Draft Comprehensive Conservation Plan and Environmental Assessment

Rainwater Basin Wetland Management District

July 2007

Prepared by the U.S. Fish and Wildlife Service

Rainwater Basin Wetland Management District
2610 Avenue Q
Kearney, NE 68848
308/236 5015

and

Region 6, Mountain–Prairie Region
Division of Refuge Planning
134 Union Boulevard, Suite 300
Lakewood, CO 80228
303/236 4305

Contents

Figures and Tables

FIGURES

TABLES

Abbreviations

Administration Act	National Wildlife Refuge System Administration Act
ATV	all-terrain vehicle
the **basin**	Rainwater Basin
CAFO	concentrated animal-feeding operation
CCP	comprehensive conservation plan
CFR	Code of Federal Regulations
COMLG	Conservation Order for Mid-continent Light Geese
CWCS	comprehensive wildlife conservation strategy
the **district**	Rainwater Basin Wetland Management District
DUD	duck use-day
EA	environmental assessment
FGDC	Federal Geographic Data Committee
FMP	fire management plan
GIS	Geographic Information System
GS	general pay schedule
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
IPM	integrated pest management
ME	metabolized energy
NASS	Natural Agricultural Statistics Service
NAWMP	North American Waterfowl Management Plan
NDEQ	Nebraska Department of Environmental Quality
NEPA	National Environmental Policy Act
NGPC	Nebraska Game and Parks Commission
NOI	notice of intent
NVCS	National Vegetation Classification System
NWR	national wildlife refuge
ORP	outdoor recreation planner
PILT	payments in lieu of taxes
PL	public law
PM	particulate matter
RWBJV	Rainwater Basin Joint Venture
refuge	national wildlife refuge
Refuge System	National Wildlife Refuge System
RONS	Refuge Operating Needs System
SAMMS	Service Asset Maintenance Management System
Service	U.S. Fish and Wildlife Service
SWG	state wildlife grant
UNL	University of Nebraska–Lincoln
USC	United States Code
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USGS–BRD	U.S. Geological Survey's biological resources division
WG	wage grade pay schedule
WMA	wildlife management area
WMD	wetland management district
WPA	waterfowl production area

Summary

Millions of ducks and geese glide into the flat plains of south-central Nebraska each spring. These migrants take their rest at the few remaining oases that dot the Rainwater Basin, where they find sanctuary and nourishment before continuing their annual migration.

Conserving the integrity of these important stopovers is the role of the Rainwater Basin Wetland Management District. The foundation for management of these public wetlands known as waterfowl production areas is the comprehensive conservation plan.

This environmental assessment includes the draft comprehensive conservation plan for the Rainwater Basin Wetland Management District. The final plan will guide management of the waterfowl production areas within the district for the next 15 years.

THE DISTRICT

The Rainwater Basin Wetland Management District is a part of the National Wildlife Refuge System of the U.S. Fish and Wildlife Service. The district, which covers 13 Nebraska counties, manages 230 tracts of land (more than 24,000 acres) that form 61 waterfowl production areas. In addition, the district manages 35 conservation easements (2,476 acres).

Each waterfowl production area typically contains wetlands that are managed for waterfowl and shorebirds. Most of the wetlands in the Rainwater Basin are small and surrounded by cropland. Extensive wetland drainage and alteration have reduced the number of wetlands in the basin to a level that threatens waterbird populations. Upland areas are managed for a high diversity of native vegetation to sustain grassland birds.

Nebraska's Rainwater Basin is internationally known for its spectacular bird migrations—329 species of birds have been observed. Common waterbirds include snow goose, northern pintail, green-winged teal, and solitary sandpiper. Grasshopper sparrow, bobolink, and ring-necked pheasant are common grassland species.


USFWS

Due to its unique location on the Central Flyway, millions of birds funnel into the district's waterfowl production areas.

Of the estimated 80,000 visitor days per year at the district, about 60% come for hunting and 40% for wildlife viewing. There is hunting that includes waterfowl, pheasant, and deer. Every spring and fall, thousands of tourists and locals visit the district to observe and enjoy the semiannual migration of cranes, waterfowl, and other birds.

VISION FOR THE DISTRICT

The Rainwater Basin provides critical habitat for millions of migratory birds. The basin's name reflects both the basis of its wetland hydrology and natural precipitation cycles. A network of functioning wetland and prairie plant ecosystems provides a native grassland mosaic that gives the local community a sense of pride and connection to the Great Plains flora and fauna. The lands managed by the wetland management district serve as an example of land stewardship mimicking natural processes, and they provide an array of wildlife-dependent educational and recreational opportunities. It is only through partnerships with individuals, agencies, and organizations that this vision can be achieved and maintained.

GOALS FOR THE DISTRICT

The following goals reflect the vision for the district—providing for healthy ecosystems and compatible opportunities for the public to appreciate and enjoy the natural environment.

Wetland Habitat Goal

Restore, enhance, and maintain the hydrology and early successional vegetation conditions essential to the conservation of migratory birds.

Upland Habitat Goal

Reestablish and maintain native grassland communities of the Rainwater Basin.

Water Rights Goal

Develop partnerships to protect the natural hydrology of WPA watersheds and ensure the necessary water rights are in place to protect future use of both ground and surface water.

Wildlife Diseases Goal

Work with partners to prevent or control the outbreak and spread of wildlife-borne diseases to protect human and migratory bird populations.

Invasive Plant Species Goal

Reduce and control the spread of nondesirable, nonnative plant species within wetland and upland habitats for the benefit of native plant and wildlife communities.

Research and Science Goal

Encourage and support research that substantially contributes to the understanding and management of the Rainwater Basin wetland and grassland ecosystem.

Cultural Resources Goal

Identify and evaluate the cultural resources in the district and protect those that are determined to be significant.

Visitor Services Goal

Provide quality wildlife-dependent recreation and educational opportunities by instilling an understanding of basic ecological processes, purpose of the Rainwater Basin Wetland Management District, and mission of the Service for persons of all abilities and cultural backgrounds.

Partnership Goal

Promote and develop partnerships with adjacent landowners, public and private organizations, Native American tribes, and other interested individuals to protect, restore, enhance, and maintain a diverse and productive ecosystem.

Socioeconomics Goal

Obtain a better understanding of the social and economic contribution WPAs make to the people and communities within the Rainwater Basin.

Operations Goal

Safely and efficiently use funding, staffing, infrastructure, and partnerships to achieve the purpose and objectives of the Rainwater Basin Wetland Management District.

THE DRAFT PLAN

The Service has prepared this environmental assessment and draft plan in cooperation with the Rainwater Basin Joint Venture, the Nebraska Game and Parks Commission, and the Biological Resources Division of the U.S. Geological Survey—along with public participation. After reviewing a wide range of public comments and management needs, the Service developed two alternatives for management of the district. Alternative B is the proposed action of the Service and is presented in chapter 6 as the draft comprehensive conservation plan.

Alternative A—Current Management (No Action)

Management of the district would remain the same, with changes in land management and public use occurring as opportunities arise. The current district staff would perform limited, issue-driven research and only monitor long-term vegetation change.

Alternative B—Integrated Partnership Approach (Proposed Action)

Alternative B addresses resource management in a holistic manner. There would be a focus on cooperation, coordination, and better exchange of information. An expanded district staff would work with partners to improve the waterfowl production areas across the landscape of the Rainwater Basin. The emphasis would be on adaptive management—as more information is known, management would be changed to improve effects on the environment.

1 Introduction

© Mike Vesey

Northern pintails are abundant at the waterfowl production areas.

The U.S. Fish and Wildlife Service (Service) has developed this draft comprehensive conservation plan (CCP) to provide a foundation for the management and use of public lands within the Rainwater Basin Wetland Management District (district) located in south-central Nebraska (see figure 1, vicinity map).

When finalized, the CCP will serve as a working guide for management programs and actions over the next 15 years.

This draft CCP was developed in compliance with the National Wildlife Refuge System Improvement Act of 1997 (Improvement Act) and Part 602 of "The Fish and Wildlife Service Manual." The actions described within this draft CCP and environmental assessment (EA) meet the requirements of the National Environmental Policy Act of 1969 (NEPA). Compliance with the NEPA is being achieved through involvement of the public. Appendix A contains more detail on these laws and policies.

The final CCP will specify the necessary actions to achieve the vision and purposes of the Rainwater Basin Wetland Management District, which Congress established to manage waterfowl production areas (WPAs) in the Rainwater Basin (basin) (see figure 2, waterfowl production areas). Wildlife and their habitats is the first priority in refuge management, and public use (wildlife-dependent recreation) is allowed and encouraged as long as it is compatible with the district's purposes.

The draft CCP and the EA have been prepared by a planning team composed of representatives from various Service programs including district and regional office staffs and from the Rainwater Basin Joint Venture (RWBJV), U.S. Geological Survey's biological resources division (USGS–BRD), and Nebraska Game and Parks Commission (NGPC). In addition, the planning team used public input. Public involvement and the planning process are described in section 1.6, "The Planning Process."

After reviewing a wide range of public comments and management needs, the planning team developed alternatives for management of the district. The team recommended one alternative to be the Service's proposed action. This action addresses all substantive issues while determining how best to achieve the purposes of the district. The proposed action is the Service's recommended course of action for management of the Rainwater Basin Wetland Management District. The proposed action is summarized in chapter 3, "Alternatives," with its predicted effects described in chapter 5, "Environmental Consequences." The details of the proposed action compose the draft CCP (chapter 6).

1.1 PURPOSE AND NEED FOR THE PLAN

The purpose of the draft CCP is to identify the role that the district will play in support of the mission of the National Wildlife Refuge System (Refuge System), and to provide long-term guidance for management of district programs and activities.

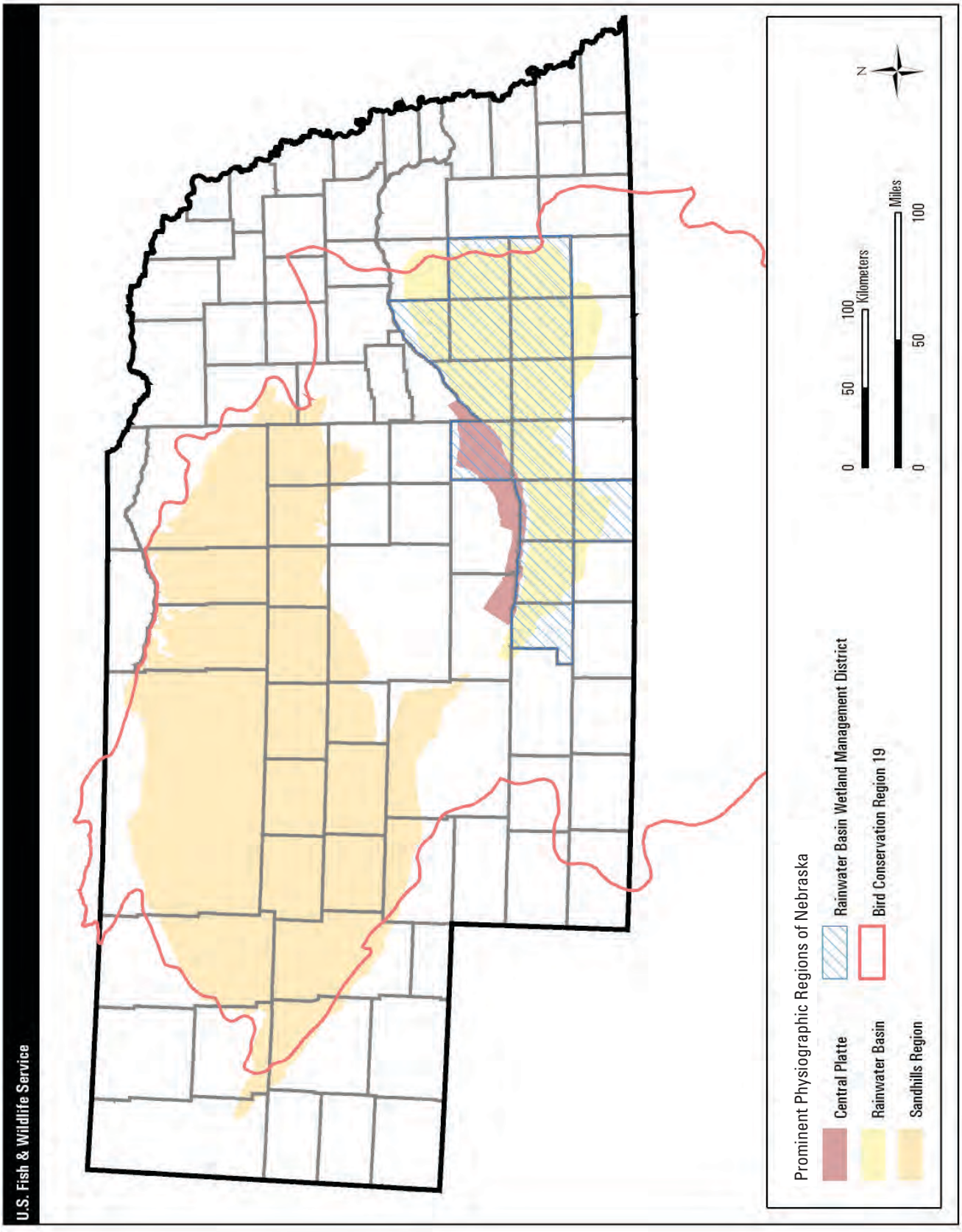


Figure 1. Vicinity map for the Rainwater Basin Wetland Management District, Nebraska.

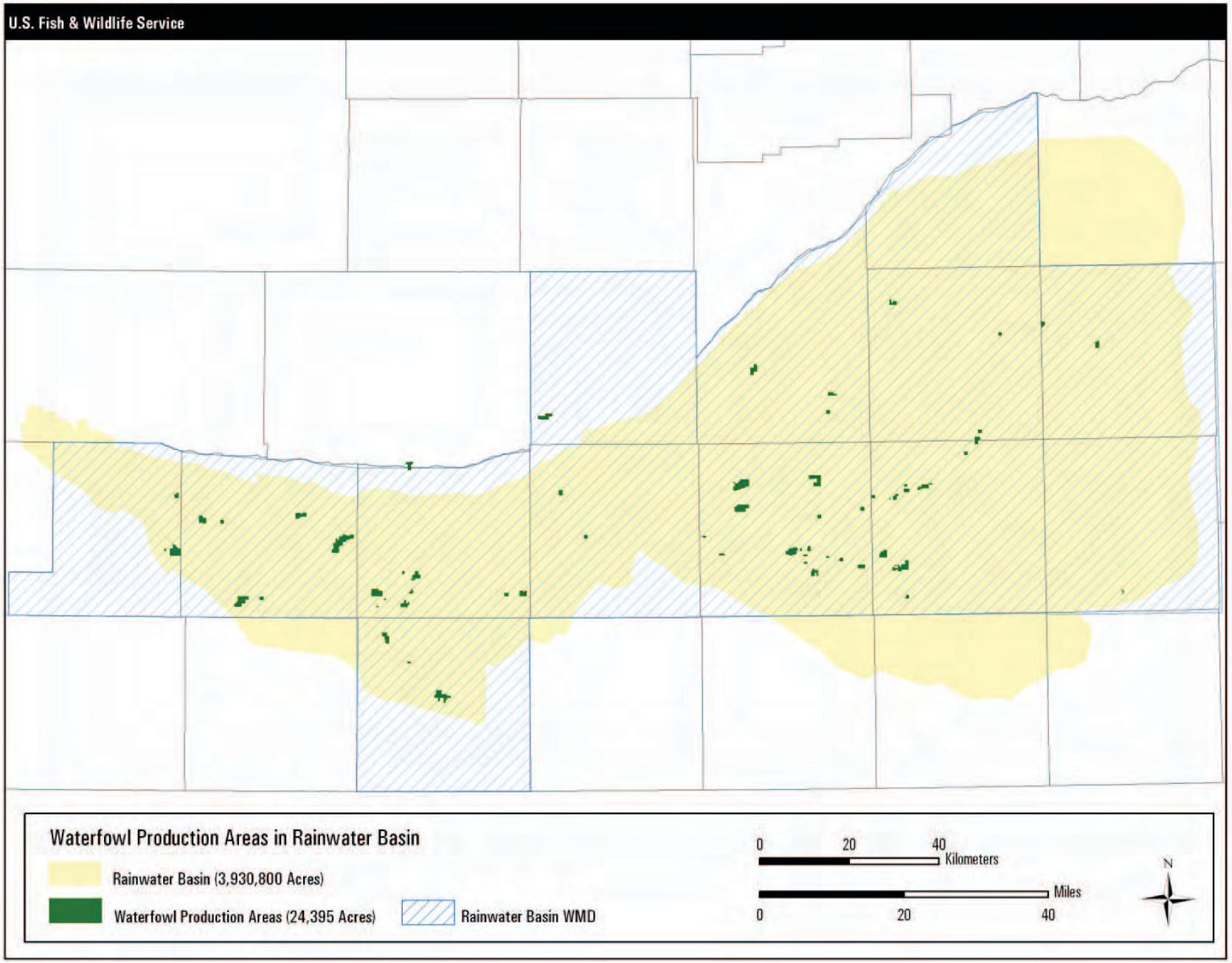


Figure 2. Waterfowl production areas in the Rainwater Basin, Nebraska.

The CCP is needed

- to communicate with the public and other partners in efforts to carry out the mission of the Refuge System;
- to provide a clear statement of direction for management of the district's WPAs;
- to provide neighbors, visitors, and government officials with an understanding of the Service's management actions on and around the district's WPAs;
- to ensure that the Service's management actions are consistent with the mandates of the Improvement Act;
- to ensure that the management of the district's WPAs is consistent with federal, state, and county plans;
- to provide a basis for the development of budget requests for the district's operation, maintenance, and capital improvement needs.

Sustaining the nation's fish and wildlife resources is a task that can be accomplished only through the combined efforts of governments, businesses, and private citizens.

1.2 THE U.S. FISH AND WILDLIFE SERVICE AND THE REFUGE SYSTEM

The Service is the principal federal agency responsible for fish, wildlife, and plant conservation. The Refuge System is one of the Service's major programs.

U.S. Fish and Wildlife Service

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

Over a century ago, America's fish and wildlife resources were declining at an alarming rate. Concerned citizens, scientists, and hunting and angling groups joined together to restore and sustain America's national wildlife heritage. This was the genesis of the U.S. Fish and Wildlife Service.

Today, the Service enforces federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and restores vital wildlife habitat, protects and recovers endangered species, and helps other governments with conservation efforts. In addition, the Service administers a federal aid program that distributes hundreds of millions of dollars to states for fish and wildlife restoration, boating access, hunter education, and related programs across America.

The Service manages the National Wildlife Refuge System including thousands of WPAs and other special management areas. It also operates 66 national fish hatcheries and 78 ecological services field stations.

Service Activities in Nebraska

Service activities in Nebraska contribute to the state's economy, ecosystems, and education programs. The Rainwater Basin Wetland Management District contributes to the economic benefits of hunting, wildlife observation, and photography in Nebraska. A report titled, "Banking on Nature 2004: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation," evaluated the effects of refuges on local economies.

Based on figures from 2004, the district is estimated to have generated $900,000 in local economic effects from recreation visits (BBC Research and Consulting 2006). The majority of effects were associated with expenditures by nonresident visitors. In addition, the district's budget contributes a stimulus to the local economy with a significant portion of payroll, maintenance, and operation expenditures spent locally.

The district employs 12 full-time employees, has a current budget of $1.8 million, and has an annual visitation of 80,000. The budget includes funds for the fire program and the Partners for Fish and Wildlife Program. In addition, volunteers contribute 240 hours to the district's operations.

The Nebraska Sport Fish and Wildlife Restoration Program is a source of federal excise taxes paid by hunters, anglers, and boaters on fishing and hunting equipment. The monies generated from this tax have economic benefits to Nebraska. In 2001, the economic impact of angler expenditures was $146 million and hunters contributed $198 million to the overall economy (U.S. Fish and Wildlife Service [USFWS] 2000).

The National Wildlife Refuge System

In 1903, President Theodore Roosevelt designated the 5.5-acre Pelican Island in Florida as the nation's first wildlife refuge for the protection of brown pelicans and other native, nesting birds. This was the first time the federal government set aside land for wildlife. This small but significant designation was the beginning of the Refuge System.

One hundred years later, the Refuge System has become the largest collection of lands in the world specifically managed for wildlife, encompassing over 96 million acres within 546 refuges and over 3,000 small areas for waterfowl breeding and nesting. Today, there is at least one refuge in every state including Puerto Rico and the U.S. Virgin Islands.

In 1997, the Improvement Act established a clear mission for the Refuge System.

> *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.*

The Improvement Act states that each national wildlife refuge (that is, each unit of the Refuge System, which includes wetland management districts) shall be managed

- to fulfill the mission of the Refuge System;
- to fulfill the individual purposes of each refuge and district;
- to consider the needs of fish and wildlife first;
- to fulfill the requirement of developing a CCP for each unit of the Refuge System, and fully involve the public in the preparation of these plans;
- to maintain the biological integrity, diversity, and environmental health of the Refuge System;
- to recognize that wildlife-dependent recreation activities including hunting, fishing, wildlife observation, photography, environmental education, and interpretation are legitimate and priority public uses;
- to retain the authority of refuge managers to determine compatible public uses.

In addition to the mission for the Refuge System, the wildlife and habitat vision for each unit of the Refuge System stresses the following principles:

- Wildlife comes first.
- Ecosystems, biodiversity, and wilderness are vital concepts in refuge and district management.
- Habitats must be healthy.
- Growth of refuges and districts must be strategic.
- The Refuge System serves as a model for habitat management with broad participation from others.

Following passage of the Improvement Act, the Service immediately began to carry out the direction of the new legislation, including preparation of CCPs for all national wildlife refuges and wetland management districts. Consistent with the Improvement Act, the Service prepares all CCPs in conjunction with public involvement. Each unit of the Refuge System is required to complete its CCP within the 15-year schedule (by 2012).

People and the Refuge System

The nation's fish and wildlife heritage contributes to the quality of American lives and is an integral part of the country's greatness. Wildlife and wild places have always given people special opportunities to have fun, relax, and appreciate the natural world.

Whether through bird watching, fishing, hunting, photography, or other wildlife pursuits, wildlife recreation contributes millions of dollars to local economies. In 2002, approximately 35.5 million people visited the Refuge System, mostly to observe wildlife in their natural habitats. Visitors are most often accommodated through nature trails, auto tours, interpretive programs, and hunting and fishing opportunities. Significant economic benefits are being generated to the local communities that surround refuges and wetland management districts. Economists report that Refuge System visitors contribute more than $792 million annually to local economies.

1.3 NATIONAL AND REGIONAL MANDATES

Refuge System units are managed to achieve the mission and goals of the Refuge System, along with the designated purpose of the refuges and districts (as described in establishing legislation, executive orders, or other establishing documents). Key concepts and guidance of the Refuge System are in the Refuge System Administration Act of 1966 (Administration Act), Title 50 of the Code of Federal Regulations (CFRs), "The Fish and Wildlife Service Manual," and the Improvement Act.

The Improvement Act amends the Administration Act by providing a unifying mission for the Refuge System, a new process for determining compatible public uses on refuges and districts, and a requirement that each refuge and district be managed under a CCP. The Service has made draft compatibility determinations (see appendix B) for the following uses at the district: haying, grazing, farming, environmental education, interpretation, wildlife observation, photography, recreational fishing, recreational hunting, and timber harvest.

The Improvement Act states that wildlife conservation is the priority of Refuge System lands and that the Secretary of the Interior will ensure that the biological integrity, diversity, and environmental health of refuge lands are maintained. Each refuge and district must be managed to fulfill the Refuge System's mission and the specific purposes for which it was established. The Improvement Act requires the Service to monitor the status and trends of fish, wildlife, and plants in each refuge and district.

A detailed description of these and other laws and executive orders that may affect the CCP or the Service's implementation of the CCP is in appendix A. Service policies on planning and day-to-day management of refuges and districts are in the "Refuge System Manual" and "The Fish and Wildlife Service Manual."

1.4 DISTRICT CONTRIBUTIONS TO NATIONAL AND REGIONAL PLANS

The Rainwater Basin Wetland Management District contributes to the conservation efforts described here.

Fulfilling the Promise

A 1999 report, "Fulfilling the Promise, The National Wildlife Refuge System" (USFWS 1999), is the culmination of a yearlong process by teams of Service employees to evaluate the Refuge System nationwide. This report was the focus of the first national Refuge System conference (in 1998)—attended by refuge managers, other Service employees, and representatives from leading conservation organizations.

The report contains 42 recommendations packaged with three vision statements dealing with wildlife and habitat, people, and leadership. This CCP deals with all three of these major topics. The planning team looked to the recommendations in the document for guidance during CCP planning.

Partners in Flight

The "Partners in Flight" program began in 1990 with the recognition of declining population levels of many migratory bird species. The challenge, according to the program, is managing human population growth while maintaining functional natural ecosystems. To meet this challenge, Partners in Flight worked to identify priority land-bird species and habitat types. Partners in Flight activity has resulted in 52 bird conservation plans covering the continental United States.

The primary goal of Partners in Flight is to provide for the long-term health of the bird life of this continent. The first priority is to prevent the rarest species from going extinct. The second priority is to prevent uncommon species from descending into threatened status. The third priority is to "keep common birds common."

There are 58 physiographic areas, defined by similar physical geographic features, wholly or partially contained within the contiguous United States and several others wholly or partially in Alaska. The Rainwater Basin Wetland Management District lies within physiographic area 34 (see figure 3, physiographic areas).

The source of the following description is from the Partners in Flight website (Butcher, no date).

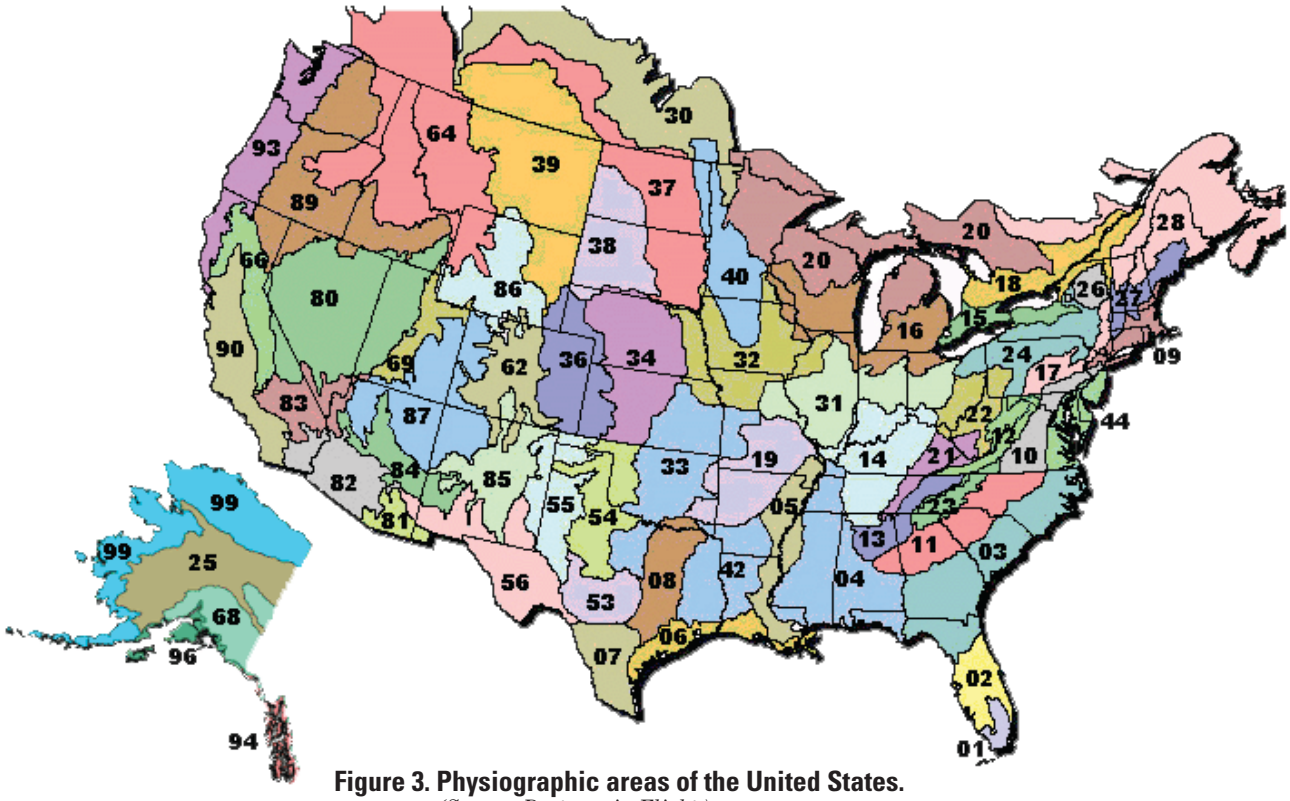


Figure 3. Physiographic areas of the United States.
(Source: Partners in Flight.)

