Refuge
Spotted knapweed	*Centaurea maculosa*	Herbaceous forb; perennial; clonal; allelopathic	Intolerant of annual burns	Early detection/rapid response, herbicide	Present in central Iowa, but not found on Refuge
Cut-leaved teasel/Common teasel	*Dipsacus laciniatus/D. sylvestris*	Herbaceous forb; biennial/ short-lived perennial	Intolerant	Early detection/rapid response, cutting, mowing, burning	Not known to be present on Refuge
Leafy spurge	*Euphorbia esula*	Herbaceous forb; perennial; clonal	Tolerant	Early detection/rapid response, herbicide treatment	Present in central Iowa, but not found on Refuge
Purple loosestrife	*Lythrum salicaria*	Herbaceous forb; perennial; clonal	Intolerant	Early detection/rapid response, herbicides, biocontrols	Present close to Refuge
European buckthorn	*Rhamnus cathartica*	Woody; perennial; seeds spread by birds	Fire controls seedlings, top-kills mature plants	Early detection/rapid response, herbicides	Present in central Iowa, but not found on Refuge
Canada thistle	*Cirsium arvense*	Herbaceous forb; perennial; clonal; cool season	Intolerant	Repeated mowing prior to bloom, chemical treatment during bud, cool season burning	Widespread patches, but only in certain plantings
Crown vetch	*Coronilla varia*	Herbaceous forb; perennial; clonal	Intolerant	Burning, mowing, herbicide treatment	Small patches, mostly along roadsides
White & yellow sweet clovers	*Melilotus alba, M. officinalis*	Herbaceous forb; biennial; seeds may remain viable for decades	Fire intolerant, but fire stimulates seed germination	Mowing during bloom stage, hand-pulling, burning	Widespread patches
Silvergrass, plumegrass	*Miscanthus sacchariflorus*	Herbaceous grass; Perennial; clonal; warm	Tolerant	Cool season burning, herbicide treatment,	Isolated patches primarily associated with former

Common name	Scientific name	Biological characteristics	Response to fire	Control method	Extent on Refuge
		season		mowing to prevent seed production	home sites (3 locations)
Smooth brome	*Bromus inermis*	Herbaceous grass; perennial; clonal; cool season	Intolerant	Cool season burning, inter-seeding	Widespread in former pastures and in prairie plantings and remnants
Tall fescue	*Festuca arundinacea*	Herbaceous grass; perennial; clonal; cool season; allelopathic	Intolerant	Cool season burning, interseeding, herbicide treatment	Present on Refuge primarily in waterways
Bird's-foot trefoil	*Lotus corniculatus*	Herbaceous forb; perennial; clonal; cool season	Intolerant but seeds germination increases	Burning, hand-pulling, herbicide treatment	Localized in disturbed areas, primarily around Visitor Center
Alfalfa	*Medicago sativa*	Herbaceous forb; perennial; clonal; cool season	Intolerant	Burning	Scattered locations
Reed canarygrass	*Phalaris arundinacea*	Herbaceous grass; perennial; clonal; cool season	Intolerant	Burning, herbicide treatment	Widespread along Walnut creek, smaller drainages and wet areas, and isolated clumps in uplands
Kentucky bluegrass	*Poa pratensis*	Herbaceous grass; perennial; clonal; cool season	Intolerant	Cool season burning, interseeding	Widespread, especially in disturbed areas
Multiflora rose	*Rosa multiflora*	Woody; perennial; clonal	Intolerant	Burning, mowing, herbicide treatment	Scattered in some prairie and savanna remnants
Red clover	*Trifolium pratense*	Herbaceous forb; perennial; clonal; cool season	Intolerant	Cool season burning	Widespread, especially in disturbed areas
Musk thistle	*Carduus nutans*	Herbaceous forb; biennial; cool season	Intolerant	Mowing or cutting at crown level	Scattered individual plants and isolated patches
Bull thistle	*Cirsium vulgare*	Herbaceous forb; biennial	Intolerant	Mowing or cutting at crown	Scattered individual plants
Poison hemlock	*Conium maculatum*	Herbaceous forb; biennial	Intolerant	Cutting at crown, burning	Isolated patches primarily associated with former home sites
Queen Anne's lace	*Daucus carota*	Herbaceous forb; biennial	Intolerant	Hand pulling, mowing	Concentrated in disturbed areas around buildings, roads, and in grazed areas
Wild parsnip	*Pastinaca sativa*	Herbaceous forb; biennial	Intolerant	Cutting at crown level, burning	Widespread scattered plants
Curly dock	*Rumex crispus*	Herbaceous forb; biennial	Intolerant	Cool season burning	Widespread, scattered plants

Appendix I: Species Lists

In this appendix

Neal Smith NWR Bird Checklist
Neal Smith NWR Butterflies
Neal Smith NWR Mammals
Neal Smith NWR Reptiles (likely to occur)
Neal Smith NWR Amphibians
Neal Smith NWR Plants

I.1 Neal Smith NWR Bird Checklist

Species and Abundance	Spring	Summer	Fall	Winter
Swans, Geese and Ducks				
Greater White-fronted Goose	r		r	
Snow Goose	o		r	
Canada Goose (resident)	u	u	o	o
Canada goose (migratory)	u		u	o
Cackling Goose	o		o	
Wood Duck*	u	u	u	
Gadwall	o		r	
American Wigeon	o		o	
Mallard*	u	u	u	u
Blue-winged Teal	o	o	o	
Northern Shoveler	o		o	
Northern Pintail	o		o	
Green-winged Teal	o		o	
Hooded Merganser	r			
Quails				
Northern Bobwhite*	o	o	o	o
Grouse and Turkeys				
Gray Partridge	r	r	r	r
Ring-necked Pheasant*	a	a	a	a
Wild Turkey*	u	u	u	u
Grebes				
Pied-billed Grebe	r		r	
Cormorants				
Double-crested Cormorant	o		o	
Pelicans				
American White Pelican	o		o	
Herons and Bitterns				
Great Blue Heron	u	u	u	
Great Egret		r	r	
Cattle Egret	r	r		
Green Heron	o	o		
Vultures				

Species and Abundance	Spring	Summer	Fall	Winter
Jays and Crows				
Blue Jay*	a	a	a	a
American Crow*	c	c	c	c
Larks				
Horned Lark*	c	c	c	c
Swallows				
Purple Martin	o	o		
Tree Swallow*	c	c	u	
Northern Rough-winged Swallow*	o	o	r	
Bank Swallow	o	o	r	
Cliff Swallow*	a	a	c	
Barn Swallow*	a	a	c	
Chickadees and Titmice				
Black-capped Chickadee*	a	a	a	a
Tufted Titmouse*	r	r	r	r
Nuthatches				
Red-breasted Nuthatch	r			r
White-breasted Nuthatch*	a	a	a	a
Creepers				
Brown Creeper	u		u	u
Wrens				
Winter Wren	o		o	
House Wren*	a	a	c	
Sedge Wren*	a	a	c	
Marsh Wren	o		o	
Gnatcatchers				
Blue-gray Gnatcatcher*	c	c	u	
Kinglets				
Golden-crowned Kinglet	u		u	o
Ruby-crowned Kinglet	c		c	
Thrushes				
Eastern Bluebird*	u	u	u	r
Veery	o			

Turkey Vulture	u	u	u	
Ospreys				
Osprey	r		r	
Hawks and Eagles				
Bald Eagle	o	o	o	o
Northern Harrier	u	r	u	u
Sharp-shinned Hawk	o		o	o
Cooper's Hawk	o	r	o	o
Broad-winged Hawk	o		r	
Swainson's Hawk	o		r	
Red-tailed Hawk*	c	c	c	c
Rough-legged Hawk	u		u	u
Falcons				
American Kestrel*	u	u	u	u
Merlin			r	
Prairie Falcon			r	
Peregrine Falcon			r	
Rails and Coots				
Sora	o	o	o	
American Coot	o		o	
Cranes				
Sandhill Crane	r	r	r	
Plovers				
American Golden-Plover	r			
Killdeer*	a	a	a	
Sandpipers				
Spotted Sandpiper*	o	o	r	
Solitary Sandpiper	o	r	r	
Greater Yellowlegs	r	r	r	
Lesser Yellowlegs	o	r	o	
Upland Sandpiper*	o	o	r	
Least Sandpiper	r	r	r	
Pectoral Sandpiper	o	r	o	
Wilson's Snipe	u	o	o	
American Woodcock*	u	u	u	
Gulls and Terns				
Franklin's Gull	o		o	
Ring-billed Gull	u		u	u
Herring Gull	o		o	o
Black Tern	r			
Pigeons and Doves				
Rock Pigeon*	u	u	u	u
Mourning Dove*	a	a	c	u
Cuckoos				
Yellow-billed Cuckoo*	u	u	u	
Black-billed Cuckoo	o	o	r	
Barn Owls				
Barn Owl	x			