Physiographic area 34, known as the "Central Mixed-grass Prairie," includes the central portion of Nebraska and Kansas, and a small portion occurs in southern South Dakota. The Nebraska Sandhills cover the northern and western portions of the area. The sandhills are an area of rolling, irregular dunes interspersed with gently sloping valleys and numerous small wetlands. The remainder of the physiographic area is a dissected loess plain, drained by several major rivers. All of the uplands are natural mixed- and tall-grass prairie communities, and the larger river valleys support northern floodplain forests.

The Nebraska Sandhills is one of the few, large, productive areas for grassland birds on the continent. It remains in excellent condition due to long-term use of virtually 100% of private lands for grazing livestock. Historical grazing practices have been, largely, beneficial. To keep the area healthy for birds, it is important to maintain the health of the ranching economy.

Priority bird species and habitats of the Central Mixed-grass Prairie are listed below:

Grassland
- lesser prairie-chicken
- greater prairie-chicken
- Swainson's hawk
- dickcissel
- long-billed curlew
- Bell's vireo
- Smith's longspur

Big River Sandbars
- piping plover

Wetlands
- American white pelican
- black rail

Large wetland–grassland complexes benefit all of the high-priority birds and are essential to some. It is important to maintain all existing complexes. The black rail is a species that uses wet meadows; its ecology remains largely unknown and more survey work and retention of potential habitat are needed.

One of the most important features of the physiographic area is the close proximity of the Platte River to the district's wetlands, which combine to form a large and diverse habitat complex. This complex provides midlatitudinal, migrational habitat for midcontinental populations of sandhill cranes (86%), snow geese (90%), white-fronted geese (90%), and mallards (50%). In addition, impressive numbers of shorebirds annually stop in the area.

Key areas are receiving attention through the RWBJV and other endeavors. The efforts—some of which involve repeated removal of woody vegetation from sandbars that have stabilized with altered hydrology—are important to continue to keep the area attractive for these birds.

Maintenance of large, unfragmented, grassland ecosystems is the conservation objective for areas such as the Missouri Coteau where agriculture is not dominant. On the drift prairie and other agricultural areas, it is important to conserve discrete blocks of grassland–wetland complexes.

North American Waterfowl Management Plan

The Rainwater Basin is located in the Central Flyway, which is one of four administrative waterfowl flyways in North America.

Due to its unique location on the Central Flyway, millions of birds—including sandhill cranes, Canada geese, snow geese, and mallards—funnel into the district's WPAs to rest and eat before continuing on their journey (see figure 4, "hourglass" flight path of migratory birds).

Figure 4. "Hourglass" flight path of migratory birds.

The Central Flyway occurs in the following states and provinces: Colorado, Kansas, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming in the United States; and Alberta and Saskatchewan in Canada. Federal, state, and provincial representatives from the United States and Canada make up the Central Flyway Council. The council meets regularly to coordinate population surveys, regulate and set hunting seasons, and plan for management of the migratory bird resource.

Canada, the United States, and Mexico united in 1986 to form the North American Waterfowl Management Plan (NAWMP) (USFWS et al. 1998), designed to restore diminishing continental waterfowl populations to the levels of the 1970s. The NAWMP envisioned a

15-year effort to achieve landscape conditions that could sustain waterfowl populations. Specific NAWMP objectives are to increase and restore duck populations to the average levels of the 1970s: 62 million breeding ducks and a fall flight of 100 million birds.

By 1985, waterfowl populations had plummeted to record lows. Habitat that waterfowl depend on was disappearing at a rate of 60 acres per hour. Recognizing the importance of waterfowl and wetlands to North Americans and the need for international cooperation to help in the recovery of a shared resource, the United States and Canada governments developed a strategy to restore waterfowl populations through habitat protection, restoration, and enhancement. Mexico became a signatory to the plan in 1994.

The plan is innovative because of its international scope, plus its implementation at the regional level. Its success depends on the strength of partnerships called "joint ventures," involving federal, state, provincial, tribal, and local governments; businesses; conservation organizations; and individual citizens.

Joint ventures are regional, self-directed partnerships that carry out science-based conservation through a wide array of community participation in the United States, Canada, and Mexico. Joint ventures develop implementation plans focusing on areas of concern identified in the plan. The Rainwater Basin Wetland Management District lies within the administrative boundary of the Rainwater Basin Joint Venture.

Rainwater Basin Joint Venture

The Rainwater Basin Joint Venture (Gersib et al. 1992) is one of 14 joint ventures formed to undertake conservation projects. The joint venture was founded in 1992 with a goal to restore and permanently protect 37,000 acres of high-quality wetlands and 25,000 acres of associated uplands with adequate water and distribution to meet the needs of waterfowl and other migratory birds.

Location

Although the RWBJV's focus is the basin, its boundary also encompasses that portion of "Bird Conservation Region 19" in Nebraska (see figure 1). Three prominent geographic features occur within the joint venture—the basin in south-central Nebraska, the Nebraska Sandhills in north-central Nebraska, and the central portion of the Platte River.

The Playa Lakes Joint Venture bounds the RWBJV on the west and south. On the east, the RWBJV borders the Upper Mississippi–Great Lakes Region Joint Venture. The RWBJV's northern boundary is the Nebraska state line and it borders the Prairie Pothole Region and the Northern Great Plains Region joint ventures.

Description

Land use in the basin portion of the RWBJV is almost entirely agriculture, with corn and soybeans being the dominant crops. The topography of the basin is flat and it is poorly drained—forming thousands of shallow wetlands. Most of the wetlands are small and incorporated into cropland. Extensive wetland drainage and alteration has reduced the number of wetlands to a level that threatens populations of waterfowl and other waterbirds. The area is part of the tall- and mixed-grass prairie region of the Great Plains.

The sandhills portion is native, mixed-grass prairie that is used for livestock production. The topography is hilly, grass-covered, sand dunes. The porous sand allows for rapid percolation, forming a large groundwater reservoir. The groundwater is exposed in the low valleys and depressions—creating over a million acres of lakes, wetlands, and wet meadows.

The Platte River is a flat, braided river that has become forested in the last century. It is historically significant for settlement and for wildlife migrations. An approximately 150-mile stretch of the river transects the Central Flyway. Each spring nearly one-half million sandhill cranes and millions of ducks and geese use the river. River use by spring-migrating waterfowl increases dramatically when the basin's wetlands are dry or frozen.

Conservation

Each joint venture includes the participation of individuals, corporations, conservation organizations, and government agencies (USFWS et al. 1998). The district contributes to and participates in the RWBJV through its Partners for Fish and Wildlife Program, participation on various committees, and management of WPAs.

Recovery Plans for Federally Listed Threatened or Endangered Species

Where federally listed threatened or endangered species occur at the Rainwater Basin Wetland Management District's WPAs, management goals and strategies in their respective recovery plans will be followed. The list of threatened or endangered species that occur at the district will change as species are listed or delisted, or as listed species are discovered on district lands.

The district lies within the historical range of the whooping crane, least tern (interior population), bald eagle, American burying beetle, and western prairie fringed orchid. All of these species have recovery plans. If these species are found in the district, the staff will follow recovery plan guidelines.

State Comprehensive Conservation Wildlife Strategy

Over the past several decades, documented declines of wildlife populations have occurred nationwide. Congress created the State Wildlife Grant (SWG) program in 2001. This program provides states and territories with federal dollars to support conservation aimed at preventing wildlife from becoming endangered and in need of protection under the Endangered Species Act. The SWG program represents an ambitious endeavor to take an active hand in keeping species from becoming threatened or endangered in the future.

According to the SWG program, each state, territory, and the District of Columbia must complete a comprehensive wildlife conservation strategy (CWCS) by October 1, 2005 to receive future funding.

These strategies will help define an integrated approach to the stewardship of all wildlife species, with additional emphasis on species of concern and habitats at risk. The goal is to shift focus from single-species management and highly specialized individual efforts to a geographically based, landscape-oriented, fish and wildlife conservation effort. The Service approves CWCSs and administers SWG program funding.

In 2005, the NGPC developed a statewide CWCS called the Nebraska Natural Legacy Plan. The planning team reviewed the legacy plan and the information obtained was used during the development of the draft CCP and EA. Implementation of the habitat goals and objectives in the draft CCP would support the goals and objectives of the legacy plan.

Nebraska Natural Legacy Plan

The planning process for the legacy plan solicited public input and the help of state, federal, and nongovernmental agencies. One of the plan's purposes was to identify areas in the state that have unique wildlife and habitat characteristics. These unique areas—"biologically unique landscapes"—are focus areas for the conservation of the state's rarest species and natural habitats.

Nebraska's mission to "develop and implement a blueprint for conserving Nebraska's flora, fauna, and natural habitats" provides the state with a way to address pressing natural resource issues. When formulating proposed actions, planners must take into account the state's strong agricultural background. Farms and ranches cover 93% of the total land area and support a significant share of Nebraska's overall biological diversity. Maintenance of biological diversity throughout the state requires that conservation efforts be directed at a broad range of land issues and management practices on public and private lands. Maintaining and improving existing habitat on working farms and ranches is essential to conserving biological diversity and offers the greatest hope for success.

Nebraska plans to improve the efficiency and effectiveness of conservation by taking a more systematic approach to identifying and prioritizing the components of biological diversity through a "course filter/fine filter" approach. Monitoring of Nebraska lands becomes a priority as the state begins implementation of the plan. Monitoring of management actions is conducted at two levels: (1) response of individual species, and (2) response of habitats or ecological communities. Monitoring trends in abundance and distribution of different habitat types can be used to detect land use changes and can help direct conservation action toward those types that are showing the steepest decline.

Nebraska divides the state into four ecoregions for management purposes: tall-grass prairie, mixed-grass prairie, sandhills, and short-grass prairie. The ecoregions that occur in the basin—mixed-grass prairie and tall-grass prairie—are further described.

Mixed-grass Prairie Ecoregion

The mixed-grass prairie ecoregion lies between the tall-grass prairie to the east and the short-grass prairie to the west, acting as a transition zone for the two. The region's climate is semiarid with annual average precipitation ranging from 28 inches in the east to 20 inches in the west. Average annual temperatures range from 52°F to 57°F. Starting in 1940, the government put in place policies to subsidize and facilitate conversion of marginal land such as playa wetlands to croplands. Center-pivot irrigation facilitated cultivation of steeper slopes and lands isolated from surface irrigation sources. Two-thirds of the land in the ecoregion is engaged in cropland production with most of the remaining grasslands used for livestock grazing.

Tall-grass Prairie Ecoregion

The tall-grass prairie ecoregion covers primarily the eastern quarter of the state, with parts extending further westward. Loess and organic matter form the

basis for the deep, fertile soils that typify eastern Nebraska. Annual precipitation ranges from 25–36 inches, with summer temperatures reaching highs of 90°F and dropping to lows of 10°F in winter. The tall-grass prairie ecoregion is considered to have more diversified farming operations than the western part of the state.

Ecoregion Threats

Native animal species and ecoregion threats are essentially the same for all four regions in Nebraska. More than 300 species of resident and migratory birds have been found in the area. Most of the 55 mammal species are widespread with no distinct affiliation to the regions. Native, large predators have become extremely rare or extirpated from the regions. The 75 species of fish present in the ecoregions are "big river" generalists that can withstand a wide variation of environmental extremes. Wetlands are used for breeding by all the amphibians and reptiles. Insects are the most diverse and perhaps the most important group ecologically and economically because they play vital roles as herbivores, predators, pollinators, decomposers, soil aerators, and as food for other wildlife.

Several stresses face and affect the ecoregions, as follows:

- Conversion and fragmentation of natural habitats.
- Wetland drainage.
- Wetland sedimentation.
- Altered hydrology of wetlands.
- Fire plays an important role in prairie maintenance by promoting nutrient cycling, creating microhabitats, and increasing plant vigor and native plant diversity. Currently, less than 1% of the state's grasslands and woodlands are burned annually. Loss of fire has resulted in the degradation of thousands of acres of prairie by invasive plant species.
- Most grazing takes place in the absence of fire and with relatively little variation in timing and intensity. Overgrazing can severely impact the composition of grasslands, and increase the amount of sediment and other pollutants entering waterbodies. Grazing systems used on prairie remnants cause losses of plant and animal diversity and ecological functions.
- Spread of invasive plants has threatened the ecoregions' biological diversity.
- Altered hydrology and channel degradation of rivers and streams cause reductions in natural flows and reduce habitat available.
- Large-scale habitat fragmentation from conversion of native habitats to crop fields, housing developments, and roads has occurred over most of the state with the exception of the Nebraska Sandhills.

1.5 ECOSYSTEM DESCRIPTION AND THREATS

The Service has adopted watersheds as the basic building blocks for carrying out ecosystem conservation (see figure 5, ecosystem map). The district is located within the Platte–Kansas rivers ecosystem. In addition, the Nebraska Natural Legacy Plan (2005) identifies the Rainwater Basin as one of 40 "biologically unique landscapes."

Platte–Kansas Rivers Ecosystem

The Platte–Kansas rivers ecosystem includes almost all of Nebraska, southeast Wyoming, northeast Colorado, and northern Kansas (see figure 6). This ecosystem encompasses approximately 182,000 square miles and is home to the Nebraska Sandhills, the largest sand dune complex in the Western Hemisphere. The sandhills and many other areas provide vital habitat for numerous threatened and endangered wildlife and plant species.

The ecosystem spans from snow-capped, barren mountain peaks in Colorado to lowland riparian cottonwood forests along the Missouri River in eastern Nebraska and Kansas. The mountainous regions are predominately a mixture of coniferous forests comprised of Douglas-fir, ponderosa pine, lodgepole pine, Engelmann spruce, and subalpine fir. Pinyon pine and juniper woodlands and aspen communities are common throughout. Alpine meadows and lakes, willow shrub lands, and barren rocky areas are common at high elevations. Forests generally transition into shrub communities dominated by sagebrush with short grasses and forbs in eastern Wyoming and western Nebraska. Farther to the east, trees give way to short-grass prairie dominated by buffalograss, blue grama, hairy grama, and western wheatgrass. The short-grass prairie turns into mixed-grass prairie, due primarily to greater annual rainfall, in central Nebraska and Kansas.

Many federally listed endangered and threatened species including the bald eagle, piping plover, whooping crane, and Eskimo curlew have sought out this area as a refuge.

Threats to the Platte–Kansas rivers ecosystem that require attention include overgrazing, invasive plants, population growth and housing development, and groundwater and surface water depletion. To overcome these threats, priorities for the ecosystem are to ensure that (1) natural, healthy ecological processes dominate; and (2) economic development complements environmental protection.

The district contributes to the accomplishment of goals and objectives for this ecosystem through its Partners for Fish and Wildlife Program and existing partnerships.

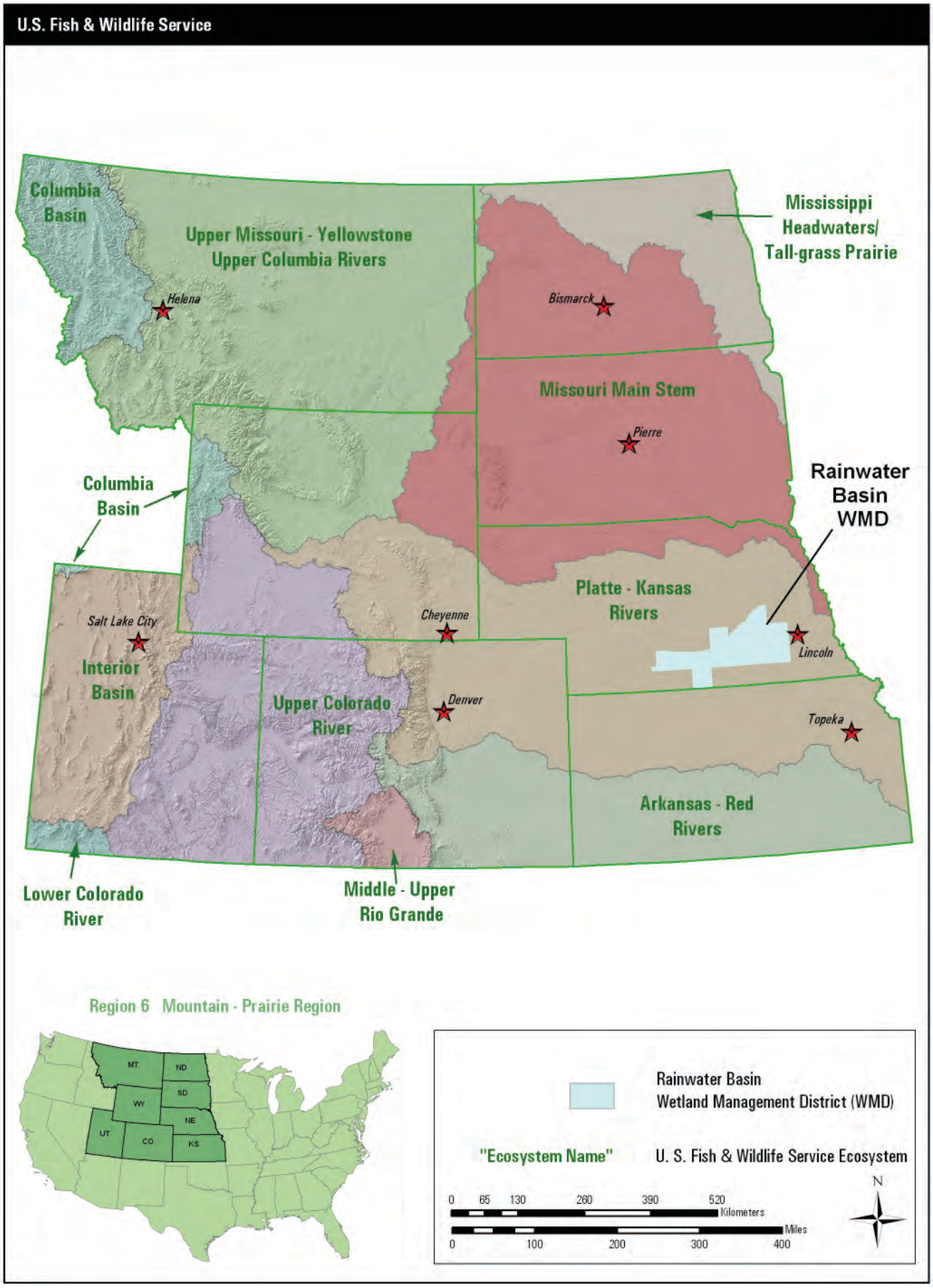


Figure 5. U.S. Fish and Wildlife Service ecosystem map.

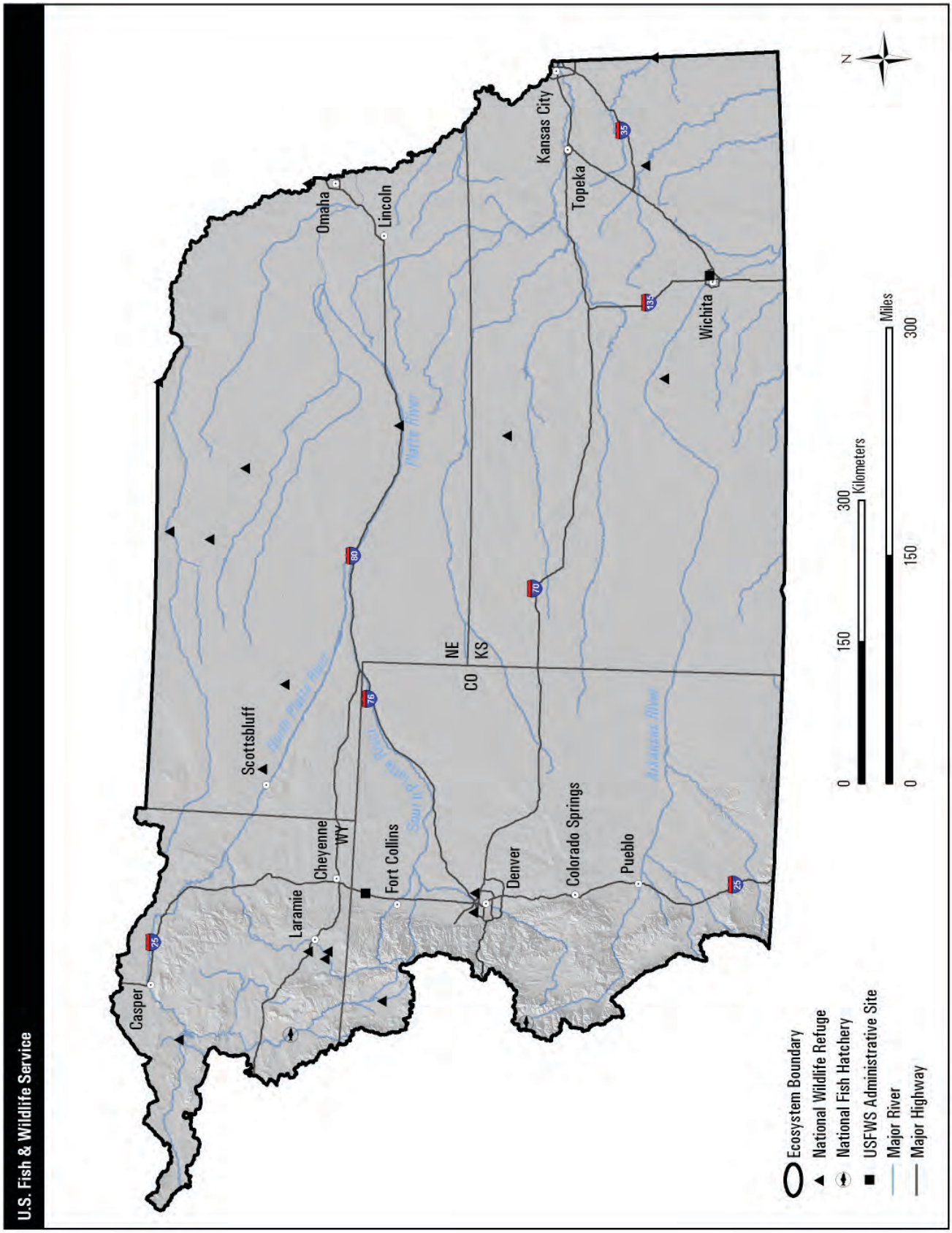


Figure 6. Platte–Kansas rivers ecosystem and Arkansas–Red rivers ecosystem map.

1.6 THE PLANNING PROCESS

This draft CCP and EA for the district are intended to comply with the Improvement Act, the NEPA, and the implementing regulations of the acts. The Service issued a final refuge planning policy in 2000. This policy established requirements and guidance for refuge and district plans—including CCPs and step-down management plans—to ensure that planning efforts comply with the Improvement Act. The planning policy identified several steps of the CCP and environmental analysis process (see figure 7, steps in the planning process).

Table 1 displays the planning process to date for this draft CCP and EA. The Service began the pre-planning process in September 2005 (see appendix C, public involvement). The planning team is personnel from the district, RWBJV, NGPC, USGS–BRD, and region 6's refuge planning division (see appendix D, preparers). During pre-planning, the team developed a mailing list, internal issues, and a special qualities list. The planning team identified current district program status, compiled and analyzed relevant data, and determined the purpose of the refuge.

Scoping is the process of obtaining information from the public for input into the planning process.

Over the course of pre-planning and scoping, the planning team collected available information about the resources of the district and the surrounding areas. Chapter 4 summarizes this information.

The draft CCP (chapter 6) outlines long-term guidance for management decisions; sets forth proposed objectives and strategies to accomplish district purposes and meet goals; and identifies the Service's best estimate of future needs.

The draft CCP details program levels that are sometimes substantially above current budget allocations and, as such, are primarily for Service strategic planning purposes.

A notice of intent (NOI) to prepare the draft CCP and EA was published in the "Federal Register" in November 2005. Scoping began in December 2005 with public meetings.

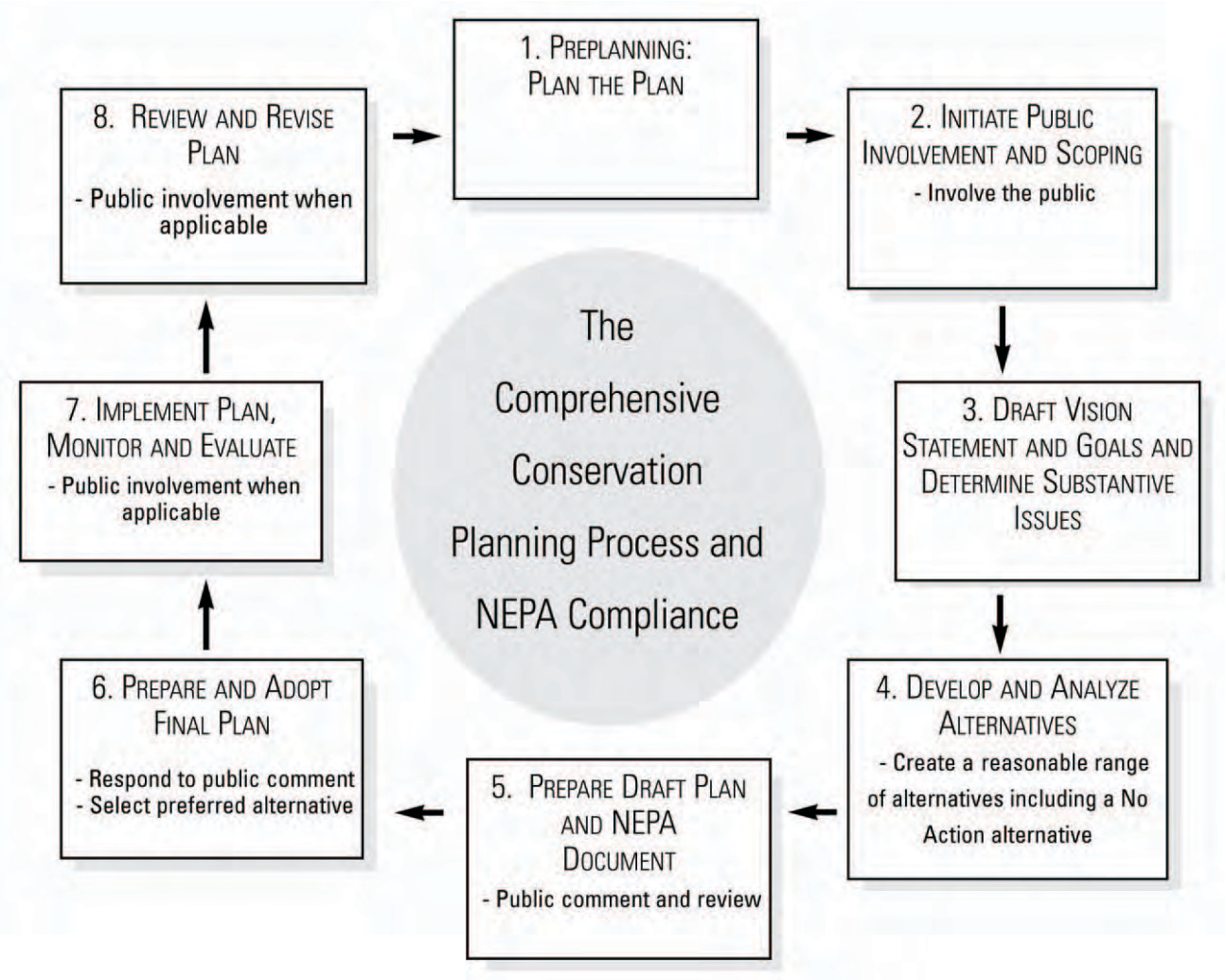


Figure 7. Steps in the planning process.

Table 1. Planning process summary for Rainwater Basin Wetland Management District, Nebraska.