Gray-cheeked Thrush	o		r	
Swainson's Thrush	u		o	
Hermit Thrush	u		u	
Wood Thrush*	r	r	r	
American Robin*	a	a	a	o
Mockingbirds and Thrashers				
Gray Catbird*	a	a	a	
Northern Mockingbird	r	r		
Brown Thrasher*	c	c	u	
Starlings				
European Starling*	c	c	c	c
Waxwings				
Cedar Waxwing*	c	c	c	r
Longspurs				
Lapland Longspur	u		u	o
Smith's Longspur	o		o	
Snow Bunting				o
Wood Warblers				
Blue-winged Warbler	r		r	
Golden-winged Warbler	r	r	r	
Tennessee Warbler	u	r	u	
Orange-crowned Warbler	o		o	
Nashville Warbler	u	o	u	
Northern Parula	o		o	
Yellow Warbler*	c	c	o	
Chestnut-sided Warbler	o	r	o	
Magnolia Warbler	u	r	u	
Cape May Warbler	r	r	r	
Yellow-rumped Warbler	c		c	
Black-throated Green Warbler	o	r	o	
Blackburnian Warbler	o	r	o	
Palm Warbler	o		o	
Bay-breasted Warbler	r		r	
Blackpoll Warbler	o		r	
Cerulean Warbler	r	r		
Black-and-white Warbler	u	o	u	
American Redstart	u	o	u	
Ovenbird	o	r	o	
Northern Waterthrush	o		o	
Mourning Warbler	r		r	
Common Yellowthroat*	a	a	c	
Wilson's Warbler	o	o	o	
Canada Warbler	o	r	o	
Yellow-breasted Chat*	o	o		
Sparrows				
Spotted Towhee			r	
Eastern Towhee*	u	u	o	r
American Tree Sparrow	c		c	a

Owls				
Eastern Screech-Owl	r	r	r	r
Great Horned Owl*	u	u	u	u
Snowy Owl	x			
Barred Owl*	u	u	u	u
Short-eared Owl*	u	r	u	u
Nightjars				
Common Nighthawk*	o	o	o	
Swifts				
Chimney Swift*	o	o	o	
Hummingbirds				
Ruby-throated Hummingbird*	u	u	u	
Kingfishers				
Belted Kingfisher*	u	u	u	r
Woodpeckers				
Red-headed Woodpecker*	u	u	r	r
Red-bellied Woodpecker*	c	c	c	c
Yellow-bellied Sapsucker	o		o	r
Downy Woodpecker*	c	c	c	c
Hairy Woodpecker*	u	u	u	u
Northern Flicker*	c	c	c	u
Pileated Woodpecker	r	r	r	r
Flycatchers				
Olive-sided Flycatcher	o		r	
Eastern Wood-Pewee*	c	c	c	
Yellow-bellied Flycatcher	o	r	o	
Acadian Flycatcher	r	r		
Alder Flycatcher	r	r		
Willow Flycatcher*	u	c		
Least Flycatcher	o	r	o	
Eastern Phoebe*	u	u	u	
Great Crested Flycatcher*	u	c	u	
Western Kingbird	r	r		
Eastern Kingbird*	c	c	u	
Scissor-tailed Flycatcher		x		
Shrikes				
Loggerhead Shrike*	o	r	o	r
Northern Shrike			r	r
Vireos				
White-eyed Vireo	x			
Bell's Vireo*	u	c	o	
Yellow-throated Vireo*	u	u	o	
Blue-headed Vireo	o		o	
Warbling Vireo*	c	c	u	
Philadelphia Vireo	r	r	r	
Red-eyed Vireo*	u	c	u	

a=abundant, c=common, u=uncommon, o=occasional, r=rare
* asterisk indicates nesting on the Refuge has occurred

Chipping Sparrow*	c	u	u	
Clay-colored Sparrow	o		o	
Field Sparrow*	a	a	c	
Vesper Sparrow*	u	u	u	
Lark Sparrow*	u	u		
Savannah Sparrow	c		c	
Grasshopper Sparrow*	a	a	u	
Henslow's Sparrow*	u	u	o	
Le Conte's Sparrow	r		u	
Fox Sparrow	u		u	
Song Sparrow*	a	a	a	u
Lincoln's Sparrow	u		u	
Swamp Sparrow	u		u	
White-throated Sparrow	c		c	r
Harris's Sparrow	u		u	
White-crowned Sparrow	u		u	
Dark-eyed Junco	a		a	a
Tanagers and Buntings				
Summer Tanager	r			
Scarlet Tanager	o	r	o	
Northern Cardinal*	c	c	c	c
Rose-breasted Grosbeak*	c	c	u	
Indigo Bunting*	a	a	u	
Dickcissel*	a	a	u	
Blackbirds and Orioles				
Bobolink*	u	u	r	
Red-winged Blackbird*	a	a	a	o
Eastern Meadowlark*	a	a	c	
Western Meadowlark*	u	u	u	o
Yellow-headed Blackbird	r			
Rusty Blackbird	r		r	r
Brewer's Blackbird	r			
Common Grackle*	c	c	c	r
Brown-headed Cowbird*	c	a	a	r
Orchard Oriole*	u	u		
Baltimore Oriole*	c	c	u	
Finches				
Purple Finch	u		o	o
House Finch*	o	o	o	o
Common Redpoll				x
Pine Siskin	o		o	o
American Goldfinch*	a	a	a	c
Old World Sparrows				
House Sparrow*	u	u	u	u

I.2 Neal Smith NWR Butterflies

Swallowtails			
Black Swallowtail	*Papilio polyxenes*	Giant Swallowtail	*Papilio cresphontes*
Eastern Tiger Swallowtail	*Papilio glaucus*		
Whites and Sulphurs			
Cabbage White	*Pieris rapae*	Clouded Sulphur	*Colias philodice*
Orange Sulphur	*Colias eurytheme*	Cloudless Sulphur	*Phoebis sennae*
Little Yellow	*Eurema lisa*	Dainty Sulphur	*Nathalis iole*
Harvesters, Coppers, Hairstreaks and Blues			
Great Gray Copper	*Lycaena xanthoides*	Striped Hairstreak	*Satyrium liparops*
Harvester	*Feniseca tarquinius*	'Olive' Juniper Hairstreak	*Callophrys gryneus gryneus*
Bronze Copper	*Lycaena hylius*	Gray Hairstreak	*Strymon melinus*
Gray Copper	*Lycaena dione*	Eastern Tailed-Blue	*Everes comyntas*
Coral Hairstreak	*Satyrium titus*	Spring Azure	*Celastrina ladon*
Banded Hairstreak	*Satryium calanus*	Summer Azure	*Celastrina ladon neglecta*
Hickory Hairstreak	*Satyrium caryaevorum*		
Brushfoots			
American Snout	*Libytheana carinenta*	American Lady	*Vanessa virginiensis*
Variegated Fritillary	*Euptoiera claudia*	Painted Lady	*Vanessa cardui*
Great Spangled Fritillary	*Speyeria cybele*	Red Admiral	*Vanessa atalanta*
Aphrodite Fritillary	*Speyeria aphrodite*	Common Buckeye	*Junonia coenia*
Regal Fritillary	*Speyeria idalia*	Red-spotted Purple	*Limentis artimis astyanax*
Meadow Fritillary	*Bororia bellona*	Viceroy	*Limenitis archippus*
Gorgone Checkerspot	*Chlosyne gornone*	Hackberry Emperor	*Asterocampa celtis*
Silvery Checkerspot	*Chlosyne nycteis*	Tawny Emperor	*Asterocampa clyton*
Pearl Crescent	*Phyciodes tharos*	Northern Pearly-eye	*Enodia anthedon*
Question Mark	*Polygonia interrogationis*	Little Wood-Satyr	*Megisto cymela*
Eastern Comma	*Polygonia comma*	Common Wood-Nymph	*Cercyonis pegala*
Gray Comma	*Polygonia progne*	Monarch	*Danaus plexippus*
Mourning Cloak	*Nymphalis antiopa*		
Skippers			
Silver-spotted Skipper	*Epargyreus clarus*	Little Glassywing	*Pompeius verna*
Common Checkered-Skipper	*Pyrgus communis*	Delaware Skipper	*Anatrylone logan*
Common Sootywing	*Pholisora catullus*	Byssus Skipper	*Problema byssus*
Least Skipper	*Ancyloxypha numitor*	Hobomok Skipper	*Poanes hobomok*
European Skipper	*Thymelicus lineola*	Sedge or Dion Skipper	*Euphyes dion*
Tawny-edged Skipper	*Polites themistocles*	Dun Skipper	*Euphyes vestris*
Northern Broken-Dash	*Wallengrenia egeremet*		