Date	*Event*	*Outcome*
June 10, 2005	Initial conference call between the district staff and regional office planning staff.	Initiated contacts to organize development of the CCP and an overview of district issues. Started development of a mailing list.
July 13–15, 2005	Site visit to the district and initial meeting with the proposed planning team.	Acquainted regional office staff and state personnel with district activities and issues. Developed a preliminary list of qualities and issues.
October 13–14, 2005	Purposes, vision, and goals workshop; Kearney, NE.	Reviewed purposes for the district. Developed a vision statement and set of goals for the draft CCP and EA.
December 5, 2005 (5–8 p.m.)	Public scoping meeting; Kearney, NE.	Presented the district's background information and the CCP process. The public queried staff and provided comments.
December 6, 2005 (5–8 p.m.)	Public scoping meeting; York, NE.	Presented the district's background information and the CCP process. The public queried staff and provided comments.
December 7, 2005 (5–8 p.m.)	Public scoping meeting; Clay Center, NE.	Presented the district's background information and the CCP process. The public queried staff and provided comments.
December 8, 2005 (5–8 p.m.)	Public scoping meeting; Holdrege, NE.	Presented the district's background information and the CCP process. The public queried staff and provided comments.
December 6–7, 2005	CCP kickoff meeting.	Finalized the planning team. Updated list of issues and qualities. Identified biological and mapping needs. Determined the CCP steps and schedule.
February 28–March 2, 2006	Alternatives development workshop; Grand Island, NE.	Developed a range of alternatives for managing the district.
March 23–24, 2006	Impacts assessment workshop via conference calls: Kearney–Lincoln–Denver.	Assessed environmental impacts, by focus area, from each alternative developed. Recommended a proposed action.
August 1–3, 2006	Biological objectives, strategies, and rationale development workshop; Kearney, NE.	Drafted the biological objectives, strategies, rationale, and bibliography for the proposed action.
August 29–31, 2006	Nonbiological objectives, strategies, and rationale development workshop; Kearney, NE.	Drafted the nonbiological objectives, strategies, rationale, and bibliography for the proposed action.
December–March 2007	First draft CCP and EA preparation.	Prepared the first draft of the CCP and EA.
Spring 2007	Internal Service and state review of the draft CCP and EA.	Collected internal comments about the draft CCP and EA. Addressed comments; prepared the draft CCP and EA for public review.

Coordination with the Public

A mailing list was developed by the planning team, consisting of more than 500 names—private citizens; local, regional, and state government representatives and legislators; other federal agencies; and interested organizations (see appendix C, public involvement).

The Service held four public scoping meetings, in open-house format, during December 2005 (see table 1 for details). Attendees provided written and oral comments and were informed that comprehensive planning was an open process where they could submit their comments at any time and by any means (letter, telephone, or Internet) until the time the CCP is final.

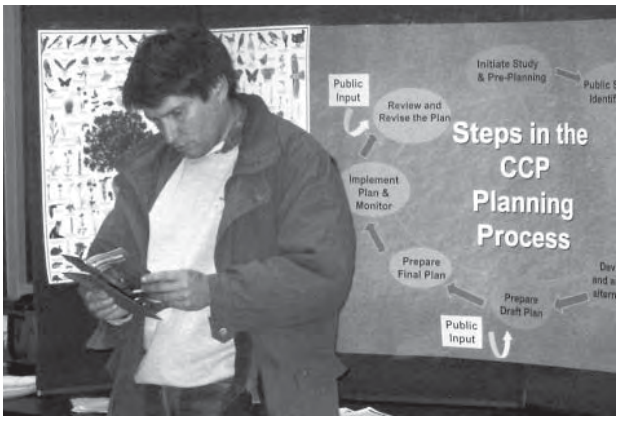
The combined total attendance to these public meetings was 63 persons. The planning team received additional written comments via mail. Seventeen written comments were received throughout the scoping process. Input obtained from meetings and correspondence, including emails, were considered in development of this draft CCP and EA.

State Coordination

In November 2005, an invitation letter to participate in the CCP process was sent by the Service's region 6 director to the director of the NGPC. Two representatives from the NGPC are part of the CCP planning team. Local NGPC wildlife managers and the district staff maintain excellent and ongoing working relations that precede the start of the CCP process.

Tribal Coordination

The planning team contacted Native American tribal representatives of the Pawnee Tribe and Otoe–Missouria Tribes. The tribal governments are part of the mailing list.



USFWS

The public came to four open houses to learn about the district and offer ideas and concerns.

Results of Scoping

Table 1 summarizes all scoping activities. Comments collected from scoping meetings and correspondence, including comment forms, were used in the development of a final list of issues to be addressed in this draft CCP and EA.

The Service determined which alternatives could best address these issues. The planning process ensures that issues with the greatest effect on the district are resolved or given priority over the life of the final CCP. Identified issues, along with a discussion of effects on resources, are summarized in chapter 2.

In addition, the Service considered suggested changes to current district management presented by the public and other groups.

2 The District

A wetland management district encompasses land that the Refuge System acquires with Federal Duck Stamp and other funds. These districts, including the Rainwater Basin Wetland Management District, are to be restored and managed primarily as prairie wetland habitat, which is critical to waterfowl and other wetland birds.

This chapter describes the establishment, vision and goals, special values, and planning issues of the district.

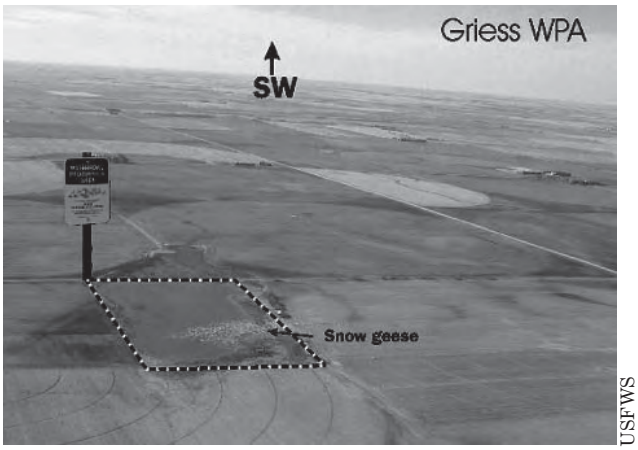
2.1 ESTABLISHMENT, ACQUISITION, AND MANAGEMENT HISTORY

The Rainwater Basin Wetland Management District was established in 1963 with the purchase of land on what is now Massie WPA. An area acquisition office of the Service was located in Hastings from 1962 to 1971, during a time when more than 14,000 acres were acquired to be managed as WPAs. Valentine National Wildlife Refuge, more than 200 miles from the nearest WPA, managed these WPAs from 1963 until 1966 when the wetland management district was staffed by one person. The district held the name of Hastings Wetland Management District until its name was changed to Rainwater Basin Wetland Management District in 1981.

The Rainwater Basin encompasses 17 counties in southern Nebraska. The district boundary encompasses 13 of these 17 counties. The district has land-purchasing authority within Adams, Clay, Fillmore, Franklin, Gosper, Hall, Hamilton, Kearney, Phelps, Polk, Saline, Seward, and York counties. The district manages WPAs in all of these counties except Polk County. In addition, the district manages one WPA that occurs outside the district boundary, in Cuming and Dodge counties.

Through the years, the Service has acquired 230 tracts of land that form 61 WPAs under the district's management. The WPAs managed by the district total 24,210.09 acres and occur across 14 Nebraska counties (see table 2). Figures 8–19 display the WPAs within each county, except for Cuming and Dodge counties, which lie outside the district boundary.

The Service's acquisition goal for the district is 24,000 acres. To date, the Service has acquired 21,703 acres of the 24,210 acres the district manages. The remaining 2,507 acres under district management have been gifted or obtained from other agencies. Three of the areas managed by the district are atypical WPAs. McMurtrey WPA in Clay County was transferred to the Service from the Department of Defense



USFWS

Snow geese congregate at Griess WPA (Fillmore County).

(originally part of the Hastings Ammunition facility). McMurtrey WPA has no public access and is managed as a closed area. In addition, the Farmers Home Administration transferred to the Service the Haseman WPA (in Cuming and Dodge counties, northwest of Omaha) and Schwisow WPA (Saline County). These two properties are different from the other 59—they are not within the basin and they occur within floodplains of the Elkhorn and Big Blue rivers respectively. Although these two WPAs are outside the basin, they are managed in the same manner as the rest of the district's WPAs and are open to public use.

Separate from the WPAs, the district contains 35 conservation easements, which total 2,476 acres. The Farmers Home Administration transferred all these areas to the Service. While the easement restrictions vary, they generally prohibit wetland drainage, grassland conversion, and development. However, 25 of the easements allow livestock grazing. Special use permits are generally required for vegetative manipulation.

2.2 SPECIAL VALUES OF THE DISTRICT

The planning team and the public identified special qualities that make the district valuable for wildlife and the American people. Attributes identified included the following:

- The district provides a critical spring staging area for millions of migratory birds that gather from the coastal states, Mexico, and South America.

Table 2. Waterfowl production areas managed by Rainwater Basin Wetland Management District, Nebraska.

County Name and WPA Summary	*WPA Name*	*Acreage*
Adams: 2 WPAs; 391.56 acres	Kenesaw	231.56
	Weseman	160.00
Clay: 16 WPAs; 6,374.48 acres	Eckhardt	175.21
	Glenvil	119.46
	Green Acres	63.66
	Hansen	320.00
	Harms	60.00
	Harvard (all units)	1,484.00
	Hultine (all units)	1,000.00
	Lange	158.76
	Massie	853.00
	McMurtrey	1,067.00
	Meadowlark	80.00
	Moger	196.70
	Schuck	80.00
	Smith	476.40
	Theesen	80.29
	Verona	160.00
Cuming and Dodge: 1 WPA, 229.11 acres	Haseman	229.11
Fillmore: 11 WPAs; 3,578.52 acres	Brauning	240.00
	County Line	408.00
	Griess	20.00
	Krause	534.26
	Mallard Haven	1,087.00
	Miller's Pond	130.78
	Morphy	89.54
	Rauscher	250.75
	Real	160.00
	Rolland	128.56
	Wilkins	529.63
Franklin: 3 WPAs; 1,783.04 acres	Macon Lakes	1,108.61
	Quadhamer	593.56
	Ritterbush	80.87
Gosper: 3 WPAs; 1,453.59 acres	Elley	60.00
	Peterson	1,156.09
	Victor Lakes	237.50
Hall: 1 WPA, 627.81 acres	Hannon	627.81
Hamilton: 3 WPAs; 1,120 acres	Nelson	160.00
	Springer	640.00
	Troester	320.00
Kearney: 9 WPAs; 2,873.75 acres	Bluestem	75.93
	Clark	451.00
	Frerichs	46.50
	Gleason	569.58
	Jensen	465.00
	Killdeer	38.36
	Lindau	152.38
	Prairie Dog	892.00
	Youngson	183.00

Table 2. Waterfowl production areas managed by Rainwater Basin Wetland Management District, Nebraska.

County Name and WPA Summary	*WPA Name*	*Acreage*
Phelps: 6 WPAs; 4,606.89 acres	Atlanta	1,147.08
	Cottonwood	560.00
	Funk	1,996.40
	Johnson	577.44
	Jones	165.97
	Linder	160.00
Polk: 0 WPA	——	——
Saline: 1 WPA, 61 acres	Schwisow	61.00
Seward: 2 WPAs; 471.14 acres	Freeman Lakes	187.76
	Tamora	283.38
York: 3 WPAs, 639.2 acres (County Line WPA occurs in two counties, Fillmore and York. This WPA's occurrence and acreage is reported in total under Fillmore County.)	County Line	(see Fillmore County)
	Heron	320.00
	Sinninger	160.00
	Waco	159.20

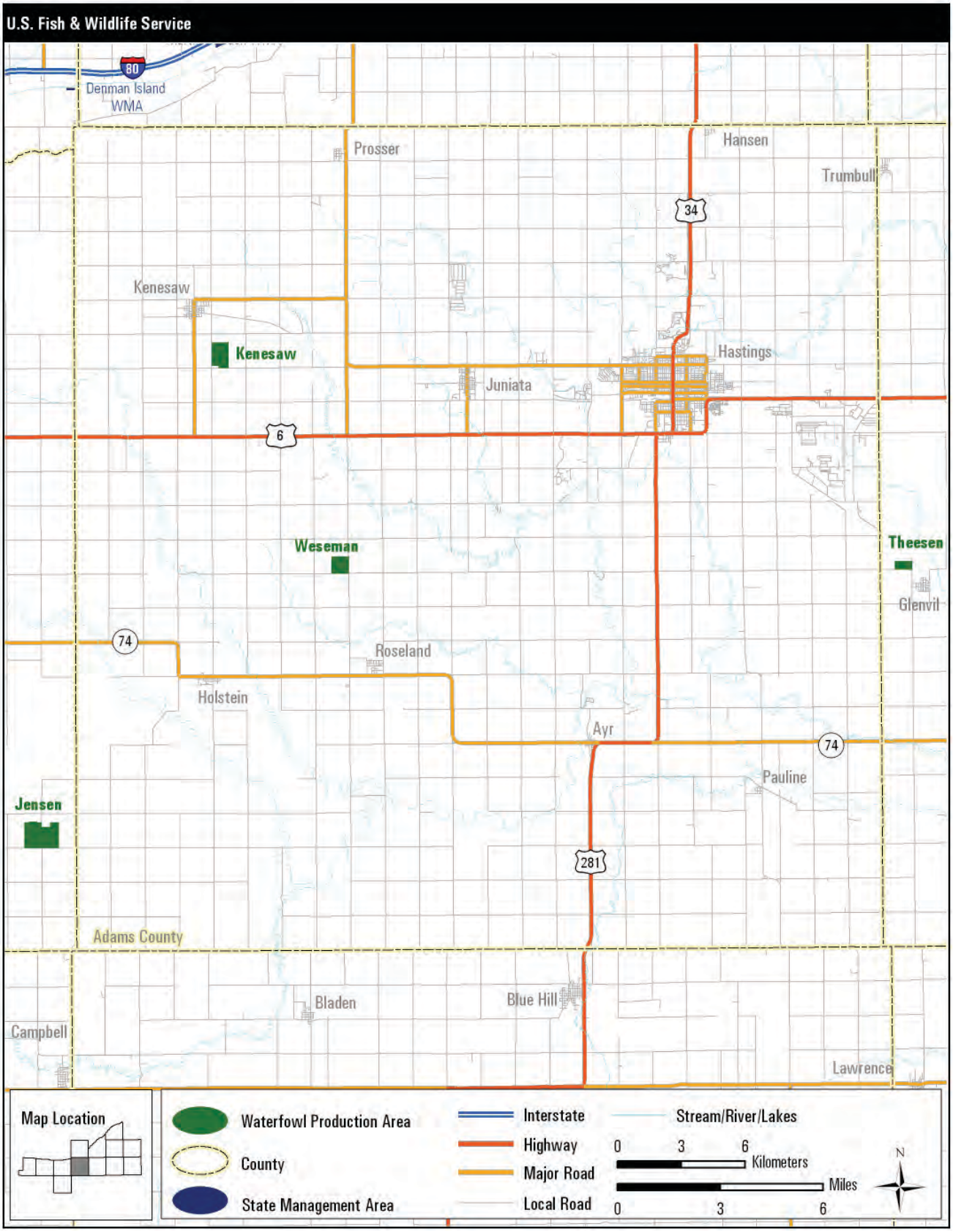


Figure 8. Waterfowl production areas in Adams County, Nebraska.

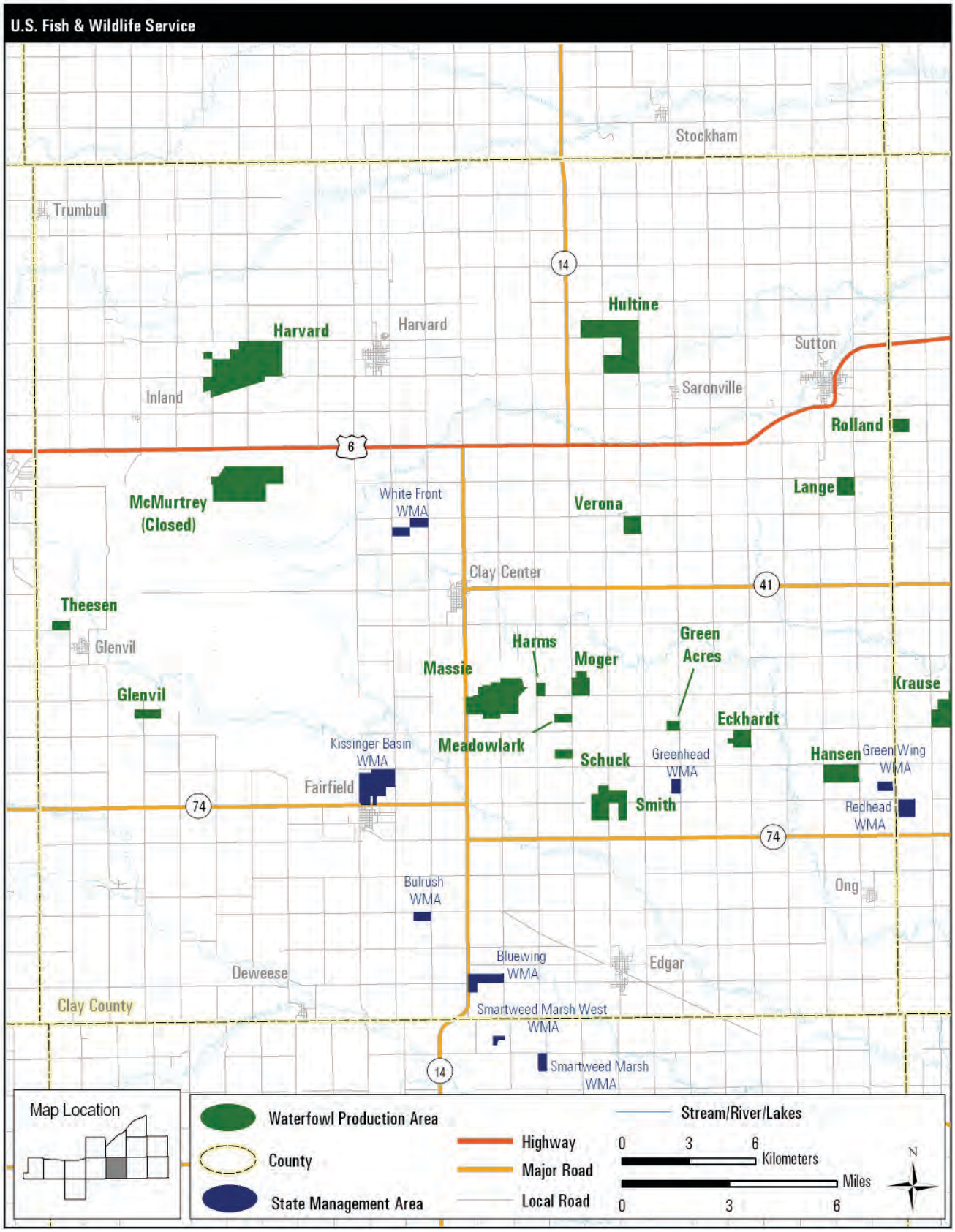


Figure 9. Waterfowl production areas in Clay County, Nebraska.

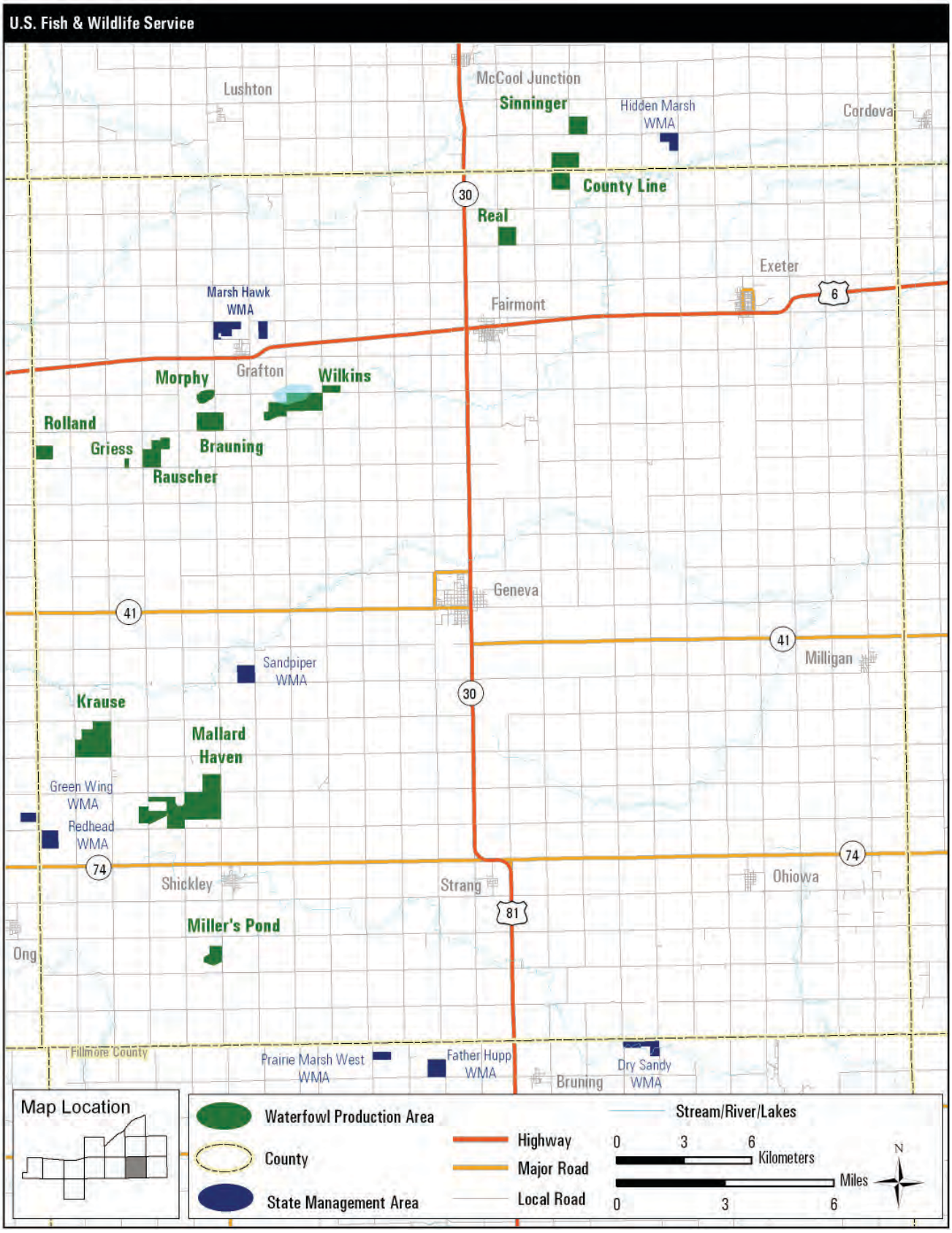


Figure 10. Waterfowl production areas in Fillmore County, Nebraska.

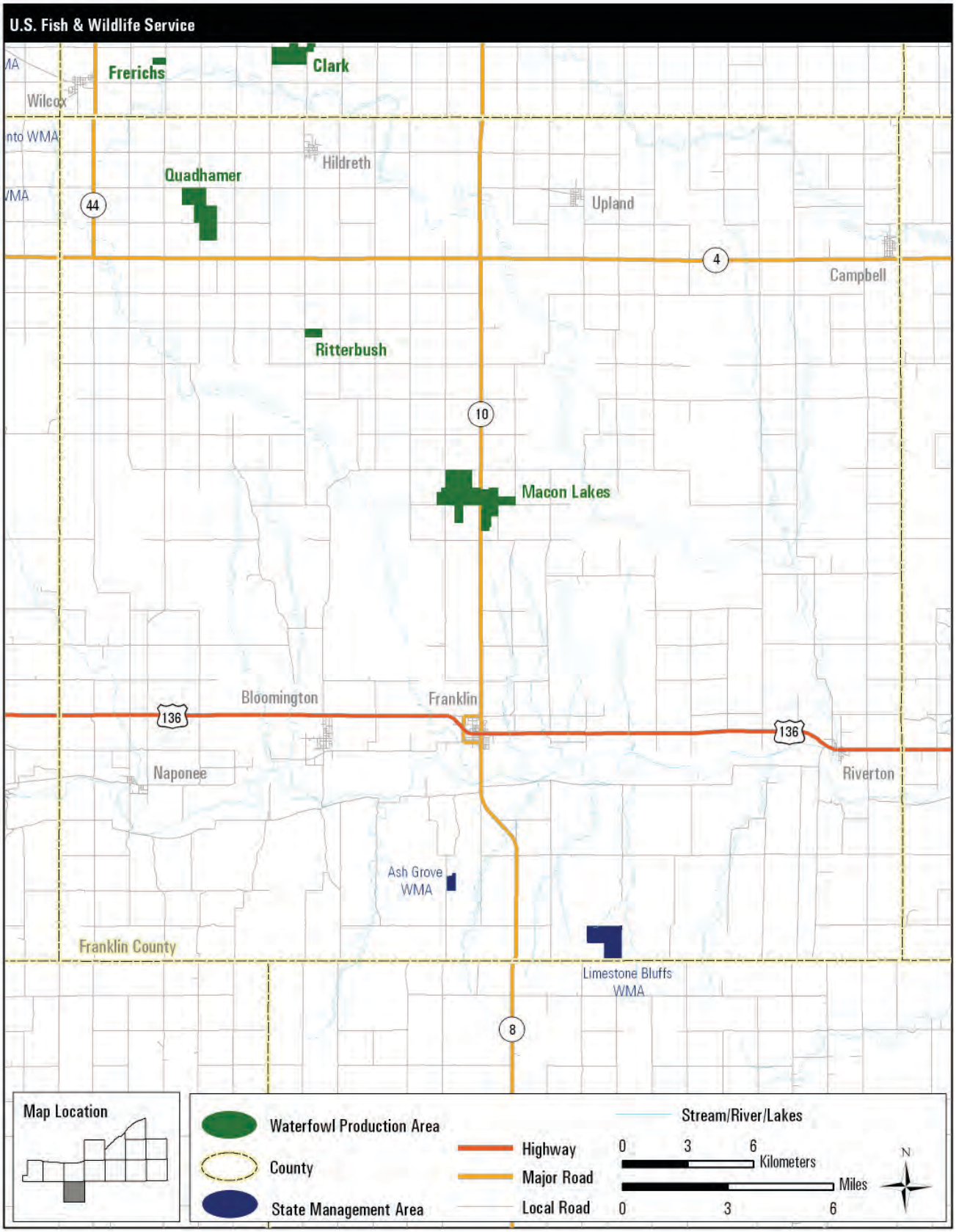


Figure 11. Waterfowl production areas in Franklin County, Nebraska.

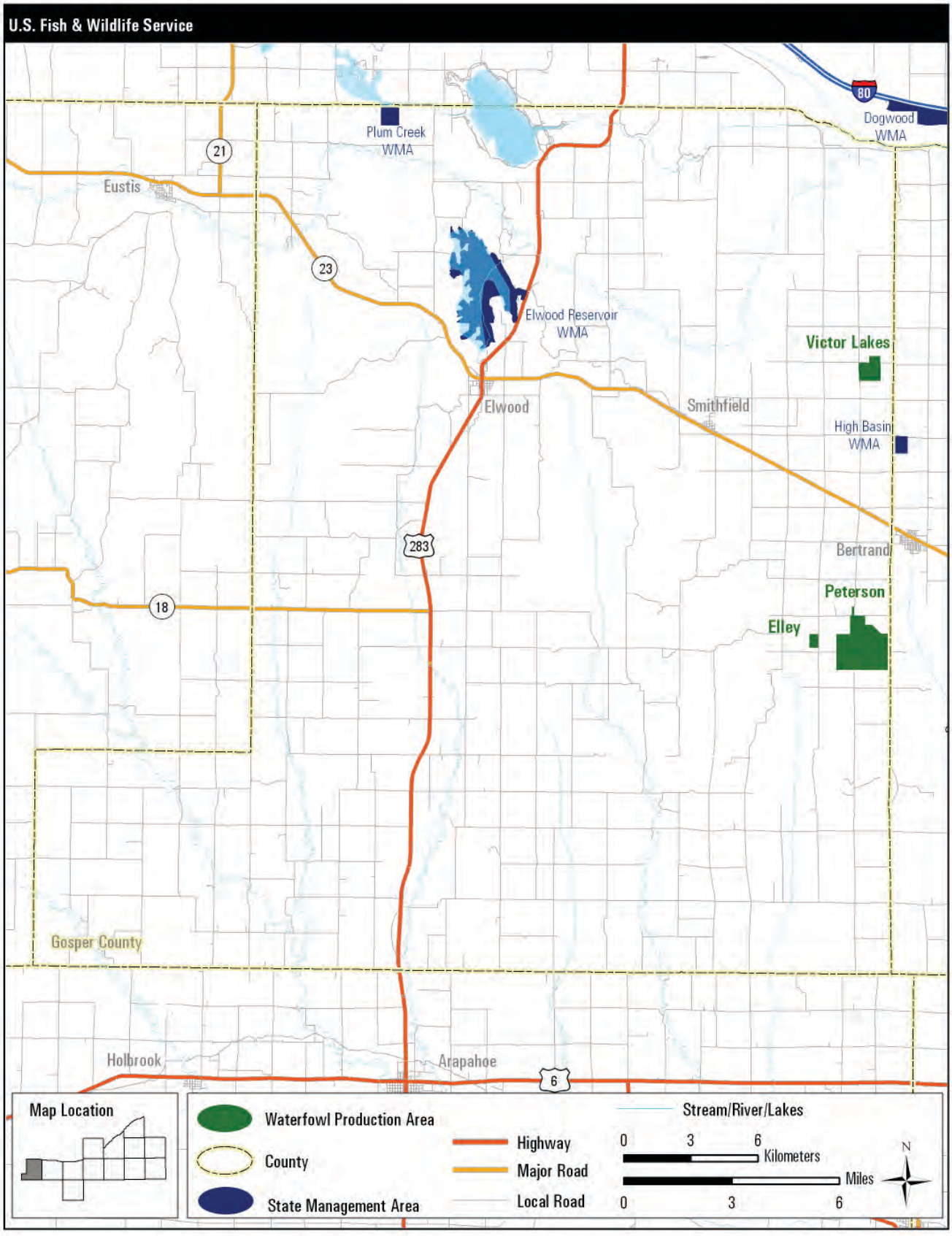


Figure 12. Waterfowl production areas in Gosper County, Nebraska.