I.3 Neal Smith NWR Mammals

Virginia Opossum*	*Didelphis virginiana*	White-footed Mouse	*Peromyscus leucopus*
Masked Shrew*	*Sorex cinereus*	Deer Mouse	*Peromyscus maculatus*
Short-tailed Shrew*	*Blarina brevicauda*	Prairie Vole	*Microtus ochrogaster*
Eastern Mole	*Scalopus aquaticus*	Meadow Vole	*Microtus pennsylvanicus*
Northern Myotis	*Myotis septentrionalis*	Muskrat	*Ondatra zibethicus*
Little Brown Bat	*Myotis lucifugus*	Meadow Jumping Mouse	*Zapus hudsonius*
Indiana Bat	*Myotis sodalis*	House Mouse	*Mus musculus*

Silver-haired Bat	*Lasionycteris noctivagans*	Norway Rat	*Rattus norvegicus*
Eastern Pipistrelle	*Pipistrellus subflavus*	Coyote	*Canis latrans*
Big Brown Bat	*Eptesicus fuscus*	Red Fox	*Vulpes vulpes*
Red Bat	*Lasiurus borealis*	Gray Fox	*Urocyon cinereoargenteus*
Hoary Bat	*Lasiurus cinereus*	Raccoon	*Procyon lotor*
Evening Bat	*Nycticeius humeralis*	Long-tailed Weasel	*Mustela frenata*
Eastern Cottontail	*Sylvilagus floridanus*	Least Weasel	*Mustela nivalis*
Eastern Chipmunk	*Tamias striatus*	Mink	*Mustela vison*
Woodchuck	*Marmota momax*	River Otter	*Lutra canadensis*
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*	Badger	*Taxidea taxus*
Fox Squirrel	*Sciurus niger*	Striped Skunk	*Mephitis mephitis*
Southern Flying Squirrel	*Glaucomys volans*	Bobcat	*Lynx rufus*
Plains Pocket Gopher	*Perognathus flavescens*	Elk**	*Cervus elaphus*
Beaver	*Castor canadensis*	White-tailed Deer	*Odocoileus virginianus*
Western Harvest Mouse	*Reithrodontomys megalotis*	Bison**	*Bison bison*

** indicates captive species introduced to enclosure at Neal Smith NWR.

I.4 Neal Smith NWR Reptiles (likely to occur)

Turtles			
Common Snapping Turtle	*Chelydra serpentina*	Blanding's Turtle	*Emydoidea blandingii*
Western Painted Turtle	*Chrysemys picta bellii*	Spiny Softshell Turtle	*Apalone spinifera*
Snakes			
Northern Water Snake	*Nerodia sipedon*	Prairie Ringneck Snake	*Diadophis punctatus arnyi*
Grahams' Crayfish Snake	*Regina grahamii*	Eastern Yellowbelly Racer	*Coluber constrictor flaviventris*
Brown (DeKay's) Snake	*Storeria dekayi*	Red Milk Snake	*Lampropeltis triangulum syspila*
Northern Lined Snake	*Tropidoclonion lineatum lineatum*	Bullsnake	*Pituophis catenifer sayi*
Eastern Garter Snake	*Thamnophis sirtalis*	Fox Snake	*Elaphe vulpina*
Plains Garter Snake	*Thamnophis radix*	Black Rat Snake	*Elaphe obsoleta obsoleta*
Western Ribbon Snake	*Thamnophis proximus proximus*	Eastern Hognose Snake	*Heterodon platyrhinos*
Western Smooth Green Snake	*Opheodrys vernalis blanchardi*		

I.5 Neal Smith NWR Amphibians

Salamanders			
Tiger Salamander	*Ambystoma tigrinum*		
Frogs and Toads			
Blanchard's Cricket Frog	*Acris crepitans blanchardi*	American Bullfrog	*Rana catesbeiana*
American Toad	*Bufo americanus*	Northern Leopard Frog	*Rana pipiens*
Eastern Gray Treefrog	*Hyla versicolor*	Pickerel Frog	*Rana palustris*
Cope's Gray Treefrog	*Hyla chrysoscelis*	Plains Leopard Frog**	*Rana blairi*
Western Chorus Frog	*Pseudacris triseriata*	Green Frog**	*Rana clamitans*

** indicates species not confirmed, but likely to occur

I.6 Neal Smith NWR Plants

Ferns			
Adiantum pedatum	Northern maidenhair fern	*Equisetum hyemale v. affine*	Common scouring-rush
Athyrium filix-femina v. angustum	Northern lady fern	*Equisetum laevigatum*	Smooth scouring-rush
Equisetum arvense	Common horsetail	*Onoclea sensibilis*	Sensitive fern
Forbs			
Abutilon theophrasti	Buttonweed	*Juncus torreyi*	Torrey's rush

Achillea millefolium ssp. lanulosa	Western yarrow	*Lactuca canadensis*	Wild lettuce
Acorus calamus	Sweetflag	*Lactuca floridana*	Blue lettuce
Agalinis tenuifolia	Slender false foxglove	*Lactuca ludoviciana*	Prairie lettuce
Agastache nepetoides	Yellow giant-hyssop	*Lactuca tatarica ssp. pulchella*	Showy blue lettuce
Agastache scrophulariifolia	Purple giant-hyssop	*Laportea canadensis*	Wood nettle
Agrimonia gryposepala	Tall agrimony	*Lemna minor*	Duckweed
Agrimonia pubescens	Soft agrimony	*Leonurus cardiaca*	Motherwort
Alisma plantago-aquatica	Water plantain	*Lespedeza capitata*	Round-headed bush clover
Allium canadense	Wild onion	*Lespedeza cuneata*	Silky bush clover
Allium cernuum	Nodding wild onion	*Liatris aspera*	Blazing star
Allium stellatum	Wild prairie onion	*Liatris cylindracea*	Blazing star
Allium tricoccum	Wild leek	*Liatris pycnostachya*	Prairie blazing star
Amaranthus hybridus	Green amaranth	*Liatris squarrosa*	Blazing star
Amaranthus retroflexus	Pigweed	*Lilium michiganense*	Michigan lily
Ambrosia artemisiifolia	Common ragweed	*Lilium philadelphicum v. andinum*	Wood lily
Ambrosia trifida	Giant ragweed	*Linum sulcatum*	Wild flax
Anemone canadensis	Canada anemone	*Lithospermum latifolium*	American gromwell
Anemone cylindrica	Windflower, thimbleweed	*Lobelia cardinalis*	Cardinal flower
Anemone quinquefolia	Wood anemone	*Lobelia inflata*	Indian tobacco
Anemone virginiana	Tall anemone	*Lobelia siphilitica*	Great lobelia
Antennaria neglecta	Pussytoes	*Lobelia spicata*	Spiked lobelia
Antennaria plantaginifolia	Ladies'-tobacco	*Lotus corniculatus*	Bird's-foot trefoil
Apocynum sibiricum	Indian hemp	*Lycopus americanus*	
Aquilegia canadensis	Columbine	*Lysimachia ciliata*	Fringed loosestrife
Arctium minus	Common burdock	*Lysimachia hybrida*	Loosestrife
Arisaema triphyllum	Jack-in-the-pulpit	*Lysimachia quadriflora*	Narrow-leaved loosestrife
Artemisia ludoviciana	White sage	*Lythrum alatum*	Winged loosestrife
Asarum canadense	Wild ginger	*Medicago sativa*	Alfalfa
Asclepias amplexicaulis	Sand milkweed	*Melilotus alba*	White sweet clover
Asclepias hirtella	Tall green milkweed	*Melilotus officinalis*	Yellow sweet clover
Asclepias purpurascens	Purple milkweed	*Mertensia virginica*	Bluebell
Asclepias sullivantii	Prairie milkweed	*Mimulus ringens*	Monkey flower
Asclepias syriaca	Common milkweed	*Mirabilis nyctaginea*	Wild four-o'clock
Asclepias tuberosa ssp. interior	Butterfly weed	*Monarda fistulosa*	Wild bergamot, horsemint
Asclepias verticillata	Whorled milkweed	*Monotropa uniflora*	Indian pipe
Asclepias viridiflora	Green milkweed	*Najas flexilis*	Common naiad
Asparagus officinalis	Garden asparagus	*Nepeta cataria*	Catnip
Aster azureus	Sky-blue aster	*Oenothera biennis ssp. centralis*	Common evening primrose
Aster cordifolius	Blue wood aster	*Oenothera villosa*	Gray evening primrose
Aster drummondii	Drummond's aster	*Onosmodium molle v. hispidissimum*	False gromwell
Aster ericoides	Heath aster, frost weed	*Onosmodium molle v. occidentale*	False gromwell
Aster laevis	Smooth blue aster	*Osmorhiza claytonii*	Sweet cicely
Aster lanceolatus	Panicled aster	*Osmorhiza longistylis*	Anise root
Aster lateriflorus	Side-flowered aster	*Oxalis stricta*	Yellow wood sorrel, lady's sorrel

Aster novae-angliae	New England aster	*Oxalis violacea*	Violet wood sorrel
Aster oblongifolius	Aromatic aster	*Parthenium integrifolium*	Feverfew, wild quinine
Aster ontarionis	Ontario aster	*Pastinaca sativa*	Wild parsnip
Aster pilosus	Hairy aster	*Pedicularis canadensis*	Lousewort
Aster praealtus	Willow aster	*Pedicularis lanceolata*	Swamp lousewort
Aster prenanthoides	Crooked stem aster	*Penstemon digitalis*	Foxglove penstemon
Aster puniceus	Swamp aster	*Penstemon gracilis*	Slender beardtongue
Aster sagittifolius	Arrow-leaved aster	*Penthorum sedoides*	Ditch stonecrop
Aster umbellatus	Flat-topped aster, white aster	*Phlox divaricata*	Sweet William, blue phlox
Astragalus canadensis	Milk vetch	*Phlox maculata*	Wild sweet William
Astragalus crassicarpus	Ground plum	*Phlox paniculata*	Garden phlox
Aureolaria grandiflora v. pulchra	Yellow false foxglove	*Phlox pilosa*	Prairie phlox
Baptisia bracteata v. glabrescens	Cream wild indigo	*Phryma leptostachya*	Lopseed
Baptisia lactea	White wild indigo	*Physalis heterophylla*	Ground cherry
Bidens cernua	Nodding bur marigold	*Physalis virginiana*	Ground cherry
Bidens connata	Purplestemmed tickseed	*Physostegia virginiana*	False dragonhead
Bidens coronata	Tickseed sunflower	*Pilea pumila*	Clearweed
Bidens frondosa	Beggar-ticks	*Plantago major*	Common plantain
Bidens polylepis	Bur marigold	*Plantago patagonica*	Wooly plantain
Bidens vulgata	Tall beggar-ticks	*Plantago rugelii*	Common plantain, Rugel's plantain
Brickellia eupatorioides	False boneset	*Podophyllum peltatum*	Mayapple
Cacalia atriplicifolia	Indian plaintain	*Polemonium reptans*	Jacob's ladder
Cacalia plantaginea	Prairie Indian plaintain	*Polygonatum biflorum*	Solomon's seal
Callirhoe involucrata	Purple poppy mallow	*Polygonum amphibium v. emersum*	Water smartweed
Caltha palustris	Marsh marigold	*Polygonum hydropiper*	Water pepper
Calystegia sepium	American bindweed	*Polygonum hydropiperoides*	Mild water pepper
Campanula americana	Tall bellflower	*Polygonum lapathifolium*	Curttop lady's thumb
Cannabis sativa	Hemp, marijuana	*Polygonum pensylvanicum v. laevigatum*	Pinkweed
Chelone glabra	White turtlehead	*Polygonum punctatum*	Water smartweed
Chenopodium album	Lamb's quarters	*Polygonum sagittatum*	Tearthumb
Cichorium intybus	Chicory	*Polygonum virginianum*	Jumpseed
Cicuta maculata	Water hemlock	*Polytaenia nuttallii*	Prairie parsley
Circaea lutetiana ssp. canadensis	Enchanter's nightshade	*Potentilla arguta*	Prairie cinquefoil
Cirsium altissimum	Tall thistle	*Potentilla norvegica*	Norwegian cinquefoil
Cirsium arvense	Canada thistle	*Potentilla recta*	Sulphur cinquefoil
Cirsium discolor	Field thistle	*Potentilla simplex*	Common cinquefoil
Cirsium Vulgare	Bull thistle	*Prenanthes alba*	Rattlesnake-root, white lettuce
Claytonia virginica	Spring beauty	*Prenanthes aspera*	Rough white lettuce
Comandra umbellata	Bastard toadflax	*Prenanthes racemosa*	Glaucous white lettuce
Convolvulus arvensis	Creeping Jenny	*Prunella vulgaris*	Self heal
Conyza canadensis	Horseweed, mule tail	*Prunella vulgaris lanceolata*	Self heal
Coreopsis palmata	Tickseed, prairie coreopsis	*Psoralidium batesii*	Scurfy pea
Coreopsis tripteris	Tall tickseed	*Pycnanthemum pilosum*	Hairy mountain mint
Coronilla varia	Crown vetch	*Pycnanthemum tenuifolium*	Slender mountain mint
Cryptotaenia canadensis	Honewort	*Pycnanthemum virginianum*	Common mountain mint

Dalea candida	White prairie clover	*Ranunculus abortivus*	Small-flowered crowfoot
Dalea leporina	Foxtail dalea	*Ranunculus fascicularis*	Early buttercup
Dalea purpurea	Purple prairie clover	*Ratibida pinnata*	Gray-headed coneflower
Daucus carota	Queen Anne's lace	*Rudbeckia hirta*	Black-eyed Susan
Delphinium tricorne	Dwarf larkspur	*Rudbeckia laciniata*	Tall coneflower
Delphinium virescens	Prairie larkspur	*Rudbeckia subtomentosa*	Fragrant coneflower
Dentaria laciniata	Toothwort	*Rudbeckia triloba*	Brown-eyed Susan
Desmodium canadense	Showy tick-trefoil	*Ruellia humilis*	Wild petunia
Desmodium glutinosum	Pointed tick-trefoil	*Rumex acetosella*	Red sorrel
Desmodium illinoense	Illinois tick-trefoil	*Rumex altissimus*	Pale dock
Dianthus armeria	Deptford pink	*Rumex crispus*	Curly dock
Dicentra cucullaria	Dutchman's breeches	*Sagittaria brevirostra*	Short-beaked arrowleaf
Echinacea pallida	Pale coneflower	*Sagittaria latifolia*	Common arrowhead
Epilobium coloratum	Cinnamon willowherb	*Sanguinaria canadensis*	Bloodroot
Erechtites hieracifolia	Fireweed	*Sanicula canadensis*	Black snakeroot
Erigeron annuus	Annual fleabane	*Sanicula gregaria*	Common snakeroot
Erigeron philadelphicus	Fleabane	*Scrophularia lanceolata*	Early figwort
Erigeron strigosus	Daisy fleabane	*Scrophularia marilandica*	Late figwort
Eryngium yuccifolium	Rattlesnake master	*Scutellaria lateriflora*	Mad-dog skullcap
Erythronium albidum	White dogtooth-violet	*Senecio aureus*	Golden ragwort
Eupatorium altissimum	Tall thoroughwort	*Senecio pauperculus*	Prairie ragwort
Eupatorium maculatum	Spotted Joe-pye-weed	*Senecio plattensis*	Prairie ragwort
Eupatorium perfoliatum	Boneset	*Silene stellata*	Starry campion
Eupatorium purpureum	Purple Joe-pye-weed	*Silene vulgaris*	Bladder campion
Eupatorium rugosum	White snakeroot	*Silphium integrifolium*	Rosinweed
Eupatorium serotinum	Late boneset	*Silphium laciniatum*	Compass plant
Euphorbia corollata	Flowering spurge	*Silphium perfoliatum*	Cup plant
Euphorbia dentata	Toothed spurge	*Sisyrinchium campestre*	Prairie blue-eyed grass
Euphorbia maculata	Carpet spurge	*Sium suave*	Water parsnip
Euthamia graminifolia	Grass-leaved goldenrod	*Smilacina racemosa*	False Solomon's seal
Fragaria virginiana	Wild strawberry	*Smilacina stellata*	Starry false Solomon's seal
Galearis spectabilis	Showy orchis	*Smilax ecirrhata*	Carrion flower
Galium aparine	Cleavers	*Solanum americanum*	Black nightshade
Galium boreale	Northern bedstraw	*Solanum carolinense*	Horse nettle
Galium circaezans	Wild licorice	*Solidago canadensis*	Tall goldenrod
Galium triflorum	Sweet-scented bedstraw	*Solidago flexicaulis*	Zig-zag goldenrod
Gaura biennis	Bienniel gaura	*Solidago gigantea*	Smooth goldenrod
Gentiana alba	Pale gentian, yellow gentian	*Solidago missouriensis*	Missouri goldenrod
Gentiana andrewsii	Bottle gentian, closed gentian	*Solidago nemoralis*	Field goldenrod
Gentiana puberulenta	Downy gentian	*Solidago riddellii*	Riddell's goldenrod
Gentianella quinquefolia ssp. occidentalis	Stiff gentian	*Solidago rigida*	Stiff goldenrod
Geranium maculatum	Wild geranium	*Solidago speciosa*	Showy goldenrod
Geum canadense	White avens	*Solidago ulmifolia*	Elm-leaved goldenrod
Geum laciniatum	Rough avens	*Sonchus asper*	Spiny-leaved sow thistle
Glechoma hederacea	Creeping Charlie, ground ivy	*Spiranthes cernua*	Nodding ladies'-tresses
Glycine max	Soybean	*Spiranthes ovalis*	Oval ladies'-tresses