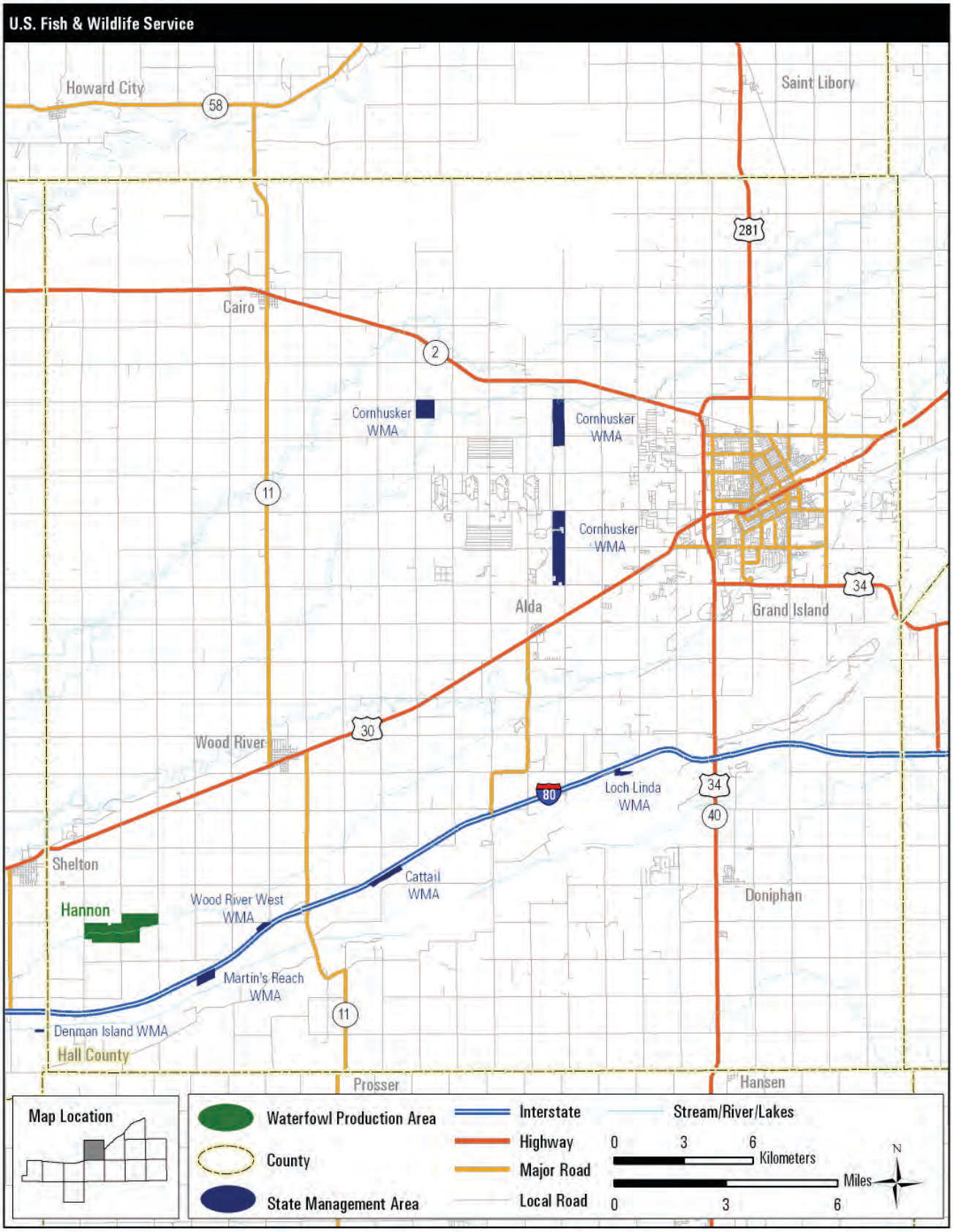


Figure 13. Waterfowl production areas in Hall County, Nebraska.

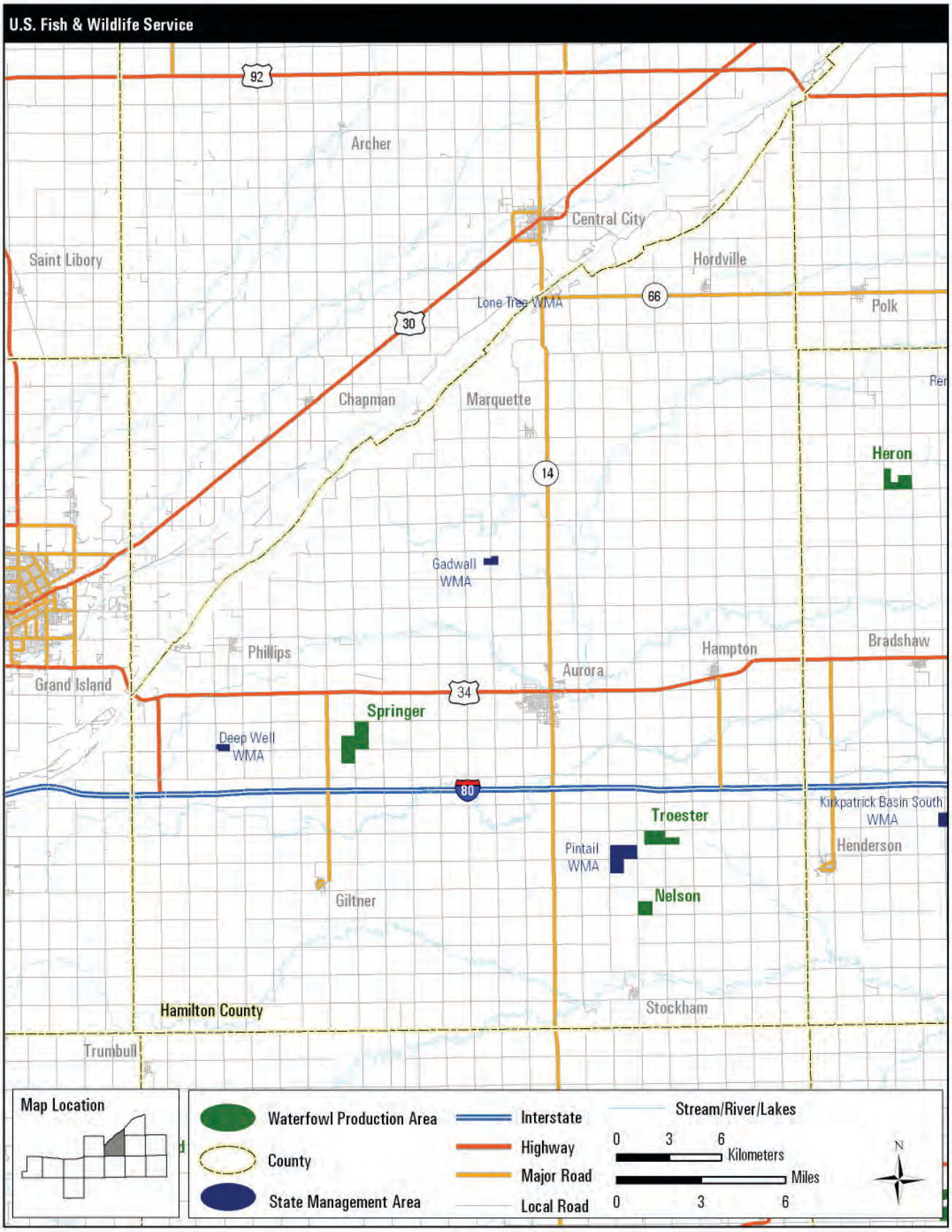


Figure 14. Waterfowl production areas in Hamilton County, Nebraska.

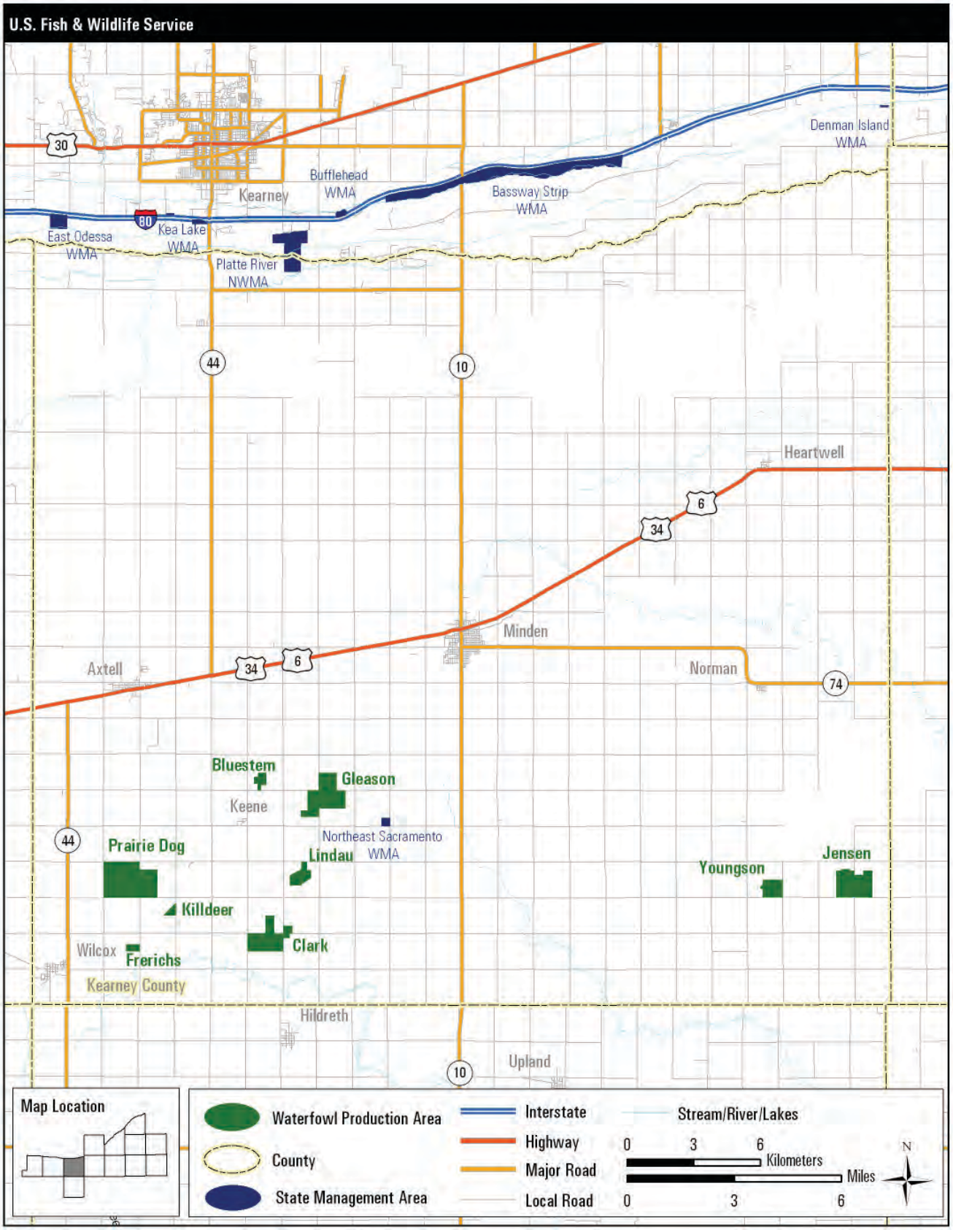


Figure 15. Waterfowl production areas in Kearney County, Nebraska.

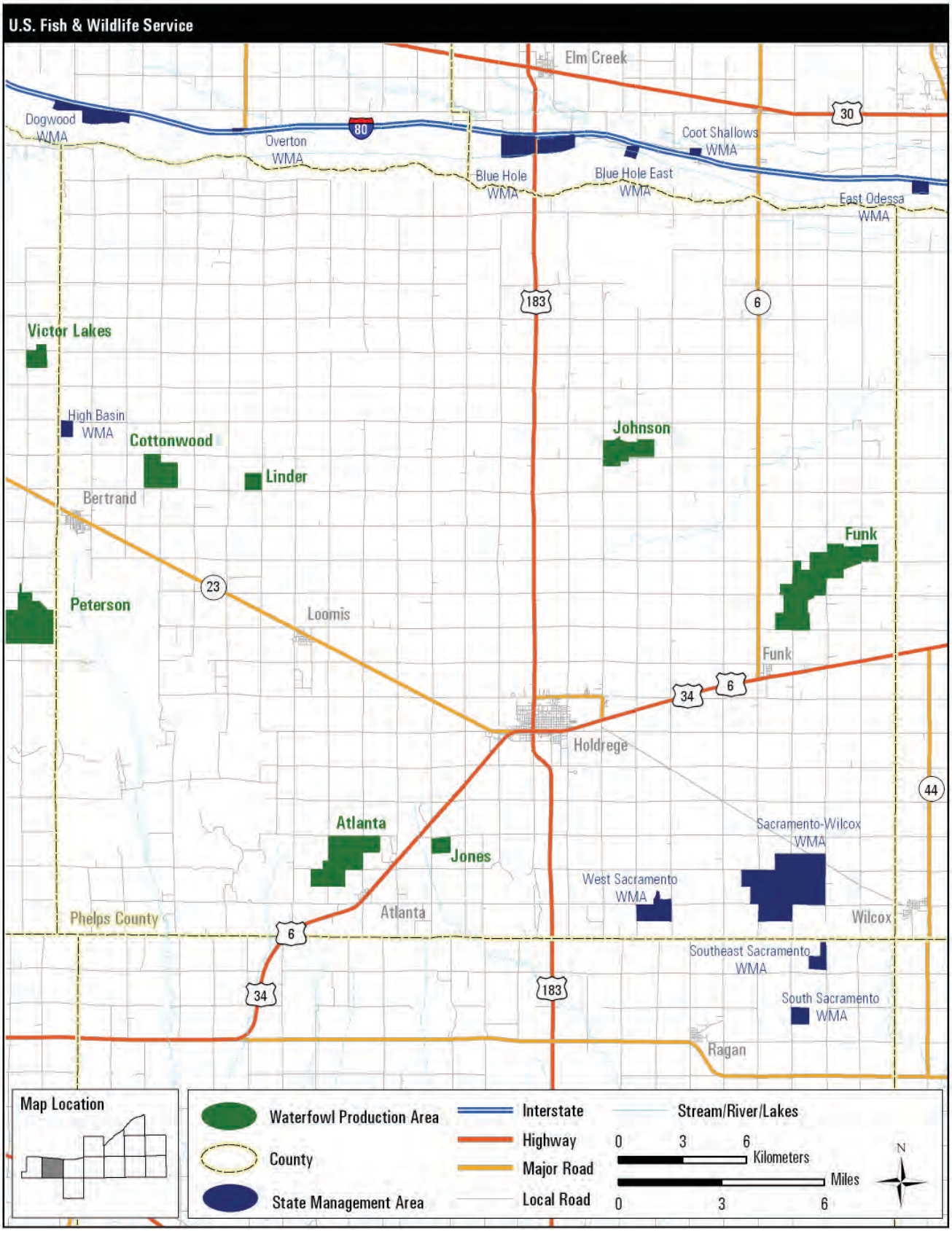


Figure 16. Waterfowl production areas in Phelps County, Nebraska.

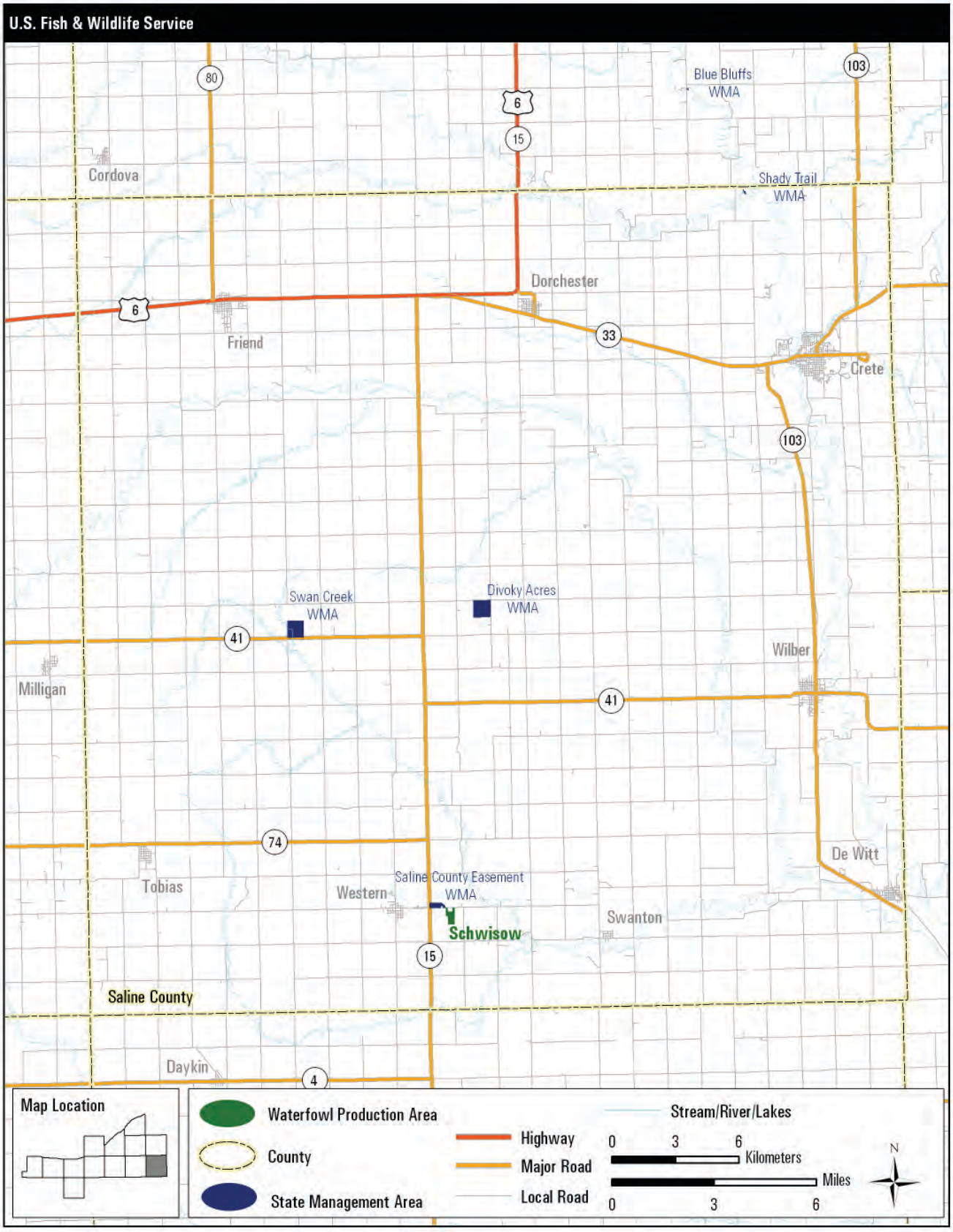


Figure 17. Waterfowl production areas in Saline County, Nebraska.

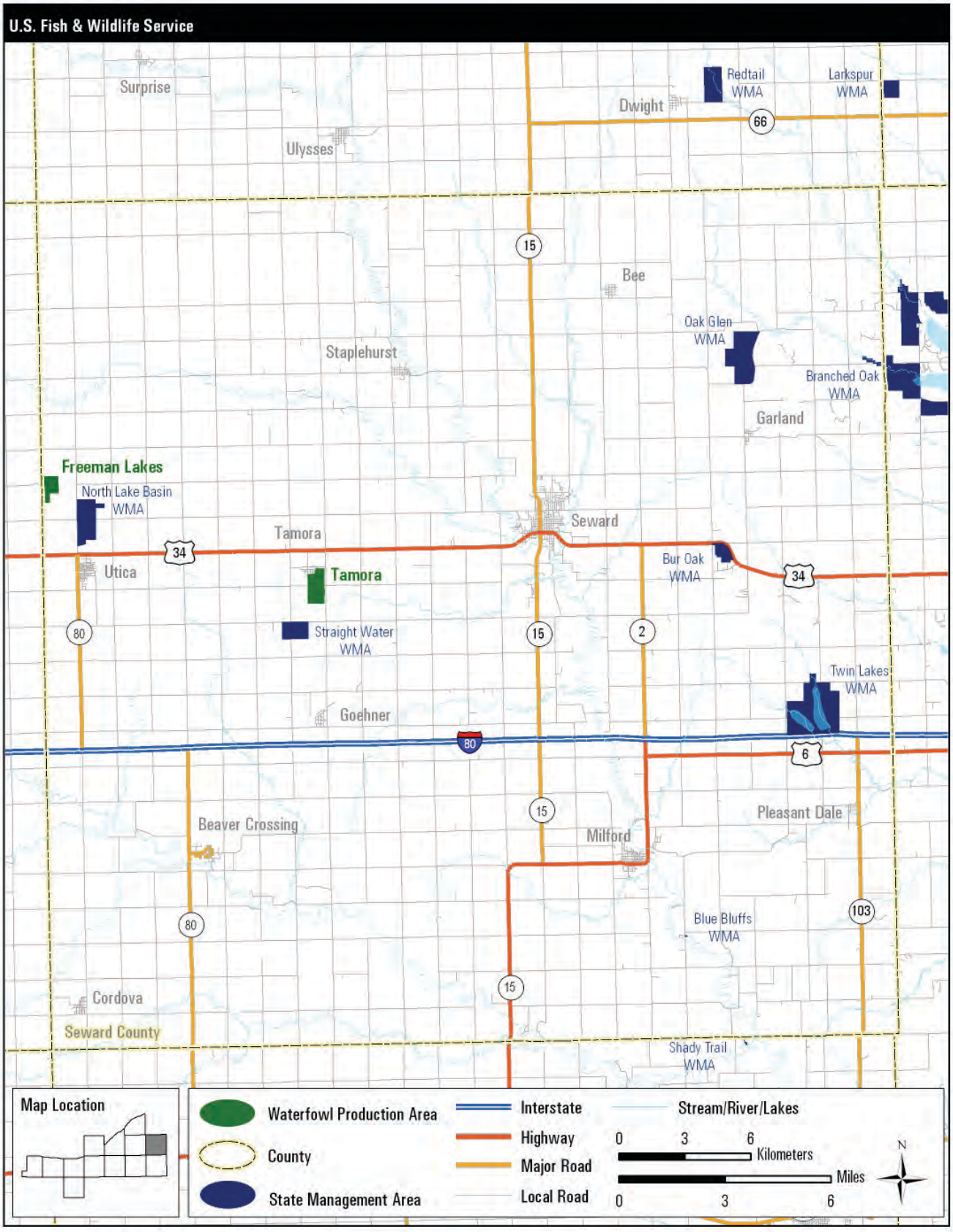


Figure 18. Waterfowl production areas in Seward County, Nebraska.

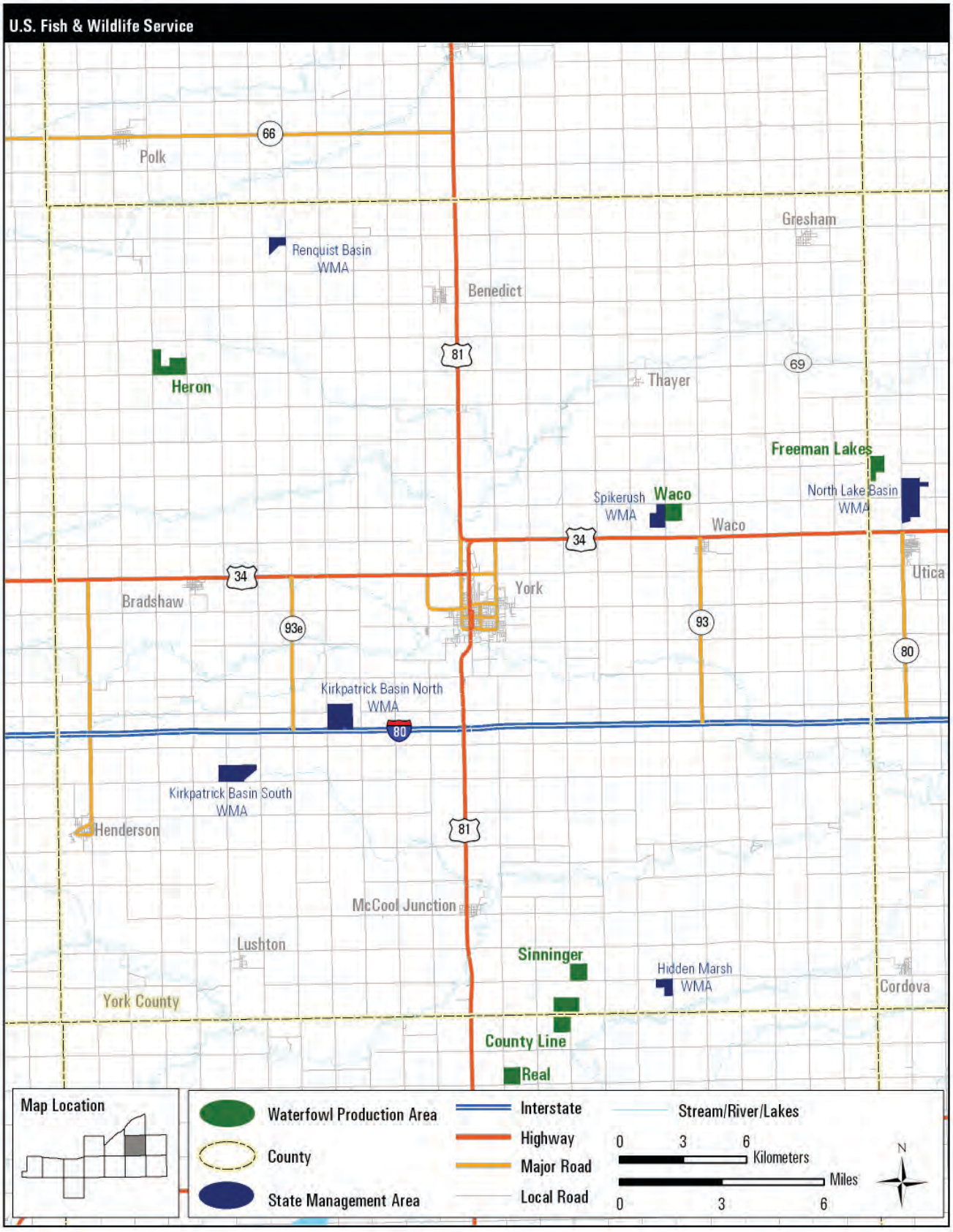


Figure 19. Waterfowl production areas in York County, Nebraska.

- Large concentrations of migratory birds use the basin in the spring: 90% of the midcontinental population of white-fronted geese, 50% of the midcontinental population of mallards, 30% of the continental population of northern pintails, and 95% of the midcontinental population of snow geese.
- The basin has the second highest number of confirmed sightings of whooping cranes along their migration route.
- Five of nine grassland species of concern nest in the basin.
- Two ecosystems, tall-grass prairie and mid-grass prairie, occur in the district.
- Most of the remaining prominent wetlands in the basin are under ownership and management of the district.
- The district has the ability to provide supplemental water to wetlands during migration.

2.3 PURPOSES FOR THE DISTRICT

The purposes for the Rainwater Basin Wetland Management District are described in the following legislation and public land orders:

Consolidated Farm and Rural Development Act (7 United States Code [USC] 2002 [a])—"For conservation purposes any real property, or interest therein … that has marginal value for agricultural production; is environmentally sensitive; or has special management importance."

Emergency Wetlands Resources Act (16 USC 3901 [b])—"It is the purpose of this chapter to promote … the conservation of the wetlands of the nation in order to maintain the public benefits they provide and to help fulfill international obligations in various migratory bird treaties and conventions with Canada, Mexico, Japan, the Union of Soviet Socialist Republics, and with various countries in the Western Hemisphere."

Migratory Bird Conservation Act (16 USC 715d [2])—"For use as an inviolate sanctuary, or for any other management purpose, for migratory birds."