Glycyrrhiza lepidota	Wild licorice	*Stachys palustris*	Woundwort
Gnaphalium obtusifolium	Everlasting	*Strophostyles leiosperma*	Small wild bean
Hackelia deflexa v. americana	Stickseed	*Taenidia integerrima*	Yellow pimpernel
Hackelia virginiana	Stickseed	*Taraxacum officinale*	Common dandelion
Helenium autumnale	Sneezeweed	*Teucrium canadense*	American germander
Helianthus annuus	Common sunflower	*Thalictrum dasycarpum*	Purple meadow-rue
Helianthus decapetalus	Pale sunflower	*Thalictrum dioicum*	Early meadow-rue
Helianthus divaricatus	Woodland sunflower	*Thalictrum thalictroides*	Rue anemone
Helianthus giganteus	Tall sunflower	*Tomanthera auriculata*	Eared false foxglove
Helianthus grosseserratus	Saw-tooth sunflower	*Tradescantia bracteata*	Long-bracted spiderwort
Helianthus hirsutus	Bristly sunflower	*Tradescantia ohiensis*	Common spiderwort
Helianthus maximiliani	Maximilian's sunflower	*Tragopogon dubius*	Goat's-beard
Helianthus mollis	Downy sunflower	*Trifolium campestre*	Low hop-clover
Helianthus occidentalis	Western sunflower	*Trifolium pratense*	Red clover
Helianthus petiolaris	Petioled sunflower	*Trifolium repens*	White clover
Helianthus rigidus	Prairie sunflower	*Triodanis perfoliata*	Venus' looking-glass
Helianthus strumosus	Pale-leaved sunflower	*Triosteum perfoliatum aurantiacum*	Late horse gentian
Helianthus tuberosus	Jerusalem artichoke	*Typha augustifolia*	Narrow-leaved cattail
Heliopsis helianthoides	Ox-eye	*Typha latifolia*	Common cattail
Hemerocallis fulva	Day lily	*Typha X glauca*	Hybrid cattail
Hepatica nobilis v. obtusa	Round-lobed liverleaf	*Urtica dioica*	Stinging nettle
Heuchera richardsonii	Alumroot	*Uvularia grandiflora*	Bellwort
Hieracium canadense	Hawkweed	*Verbascum thapsus*	Common mullein
Hydrophyllum virginianum	Virginia waterleaf	*Verbena hastata*	Blue vervain
Hypericum punctatum	Spotted St. John's wort	*Verbena stricta*	Hoary vervain
Hypericum pyramidatum	Giant St. John's wort	*Verbena urticifolia*	White vervain
Hypoxis hirsuta	Yellow stargrass	*Verbesina alternifolia*	Wingstem
Impatiens capensis	Spotted touch-me-not	*Vernonia baldwinii*	Baldwin's ironweed
Impatiens pallida	Pale touch-me-not, jewel weed	*Vernonia fasciculata*	Ironweed
Ipomoea hederacea	Ivy-leaved morning glory	*Viola pedata*	Bird's-foot violet
Iris shrevei	Blue flag	*Viola pedatifida*	Prairie violet
Iris x germanica	Bearded iris	*Viola pratincola*	Common blue violet
Isopyrum biternatum	False rue anemone	*Viola pubescens*	Downy yellow violet
Juncus dudleyi	Dudley's rush	*Xanthium strumarium*	Cocklebur
Juncus tenuis	Path rush	*Zizea aurea*	Golden alexanders
Grasses			
Agropyron repens	Quack grass	*Hordeum pusillum*	Little barley
Agropyron smithii	Western wheatgrass	*Hystrix patula*	Bottlebrush grass
Agrostis gigantea	Redtop	*Koeleria macrantha*	June grass
Agrostis hyemalis	Ticklegrass	*Leersia oryzoides*	Rice cut-grass
Agrostis perennans	Upland grass	*Leersia virginica*	Whitegrass
Andropogon gerardii	Big bluestem	*Miscanthus sacchariflorus*	Plume grass
Bouteloua curtipendula	Side-oats grama	*Muhlenbergia cuspidata*	Plains muhly
Bromus inermis	Smooth brome	*Muhlenbergia frondosa*	Wirestem muhly
Bromus japonicus	Japanese brome	*Muhlenbergia mexicana*	Leafy satin grass
Bromus pubescens	Canada brome	*Muhlenbergia racemosa*	Marsh muhly
Bromus secalinus	Cheat grass	*Muhlenbergia schreberi*	Nimblewill

Calamagrostis canadensis	Bluejoint	*Muhlenbergia sobolifera*	Rock muhly
Calamovilfa longifolia	Prairie sandreed	*Panicum capillare*	Old witchgrass
Cinna arundinacea	Wood reed	*Panicum dichotomiflorum*	Knee grass, spreading witchgrass
Dactylis glomerata	Orchard grass	*Panicum virgatum*	Switchgrass
Diarrhena americana v. obovata	Beak grass	*Paspalum setaceum*	Bead grass
Dichanthelium acuminatum	Panic grass	*Phalaris arundinacea*	Reed canarygrass
Dichanthelium latifolium	Broad-leaved panic grass	*Phleum pratense*	Timothy
Dichanthelium oligosanthes	Heller's witchgrass	*Phragmites australis*	Reed
Dichanthelium oligosanthes var. screbnerianum	Scribner's panic or rosette grass	*Poa compressa*	Canadian bluegrass
Dichanthelium sabulorum var. patulum	Hemlock rosette grass	*Poa pratensis*	Kentucky bluegrass
Digitaria ischaemum	Smooth crabgrass	*Schizachyrium scoparium*	Little bluestem
Digitaria sanguinalis	Common crabgrass	*Setaria faberi*	Giant foxtail
Echinochloa crusgalli	Barnyard grass	*Setaria glauca*	Yellow foxtail
Echinochloa muricata	Spiny barnyard grass	*Setaria verticillata*	Bristly foxtail
Eleusine indica	Goose grass	*Setaria viridis*	Green foxtail
Elymus canadensis	Canada wild rye	*Sorghastrum nutans*	Indian grass
Elymus villosus	Slender wild rye	*Spartina pectinata*	Slough grass, cord grass
Elymus virginicus	Virginia wild rye	*Sphenopholis obtusata*	Prairie wedge grass
Eragrostis cilianensis	Stinkgrass	*Sporobolus asper*	Dropseed
Eragrostis hypnoides	Pony grass	*Sporobolus heterolepis*	Prairie dropseed
Eragrostis pectinacea	Small lovegrass	*Stipa spartea*	Porcupine grass
Eragrostis spectabilis	Purple lovegrass	*Tridens flavus*	Purple top
Festuca obtusa	Nodding fescue	*Tripsacum dactyloides*	Gama grass
Glyceria striata	Fowl manna grass	*Zea mays*	Cultivated corn
Hordeum jubatum	Squirrel-tail barley		
Sedges			
Carex atherodes	Hairy-leaved lake sedge	*Carex tribuloides*	Awl-fruited oval sedge
Carex bicknellii	Bicknell's sedge	*Carex vulpinoidea*	Brown fox sedge
Carex blanda	Common wood sedge	*Cyperus esculentus*	Yellow nut grass
Carex brevior	Plains oval sedge	*Eleocharis acicularis*	Needle spike rush
Carex cephalophora	Short-headed bracted sedge	*Eleocharis engelmannii*	Engelmann's spike rush
Carex cristatella	Crested oval sedge	*Eleocharis macrostachya*	Large-spiked spike rush
Carex gravida	Long-awned bracted sedge	*Scirpus acutus*	Hard-stemmed bulrush
Carex grayi	Common bur sedge	*Scirpus americanus*	Threesquare
Carex molesta	Field oval sedge	*Scirpus atrovirens*	Dark green bulrush
Carex pensylvanica	Pennsylvania oak sedge	*Scirpus cyperinus*	Wooly bulrush
Carex rosea	Curly-styled wood sedge	*Scirpus fluviatilis*	River bulrush
Carex shortiana	Short's sedge	*Scirpus heterochaetus*	Slender bulrush
Carex sparganioides	Loose-headed bracted sedge	*Scirpus validus v. creber*	Soft-stemmed bulrush
Carex sprengelii	Long-beaked sedge	*Scleria triglomerata*	Tall nut-rush
Carex stricta	Common tussock sedge		
Shrubs			
Amorpha canescens	Lead plant	*Rosa blanda*	Meadow rose
Amorpha fruticosa	Indigo bush, false indigo	*Rosa carolina*	Pasture rose
Berberis thunbergii	Japanese barberry	*Rosa multiflora*	Multiflora rose
Ceanothus americanus v. pitcheri	New Jersey tea	*Rubus allegheniensis*	Blackberry

Ceanothus herbaceus v. pubescens	Redroot	*Rubus flagellaris*	Dewberry
Cornus amomum ssp. obliqua	Silky dogwood	*Rubus idaeus idaeus*	Cultivated red raspberry
Cornus drummondii	Rough-leaved dogwood	*Rubus idaeus var. strigosus*	Red raspberry
Cornus foemina ssp. racemosa	Gray dogwood	*Rubus occidentalis*	Black raspberry
Corylus americana	Hazelnut	*Salix discolor*	Pussy willow
Elaeagnus umbellata	Autumn olive	*Salix exigua ssp. interior*	Sandbar willow
Euonymus atropurpureus	Wahoo, burning bush	*Salix humilis*	Prairie willow
Prunus virginiana	Choke cherry	*Salix pentandra*	Bay-leaved willow
Rhamnus cathartica	Common buckthorn	*Salix rigida*	Heart-leaved willow
Rhus glabra	Smooth sumac	*Symphoricarpos orbiculatus*	Coralberry, buckbrush
Ribes missouriense	Wild gooseberry	*Syringia vulgaris*	Lilac
Ribes odoratum	Buffalo currant	*Viburnum lentago*	Nannyberry
Rosa arkansana v. suffulta	Sunshine rose		
Trees			
Acer negundo	Box elder	*Populus deltoides*	Cottonwood
Acer nigrum	Black maple	*Populus tremuloides*	Quaking aspen
Acer saccharinum	Silver maple	*Prunus americana*	Wild plum
Aesculus glabra	Ohio buckeye	*Prunus mexicana*	Big-tree plum
Carya cordiformis	Bitternut hickory	*Prunus serotina*	Wild black cherry
Carya ovata	Shagbark hickory	*Quercus alba*	White oak
Celtis occidentalis	Hackberry	*Quercus borealis v. maxima*	Northern red oak
Crataegus calpodendron	Sugar hawthorn	*Quercus macrocarpa*	Bur oak
Crataegus crus-galli	Cockspur hawthorn	*Quercus velutina*	Black oak
Crataegus mollis	Downy hawthorn	*Robinia pseudoacacia*	Black locust
Fraxinus pennsylvanica v. lanceolata	Green ash	*Salix alba*	White willow
Gleditsia triacanthos	Honey locust	*Salix amygdaloides*	Peach-leaved willow
Gymnocladus dioica	Kentucky coffee tree	*Salix babylonica*	Weeping willow
Juglans nigra	Black walnut	*Salix fragilis*	Crack willow
Juniperus virginiana	Red cedar	*Salix nigra*	Black willow
Maclura pomifera	Osage orange, hedge apple	*Tilia americana*	Basswood, American linden
Malus ioensis	Wild crab	*Ulmus americana*	American elm
Malus sylvestris	Apple	*Ulmus pumila*	Siberian elm
Morus rubra	Red mulberry	*Ulmus rubra*	Red elm, slippery elm
Populus alba	Silver poplar		
Vines			
Amphicarpaea bracteata	Hog peanut	*Parthenocissus quinquefolia*	Virginia creeper
Apios americana	Ground-nut	*Polygonum scandens*	Climbing false buckwheat
Celastrus scandens	Bittersweet	*Sicyos angulatus*	Bur cucumber
Clematis pitcheri	Leather flower	*Smilax herbacea*	Carrion flower
Echinocystis lobata	Wild balsam apple	*Smilax hispida*	Greenbrier
Humulus lupulus	Common hops	*Solanum dulcamara*	European bittersweet
Lonicera prolifera	Wild honeysuckle	*Toxicodendron radicans ssp. negundo*	Poison ivy
Menispermum canadense	Moonseed	*Vitis riparia*	Riverbank grape

Appendix J: Research Publications (2001–2011)

Asbjornsen, H., L. A. Brudvig, and M. D. Tomer. 2007. "Ecohydrological implications of restoring Midwestern bur oak savannas after woody encroachment." *Ecological Restoration* 25: pp. 58–59.

Asbjornsen, H., G. Mora, and M. Helmers. 2007. "Variation in water uptake dynamics among contrasting agricultural and native plant communities in the Midwestern U.S." *Agriculture, Ecosystems, and Environment* 121: pp. 343–356.

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Asbjornsen, H., G. Shepard, M. Helmers, and G. Mora. 2008. "Seasonal patterns in depth of water uptake under contrasting annual and perennial systems in the Corn Belt Region of the Midwestern U.S." *Plant and Soil* 308: pp. 69–92.

Atwell, R. C., L. A. Shulte, and L. M. Westphal. 2009. "Landscape, community, countryside: linking biophysical and social scales in US Corn Belt agricultural landscapes." *Land Use Policy* 24: pp. 791–804.

Atwell, R. C., L. A. Shulte, and L. M. Westphal. 2009. "Linking resilience theory and diffusion of innovations theory to understand the potential for perennials in the U.S. Corn Belt." *Ecology and Society* 14(1).

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Halbert, N. D., P. J. P. Gogan, R. Hieber, and J. N. Derr. 2007. "Where the buffalo roam: The history and genetics in the conservation of bison on U.S. federal lands." *Park Science* 24: pp. 22–29.

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Hedrick, P. W. 2009. "Conservation genetics and North American bison (*Bison bison*)." *Journal of Heredity* 100: 411–420.

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Perez-Bidegain, M., J. M. Helmers, and R. Cruse. 2010. "Modeling phosphorous transport in an agricultural watershed using the WEPP model." *Journal of Environmental Quality* 39: pp. 2121–2129.

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Appendix K: Compliance Requirements

American Indian Religious Freedom Act, 42 U.S.C. 1996, 1996a (1976)
Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve American Indian religious cultural rights and practices.

Americans with Disabilities Act of 1990, 42 U.S.C. 12101 et seq.
Prohibits discrimination in public accommodations and services.

Antiquities Act of 1906. 16 U.S.C. 431 et seq.
Authorizes the scientific investigation of antiquities on federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

Archaeological and Historic Preservation Act 16 U.S.C.469-469c
Directs the preservation of historic and archaeological data in federal construction projects.

Archaeological Resources Protection Act of 1979, 16 U.S.C. 470aa et seq.
Protects materials of archaeological interest from unauthorized removal or destruction and requires Federal managers to develop plans and schedules to locate archaeological resources.

Architectural Barriers Act of 1968, 42 U.S.C. 4151 et seq.
Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

Clean Water Act of 1977, 33 U.S.C. 1251
Requires consultation with the Corps of Engineers (404 permits) for major wetland modifications.

Cultural Resources and Historic Preservation
The National Wildlife Refuge System Improvement Act of 1997, Section 6, requires the Service to make a determination of compatibility of existing, new and changing uses of Refuge land; and Section 7 requires the Service to identify and describe the archaeological and cultural values of the refuge.

The National Historic Preservation Act, Section 106, requires federal agencies to consider impacts their undertakings could have on historic properties; Section 110 requires Federal agencies to manage historic properties, e.g., to document historic properties prior to destruction or damage; Section 101 requires federal agencies consider Indian tribal values in historic preservation programs, and requires each federal agency to establish a program leading to inventory of all historic properties on its land.