Migratory Bird Conservation Act (16 USC 715i [a])—"Areas of lands, waters, or interests therein acquired or reserved pursuant to this subchapter shall … be administered … to conserve and protect migratory birds in accordance with treaty obligations with Mexico, Canada, Japan and the Union of Soviet Socialist Republics, and other species of wildlife found thereon, including species that are listed … as endangered or threatened species, and to restore and develop adequate wildlife habitat."

Migratory Bird Hunting and Conservation Stamp Act (16 USC 718 [c])—"Small areas, to be designated as 'Waterfowl Production Areas' may be acquired without regard to the limitations and requirements of the Migratory Bird Conservation Act, but all of the provisions of such Act which govern the administration and protection of lands acquired thereunder, except the inviolate sanctuary provisions of such Act, shall be applicable to areas acquired pursuant to this subsection."

Public Land Order 6979 (May 25, 1993)—"To protect waterfowl production areas."

Public Land Order 7206 (June 24, 1996)—"The following described public lands are hereby withdrawn from settlement, sale, location or entry under the general land laws, including the U.S. mining law, but not from leasing under the mineral leasing laws, to protect waterfowl production areas. This withdrawal will expire 50 years from the effective date of this order unless … the Secretary determines that the withdrawal shall be extended."

2.4 VISION

The Rainwater Basin provides critical habitat for millions of migratory birds. The basin's name reflects both the basis of its wetland hydrology and natural precipitation cycles. A network of functioning wetland and prairie plant ecosystems provides a native grassland mosaic that gives the local community a sense of pride and connection to the Great Plains flora and fauna. The lands managed by the wetland management district serve as an example of land stewardship mimicking natural processes, and they provide an array of wildlife-dependent educational and recreational opportunities. It is only through partnerships with individuals, agencies, and organizations that this vision can be achieved and maintained.

2.5 GOALS

The following goals reflect the vision for the district—providing for healthy ecosystems and compatible opportunities for the public to appreciate and enjoy the natural environment.

Wetland Habitat Goal

Restore, enhance, and maintain the hydrology and early successional vegetation conditions essential to the conservation of migratory birds.

Upland Habitat Goal

Reestablish and maintain native grassland communities of the Rainwater Basin.

Water Rights Goal

Develop partnerships to protect the natural hydrology of WPA watersheds and ensure the necessary water rights are in place to protect future use of both ground and surface water.

Invasive Plant Species Goal

Reduce and control the spread of nondesirable, nonnative plant species within wetland and upland habitats for the benefit of native plant and wildlife communities.

Wildlife Diseases Goal

Work with partners to prevent or control the outbreak and spread of wildlife-borne diseases to protect human and migratory bird populations.

Research and Science Goal

Encourage and support research that substantially contributes to the understanding and management of the Rainwater Basin wetland and grassland ecosystem.

Cultural Resources Goal

Identify and evaluate the cultural resources in the district and protect those that are determined to be significant.

Visitor Services Goal

Provide quality wildlife-dependent recreation and educational opportunities by instilling an understanding of basic ecological processes, purpose of the Rainwater Basin Wetland Management District, and mission of the Service for persons of all abilities and cultural backgrounds.

Partnership Goal

Promote and develop partnerships with adjacent landowners, public and private organizations, Native American tribes, and other interested individuals to protect, restore, enhance, and maintain a diverse and productive ecosystem.

Socioeconomics Goal

Obtain a better understanding of the social and economic contribution WPAs make to the people and communities within the Rainwater Basin.

Operations Goal

Safely and efficiently use funding, staffing, infrastructure, and partnerships to achieve the purpose and objectives of the Rainwater Basin Wetland Management District.

2.6 PLANNING ISSUES

The Service held four public meetings, sent news releases to the local and regional press, published an announcement in the "Federal Register," and sent numerous mailings to solicit public input on important issues. Following are the most significant issues identified, which are addressed throughout this draft CCP and EA.

USFWS

Kenesaw Waterfowl Production Area (Adams County).

Habitat Management

The district's primary purpose is to provide optimal migration habitat for waterfowl, waterbirds, and other species that depend on a grassland–wetland ecosystem. To achieve goals and objectives set for the district's habitats, there must be aggressive management. Nearly all lands bought for the district had been drained and farmed and have required extensive restoration.

Restoration work is not achieved by merely plugging a drainage ditch or planting native grasses. Restoration requires years of assertive management to establish native grasslands that can compete or withstand the influence of early succession, such as encroachment or dominance of weedy or woody plants. Planned grazing and burning are the two more common treatments used to reach a naturally dynamic grassland–wetland ecosystem. Staff levels are currently at a level that is more in line with managing a native grassland community rather than restoring drained and farmed lands.

There is a gap between the public's perception of wetland ecology and an understanding of how managed disturbance mimics natural disturbance and creates a healthier ecosystem. When a WPA wetland goes dry, a portion of the public expects additional water pumping be done, another portion expects management to be changed to benefit pheasants rather than waterfowl, and another portion simply concludes that no management is being done. Prescribed fire and grazing are perceived by some as

habitat destruction rather than a management tool that is beneficial in sustaining these habitats.

Water and Wetland Management

Wetlands within the Rainwater Basin are in multiple ownerships and the district has been unsuccessful in obtaining complete ownership of the wetlands at many WPAs. On some WPAs, the areas were bought with little or no adjacent upland. Without complete ownership, restoration and management of the wetland is difficult or not possible. The WPAs and their watersheds (the surrounding areas that naturally drain into the WPAs' wetlands) are altered by land leveling, diversion of runoff water away from the wetland, and lowered water quality associated with agricultural runoff and sedimentation. Agricultural runoff includes effluents from feedlots. Some of the WPAs contain legal drainage tiles (underground drainage systems that pre-date the WPAs' existence) that prevent wetland restoration. Nebraska water laws do not protect WPAs from having the natural runoff captured before it reaches the wetland.

USFWS

Pumping water to wetlands.

Pumping groundwater to provide supplemental water to wetlands is critical to maintain habitat during the spring and fall migrations. However, the growing demand for groundwater is creating a conflict between agricultural needs and wildlife needs. Increasing energy costs, antiquated equipment, and growing restrictions on groundwater usage are threatening the district's ability to provide adequate water.

Invasive Plant Control

Invasive plants, especially those designated as noxious weeds, have the ability to degrade wildlife habitat and to spread into adjacent lands. This has been a significant issue for the district for years. The district directs a large portion of their resources for the control of invasive plants. Integrated pest management (IPM) strategies currently include prescribed fire, grazing, mowing, herbicides, biological control using introduced insects, "interseeding," and farming.

The establishment of new invasive plants—such as salt cedar and purple loosestrife—is a constant threat. Generally, an immediate control response to new invasive plants is most effective in the long term.

Wildlife Disease Control

Since 1975, the district has had a history of avian cholera. In 1980 and 1998, avian cholera outbreaks killed over 100,000 birds during the spring migrations. The high concentration of birds each spring poses a threat of disease outbreaks and the spread of disease in the Central Flyway. Management actions taken have included increased pumping to improve water quality and quantity and collection of infected carcasses to control the spread of disease.

In 2005, there was a positive case of chronic wasting disease found in Hall County within the Rainwater Basin. The disease is expected to continue to spread eastward across Nebraska.

In the future, the H5N1 strain of avian influenza is expected to migrate from the Eastern Hemisphere to the Western Hemisphere. Because of the high concentration of birds found throughout the basin during spring migration, there is a concern about the spread of the disease.

Species of Concern

Species of concern are the prairie dog and federally listed threatened and endangered species.

In July 1998, the National Wildlife Federation petitioned the Service to list the black-tailed prairie dog as a threatened species under the Endangered Species Act. In the fall of 1999, the Service's regional director (region 6) issued a moratorium on all control of black-tailed prairie dogs on Service lands. In February 2000, the Service concluded that this species warranted listing, but was precluded from being listed due to concerns and resource constraints related to other higher priority species. In August 2004, an updated evaluation of the best available scientific information led the Service to determine that the black-tailed prairie dog should be removed as a candidate for listing.

Prairie dog colonies are located on five WPAs scattered throughout the district. The five sites had historical use, and management has been done to allow the dog towns to continue. The spread of the populations to private lands has been controlled by two factors: (1) the sites are surrounded by cropland; and (2) the precipitation level causes native grasses to grow faster than the prairie dogs can remove it. The tall vegetation keeps the town to a manageable size. A management plan written in 2003 is included in appendix E.

The CCP will not address specifically this species any further because (1) the district currently manages black-tailed prairie dog colonies in accordance with the

existing management plan (appendix E), and (2) the existing colonies within the district are stable.

The district staff, in consultation with staff from region 6's ecological services, reviewed all threatened and endangered species with historical ranges on or near the district to determine if additional actions could be taken to restore or enhance habitat for endangered species. These species are the whooping crane, bald eagle, interior population of the least tern, American burying beetle, and western prairie fringed orchid. No species were identified as requiring actions different from those being taken to meet the purposes of the district.

The "Biological Integrity, Diversity, and Environmental Health Policy" (USFWS 2001) guides Service personnel in carrying out the clause of the Improvement Act that directs the Secretary of the Interior to ensure the maintenance of the "biological integrity, diversity, and environmental health" of the Refuge System. This policy guides the Service to consider restoration of lost or severely degraded components of the Refuge System "where appropriate and in concert with refuge purposes and the Refuge System mission"; this includes federally listed species.

Research and Science

The Rainwater Basin serves as a critical staging area during spring migration. While the birds are in the basin, they feed extensively in surrounding croplands and within the wetlands. When they are not feeding, these birds roost on the larger wetlands. There is little information to determine whether the basin is meeting the needs and energetics of waterfowl and other migratory birds. Such information would help direct management actions by the district.

Water-pumping decisions rely heavily on intuition because of the limited scientific information that is available. The district's intent for pumping is to provide water in those wetlands that provide the most food and resting area for birds. It is unknown how the hydrology of individual wetlands in the basin, in combination with water pumping, can provide optimal habitat conditions. For example, is it the wisest use of water to pump a wetland with wet soils and less preferred plant species or a wetland with dry soil and preferred plant species.

The distribution and abundance of amphibians, reptiles, invertebrates, and small mammals on the WPAs is unknown.

As part of the CCP development process, a Service-funded socioeconomic study determined the extent to which the existence and operations of the district benefit the local and state economies. Excerpts from this report are included in chapter 4 (affected environment) and chapter 5 (environmental consequences).

Visitor Services

Hunting, fishing, wildlife observation, photography, environmental education, and interpretation are all uses allowed on WPAs. The high concentration of birds and the limited public lands available for public recreation in the basin makes this an issue of interest. There is a demand for increased and improved recreational hunting opportunities on the WPAs. By regulation, lands acquired as WPAs are open to public trapping as well.

The public has a significant misunderstanding about the types and management of public lands in the basin, particularly those managed by the district and the NGPC. This is an issue because both agencies manage public uses differently and their respective missions, while complementary, are not exactly alike. This fact often causes confusion between wildlife enthusiasts and the public in general.

Many people in the local communities are not aware of the district's existence because district personnel are based more than 20 miles away from the WPAs. In addition, the district office is not easily located in an older industrial portion of Kearney.

Partnerships

The scattering of small public areas (WPAs) among privately owned lands increases the need to build partnerships throughout the Rainwater Basin. The district cannot address many of the opportunities without the help of partners. This is especially the case for visitor services, particularly in environmental education. Public involvement would strengthen local interest and increase the district's ability to manage and promote wildlife resources. The district is not fully using the skills and resources of other groups, organizations, and local communities. In turn, the district is not providing the resources and expertise that would help local conservation groups meet their objectives.

Operations

The basin encompasses 4,200 square miles in a 17-county area of southern Nebraska. The district extends across 13 of those counties. The distance from the easternmost to the westernmost WPA is 133 miles. The logistics of transporting equipment and traveling to WPAs makes it difficult to effectively manage the properties. It takes the district staff 2 hours each way to reach the farthest WPA, which reduces to 4–6 hours the amount of time to work at an area. Because of the long distances, fuel costs are a major burden. In a typical year, the staff drives approximately 110,000 miles.

The district faces immediate challenges with its headquarters. The Service leased the office/shop facility in 1977 when the staff consisted of four people. The office portion was an open foyer and three rooms. In

1994, to accommodate the new private lands staff and migratory bird biologist, a portion of the shop was converted to office space. In 2000, to accommodate the new fire staff and station biologist, the library/conference room was converted into a cramped, open-office setting for four desks. There are currently 12 people in the staff.

The heating system for the office was installed in the shop portion of the building. The office area has only one exit or opening leading to the outside. No windows exist in any of the offices. There is no exchange of fresh air, so the furnace recycles office and shop air continually throughout the office portion.

The development of a fire program brought with it two fire engines that have to be stored inside at all times—reducing the amount of working and storage area for other equipment. During the spring fire program, the shop area is crowded with fire engines, water tenders, and all-terrain vehicles (ATVs) to prevent freezing during the cold nights. The shop is the only storage facility on the site and ATVs used for weed spraying have to be stored in the shop during summer months. The high temperatures inside the shop during the summer cause the herbicide mixture to volatize and enter the office.

The district headquarters facility is located in an urban setting that consists of a mixture of trailer homes and an industrial park. Its location does not invite the public to visit the office and public visitation is very low. Theft and vandalism have increased.

The headquarters site does not include any cold storage facility and some equipment has to be stored at two WPAs—one in the eastern portion of the district and the other in the western portion. All heavy equipment is stored outside in an unsecured area. The storage facility in the east (McMurtrey WPA) has access only through a courtesy agreement with neighboring landowners.

3 Alternatives

USFWS

Grazing comparison at Moger WPA (Clay County): grazed (left) and ungrazed (right).

Alternatives are different approaches to management of the district. The alternatives are designed to (1) resolve issues; (2) achieve the district's purposes, vision, and goals identified in the draft CCP and EA; (3) help fulfill the mission of the Refuge System; and (4) comply with current laws, regulations, and policies. The NEPA requires an equal and full analysis of both alternatives considered for implementation.

This chapter describes two management alternatives for the Rainwater Basin Wetland Management District: "Alternative A, Current Management (No Action)" and "Alternative B, Integrated Partnership Approach (Proposed Action)."

3.1 ALTERNATIVES DEVELOPMENT

In December 2005, the Service held four meetings with the public to identify the issues and concerns associated with the management of the district. The public involvement process is summarized in greater detail in chapter 1, section 1.6 "The Planning Process." Based on public input and internal scoping of issues as well as guidelines from the NEPA, Improvement Act, and Service planning policy, the Service identified the substantive issues that will be addressed in the alternatives. These issues, detailed in chapter 2, section 2.6 "Planning Issues" are as follows:

- habitat management
- water and wetland management
- invasive plant control
- wildlife disease control
- species of concern
- research and science
- visitor services
- partnerships
- operations

In addition, each alternative addresses three other topics of management concern: land protection, cultural resources, and socioeconomics.

3.2 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

After extensive analysis and discussion, the Service did not consider any alternatives other than the two that are fully developed in this chapter.

3.3 ELEMENTS COMMON TO BOTH ALTERNATIVES

Commonality exists between the two alternatives developed. Vegetation management on the uplands and wetlands would use the same management actions such as prescribed fire, grazing, and rest. Wetland restoration and water pumping are identified as management actions in both alternatives. Control of invasive plants in both alternatives would use IPM to control both noxious and invasive plants.

Management of hunting, wildlife observation, photography, environmental education, and interpretation is common to both alternatives.

3.4 DESCRIPTION OF ALTERNATIVES

Each alternative addresses the previously described issues and topics differently. Partnerships, as the overall strategy for meeting the goals, are described in relevant program areas.

Alternative A—Current Management (No Action)

Under alternative A, management activities being conducted by the Service would remain the same, with changes in land management and public use occurring as opportunities arise. Current habitat and wildlife practices benefiting migratory species and other wildlife would not be expanded or changed. The staff would perform limited, issue-driven research and only monitor long-term vegetation change. No new funding or staff levels would occur and programs would follow the same direction, emphasis and intensity as they do at present.

Habitat Management

The district would manage habitat through adaptive resource management at the WPAs—primarily wetlands and uplands—to attain natural diversity.

Alternative A would maintain the current level of habitat management at the district at approximately the same intensity. Management actions would address resource problems that are threatening or that have deteriorated habitat conditions to the level where the habitat is no longer meeting the vision for the district.

This approach is a "restoration approach" rather than a "maintenance approach" to habitat management. The WPAs that are in good habitat condition would be given little attention. Limited staff and funding would be directed toward improving WPAs that have habitat degraded to a level where severe actions have to be taken to restore quality habitat. Such actions are generally removal of large mature trees, large-scale herbicide application, and mechanical removal of silt from wetlands. The district's removal of trees is a management tool to restore prairie habitat, not to be confused with tree harvesting.

Grasslands would be managed using a combination of prescribed fire, prescribed grazing, limited haying, and tree removal. Restoration activities would use a high-diversity seed mixture collected from the local area. Volunteer trees and select shelterbelts would be removed. No new shelterbelts would be planted. The district would carry out an IPM program for invasive plants using herbicide application, cropping, grazing, prescribed fire, high-diversity native plant seeding, and haying.

Upland restoration activities would focus on (1) previously plowed areas on newly acquired lands, and (2) lands that have heavy weed or nonnative plant infestations. These areas would be cropped for several years before reseeding.

The district would continue to participate in various partnerships including the RWBJV. District staff would continue to serve in leadership roles, but involvement in new projects and programs would be limited.

Livestock grazing would be allowed only at WPAs with suitable facilities (such as fences and livestock water) to mimic intense, short-duration grazing similar to presettlement grazing patterns of wild large ungulates. Areas with no boundary fences or lacking water would be under-managed (receive minimal management) because poor fencing and lack of adequate water supplies would not allow the proper grazing treatment rate to meet management objectives.

Once the appropriate vegetative treatment was used to meet habitat objectives, an area would remain rested until additional treatment was needed.

Wetlands

Water and wetland management would continue at the current intensity. Limited work would be done on wetlands in multiple ownership. Acquisition of the remaining wetland parcels would be low priority and parcels would be acquired when opportunities arise and on a willing-seller basis only.

Annual wetland management would be focused on attaining a natural diversity and interspersion of open-water and early successional plant species—dominated by seed-producing, annual, wetland species. Vegetation would be managed to closely mimic the natural ecological processes of the ecosystem. Staff and resources would allow only some of the WPAs to be managed each year. Wetlands that have quality waterfowl habitat would not be given the needed management and would decline in quality until they become priorities.

Primary management techniques would be periodic prescribed burning, grazing, resting, shredding, weed control, disking, and water pumping. Prescribed fire frequency would be determined by the level of funding available; burning would be limited to controlling trees rather than to enhance the native grassland.


USFWS

Shredder in wetland.

Disking would be used to mimic the herding effect of wild animals by knocking down erect vegetation and disturbing the soil surface. Its use would be limited to areas where grazing and burning are not practical.

Management priority would be given to wetlands over uplands. The WPAs with limited waterfowl habitat would receive low management attention.

Uplands

Management of uplands would focus on attainment of natural diversity and interspersion of grasses and forbs characteristic of the presettlement period. Cropping would be done only to prepare the soil to reseed a high-diversity, native, grass and forb seed mix—using local genotypes (genetic constitution of an organism) whenever possible. Areas with low plant diversity would be "interseeded" with a high-diversity, native, grass and forb mix. Trees would be removed to create an open vista and conditions typical of the presettlement period.

Grassland would be managed to closely mimic the natural ecological processes of the ecosystem. Primary management techniques would include periodic use of prescribed fire, grazing, and haying. Burning frequency would be determined by the level of funding available, with burning being limited to control of trees rather than to enhance the native grassland.

Haying and mowing would be used to remove dense stands of undesirable plant species and to create firebreaks. Its use would be limited to areas where grazing and prescribed fire are not practical.

Water and Wetland Management

Water management is central to meeting the purposes of the district.

Supplemental Water (Pumping)

Wetlands would be managed with a combination of water pumping, prescribed fire, prescribed grazing, tree removal, and limited haying. Nearly all water pumping carried out with district funds and staff would be directed toward spring migration. Fall water pumping would only occur if funding exceeded spring water-pumping needs. Fall water pumping would begin near November 1 to increase the probability that water would still be present during spring migration. Spring water pumping would be directed only toward waterfowl habitat; limited water pumping would be done for shorebirds and other water-dependent species.

Strategies would include targeting wetlands that would provide optimal waterfowl habitat and provide enough water throughout the district to adequately disperse birds.

Water pumping would be limited to a small number of WPAs and would sustain shallow water on large mud flats for shorebird and whooping crane migration.

Water Quality and Quantity

Long-term wetland management would focus on restoring the hydrology of the wetlands to the highest feasible level. Management actions would include removal of sediment, removal of water concentration pits, and clearance of trees.

The district would continue to work with neighboring landowners to improve the quality and quantity of runoff reaching the WPAs.

The district staff would monitor runoff from livestock confinement areas only during large inflow events. Actions associated with water quality and feedlot runoff would be limited to only severe problems that are clearly in violation of state regulations.

Water Rights

The Service would assume that natural surface water runoff to WPA wetlands would not be captured or diverted by non-Service parties. The staff at the district does not have a clear understanding nor a comprehensive compendium of all the water rights held by the Service in the basin. Under alternative A, this situation would continue to be unresolved.

Invasive Plant Control

Invasive plant species would be mapped, treated, and monitored. Areas with invasive plants and other noxious weeds would be mapped and recorded in the Geographic Information System (GIS) to (1) improve response time in future years, and (2) to monitor any change associated with treatments.

Treatments would include chemical application, biological control (insect), mechanical removal (mowing), and physical stressors (burning and grazing). Control priorities would be as follows:

1. state-listed noxious weeds
2. species that degrade wetland habitat
3. species that degrade upland habitat

Lower priority would be given to invasive plant species such as reed canarygrass, crown vetch, intermediate wheatgrass, Kentucky bluegrass, and brome. These species would be treated as available staff and time allowed.

Wildlife Disease Control

The district staff would continue to monitor the WPAs for and respond to wildlife diseases during spring and fall migrations. Monitoring would primarily be looking for bird behavior or mortality that is out of the ordinary. Most monitoring would be done in the spring, primarily during and after the peak migration. Historically, avian cholera outbreaks do not occur until the peak of migration. Fall monitoring would occur on an unscheduled basis. Control would include monitoring, collecting carcasses, and conducting diagnostics. Wildlife disease control is addressed in detail in the district's disease contingency plan.

There would be no monitoring of diseases in upland birds, mammals, and other wildlife.

Species of Concern

No change would occur in the management of prairie dogs or threatened and endangered species. Management would be directed toward mimicking the natural ecological process of the Rainwater Basin. These actions would be compatible with species of concern but would not be directed specifically to individual species.

Research and Science

No change would occur in research. Research would be in line with chance opportunities. The involvement of the district in research projects would vary based on research needs. The district would continue to assist others to conduct research by helping to obtain funds and providing research areas; there would be limited staff and housing assistance.

Habitat and Wildlife

District staff would continue to use quantitative monitoring techniques to assess (1) the effects that management treatments have on plant communities, (2) wetland habitat availability in the spring, and (3) wetland habitat conditions in the fall. There would be annual monitoring of populations of spring "light" geese (Ross' and snow geese).

The district staff would help cooperating partners, universities, and scientists develop research projects that focus on the Service's research priorities. No formal research priorities would be established. However, the Service's priorities would be reflected within the RWBJV research priorities document. Other research projects that may not be a priority for the district would receive staff support to ensure completion. The district staff would (1) help find funding, (2) provide technical review, (3) make WPAs available for projects, and (4) help to develop new methods for research when needed. A limited amount of quantitative monitoring would be done. Most monitoring would be done subjectively to assess the effects of management actions at WPAs.

Socioeconomics

There would be no additional analysis conducted for the socioeconomic situation related to management of the district.

Land Protection

Land acquisition would remain limited to opportunistic fee-title purchases from willing sellers. The Service would focus on acquisition of remaining wetlands that have partial district ownership.

No easement acquisition would occur and the criteria for acquisition would continue to be unclear and focus on larger wetlands only.

Cultural Resources

Cultural resources would continue to receive minimal attention. Inventories would only be done in response to activities that constitute undertakings under section 106 of the National Historic Preservation Act.

Visitor Services

No change in public use would occur. All WPAs would continue to be open to hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Existing information kiosks, trails, and blinds would be maintained. No additional facilities would be constructed. Contact with the public would continue to be low because of the office's location and its long distance from wildlife and their habitats.

Hunting

Hunting and trapping programs would continue for management of wildlife and to provide a compatible, priority, wildlife-dependent use. Hunting would be closed at some WPAs during the late-winter, light goose season.

Fishing

Since the wetlands at the WPAs are not conducive to any type of sport fisheries, there would be no management to develop or sustain fisheries at the WPAs.

Wildlife Observation and Photography

There would be limited, unimproved opportunities for wildlife observation and photography.

Environmental Education and Interpretation

There would be limited environmental education and interpretation opportunities. The district would continue to maintain a website describing the district

and its activities. No environmental education would be provided to schools and groups.

Public Access

The district would close temporarily some WPAs to protect species sensitive to human disturbance. The district would maintain adequate signage at some, but not all of the WPAs. No public use plan would be established.

USFWS

This interpretive sign at Massie WPA (Clay County) was one of three created through a partnership with the NGPC.

Partnerships

Alternative A calls for no change in the district's involvement in partnerships. Partnerships would be limited to those that most directly help the district meet its habitat goals. Partnerships that promote public use, public awareness of the basin's wetlands, and community involvement would continue to receive low priority.

Socioeconomics

The district would continue to be managed much as it is today, thus socioeconomic change would be minimal. No significant capital investment in public use facilities would be made. Wildlife-dependent recreation would likely remain an undeveloped element of the district's operations. (BBC Research and Consulting 2006)

The district would likely remain a destination hunting and wildlife viewing location. On-site employment and visitor counts, as well as off-site effects, would remain at or near current levels. (BBC Research and Consulting 2006)

Current visitor activity at the district generates around $900,000 of new economic activity in the regional economy each year. Visitor spending would likely remain at or very close to current levels. (BBC Research and Consulting 2006)

Operations

General operations to manage the district—including the work of district staff, law enforcement, and facilities for staff and visitors—would continue at current levels.

Alternative A calls for no change in current operations associated with the large distances between WPAs and the headquarters facilities. The large distance requires additional transportation and staff costs to move equipment from storage to the repair site. The infrastructure of the district would remain minimal or substandard.

Staff and Funding

The staff level would remain the same, with a focus on restoration and management of wetlands.

Law Enforcement

Law enforcement functions would be minimal, with most enforcement activities directed toward violations of state and federal game laws.

Facilities and Equipment

Office facilities would continue in the existing leased building in the industrial area of the Kearney. The district would continue to operate out of an inadequate headquarters facility, which lacks needed office space and equipment storage. The staff would continue working in crowded conditions, sharing of office desks and equipment, and having air quality problems.

Maintenance of equipment would be inefficient because of the large distance between equipment storage areas and shop facilities. Valuable large equipment would be exposed to the weather, increasing their wear and maintenance. Equipment would continue be unprotected from weather extremes and vandalism.

Pumping of water for the wetlands would be limited and accomplished with antiquated wells.

Alternative B—Integrated Partnership Approach (Proposed Action)

Alternative B is the proposed action for the CCP for Rainwater Basin Wetland Management District. The emphasis of this alternative is to address all management aspects in a holistic manner. The alternative would encourage cooperation, coordination, and better exchange of information.

The district would work with formal and informal partners, including landowners, to improve WPAs at a landscape level. Actions would strive to build a neighborly interaction for privately owned and district lands within each watershed. An example would be to help a neighbor fill a water concentration pit that benefits the neighbor and the wetland. The district would work with partners to complete the engineering and funding. A second example would be to work with partners to help local livestock producers find enough grazing land to support livestock in the basin. The project would help assure livestock are available if grazing is needed at specific WPAs.

Land management would depend more on adaptive management—as more information is known, changes

could be made to improve management and its effect on the environment. It is expected that local communities would have a better understanding of the local and national benefits of the Rainwater Basin's wetlands and have an increased pride in this basin's contribution to the Central Flyway migration.

Habitat Management

The district would holistically manage habitat at the WPAs—primarily wetlands and uplands—to attain natural diversity. Adaptive resource management would be combined with partnerships to increase its effectiveness.

Boundary fencing and livestock watering would be increased to allow for better plant management at the WPAs. Larger herds would allow for more intense grazing during a shorter period of time.

Through a joint effort with partners, burning frequency would be increased. The focus would shift from control of the spread of woody plants to maintenance and improvement for healthy grasslands and wetlands. The joint effort could allow burns on areas where individual partners did not have enough staff or resources to burn alone.

Wetlands

Annual wetland management would be similar to that described for alternative A. This includes periodic use of prescribed fire, grazing, resting, shredding, weed control, disking, and water pumping. In addition, alternative B would incorporate new partnerships to accomplish the management objectives more efficiently.