The Archaeological Resources Protection Act of 1979 (ARPA) prohibits unauthorized disturbance of archeological resources on federal and Indian land; and other matters. Section 10 requires establishing “a program to increase public awareness” of archeological resources. Section 14 requires plans to survey lands and a schedule for surveying lands with “the most scientifically valuable archaeological resources.” This Act requires protection of all archeological sites more than 100 years old (not just sites meeting the criteria for the National Register) on federal land, and requires archeological investigations on federal land be performed in the public interest by qualified persons.

The Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) imposes serious delays

on a project when human remains or other cultural items are encountered in the absence of a plan. The American Indian Religious Freedom Act (AIRFA) iterates the right of Native Americans to free exercise of traditional religions and use of sacred places.

Executive Order 13007, Indian Sacred Sites (1996), directs federal agencies to accommodate access to and ceremonial use, to avoid adverse effects and avoid blocking access, and to enter into early consultation.

Emergency Wetlands Resources Act of 1986, 16 U.S.C. 3901 et seq.
Promotes the conservation of migratory waterfowl and offsets or prevents the serious loss of wetlands by the acquisition of wetlands and other essential habitats.

Endangered Species Act of 1973, 16 U.S.C. 1531 et seq.
Requires all federal agencies to carry out programs for the conservation of endangered and threatened species.

Executive Order 11988, Floodplain Management (1977)
Each federal agency shall provide leadership and take action to reduce the risk of flood loss and minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

Executive Order, Protection of Wetlands 11990
Executive Order 11990 directs federal agencies to (1) minimize destruction, loss, or degradation of wetlands and (2) preserve and enhance the natural and beneficial values of wetlands when a practical alternative exists.

Executive Order 12372, Intergovernmental Review of Federal Programs (1982)
Directs the Service to send copies of the Environmental Assessment to state planning agencies for review.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994)
Establishes environmental justice as a Federal government priority and directs all federal agencies to make environmental justice part of their mission. Environmental justice calls for fair distribution of environmental hazards.

Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System (1996)
Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the System.

Executive Order 13007, Indian Sacred Sites (1996)
Directs federal land management agencies to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, avoid adversely affecting the physical integrity of such sacred sites, and where appropriate, maintain the confidentiality of sacred sites.

Farmland Protection Policy Act, Public Law 97-98, 7 U.S.C. 4201 (1981)
Minimizes the extent to which federal programs contribute to the unnecessary and irreversible

conversion of farmland to nonagricultural uses.

Federal Noxious Weed Act, 7 U.S.C. 2801 et seq. (1975)
Requires the use of integrated management systems to control or contain undesirable plant species, and an interdisciplinary approach with the cooperation of other federal and state agencies.

Federal Records Act of 1950, 44 U.S.C. 31
Directs the preservation of evidence of the government's organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

Fish and Wildlife Act of 1956, 16 U.S.C. 742a et seq.
Established a comprehensive national fish and wildlife policy and broadened the authority for acquisition and development of refuges.

Fish and Wildlife Coordination Act 16 U.S.C. 661 et seq. (1934)
Requires that the U.S. Fish and Wildlife Service and state fish and wildlife agencies be consulted whenever water is to be impounded, diverted or modified under a Federal permit or license. The Service and state agency recommend measures to prevent the loss of biological resources, or to mitigate or compensate for the damage. The project proponent must take biological resource values into account and adopt justifiable protection measures to obtain maximum overall project benefits. A 1958 amendment added provisions to recognize the vital contribution of wildlife resources to the Nation and to require equal consideration and coordination of wildlife conservation with other water resources development programs. It also authorized the Secretary of Interior to provide public fishing areas and accept donations of lands and funds.

Fish and Wildlife Improvement Act of 1978, 16 U.S.C. 742a
Improves the administration of fish and wildlife programs and amends several earlier laws including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. It authorizes the Secretary to accept gifts and bequests of real and personal property on behalf of the United States. It also authorizes the use of volunteers on Service projects and appropriations to carry out a volunteer program.

Historic Sites, Buildings and Antiquities Act (also known as the Historic Sites Act of 1935), 16 U.S.C. 461 et seq.
Declares it a national policy to preserve historic sites and objects of national significance, including those located on refuges. Provides procedures for designation, acquisition, administration, and protection of such sites.

Land and Water Conservation Fund (1965), 16 U.S.C. 460 et seq.
Uses the receipts from the sale of surplus federal land, outer continental shelf oil and gas sales, and other sources for land acquisition under several authorities.

Migratory Bird Conservation Act, 16 U.S.C. 715 et seq.
Establishes procedures for acquisition by purchase, rental, or gift of areas approved by the Migratory Bird Conservation Commission.

Migratory Bird Hunting Stamp Act. Also known as the Duck Stamp Act, 16 U.S.C. 718 et seq. (1934)
Requires every waterfowl hunter 16 years of age or older to carry a stamp and earmarks proceeds of the

Duck Stamps to buy or lease waterfowl habitat. A 1958 amendment authorizes the acquisition of small wetland and pothole areas to be designated as 'Waterfowl Production Areas,' which may be acquired without the limitations and requirements of the Migratory Bird Conservation Act.

Migratory Bird Treaty Act, 16 U.S.C. 703 et seq.
Designates the protection of migratory birds as a federal responsibility. This Act enables the setting of seasons, and other regulations including the closing of areas, federal or nonfederal, to the hunting of migratory birds.

National Environmental Policy Act of 1969, 42 U.S.C. 4321 et seq.
Requires the disclosure of the environmental impacts of any major federal action significantly affecting the quality of the human environment.

National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq.
Establishes as policy that the federal government is to provide leadership in the preservation of the nation's prehistoric and historic resources. Section 106 requires federal agencies to consider impacts their undertakings could have on historic properties; Section 110 requires federal agencies to manage historic properties, e.g., to document historic properties prior to destruction or damage; Section 101 requires federal agencies to consider Indian tribal values in historic preservation programs, and requires each federal agency to establish a program leading to inventory of all historic properties on its land.

National Trails System Act, 16 U.S.C. 1241 et seq. (1968)
Assigns responsibility to the Secretary of Interior and thus the Service to protect the historic and recreational values of congressionally designated National Historic Trail sites.

National Wildlife Refuge System Administration Act of 1966, 16 U.S.C. 668dd, 668ee
Defines the National Wildlife Refuge System and authorizes the Secretary to permit any use of a refuge provided such use is compatible with the major purposes for which the refuge was established. The Refuge Improvement Act clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation and photography, and environmental education and interpretation); establishes a formal process for determining compatibility; established the responsibilities of the Secretary of Interior for managing and protecting the System; and requires a Comprehensive Conservation Plan for each refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

National Wildlife Refuge System Improvement Act of 1997, 16 U.S.C. 668dd
Considered the "Organic Act of the National Wildlife Refuge System. Defines the mission of the System, designates priority wildlife-dependent public uses, and calls for comprehensive refuge planning. Section 6 requires the Service to make a determination of compatibility of existing, new and changing uses of Refuge land; and Section 7 requires the Service to identify and describe the archaeological and cultural values of the refuge.

The Act also directs the administration of the Refuge System to ensure the biological integrity, diversity, and environmental health of the System. According to the U.S. FWS Service Manual (601 FW3) this refers to the maintenance of existing elements, and where appropriate the restoration of lost or severely degraded elements. Integrity pertains to biotic composition, structure, and function at genetic, organismal, and community levels. Diversity includes protection of the broad variety of living organisms,

genetic distinctions, and community compositions. Environmental health recognizes the importance of both biotic and abiotic features and processes in the System. The standard of measure for each of these terms is defined using historic conditions, or conditions and processes present prior to substantial anthropogenic changes, as indicated by the best available science and sound professional judgment.

National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act of 1998, 16 U.S.C. 742a
Amends the Fish and Wildlife Act of 1956 to promote volunteer programs and community partnerships for the benefit of national wildlife refuges, and for other purposes.

Native American Graves Protection and Repatriation Act, 25 U.S.C. 3001 et seq. (1990)
Requires federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

Refuge Recreation Act, 16 U.S.C. 460k et seq. (1962)
Allows the use of national wildlife refuges for recreation when such uses are compatible with the refuge's primary purposes and when sufficient funds are available to manage the uses.

Refuge Revenue Sharing Act,16 U.S.C. 715s (1935)
Requires revenue sharing provisions to all fee-title ownerships that are administered solely or primarily by the Secretary through the Service.

Rehabilitation Act of 1973, 29 U.S.C. 701 et seq.
Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the federal government to ensure that anybody can participate in any program.

Rivers and Harbor Appropriation Act (1899) (33 U.S.C. 403)
Section 10 of this Act requires the authorization by the U.S. Army Corps of Engineers prior to any work in, on, over, or under a navigable water of the United States.

Surface Mining Control and Reclamation Act of 1977, 30 U.S.C. 1201 et seq.
Regulates surface mining activities and reclamation of coal-mined lands. Further regulates the coal industry by designating certain areas as unsuitable for coal mining operations.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act, 16 U.S.C. 667b-667d (1948)
Provides that upon a determination by the Administrator of the General Services Administration, real property no longer needed by a federal agency can be transferred without reimbursement to the Secretary of Interior if the land has particular value for migratory birds, or to a state agency for other wildlife conservation purposes.

Treasury and General Government Appropriations Act, Pub. L. 106-554, §1(a)(3), Dec. 21, 2000, 114 Stat. 2763, 2763A–125
In December 2002, Congress required Federal agencies to publish their own guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information that they disseminate to the public (44 U.S.C. 3502). The amended language is included in Section 515(a). The Office of Budget and Management (OMB) directed agencies to develop their own guidelines to address the requirements of the law. The Department of the Interior instructed bureaus to prepare separate guidelines on how they would apply the Act. The U.S. Fish and Wildlife Service has developed “Information Quality Guidelines”

to address the law.

Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, 42 U.S.C. 4601 et seq.
Provides for uniform and equitable treatment of persons who sell their homes, businesses, or farms to the Service. The Act requires that any purchase offer be no less than the fair market value of the property.

Wilderness Act of 1964, 16 U.S.C. 1131 et seq.
Directed the Secretary of Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within National Wildlife Refuge and National Park Systems and to recommend to the President the suitability of each such area or island for inclusion in the National Wilderness Preservation System, with final decisions made by Congress. The Secretary of Agriculture was directed to study and recommend suitable areas in the National Forest System.

Appendix L: Glossary

Alternative
A set of objectives and strategies needed to achieve refuge goals and the desired future condition.

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

Compatible Use
A wildlife-dependent recreational use, or any other use on a refuge that will not materially interfere with or detract from the fulfillment of the mission of the Service or the purposes of the refuge.

Comprehensive Conservation Plan
A document that describes the desired future conditions of the refuge, and specifies management actions to achieve refuge goals and the mission of the National Wildlife Refuge System.

Cultural Resources
"Those parts of the physical environment -- natural and built -- that have cultural value to some kind of sociocultural group ... [and] those non-material human social institutions...." Cultural resources include historic sites, archeological sites and associated artifacts, sacred sites, traditional cultural properties, cultural items (human remains, funerary objects, sacred objects, and objects of cultural patrimony), and buildings and structures.

Ecosystem
A dynamic and interrelated complex of plant and animal communities and their associated non-living environment.

Ecosystem Management
Management of an ecosystem which includes all ecological, social, and economic components that make up the whole of the system.

Endangered Species
Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the *Federal Register*.

Environmental Assessment
A systematic analysis to determine if proposed actions would result in a significant effect on the quality of the environment.

Extirpation
The local extinction of a species that is no longer found in a locality or country, but exists elsewhere in the world.

Goals
Descriptive statements of desired future conditions.

Interjurisdictional Fish
Fish that occur in waters under the jurisdiction of one or more states, for which there is an interstate fishery management plan or which migrates between the waters under the jurisdiction of two or more states bordering on the Great Lakes.

Issue
Any unsettled matter that requires a management decision. For example, a resource management problem, concern, a threat to natural resources, a conflict in uses, or in the presence of an undesirable resource condition.

National Wildlife Refuge System
All lands, waters, and interests therein administered by the U.S. Fish and Wildlife Service as wildlife refuges, wildlife ranges, wildlife management areas, waterfowl production areas, and other areas for the protection and conservation of fish, wildlife and plant resources.

Objectives
A concise statement of what we want to achieve, how much we want to achieve, when and where we want to achieve it, and who is responsible for the work. Objectives derive from goals and provide the basis for determining strategies, monitoring refuge accomplishments, and evaluating the success of strategies.

Preferred Alternative
The Service's selected alternative identified in the Draft Comprehensive Conservation Plan.

Scoping
A process for determining the scope of issues to be addressed by a comprehensive conservation plan and for identifying the significant issues. Involved in the scoping process are federal, state and local agencies; private organizations; and individuals.

Species
A distinctive kind of plant or animal having distinguishable characteristics, and that can interbreed and produce young. A category of biological classification.

Strategies
A general approach or specific actions to achieve objectives.

Threatened Species
Those plant or animal species likely to become endangered species throughout all of or a significant portion of their range within the foreseeable future. A plant or animal identified and defined in accordance with the 1973 Endangered Species Act and published in the *Federal Register*.

Undertaking
“A project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; those requiring a Federal permit, license or approval...,” i.e., all Federal actions.

Vegetation
Plants in general, or the sum total of the plant life in an area.

Vegetation Type
A category of land based on potential or existing dominant plan species of a particular area.

Watershed
The entire land area that collects and drains water into a stream or stream system.

Wetland
Areas such as lakes, marshes, and streams that are inundated by surface or ground water for a long enough period of time each year to support, and that do support under natural conditions, plants and animals that require saturated or seasonally saturated soils.

Wildlife-dependent Recreational Use
A use of refuge that involves hunting, fishing, wildlife observation and photography, or environmental education and interpretation, as identified in the National Wildlife Refuge System Improvement Act of 1997.

Wildlife Diversity
A measure of the number of wildlife species in an area and their relative abundance.

Water Birds
This general category includes all birds that inhabit lakes, marshes, streams and other wetlands at some point during the year. The group includes all waterfowl, such as ducks, geese, and swans, and other birds such as loons, rails, cranes, herons, egrets, ibis, cormorants, pelicans, shorebirds and passerines that nest and rely on wetland vegetation.

Appendix M: Mailing List

The following is an initial list of government offices, private organizations, and individuals who will receive notice of the availability of this Draft CCP. We will continue to add to this list.

Federal Officials

- U.S. Senator Charles Grassley
- U.S. Senator Thomas Harkin
- U.S. Representative Leonard Boswell

Federal Agencies

- U. S. Army Corps of Engineers
- U.S. Department of Agriculture Service Center, Polk County

Native American Tribes

- Sac and Fox Tribe of the Mississippi in Iowa

State Officials

- State Senator Dennis Black
- State Representative Kim Pearson

State Agencies

- Iowa Department of Natural Resources
- Iowa Division of Tourism

City/County/Local Governments

- Jasper County Conservation Board
- Jasper County Board of Supervisors
- Marshall County Conservation Board
- Polk County Conservation Board
- City of Prairie City

Libraries

- Altoona Public Library

Organizations

- Iowa Audubon Society
- Iowa Farm Bureau Federation
- Iowa Meetings Association
- Iowa Native Plant Society
- Iowa Natural Heritage Foundation
- Iowa Prairie Network
- Iowa Rural Water Association
- Izaak Walton League, Ding Darling Chapter
- Johnson County Heritage Trust
- National Wild Turkey Federation

- Newton Convention and Visitors Bureau
- Newton Jaycees
- Pella Chamber of Commerce
- Pella Convention Bureau
- Pheasants Forever
- Sierra Club
- The Nature Conservancy
- Local businesses
- Local garden clubs
- Local schools and youth groups

Colleges and Universities

- Iowa State University
- Bethel College
- Drake University
- University of Northern Iowa

Media

- Local radio and TV stations; Refuge media contacts

Individuals

- Individuals who participated in open house sessions or who requested to be on the Neal Smith NWR mailing list; adjacent landowners

Appendix N: List of Preparers

Neal Smith National Wildlife Refuge Staff
Christy Smith, Wildlife Refuge Manager
Cheryl Groom, Deputy Refuge Manager
Karen Viste-Sparkman, Wildlife Biologist
Nancy Gilbertson, Wildlife Refuge Manager (retired)

Branch of Conservation Planning Staff:
Karen Westphall, Wildlife Biologist/Planner, Region 3 USFWS
Gabe DeAlessio, GIS Specialist, Region 3 USFWS
Mark Hogeboom, Writer/Editor, Region 3 USFWS

Regional Office Staff
Josh Eash, Regional Hydrologist, Region 3 USFWS
Patricia Heglund, Regional Biologist, Region 3 USFWS
James Myster, Regional Archaeologist, Region 3 USFWS
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