An example may be to combine into a planned grazing system the Service's WPAs and the NGPC's wildlife management areas (WMAs). This approach could be expanded to include larger, privately owned wetlands that currently remain idle or unmanaged. Another example would be to develop formal agreements for sharing of staff for prescribed burning. Such agreements could include state and federal agencies, nonprofit organizations, and local fire departments. A third example would be to develop mutual agreements with local sporting clubs to assist in management of nearby WPAs.

As in alternative A, disking would be used to mimic the herding effect of wild animals by knocking down erect vegetation and disturbing the soil surface. Its use would be limited to areas where grazing and burning are not practical.

Uplands

As in alternative A, management of uplands would focus on attaining natural diversity and interspersion of grasses and forbs characteristic of the presettlement period. In addition, alternative B would incorporate new partnerships to accomplish the management objectives more efficiently.

USFWS

Prescribed fire is an important tool used to manage both wetland and upland habitats.

Cropping would be undertaken only to prepare the soil to reseed a high-diversity, native, grass and forb seed mix—using local genotypes whenever possible. Areas with low plant diversity would be "interseeded" with a high-diversity, native, grass and forb mix. Trees would be removed to create an open vista and conditions typical of the presettlement period.

Grassland would be managed to closely mimic the natural ecological processes of the ecosystem. Primary management techniques would include periodic use of prescribed fire, grazing, and haying. Use of prescribed fire would be expanded from a restoration practice to use for maintenance of healthy upland plant communities.

Haying and mowing would be used to remove dense stands of undesirable plant species and to create firebreaks. Its use would be limited to areas where grazing and prescribed fire are not practical.

Water and Wetland Management

Water management is central to meeting the purposes of the district.

Supplemental Water (Pumping)

Water pumping in spring and fall would be done with district funds and additional funds contributed through partnership efforts.

Water Quality and Quantity

As in alternative A, long-term wetland management would focus on restoring the hydrology of the wetlands to the highest, feasible level. Management actions would include removal of sediment, filling of water concentration pits, and clearance of trees.

In addition, expertise and resources would be sought through partnerships to address problems that extend beyond WPA boundaries. Partnerships would be used to increase monitoring of water entering the WPA's wetlands and to assess effects on plants and wildlife.

Water Rights

The Service would obtain and protect necessary water rights. District staff would coordinate with partners to gain public support for the protection of surface water runoff to the basin's wetlands.

District staff would seek to obtain a comprehensive water rights and hydrology compendium for the district from the Service's region 6 water resources division.

Invasive Plant Control

There would be no change in management or control of invasive plants. Control would continue on an annual basis with priority given to those species identified by the state of Nebraska as noxious weeds. The district would continue an IPM program for invasive plants that uses herbicide application, cropping, grazing, prescribed fire, high-diversity native plant reseeding, and haying. Herbicide application would be the primary control method.

Invasive plant control would be the same as for alternative A but would combine cooperative efforts with other land management agencies, primarily the NGPC. Arrangements would be made for each partner to control the other partners' invasive plants on nearby areas.

Wildlife Disease Control

As in alternative A, district staff would continue to monitor for and respond to wildlife diseases during spring and fall migrations. There would be no monitoring of diseases in upland birds, mammals, and other wildlife.

Partnerships would be used to increase awareness and preparedness for monitoring, detection, and techniques to deal with avian cholera, avian influenza, and chronic wasting disease. District staff would develop a wildlife disease plan.

Species of Concern

As in alternative A, no change would occur in the management of prairie dogs or threatened and endangered species. Management would be directed toward mimicking the natural ecological process of the basin. These actions would be compatible with species of concern but would not be directed specifically to individual species.

Research and Science

The district would become more active in identifying research needs, obtaining funding, conducting research, and providing expertise.

Habitat and Wildlife

Through the RWBJV, the resources of various partners would be combined to make certain that research was not redundant and was directed toward priority resource needs. The district would assist research efforts by providing temporary living quarters, office space, and lands for research.

The district would continue to use quantitative monitoring techniques to assess what effects management treatments have on plant communities, wetland habitat availability in the spring, and wetland habitat conditions in the fall. Annual population surveys would go beyond light goose and sandhill crane surveys to include other species such as shorebirds and grassland-nesting species.

The district would join with RWBJV partners to begin to quantify the benefits wetlands provide to local communities and society in general. Research work would focus on (1) wetland benefits associated with groundwater, and (2) surface water quality and quantity.

Socioeconomics

The Service would identify and quantify socioeconomic benefits that local communities derive from the district.

Land Protection

The Service would seek authority to increase the district's acquisition limit from 24,000 acres to 46,000 acres as identified in the 1986 "Rainwater Basin of Nebraska Migratory Bird Habitat Acquisition Plan" (USFWS and NGPC 1986).

The RWBJV would take the leadership role to coordinate land acquisition among the partners. The GIS would be used to help identify wetlands with the highest biological importance. Acquisition would expand beyond fee-title purchases to include perpetual easements.

The RWBJV would help coordinate which areas to acquire in fee-title versus perpetual easement versus other agricultural programs. Easement ownership would be done on those wetlands that provide biological functions while remaining in private ownerships. Such wetlands would include shallow, seasonal wetlands located in pastureland. Acquisition of specific wetlands would be targeted toward the appropriate partner's ownership. An example would be arranging for the NGPC to buy a wetland that is near another wetland owned by them.

Cultural Resources

A partnership through the RWBJV would develop a basin-wide program to identify and evaluate the cultural resources in the basin. A sensitivity model would be established to concentrate survey efforts on areas with a high potential for cultural resources.

Inventories would continue to be done in response to activities that constitute undertakings under section 106 of the National Historic Preservation Act. A multi-

agency programmatic agreement would be carried out that would make the process more efficient.

Visitor Services

As in alternative A, all WPAs would remain open to the six priority wildlife-dependent recreational uses identified in the Improvement Act—hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Additional signs would be placed throughout most of the WPAs, especially at all the high-profile areas. A public use plan would be developed and more emphasis would be placed on outreach and environmental education. The district would continue to maintain a website and increase the amount and timeliness of the information.

Hunting

As in alternative A, hunting and trapping programs would continue for management of wildlife and to provide a compatible, priority, wildlife-dependent use. Hunting would be closed at some WPAs during the late-winter, light goose season.

In addition, a hunt plan would be developed. District staff would work with partners to increase the number of accessible hunting blinds and to provide up-to-date conditions to the public. The district would increase the signage at and around the WPAs.

Fishing

As in alternative A, there would be no management to develop or sustain fisheries at the WPAs.

Wildlife Observation and Photography

District staff would develop partnerships and volunteerism to promote and expand viewing opportunities—more hiking trails and viewing blinds. District staff and partners would develop and distribute bird-viewing guides and maps.

Environmental Education and Interpretation

The district would establish a formal program and facilities for environmental education and interpretation. The district would continue to maintain a website describing the district and its activities. District staff would build support for the district through volunteers and partnerships.

Public Access

The district would close temporarily some WPAs to protect species sensitive to human disturbance. The district would maintain adequate signage at and around the WPAs.

Partnerships

The overlap between the goals and objectives of the district and the RWBJV creates a win–win opportunity for both. The RWBJV partnerships fit "hand-in-glove" with those that have direct and tangible benefit to the district. Mutual support between the district and the RWBJV would enhance accomplishments and more than compensate for the time and leadership commitments of district staff to the RWBJV.

USFWS

Ducks Unlimited and RWBJV funded the installation of nearly 3 miles of pipeline to deliver well water to 10 WPAs.

Socioeconomics

Under this alternative, the district would continue to be managed much as it is today, but with the help of various partnerships the socioeconomic change might be significant. Capital investment in visitor service facilities would be made through partnerships and as funding sources allow. Wildlife-dependent recreation would be further developed. The district would remain a destination location for hunting and wildlife viewing; with the added emphasis on visitor services, these wildlife-dependent recreational opportunities would increase visitor use.

On-site employment and visitor counts, as well as off-site effects, would likely increase from current levels. It is expected that an increased visitor activity at the district would surpass the current $900,000 of new economic activity in the regional economy each year. Visitor spending would likely increase from current levels due to increased visitation.

Operations

The district would construct an office/visitor center, cold-storage building, and shop facility on Service-owned property. The infrastructure of the district would change dramatically.

Staff and Funding

Staffing would increase, as budgetary realities allow, to address the changes that would occur under alternative B. New staff would include an outdoor recreation planner, a full-time law enforcement officer, a maintenance worker, and an additional refuge operations specialist.

Law Enforcement

The district would hire a full-time law enforcement officer and develop a law enforcement plan.

Facilities and Equipment

An office/visitor center and a cold-storage and shop facility would be constructed on Service-owned property. The entire infrastructure would include buildings for equipment storage and repair and temporary quarters for researchers, volunteers, and fire crews.

District staff would maintain property and equipment in a safe, working condition. Adequate radio and telephone communications would be provided for staff safety and management efficiency.

Water-pumping facilities at existing wells would be increased and modernized.

The district would construct livestock water structures and boundary fences around most of the WPAs to facilitate use of grazing as a management tool.

3.5 COMPARISON OF ALTERNATIVES AND ENVIRONMENTAL CONSEQUENCES

Table 3 displays a comparison of the alternatives' management actions related to the issues and topics described in section 3.2 "Alternatives Development." In addition, the estimated environmental consequences of each alternative's management actions are summarized; the complete narrative about environmental consequences is in chapter 5.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
MANAGEMENT APPROACH	
Manage for migratory species and other wildlife. Continue the current level of public use. Perform limited research. Monitor long-term vegetation change. Apply adaptive resource management.	Manage for migratory species and other wildlife. Work extensively with partners to improve the timing and application of management practices. Increase the level of wildlife-dependent public use. Build community support. Work with partners to increase research. Monitor effects of management and use research results to modify management.
HABITAT MANAGEMENT, Wetlands—Management Actions	
Manage to attain a natural diversity and interspersion of open-water and early successional plant species. Manage to mimic natural ecological processes. Restore wetland hydrology. Fill water concentration pits. Measure sediment depths. Remove sediment in problem areas. Remove trees to re-create historical conditions. Use prescribed fire to restore areas threatened by invasive plants, primarily woody vegetation. Apply grazing that mimics high-intensity, short-duration grazing that occurred presettlement. Use disking to mimic vegetation trampling and soil tilling caused by large herds. Rest areas once the preferred vegetation has been attained.	*Same as alternative A, plus the following:* Use partnerships to more efficiently accomplish objectives. Expand use of prescribed fire—from restoration to use for maintenance of healthy wetland plant communities. Use large livestock herds for more intense grazing in less time.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
HABITAT MANAGEMENT, Wetlands—Environmental Consequences	
Restored wetlands would receive most of their historical watershed runoff. Only areas with high value for migratory birds would receive priority.	The use of grazing would improve through adaptive resource management. Expanded partnerships would allow more district lands to be treated to achieve desirable conditions.
HABITAT MANAGEMENT, Uplands—Management Actions	
Manage to attain a natural diversity and interspersion of grasses and forbs characteristic of presettlement vegetation. Manage to mimic natural ecological processes. Apply adaptive resource management. Use prescribed fire to restore areas threatened by invasive plants, primarily woody vegetation. Use short-term cropping or farming to prepare soil to reseed high-diversity seed mixes. Seed and "interseed" using seeds from locally harvested genotypes. Apply grazing to mimic high-intensity, short-duration grazing that occurred presettlement. Use haying to remove dense stands of undesirable plant species and to create firebreaks. Rest areas once the preferred vegetation has been attained.	*Same as alternative A, plus the following:* Use partnerships to more efficiently accomplish objectives. Expand use of prescribed fire—from restoration to use for maintenance of healthy upland plant communities. Increase boundary fencing and livestock watering.
HABITAT MANAGEMENT, Uplands—Environmental Consequences	
Highly degraded habitats would receive priority for management. Habitats in good condition would be treated only if resources and time allows—this could cause degradation at WPAs with adequate wildlife habitat.	The use of grazing and fire would improve through adaptive resource management. Expanded partnerships would allow more district lands to be treated to achieve desirable conditions, without allowing others to deteriorate.
WATER AND WETLAND MANAGEMENT, Supplemental Water (Pumping)—Management Actions	
Pump water for availability for the spring migration. Give priority to wetlands with optimal waterfowl habitat; increase the dispersal of waterfowl in the district. Pump water to provide shallow water and large mud flats for shorebird and whooping crane migration.	*Same as alternative A, plus the following:* Build partnerships and local support to increase the water-pumping capabilities during spring and fall migration.
WATER AND WETLAND MANAGEMENT, Supplemental Water (Pumping)—Environmental Consequences	
No changes in the water-pumping situation would mean less habitat available for migratory birds during critical times of migration.	Expanded partnerships would allow more water to be pumped into wetlands in the district to achieve desirable conditions during migration.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
WATER AND WETLAND MANAGEMENT, Water Quality and Quantity—Management Actions	
Restore wetland hydrology. Remove sediment, fill water pits, and clear trees. Work with landowners to improve runoff reaching the WPAs. Monitor runoff from livestock confinement areas only during large inflow events.	*Same as alternative A, plus the following:* Use partnerships to increase monitoring of water entering WPA wetlands; assess effects on plants and wildlife. Use partnerships for research and monitoring to find out the benefits of the basin's wetlands to surface water quality and groundwater recharge.
Water and Wetland Management, Water Quality and Quantity—Environmental Consequences	
No changes in staff levels would mean that only clear violations of water quality laws would be acted upon. Ongoing and future undetected violations would likely affect the quality and quantity of water reaching the WPAs' wetlands.	Expanded partnerships could allow avoidance and rectification of water quality laws, as well as agreements that benefit wildlife habitats as well as resources available landowners neighboring WPAs.
WATER AND WETLAND MANAGEMENT, Water Rights—Management Actions	
Assume that natural surface water runoff to WPA wetlands would not be captured or diverted by non-Service parties.	Work with partners to gain public support for protection of surface water runoff to the basin's wetlands. Obtain and protect water rights. Obtain a comprehensive water rights and hydrology compendium.
WATER AND WETLAND MANAGEMENT, Water Rights—Environmental Consequences	
The Service would have an inadequate handle on water rights held or needed by the district to achieve the vision and goals.	Expanded and diversified partnerships would help improve and protect water quality and quantity reaching WPAs.
INVASIVE PLANT CONTROL—Management Actions	
Control invasive plants with IPM—use reseeding, herbicide, grazing, haying, mowing, and prescribed fire as management strategies. Map, treat, and monitor infested areas. Treat in priority order—(1) noxious weeds, (2) plant species degrading wetlands, and (3) species degrading uplands.	*Same as alternative A, plus the following:* Build partnerships to increase the efficiency of invasive plant control.
INVASIVE PLANT CONTROL—Environmental Consequences	
The district would be able to contain the spread of the most noxious plant species at most of the WPAs, but not eradicate the problem.	Through expanded parterships, the district would be able to contain the spread of the most noxious plant species at most of the WPAs in a more efficient and cost-effective manner, being almost able to eradicate the problem.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
WILDLIFE DISEASE CONTROL—Management Actions	
Monitor and respond to avian cholera and other disease outbreaks.	*Same as alternative A, plus the following:* Use partnerships to increase preparedness for wildlife diseases. Develop a wildlife disease plan.
WILDLIFE DISEASE CONTROL—Environmental Consequences	
The district would be able to contain the spread of known epizootic diseases but might be unable to contain the spread of new wildlife diseases.	Through expanded partnerships, the district would be able to respond quicker to contain the spread of epizootic diseases in a more efficient and cost-effective manner.
SPECIES OF CONCERN—Management Actions	
Manage to mimic natural ecological processes.	*Same as alternative A.*
SPECIES OF CONCERN—Environmental Consequences	
Effects to known species of concern would be neutral or positive.	Proper grazing would maintain prairie dog populations at acceptable levels. There would be an increase in rarer species because of changes in management and coordination with partners.
RESEARCH AND SCIENCE, Habitat and Wildlife—Management Actions	
Assist partners, universities, and scientists to develop projects that focus on district priorities. Find funding, provide technical assistance and review, provide research sites, and develop new methods for research. Use quantitative monitoring techniques to assess wetland management and wildlife populations.	*Same as alternative A, plus the following:* Work with partners to increase the volunteer, internship, and graduate research programs. Provide temporary housing for researchers and volunteers. Expand monitoring to include upland habitats and grassland birds. Increase research on the hydrology of the WPAs' watersheds.
RESEARCH AND SCIENCE, Habitat and Wildlife—Environmental Consequences	
The district would benefit minimally from occasional research performed within the district. Limited monitoring would be performed as district resources allow.	Through expanded partnerships the district would be able to engage in activities and support that lead into research that directly benefits the management activities of the district. Monitoring is likely to increase in areas and at times currently not available.
RESEARCH AND SCIENCE, Socioeconomics—Management Actions	
Conduct no additional analysis of the socioeconomic situation.	Identify and quantify socioeconomic benefits that local communities derive from the district.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
RESEARCH AND SCIENCE, Socioeconomics—Environmental Consequences	
The district would continue to have a lack of knowledge on the current conditions where socioeconomic benefits local communities and municipalities derive from the existence and management of the district.	Through expanded parterships, the district would be able to ascertain the benefits that it provides to local municipalities and to Nebraska. The district would be able to find areas where visitor services could be expanded to provide more benefits to the community. More segments of the population would be reached to gain further support for conservation efforts.
LAND PROTECTION—Management Actions	
Buy land only in fee title from willing sellers. Focus on remaining wetlands having partial district ownership.	Through partnerships, expand land protection with perpetual easements. Coordinate with partners to identify lands that need protection and transfer to appropriate agencies.
LAND PROTECTION—Environmental Consequences	
Only a few of the wildlife-habitat parcels of land remaining in the basin would be protected, leaving other potential tracts of land without protection.	Expanded partnerships would allow for innovative and expanded methods to conserve lands with value to wildlife throughout the basin. Complete ownership of wetlands would allow more effective management.
CULTURAL RESOURCES—Management Actions	
Follow requirements of the National Historic Preservation Act prior to any undertaking.	*Same as alternative A, plus the following:* Work with partners to develop a basin-wide program to identify and evaluate cultural resources. Implement a multi-agency programmatic agreement that would make the process more efficient.
CULTURAL RESOURCES—Environmental Consequences	
Efforts to identify cultural resources would only take place in response to a proposed undertaking.	Expanded partnerships would allow for proactive identification of cultural resources, not just those in the area of a proposed undertaking. This would also help to speed up the process for future habitat management activities.
VISITOR SERVICES, Hunting—Management Actions	
Provide opportunities to hunt and trap. Close some WPAs to hunting during the late-winter, light goose season.	*Same as alternative A, plus the following:* Develop a hunt plan. Work with partners to increase the number of accessible hunting blinds. Work with partners to provide up-to-date wetland conditions to the public.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
VISITOR SERVICES, Hunting—Environmental Consequences	
The district would continue to be a destination for avid hunters. The district would lack the information about the level of use by and satisfaction of hunters.	Through the development of a hunt plan and partnerships, the district would better understand hunter use, hunter satisfaction, and potential areas to improve its infrastructure to meet visitors' needs.
VISITOR SERVICES, Fishing—Management Actions	
Do not manage to develop or sustain a fisheries.	*Same as alternative A.*
VISITOR SERVICES, Fishing—Environmental Consequences	
Fisheries would not be developed.	*Same as alternative A.*
VISITOR SERVICES, Wildlife Observation and Photography—Management Actions	
Provide limited opportunities for wildlife observation and photography.	Develop partnerships and volunteerism to promote and expand wildlife-viewing opportunities. Increase the number of hiking trails and viewing blinds. Work with partners to develop and distribute bird-viewing guides and maps.
VISITOR SERVICES, Wildlife Observation and Photography—Environmental Consequences	
Limited opportunities for these public uses would cause these activities to remain at current levels.	Through the development of partnerships, the district would better understand the level of use by and satisfaction of wildlife observers and photographers. The district would be able to identify potential areas to improve its infrastructure to meet visitor's needs.
VISITOR SERVICES, Environmental Education and Interpretation—Management Actions	
Provide limited environmental education and interpretation. Provide a current webpage.	*Same as alternative A, plus the following:* Establish a formal environmental education and interpretation program and facilities. Emphasize partnerships with local groups and organizations. Build support through volunteers and partnerships.
VISITOR SERVICES, Environmental Education and Interpretation—Environmental Consequences	
The limited opportunities for these public uses would cause these activities to remain at current levels.	Through the development of partnerships, the district would better understand the level of use by and satisfaction of people wanting to learn more about the environment. The district would be able to identify potential areas to improve its infrastructure to meet visitor's needs.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
VISITOR SERVICES, Public Access—Management Actions	
Temporarily close some WPAs when needed to protect species sensitive to human disturbance. Maintain identification and boundary signs at the WPAs.	*Same as alternative A, plus the following:* Increase the number of the Service's WPA signs on district lands. Increase the number of directional signs on main roads and highways.
VISITOR SERVICES, Public Access—Environmental Consequences	
No changes in management would lead to the same level of use as currently occurs as visitors would not always know where the WPAs are located	Expanded and improved signage is likely to lead to better recognition of the Service and the district, as well as possible increase in public visitation
PARTNERSHIPS—Management Actions	
Limit partnerships to those that can help meet habitat goals.	*Same as alternative A, plus the following:* Assure that the partnerships joined or created are mutually beneficial and provide a return on investment.
PARTNERSHIPS—Environmental Consequences	
It is unlikely that the district could meet the vision and goals. Public misunderstanding of management activities and goals would continue, and there would be a lack of public support.	Expanded partnerships would enable the district to make significant progress in meeting the vision and goals. Public awareness would be increased and vandalism decreased because of expanded education and interpretation programs.
SOCIOECONOMICS—Management Actions	
Make no investment in facilities or additional staff.	Improve management and visitor services to increase public use and appreciation of wetland resources.
SOCIOECONOMICS—Environmental Consequences	
Effects would be neutral or minimal, with district expenditures and visitation near current levels.	There would be long-term positive effects on the local economy due to increased visitation because of improvement of habitat and facilities.
OPERATIONS, Staff and Funding—Management Actions	
Retain the current staff level to manage wetlands.	Expand the staff level as budgets allow to address increasing needs.
OPERATIONS, Staff and Funding—Environmental Consequences	
The district would manage habitats in a more reactive than proactive way. This may lead to some degradation of habitats due to invasive plant encroachment and under-management.	The district would be able to improve more lands for migratory and other wildlife species. There would be increased opportunities for compatible public recreation.

Table 3. Comparison of alternatives and environmental consequences.

Alternative A—Current Management (No Action)	*Alternative B—Integrated Partnership Approach (Proposed Action)*
OPERATIONS, Law Enforcement—Management Actions	
Maintain a limited law enforcement program.	Develop a law enforcement plan. Establish a position for one full-time law enforcement officer.
OPERATIONS, Law Enforcement—Environmental Consequences	
Current levels of law enforcement would likely lead to inadequate protection of resources and wildlife.	The Service would be able to conduct year-round patrols to enforce laws and regulations and increase contacts with hunters, neighbors, and visitors. This increased presence would provide more protection of district resources.
OPERATIONS, Facilities and Equipment—Management Actions	
Operate from a substandard rental office and shop. Maintain property and equipment in safe, working condition. Operate and repair antiquated water-pumping facilities; limit pumping to existing facilities.	Construct an office/visitor center, cold-storage building, shop facility, and temporary housing facilities for volunteers, researchers, and fire crews. Maintain property and equipment in safe, working condition. Provide adequate radio and telephone communications. Increase and modernize water-pumping facilities. Construct livestock water structures and boundary fences around most WPAs to facilitate use of grazing as a management tool.
OPERATIONS, Facilities and Equipment—Environmental Consequences	
Continued use of existing facilities would perpetuate the inability of the staff to perform adequately and could also lead to preventable accidents.	Use of modern facilities that meet the Service's safety standards would allow the staff to work without unnecessary risks and be more productive and efficient.

4 Affected Environment

Gary Eslinger/USFWS

The stiff sunflower is a native forb in the Rainwater Basin.

The Rainwater Basin Wetland Management District manages 61 noncontiguous tracts of federal land totaling 24,210.09 acres in south-central Nebraska. All of these lands within the Rainwater Basin are WPAs, which each typically contain one large wetland. Together, these WPAs are managed as a grassland ecosystem designed to provide optimal habitat for waterfowl and shorebirds. Uplands (nonwetlands) are managed for a high diversity of native grass species and grassland birds. The district also manages 35 conservation easements totaling 2,476 acres.

This chapter describes the physical environment and biological resources of the basin and the district. In addition, the affected environment includes the fire and grazing history, cultural resources, special management areas, visitor services, socioeconomic environment, and operations of the district.

4.1 PHYSICAL ENVIRONMENT

The Rainwater Basin is located near the center of the Great Plains. Its geographical region encompasses approximately 4,200 square miles covering portions or all of 17 counties in south-central Nebraska. The widest span is 160 miles across, extending from Gosper County to central Seward County. The northern edge parallels the central Platte River. The southern edge lies about 10 miles from the Kansas border.

Global Warming

The U.S. Department of the Interior issued Order No. 3226 in 2001 requiring federal agencies under its direction that have land management responsibilities to consider potential climate change effects as part of long-range planning endeavors.

The Department of Energy's report, "Carbon Sequestration Research and Development" (USDOE 1999), concluded that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. The report defines carbon sequestration as "the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere."

The increase of carbon dioxide (CO_2,) within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as "global

warming." In relation to comprehensive conservation planning for Refuge System units, carbon sequestration constitutes the primary climate-related effect to be considered in planning.

Vegetated land is a tremendous factor in carbon sequestration. Large, naturally occurring communities of plants and animals that occupy major habitats—grasslands, forests, wetlands, tundra, and desert—are effective both in preventing carbon emission and in acting as biological "scrubbers" of atmospheric CO_2.

One Service activity in particular—prescribed burning—releases CO_2, directly to the atmosphere from the biomass consumed during combustion. However, there is no net loss of carbon because new vegetation quickly germinates and sprouts to replace the burned-up biomass. This vegetation sequesters an approximately equal amount of carbon as was lost to the air (Dai et al. 2006).

Several other effects of climate change may need to be considered in the future:

- Habitat available in lakes and streams for cold-water fish such as trout and salmon could be reduced.
- Forests may change, with some plant species shifting their range northward or dying out and other trees moving in to take their place.
- Ducks and other waterfowl could lose breeding habitat because of stronger and more frequent droughts.
- Changes in the timing of migration and nesting could put some birds out of synchronization with the life cycles of their prey.

Climate

The basin has a continental climate characteristic of extreme temperature changes through the seasons and relatively low precipitation rates. The district averages 21–28 inches (west to east) of precipitation annually. Eighty percent of the precipitation occurs between April and September. The change in precipitation amount across the district is primarily responsible for the shift from mixed-grass prairie in the west to tall-grass prairie in the east.

Winter temperatures average 27°F, while summer temperatures average 75°F. Daily minimum temperatures above 32°F occur 136–177 days. Relative humidity averages 55% at midafternoon and 80% at dawn across most of the basin. Annual evaporation in the basin exceeds rainfall accumulations. Evaporative losses in Phelps County were computed by the Thornthwaite method. These losses average more than 5.3 inches per month (June–August). Annual free-water evaporation from small bodies of water average 46 inches; about 77% of that amount is lost from May through October. Evaporative losses can significantly reduce the amount of pooled surface water.

Physiography, Geography, and Soils

The 59 WPAs found within the basin contain the same geological and soil characteristics. The Rainwater Basin lies in the flat to gently rolling, mixed-grass, loess plains of south-central Nebraska. This area is geologically new and has not developed a complete system of streams to drain surface water. It is from this characteristic that the area received its name—Rainwater Basin.

Wind-deposited Peorian Loess occurs extensively across the basin and has about 10,000 years of stability (Keech and Dreezen 1959). Upland soils that formed in wind-deposited material include Crete, Hastings, Holdrege, Hord, and Uly (Kuzila 1984). The soils are suitable for farming, with about 80% of the land being cropped.

The shallow, flat depressions formed by wind scouring are often referred to as playa wetlands because of their ephemeral (lasting for a brief time) nature. Radiocarbon dating indicates the wetlands were created near the end of the Ice Age, 20,000–25,000 years ago. Some depressions may have been enlarged and new ones created as recently as 3,000 years ago (Farrar 1996a). Over thousands of years, minute clay particles accumulated in the bottoms of the depressions, effectively sealing them off and preventing water from seeping away. The impervious clay layers are 6–72 inches thick. The wetland soils are predominantly Butler, Fillmore, Scott, and Massie (Kuzila 1994, Kuzila and Lewis 1993).

The Service and RWBJV grouped the basin's land cover into 22 categories (see table 4). Cropland covers 80% of the landscape. Grassland covers 10% and roads cover 2.6%. Nonfarmed wetlands represent 1%. Figures 20–22 show the land cover, grouped into 10 simplified categories, across the basin.

Water Resources

This section describes the relationships between the hydrology, wetlands, and water quality in the basin in relation to the district's WPAs. In addition, this section describes the water rights situation.

Hydrology

As a whole, groundwater levels throughout most of the basin have little influence on wetlands. Artificial groundwater mounds occur near irrigation delivery canals and some wetlands do benefit from this water source. Most of the basin has groundwater located more than 50 feet deep; some is 400 feet or deeper (see figure 23, groundwater map). One area east of the Tri-County canal (including Johnson WPA and Funk WPA) has groundwater levels that are less than 50 feet deep (Ekstein and Hygnstrom 1996), showing a rise of more than 50 feet from the period before development to now (see figure 23, groundwater map). Recent (2000–2006) groundwater levels have shown a decline from

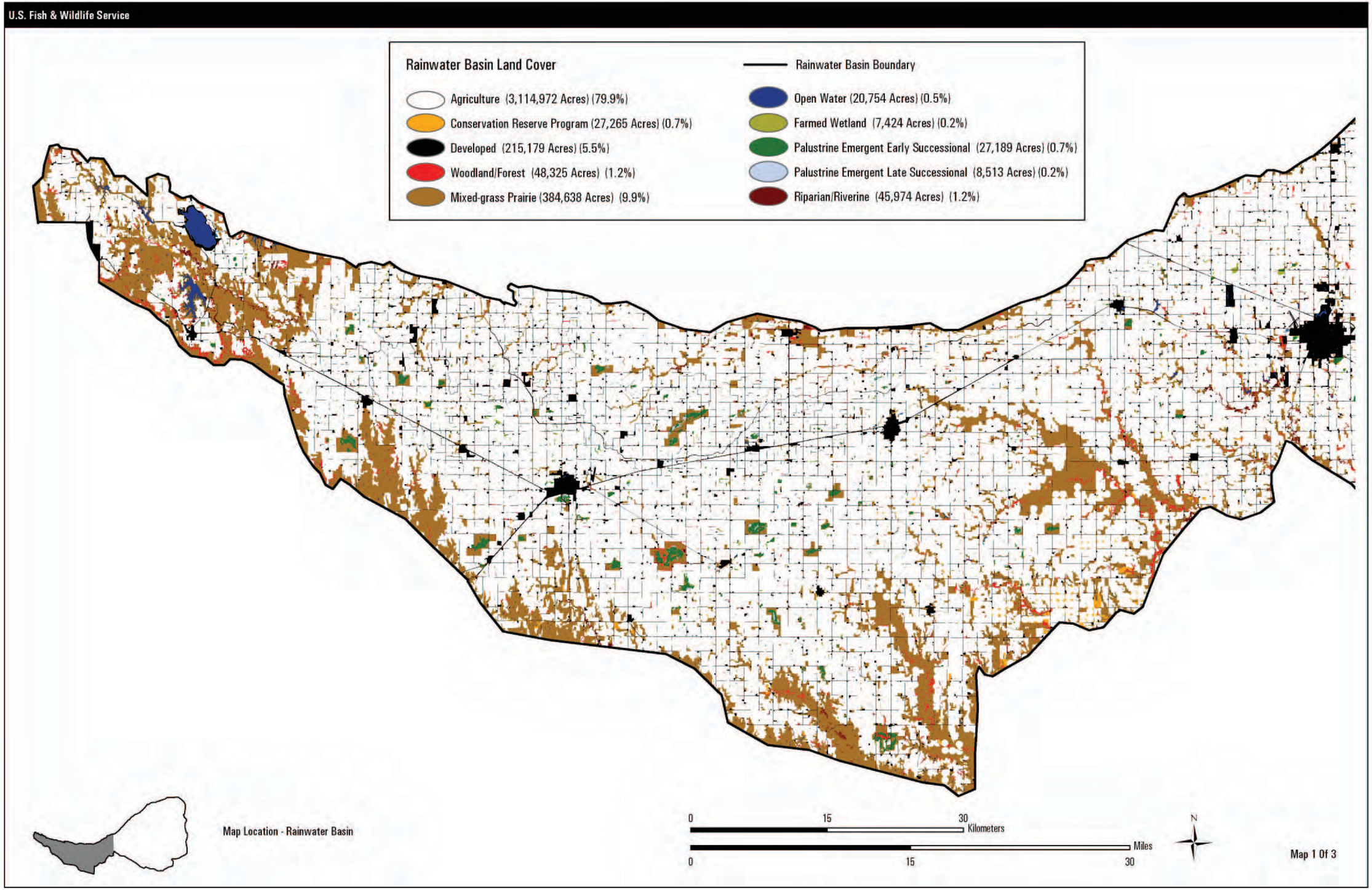


Figure 20. Land cover in the western portion of the Rainwater Basin, Nebraska.

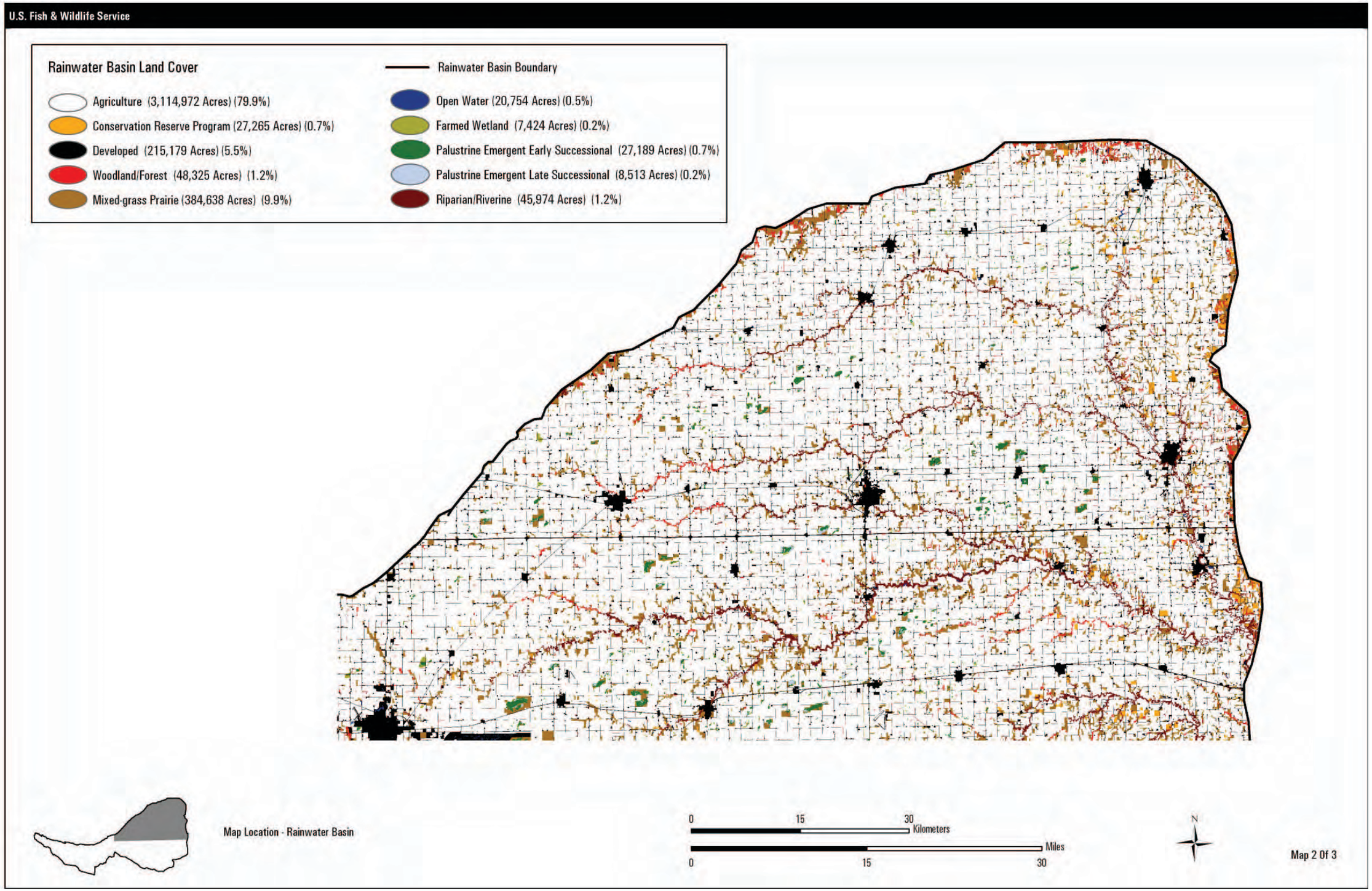


Figure 21. Land cover in the northeastern portion of the Rainwater Basin, Nebraska.

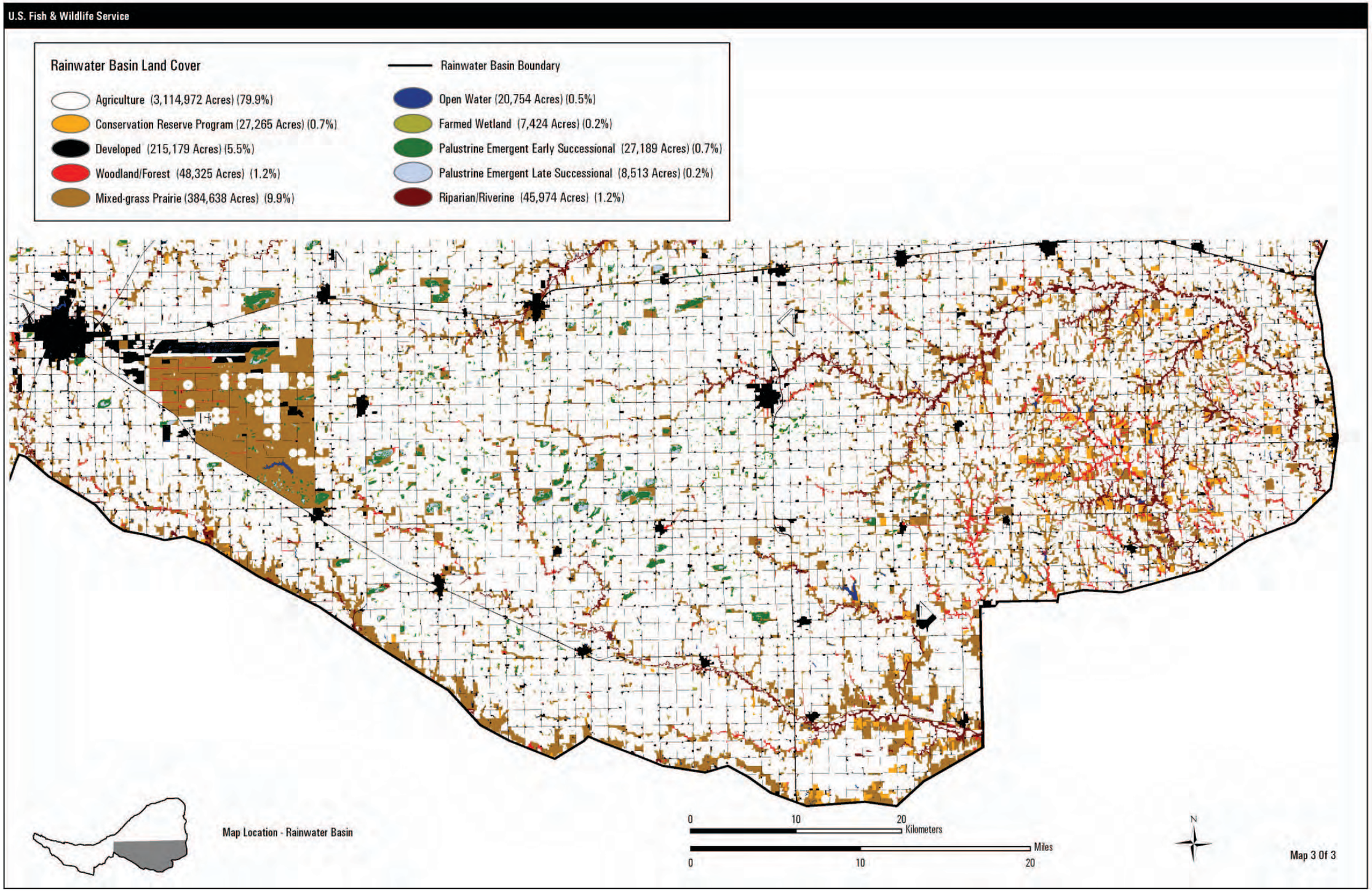


Figure 22. Land cover in the southeastern portion of the Rainwater Basin, Nebraska.

Table 4. 2004 Land cover in the Rainwater Basin.

Land Cover	*Acres*	*Percent*
agriculture (crop)	3,114,972	79.9
Conservation Reserve Program	27,265	0.7
road	102,838	2.6
developed urban area	27,969	0.7
developed rural area	80,873	2.1
other developed area	3,041	0.1
woodland forest	48,325	1.3
range/grass/pasture	384,031	9.8
sand pit	84	0.0
lagoon	486	0.0
irrigation reuse pit	5,487	0.1
reservoir	3,887	0.1
stock pond	11,298	0.3
farmed wetland	7,424	0.2
early successional hydrophytes*	27,189	0.7
late-successional hydrophytes*	8,513	0.2
riparian canopy	45,253	1.2
riparian shrubland	245	0.0
river channel	249	0.0
sandbar	46	0.0
wet meadow	971	0.0
floodplain marsh	189	0.0
Total	3,900,635	100.0

(Source: Bishop and Reker 2006.)
**A hydrophyte is a plant that is adapted to grow in water.*

5–15 feet throughout most of the basin, with a few areas decreasing more than 25 feet (UNL 2006a).

The development of center-pivot irrigation in the last third of the century has placed great demand on the groundwater underlying the basin. Irrigation, compounded by extensive drought conditions, has caused the state legislature to pass legislation to begin to control the declines in groundwater. Eleven river basins within the state have been determined to be overappropriated (that is, permitted uses for the water in the stream or river exceeds the amount of water in the stream or river). Nebraska's natural resource districts in those river basins are required to develop an integrated surface water and groundwater management plan for each river basin. Only the extreme western edge of the Rainwater Basin Wetland Management District lies within an overappropriated river basin. However, the natural resource districts within the basin have placed a moratorium on new wells and require stricter monitoring on water pumping.

There are 71 registered groundwater wells scattered over 39 of the district's WPAs. Only 26 WPAs have water-pumping capability and only 23 of these WPAs can pump water due to ownership issues relating to the "hydric footprint" (soil characteristics that indicate the existence of a wetland basin). These existing wells have the ability to deliver water to 2,230 wetland acres (approximately 20% of the total WPA wetland acres). Each well is metered and complies with state regulations for irrigation wells.

Groundwater recharge may occur in the basin and is being investigated in a 2-year research project. Research from playa lakes in Texas and New Mexico indicates that playas recharge groundwater by playa water percolating through the soils (referred to as "interstitial and macropore flow") (Wood 2000).

Wetlands and Water Quality

Mapping done in the middle part of the last century indicated that the basin contained about 100,000 acres of wetland habitat in 4,000 basins (Schildman and Hurt 1984). However, modern soil surveys indicate two to three times as many wetlands existed (Gersib et al. 1990). Ducks Unlimited inventoried the hydric soils (those characterized by considerable moisture) and computed the historical number of wetlands to be 204,436 acres (personal communication with Darin Blunk, Bismarck, ND, 2004). Figure 24 displays the historical wetlands in the basin.

In 2004, a spring habitat assessment by the Great Plains GIS office found that only 1,693 basins (14% of the historical number) contained some wetland function in the form of retained water; the area totaled 27,839 total acres. The public wetlands provided 45% of the waterfowl habitat but represented only 9% of the 1,693 wetlands. Figure 25 displays the current wetlands in the basin.

Agricultural development has been responsible for most of the wetland loss (Schildman and Hurt 1984). Modifications within the watersheds and the wetlands have caused many wetlands to become more ephemeral in nature. Land leveling and the diversion of runoff to concentration pits and road ditches are the primary causes (Raines et al. 1990). The Great Plains GIS office has identified 11,859 concentration pits totaling 7,506 acres within the basin. The pits' water storage capacity is about two-thirds of the historical storage capacity of wetlands in the basin. There are 627 pits within individual WPA watersheds. Agricultural runoff has increased siltation and deposited related chemicals, which has resulted in poor water quality and partial filling of many wetlands (Gersib 1991, Frankforter 1996).

In their natural state, the larger wetlands collected runoff from several square miles. If precipitation was adequate, the wetlands probably held water throughout most years. The most common wetlands are small—covering less than 40 acres. The larger, less common wetlands reach nearly 1,000 acres.

On average, each WPA contains one large, seasonal or semipermanent wetland. Wetlands under district ownership total 11,117 acres. The ratio of wetland to upland is 1:1. The wetlands occupy about 16% of their watershed, with the wetland receiving its runoff water from agricultural lands. Waterfowl production area

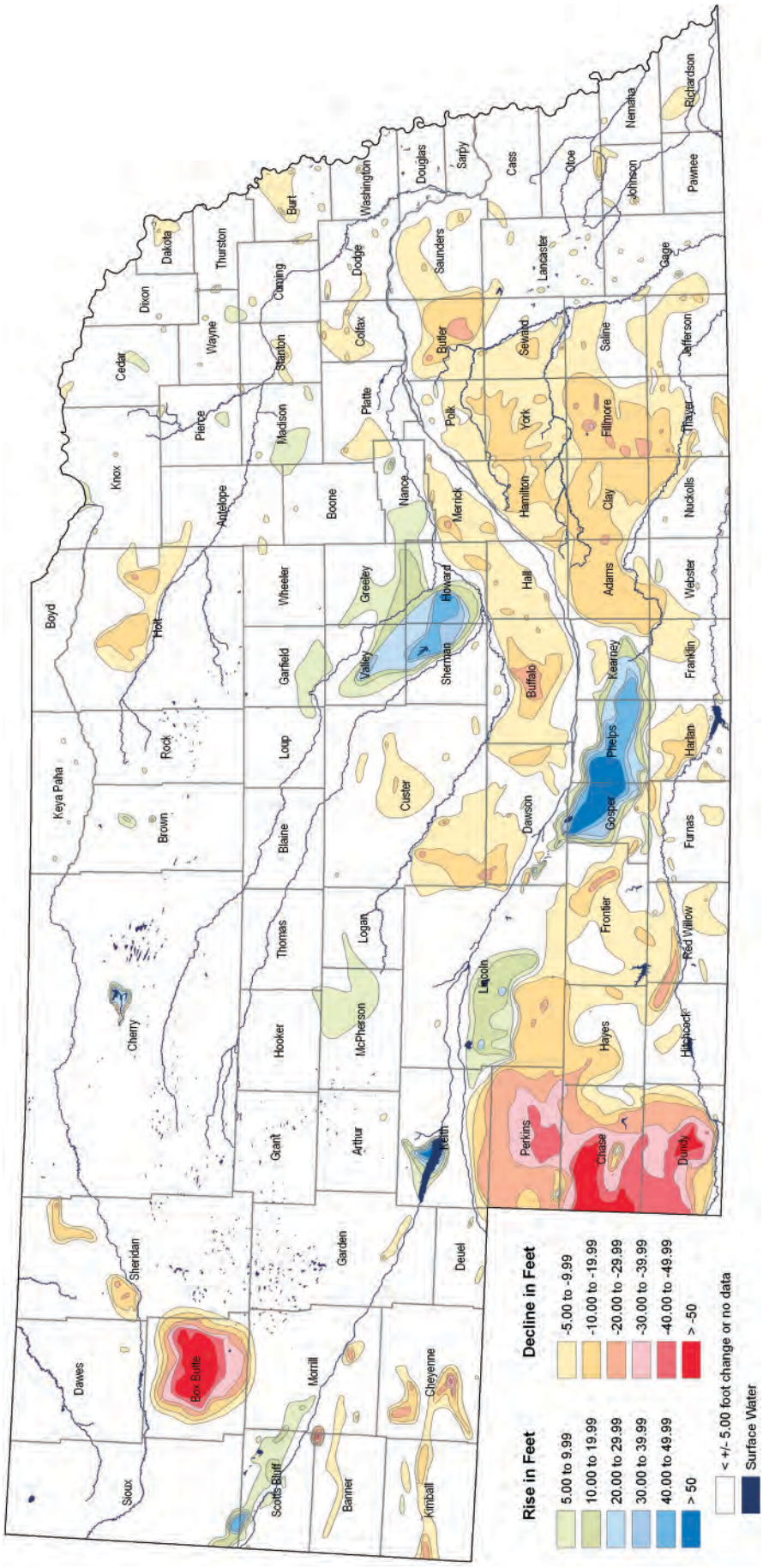


Figure 23. Groundwater-level changes in Nebraska—predevelopment to spring 2006.
(Source: University of Nebraska–Lincoln [UNL] 2006b.)

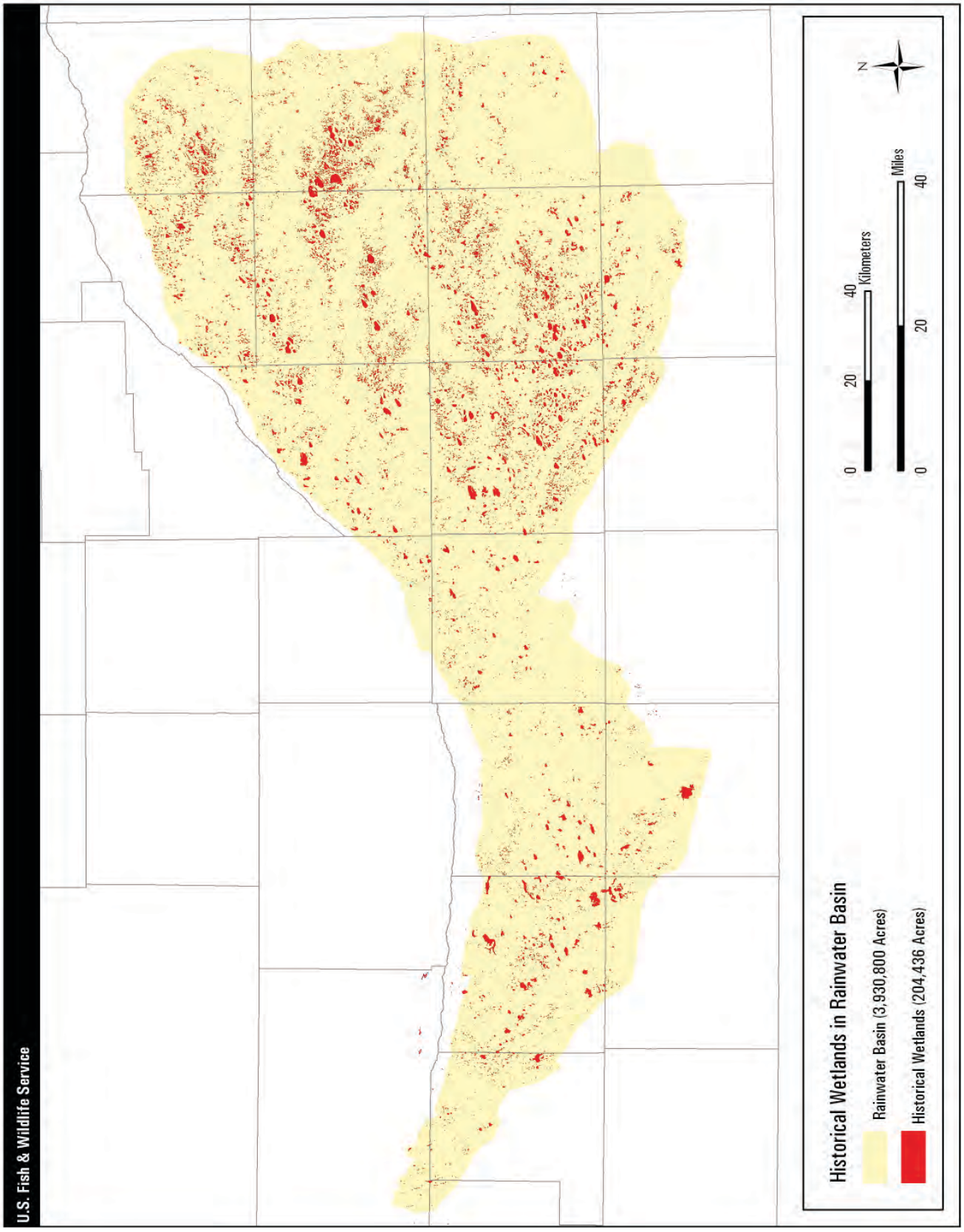


Figure 24. Historical wetlands in the Rainwater Basin, Nebraska.

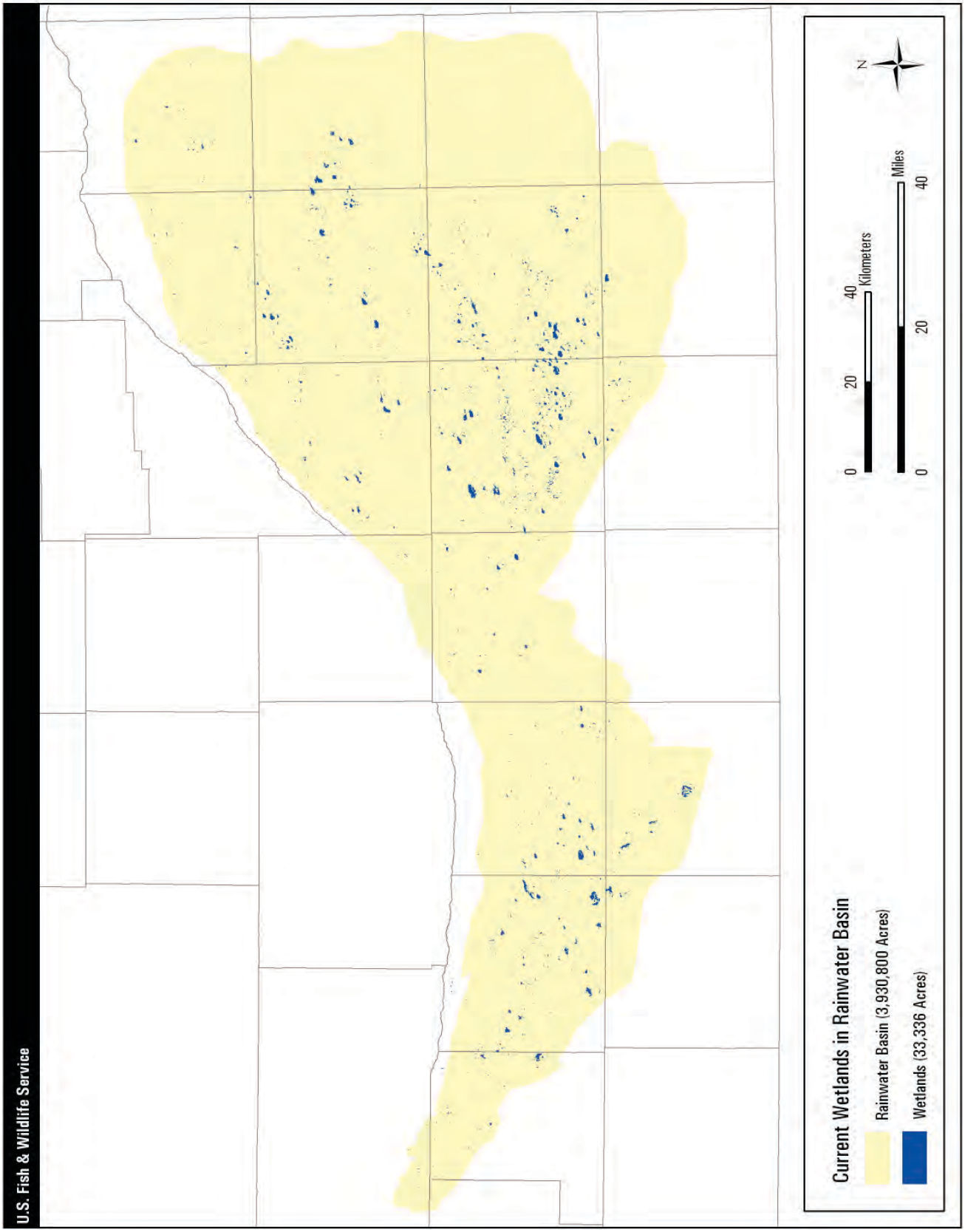


Figure 25. Current wetlands in the Rainwater Basin, Nebraska.

watersheds range in size from 153 to 15,852 acres, with an average size of 3,024 acres.

Dikes, ditches, and water control structures exist at the larger WPAs. Divided ownership of a large wetland has caused the district to try to restore its portion of the wetland to the maximum level it can. For example, surface drains occur on 13 WPA wetlands and affect the hydrology to some degree. Most of the drains only function when the wetlands are more than 80% full.

USFWS

This water control structure at Funk WPA (Phelps County) helps direct water to three different units.

In the early 1900s, counties authorized drainage districts to facilitate weltand drainage. Each district was specific to one large wetland, with drainage being done with subsurface tile drains. Five WPAs—Miller's Pond, Nelson, Springer, Troester, and Wilkins—have active tile drains. Tile drains as deep as 50 feet were tunneled though hills (Farrar 1982, 1996b). The age and structural integrity of the drains cause concern for their future. The district's desire to abandon drains is in conflict with other landowners owning a portion of the wetlands.

Water Rights

The district does not have any surface water rights because no water from streams is diverted to wetlands. However, the district has water contracts with Central Nebraska Public Power and Irrigation District for the delivery of 762 acre-feet annually to Funk WPA and Victor Lakes WPA. The water contracts transferred with the property when it was bought. The district has filed to cancel the contracts because the timing and amount of water delivered does not benefit waterfowl. These contracts are scheduled to end within 5 years.

There are no well-defined legal rights protecting surface water in wetlands. For example, where the Service owns half of a wetland, the neighboring landowner might dig a pit for irrigation re-use or for a more permanent source of livestock water or for hunting. The neighbor captures the first runoff, and the Service-owned wetland will only receive runoff water after the neighbor's pit is filled. If there is not enough runoff to overfill the pit, the Service-owned wetland will get little or no water, especially when most of the runoff comes from the neighboring land.

Nebraska's water law requires irrigators to control irrigation runoff. Infractions are difficult to enforce and the irrigator often views the runoff flowing onto public lands as a benefit to wildlife. However, the law does allow natural runoff to be diverted or used by anyone within a closed watershed. A closed watershed does not drain into a perennial or permanent stream. In an open watershed, runoff from a normal rain event runs off the land into a stream. In the future, water may become valuable enough to cause landowners to capture and use runoff before it can get to the WPAs.

Groundwater rights differ from surface water rights. Nebraska's water law only requires that irrigation wells have a permit before being drilled. After well installation, the owner is allowed "reasonable and beneficial use of the groundwater." High water demands and drought conditions are expected to cause natural resource districts to place more restrictions on groundwater use. Currently, the natural resource districts have a moratorium on new wells.

Air Quality

The National Ambient Air Quality Standards include maximum allowable pollution levels for particulate matter, ozone, sulfur dioxide, nitrogen dioxide, lead, and carbon dioxide.

Particulate matter (PM) is a generic term for a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. The smaller the size of the particle, the deeper it can penetrate into lung tissue. There are no standards for PM size in relation to prescribed fire because prescribed fires release many sizes of PM. However, there are regulations for the amount of different sizes of particles. The standards for $PM_{2.5}$ (published in the "Federal Register" on October 17, 2006) set a 24-hour standard of 35 microns/cubic meter, with an annual standard of 15 microns/cubic meter.

The Rainwater Basin in general has good air quality, with no nearby manufacturing sites or major air pollution sources. Feedlots near the WPAs produce odors and can produce particulate matter. The state of Nebraska has minimal smoke management guidelines and regulations that pertain to agricultural burning and the prevention of smoke lingering on roadways and other sensitive areas. Windblown dirt from cropland and carbon from automobiles and diesel engines contributes to particulate matter.

4.2 BIOLOGICAL RESOURCES

This section describes vegetation, wildlife, and their associated communities at the district. Species lists are found in appendix F (plants), appendix G (amphibians, reptiles, and mammals), and appendix H (birds).

Wetlands and Associated Vegetative Communities

The district manages 11,117 acres of hydrophytes (wetland plant species). During drawdown or drought, emergent vegetation dominates the wetlands. In wet years, submerged vegetation can occur. The 2004 vegetation mapping established community names and determined the acreage for each vegetative zone (see table 5). These names or categories have been cross-referenced with the National Vegetation Classification System (NVCS). Appendix I contains more explanation.

Table 5. Habitat types at the district in 2004.

Habitat Type	*Acres*	*Percent*
buildings	2.7	0.01
bull thistle	0.4	0.00
Canada thistle	67.1	0.29
cattail	656.6	2.83
leafy spurge	0.1	0.00
moist-soil plants	5,014.5	21.62
musk thistle	10.6	0.05
parking lot	0.3	0.00
reed species (*Phragmites* spp.)	1.1	0.00
reed canarygrass	1,963.8	8.47
road	3.2	0.01
bulrush species	1,145.0	4.94
trees	554.3	2.39
water or mud flat	585.0	2.52
wet meadow	1,717.8	7.41
annual weeds	99.5	0.43
cropland	478.1	2.06
introduced forbs	4.4	0.02
invasive cool-season plants	3,192.9	13.77
native grassland	232.4	1.00
newly seeded	370.7	1.60
planted native cool-season plants	409.2	1.76
planted native warm-season plants	6,668.9	28.75
prairie dog town	14.9	0.06
Total	23,193.5	100.00

Native wetland plants occur on 9,148 acres. Currently, cattail dominates 657 acres and river bulrush dominates 1,145 acres. Moist-soil plants (5,014 acres) and wet meadow (1,718 acres) are the more prevalent associations. Reed canarygrass and reeds add an additional 1,965 acres of wetland habitat but are considered introduced species and are targeted for reduction (see table 5). Other invasive plants that occur in wetlands at the WPAs include Canada thistle, purple loosestrife, and "volunteer" deciduous trees.

Upland and Associated Vegetative Communities

The district manages 12,044 acres of upland habitat at the WPAs. Vegetation includes native, cool- and warm-season grasses, forbs, planted and "volunteer" trees, and invasive plants. Native, warm-season grass stands are dominated by big bluestem, little bluestem, Indiangrass, switchgrass, Junegrass, needle and thread, and leadplant. Undesirable and invasive plant species include Canada thistle, musk thistle, leafy spurge, smooth brome, intermediate wheatgrass, and Kentucky bluegrass.

During the 1960s and '70s, the district planted native warm-season grass and dense nesting cover on many areas to promote waterfowl production. These plantings lacked vegetative diversity and frequently became dominated by one or two species, which reduced the grassland's attractiveness to a variety of wildlife species. Most of these stands have been "interseeded" with a high-diversity (more than 80 species) grassland mix.

Between 400 and 700 acres are farmed, usually with soybeans. Farming is done for 2–4 years to reduce the seed source of weed seeds in the soil and to prepare the land to reseed with native grasses and forbs.

The WPAs have undesirable woody species—green ash, cottonwood, willow, eastern red cedar, and elm. These species are continually controlled or removed throughout the district. Native tree species such as buffaloberry, mulberry, chokecherry, and American plum occur and are not targeted for removal; however, some of these native trees may be inadvertently cleared during large-scale reduction treatment of undesirable trees.

Shrub and Tree Plantings (Shelterbelts)

Shelterbelts were planted along the boundaries of many of the district's WPAs in the 1970s. The shelterbelts are mostly mature eastern red cedars that have shaded out native vegetation. Since that time, the district has realized that tree planting is not compatible with the purposes of the district.

Fire and Grazing History

Historically, grassland species in the northern Great Plains co-existed or adapted to various disturbance

regimes such as fire and large-scale grazing. Settlement and the expansion of agriculture have removed fire and high-intensity, short-duration grazing from the basin.

Fire

Whether lightning-induced or deliberately set by Native Americans, fire has influenced the grassland ecosystem of the basin. A handful of fire-tolerant shrubs such as chokecherry, American plum, and leadplant are present; other woody species that are killed by fire are now restricted to areas protected from fire.

It is estimated that presettlement (historical) fire frequency on mixed-grass prairie was 5–7 years. These fires sustained diverse and healthy grasslands. The district uses prescribed fire to simulate the historical influence wildland fires had on the plant communities. Most prescribed fire treatments are completed during late winter through green-up in spring. Spring presents opportunities to complete prescribed burns when temperatures are low, humidity is high, and the fire is easier to control. In addition, the timeframe coincides with other district management activities. During the last 10 years, district fire treatments have increased from about 6 prescribed burns to 25–35 burns each year, covering 4,000–5,500 acres. District experience has shown that prescribed burning of residual wetland vegetation helps promote annual plants during drier years.

Grazing

Similar to fire, grazing greatly influenced the structure and composition of grassland communities. Herbivores such as the bison, elk, deer, pronghorn, and black-tailed prairie dog maintained grassland vigor and created patches of varying stand height and density. Grazing influenced the soil productivity, plant diversity, animal diversity, and other processes to produce unique successional patterns in the landscape at multiple scales.

Vegetation in grassland communities has developed growth strategies that allows for grazing at or near the ground without killing the plants. Some plant species contain bitter or toxic substances that cause animals to avoid grazing on them. Some species have spines that cause injury to a grazing animal's mouth. Small mammals and deer "naturally" graze at the WPAs. Additional grazing by large herbivores such as cattle is needed, at times, to maintain wetland and upland vegetation.

The district staff works with local cattle producers to provide grazing disturbance. Upland grazing is generally conducted during spring and early summer, and again in fall, to (1) stress exotic cool-season grasses or invasive plants, and (2) increase the vigor of native warm-season grasses and forbs. Wetland grazing occurs for much of the growing season to stress and physically injure invasive or aggressive wetland species such as cattail. This grazing strategy favors early successional species that provide wildlife food, create diverse habitats, and limit the expansion of invasive plants.

Wildlife

This section describes the animals that are common at the WPAs, as well as those that are uncommon, threatened, or endangered.

Amphibians and Reptiles

Amphibians that occur in the basin include the plains spadefoot toad, Woodhouse's toad, Great Plains toad, Blanchard's cricket frog, western chorus frog, bullfrog, and plains leopard frog. Appendix G contains a list of amphibians and reptiles that occur in the basin.

Semipermanent wetlands provide habitat for the painted turtle, chorus frog, common gray treefrog, and snapping turtle. The ornate box turtle lives in grassland areas. The western garter snake, red-sided garter snake, bullsnake, and eastern yellowbelly racer are common. The western hog-nosed snake occurs less frequently and prefers dry sandy prairies. The two rare snakes that can occur are smooth green snake and red-bellied snake.

The lesser earless lizard may occur in open sandy soil with little or sparse vegetation. The six-lined racerunner can be found in both lowland and upland sites.

Mammals

The most common, larger mammals found at the WPAs are white-tailed deer, coyote, raccoon, striped skunk, eastern cottontail, American badger, and Virginia opossum. Mule deer have been seen at the western WPAs but are uncommon. During wet periods, muskrat and mink are common. The black-tailed prairie dog occurs at five WPAs: McMurtrey, Prairie Dog, Atlanta, Hultine, and Clark. Appendix G contains a list of mammals that occur in the basin.

Dave Menke/USFWS

Muskrat

Less common mammals are red fox, black-tailed jackrabbit, woodchuck, Franklin's ground squirrel, and eastern fox squirrel. Small mammals that are common include thirteen-lined ground squirrel, northern pocket gopher, plains pocket gopher, Ord's kangaroo rat, meadow jumping mouse, meadow vole, northern grasshopper mouse, and white-footed mouse.

Birds

The Rainwater Basin is internationally known for its spectacular bird migrations—not only numbers of birds but also the large proportion of the continental population of prominent species. Thirty species of shorebirds use wetlands in the basin. Of the 329 species of birds that have been observed in the basin (Sharpe et al. 2001), 96 species nest (Mullhoff 2001). Appendix H contains a list of birds that occur in the basin.

Common grassland species include grasshopper sparrow, dickcissel, western meadowlark, bobolink, northern bobwhite, ring-necked pheasant, field sparrow, and northern harrier. The greater prairie-chicken is becoming more common and is found at these WPAs: Harvard, Hultine, Funk, Quadhamer, Prairie Dog, Lindau, and Jensen.

The spring migration chronology usually starts with a buildup of Canada geese on the Platte River until the basin's wetlands begin to thaw. Numbers of snow geese, white-fronted geese, and mallards begin to peak by mid- to late-February. In early March, northern pintail numbers peak, followed by Ross's geese and green-winged teal. The numbers of other divers and puddle ducks usually peak during mid- to late-March. Cinnamon teal may be seen as far east as Harvard WPA in late March, but is more common west of Hastings.

Most shorebirds pass through the basin between April 15 and May 15. According to Jorgensen (2004), the most common, spring, shorebird migrants are the following species:

black-bellied plover
American golden-plover
semipalmated plover
greater yellowlegs
lesser yellowlegs
willet
upland sandpiper
Hudsonian godwit
dunlin
short-billed dowitcher
long-billed dowitcher
Wilson's snipe
Wilson's phalarope
semipalmated sandpiper
least sandpiper
white-rumped sandpiper
Baird's sandpiper
stilt sandpiper
buff-breasted sandpiper

Donna Dewhurst/USFWS

Greater Yellowlegs

Rainwater Basin has one of the largest concentrations of buff-breasted sandpiper during its spring migration. Common, late-summer migrants are the following: greater yellowlegs; lesser yellowlegs; Wilson's snipe; long-billed dowitcher; and sandpipers (solitary, upland, least, semipalmated, stilt, and pectoral).

The peregrine falcon frequents wetlands during peak, shorebird migration periods. In contrast, the prairie falcon is most numerous in late January when horned lark and meadowlark are common. The merlin is primarily a winter visitor and a spring migrant (Johnsgard 1997). The burrowing owl nests at Prairie Dog WPA and Atlanta WPA. The short-eared owl is common at many of the larger WPAs during the winter months.

The Harris's sparrow can be seen at the eastern WPAs that have brushy growth or American plum thickets.

Threatened and Endangered Species

In Nebraska, there are eight state- and federally listed endangered species, four state- and federally listed threatened species, six state-listed endangered species, and nine state-listed threatened species (see table 6).

The state- and federally endangered whooping crane and piping plover use wetlands at the basin. Forty-two percent of confirmed observations of whooping crane in Nebraska have been at the basin's wetlands (Richert 1999). Most of these sightings occur the first two weeks of April, or late October through mid-November. Piping plovers are rarely seen at the basin's wetlands due to their size and the number of other shorebirds that would be using mud flat habitats in late April through mid-May (Johnsgard 1997).

Table 6. Nebraska's state-listed and federally listed species.

Common Name	*Scientific Name*	*State Status*	*Federal Status*
PLANTS—7 Species			
Hayden's (blowout) penstemon	*Penstemon haydenii*	endangered	endangered
Colorado butterfly plant	*Gaura neomexicana* ssp. *coloradensis*	endangered	endangered
saltwort	*Salicornia rubra*	endangered	—
western prairie fringed orchid	*Platanthera praeclara*	threatened	threatened
Ute lady's tresses	*Spiranthes diluvialis*	threatened	threatened
ginseng	*Panax quinquefolium*	threatened	—
small white lady's slipper	*Cypripedium candidum*	threatened	—
INSECTS—2 Species			
American burying beetle	*Nicrophorus americanus*	endangered	endangered
Salt Creek tiger beetle	*Cincindela nevadica lincolniana*	endangered	—
REPTILES—1 Species			
massasauga	*Sistrurus catenatus*	threatened	—
FISH—7 Species			
pallid sturgeon	*Scaphirhyncus albus*	endangered	endangered
Topeka shiner	*Notropis topeka*	endangered	endangered
sturgeon chub	*Macrhybopsis gelida*	endangered	—
blacknose shiner	*Notropis heterolepis*	endangered	—
lake sturgeon	*Acipenser fulvescens*	threatened	—
northern redbelly dace	*Phoxinus eos*	threatened	—
finescale dace	*Phoxinus neogaeus*	threatened	—
BIRDS—6 Species			
Eskimo curlew	*Numenius borealis*	endangered	endangered
whooping crane	*Grus americana*	endangered	endangered
interior least tern	*Sterna antillarum athalassos*	endangered	endangered
bald eagle	*Haliaeetus leucocephalus*	threatened	threatened
piping plover	*Charadrius melodus*	threatened	threatened
mountain plover	*Charadrius montanus*	threatened	—
MAMMALS—4 Species			
black-footed ferret	*Mustela nigripes*	endangered	endangered
swift fox	*Vulpes velox*	endangered	—
river otter	*Lutra canadensis*	threatened	—
southern flying squirrel	*Glaucomys volans*	threatened	—

Bald eagles are most common during peak waterfowl migration.

4.3 CULTURAL RESOURCES

Archaeological and architectural remains representing 12,000 years of human occupation are potentially located in the district. There has been very limited, formal, cultural resource survey done in the area. However, sites in the surrounding areas span the time from the earliest Paleo-Indian occupation through the rural and agricultural development of the early twentieth century. Nearby sites are located in a variety of geographical settings and exhibit a wide range of artifacts and features, but definite trends in site types and changes through time are apparent.

Archaeological evidence indicates that the earliest humans, called the Paleo-Indians, migrated to the region near the close of the Ice Age approximately 12,000 years ago. These people had a highly mobile lifestyle that depended on the hunting of big game including mammoths and the huge, now-extinct bison. The hallmark of most Paleo-Indian sites are the beautiful but deadly spear points that are generally recovered from animal kill and butchering sites and small temporary camps.

There was a gradual but definite shift in the pattern of human use of the area beginning about 9,000 years ago. The changes were due to a combination of climatic fluctuations and an increasing population, coupled with tremendous social change and technological innovation. This stage is referred to as the Archaic and lasted until about 2,000 years ago. Although the Archaic stage is better represented in the archaeological record than the preceding Paleo-Indian stage, the interpretation of the remains is difficult. Evidence of a greater diversity of tools and increased use of native plants is found on many sites but the remains also suggest a more localized and less mobile population.

By 2,000 years ago, the populations of the area became increasingly influenced by the woodland cultures to the east. This period, referred to as the Plains Woodland (1,000–2,000 years ago), brought great changes and innovation including the advent of pottery, the bow and arrow, and semipermanent dwellings. Small villages began to be established and evidence of early agriculture is found along some of the waterways.

Beginning approximately 1,000 years ago until approximately 600 years ago, evidence of an increasingly sedentary population is found at many of the sites. This adaptation is referred to as the Central Plains village tradition and amplifies many of the trends began during the Plains Woodland period. Small villages of earthen structures with associated agricultural fields were more common. The increased use of pottery in conjunction with the construction of food storage pits reflect a population that was spending increasing amounts of time in one location.

Early postcontact occupation of the area (100–400 years ago) included the Pawnee and possibly the Arikara peoples. Their settlements tended to be large villages with extensive agricultural fields—often located along the major waterways. Bison hunting, fishing, and Euro-American trade were also primary components of the economy. Beginning in the early 1700s, explorers began to make incursions into the area and by the mid-1800s there was a regular stream of emigrants passing through on their way west. Many of these travelers chose to stay and settle in the area referred today as the Rainwater Basin.

4.4 SPECIAL MANAGEMENT AREAS

McMurtrey WPA, which lies adjacent to the Meat Animal Research Center, is closed to public use because no public access exists. The WPA contains 1,067 acres (513 wetland acres). Land and vegetation management is the same as for other areas managed by the district. The WPA has two wells and water is pumped during dry years to provide a refuge area for migratory birds.

The district manages two additional areas that are located outside the basin. Schwisow WPA, in Saline County (within the district's boundary), is 61 acres. Haseman WPA is located on the border of Cuming and Dodge counties, outside of the district's boundary. The Farmers Home Administration transferred both properties to the district. Schwisow WPA is primarily riparian habitat along the Little Blue River with some oak-timbered upland. Haseman WPA covers 229.11 acres, with 160 acres of riparian wetland along State Highway 275. Both areas are open to the public uses allowed at the district's other WPAs. The Service is considering these WPAs for property exchange or divestiture for the following reasons: (1) the lands do not meet the purpose of the district, (2) the distance of the WPAs is so far from the district's facilities that staff visits require overnight lodging, and (3) another agency may be able to more efficiently manage the riparian habitats.

4.5 VISITOR SERVICES

The district has 60 of the 61 WPAs it manages open to the public; McMurtrey is the only WPA closed to all public use. The Improvement Act outlines wildlife-dependent and wildlife-compatible uses. These uses include hunting, trapping, fishing, wildlife observation, photography, environmental education, and interpretation. Hunting and wildlife observation are the most popular activities, accounting for 80% of annual visitation. (BBC Research and Consulting 2006)

There are no official visitation data available for the district. All visitation figures reflect best available estimates by district staff. Visitation levels fluctuate between 60,000 and 80,000 visitor days per year, depending on the water level and habitat quality. A typical breakdown of annual visitation by use is

about 60% hunting and 40% wildlife viewing. (BBC Research and Consulting 2006)

All WPAs are marked with boundary signs. Proper signs identify four of the most prominent WPAs in the district. The other WPAs are unmarked and the only locator for these areas is a district brochure map that shows their locations within the district.

Hunting, Trapping, and Fishing

Visitors generally hunt various waterfowl, pheasant, and deer at the district. The major hunting season for all species is October through December, although there is a light goose–hunting season in the spring. (BBC Research and Consulting 2006)

Hunting, trapping, and fishing are allowed in accordance with state regulations. There is a viewing blind at Funk WPA, which is accessible to hunters with disabilities.

The WPAs, other than McMurtrey, are open to fishing. However, the physical characteristics and hydrologic conditions of the wetlands in the WPAs do not provide for a viable fishery.

Wildlife Observation and Photography

The most popular wildlife-viewing season is during spring migration, which lasts from mid-February through April (BBC Research and Consulting 2006).

Every spring and fall, thousands of tourists and locals visit the district to observe and enjoy the semiannual migration of waterfowl and other birds from the southern United States and Mexico to Canada and vice-versa. As a result, ornithologists, amateur birders, hunters, and the general population are witness to a remarkable natural phenomenon. (BBC Consulting 2006)

There are two viewing blinds, one each at Funk WPA and Massie WPA. Funk WPA has approximately 2 miles of developed trail (constructed in 2006).

USFWS

Visitors can view flocks of snow geese (seen in the distance) from this blind at Massie WPA (Clay County). An interpretive sign provides information.

Environmental Education

The district does not provide any public environmental education programs. It is only on rare occasion that district staff is available to conduct a wetland tour. One reason for that is the long distance between the office and the WPAs. The district's office is located in an industrial park in Kearney, approximately 20 miles from its closest WPA.

Interpretation

There are information kiosks at four WPAs: Mallard Haven, Massie, Funk, and Harvard. Plans for 2007 include additional interpretive signs.

4.6 PARTNERSHIPS

The district is engaged in various partnerships that allow the district to pursue the purposes for the district. While these partnerships help the district to conserve habitats, the district would benefit from expansion in the number and variety of partnerships. Current formal and informal partnerships include those with groups such as the RWBJV, Ducks Unlimited, Pheasants Forever, and The Nature Conservancy.

4.7 SOCIOECONOMIC ENVIRONMENT

A socioeconomic study prepared by BBC Consulting (2006) is the source for information in this section.

The Rainwater Basin supports hunting, trapping, photography, wildlife observation, and environmental education for the public. These recreational activities attract both visitors and dollars from outside the 17-county basin that benefits the local communities. Ancillary visitor activity—such as spending on food, gasoline, and overnight lodging in the local area—provides local businesses with supplemental income and increases the local tax base. District management decisions regarding public access, expansion of services, and other district-related operations may affect recreational traffic and thus visitor expenditure levels.

Population and Demographics

Nebraska's population in 2006 was estimated at 1,768,331, a 3.4% increase from 2000. The reported population for the basin in 1999 was 201,245. Rural emigration is a concern with 89% of Nebraska's cities having fewer than 3,000 people. Fifty-three of the 93 counties have reported declining populations between 1990 and 2000. The three major cities of Grand Island, Kearney, and Hastings contribute to 48% of basin's 2004 population (U.S. Census Bureau 2000–2007). These cities' populations totaled 157,662 in 2004 (U.S. Census Bureau 2000–2007).

The 17 counties encompassing the basin are currently neither losing nor gaining population. In comparison, the population of Nebraska has increased at a steady

pace since 1980 (see figure 26). While the population retention of the 17 counties is better than many rural Midwestern counties, the gradual loss of residents undoubtedly affects the socioeconomic conditions of the area.

Figure 27 illustrates the aging population within the 17 counties. In 1980, about 26% of the population was between 18 and 34 years old, while that same demographic constituted only 22% of the population in 2004. The median age for the 17 counties has increased by about 6 years since 1980, a trend that is found throughout the state.

Employment

The civilian workforce for the 17 counties within the basin has increased by about 250 workers per year since 2000, and it is predicted to increase by another 1,000 workers to 107,980 by the year 2009. Estimates from the year 2004 calculated the unemployment rate for the 17 counties within the basin at 3.4%. This is on par with the state of Nebraska, whose 2004 estimate calculated the statewide unemployment rate at 3.5%.

Agricultural row cropping is the main economic enterprise throughout the basin. Eighty percent of the land base is cropland. Major crops are corn and soybeans. Other crops that may occur include wheat, milo, sorghum, and alfalfa. Ranching is a secondary enterprise with 10% of the area being grassland. The number of farms per county in the basin range from 345 in Gosper County to 974 in Seward County. The average-sized farm in the basin in 1987 was 506 acres.

While agriculture has been the traditional mainstay of the state's economy, new industries such as health care and services now employ an increasing portion of the state's residents. In the 17 counties within the basin, the total number of farms has decreased at a notable rate. In 1964, the 17 counties supported over 16,500 farms. That number of farms declined to just over 9,200 in 2002 (see figure 28).

Business Concentration

The 17 counties within the basin employ a large number of white-collar workers, with over 13% of its total workforce in the office and administrative support occupations. However, the basin also contains a large manufacturing sector, with 12% of its total workforce employed in production occupations. Other high-ranking occupations include sales and related occupations, education training and library occupations, and food preparation. It should be noted that only 6% of the entire workforce is employed in the agricultural industry.

Rainwater Basin Wetland Management District Current Conditions

About 60% of district visitors live in the 17 counties within the basin. Most destination visitors come for the weekend and stay 1–2 nights, usually in Grand Island, Kearney, Hastings, or York.

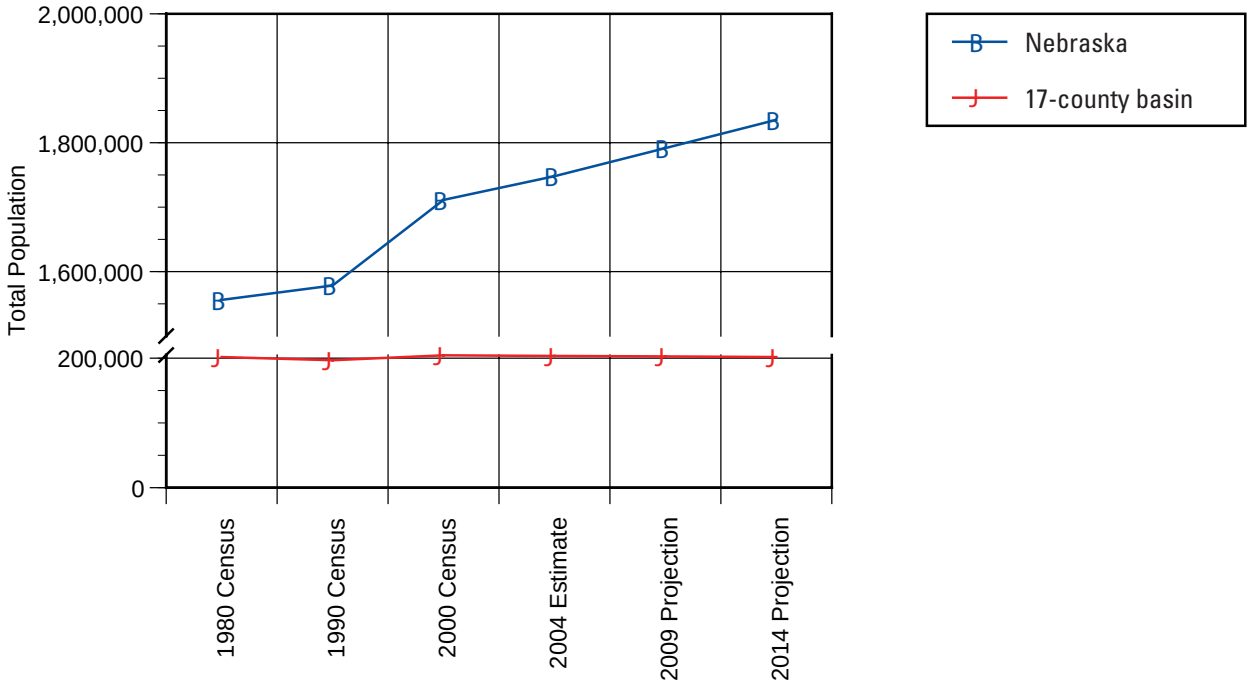


Figure 26. Populations of Nebraska and the 17 counties in the Rainwater Basin.
(Note: 2004, 2009, and 2014 populations are estimates. Source: U.S. Census Bureau, PCensus, 2006.)

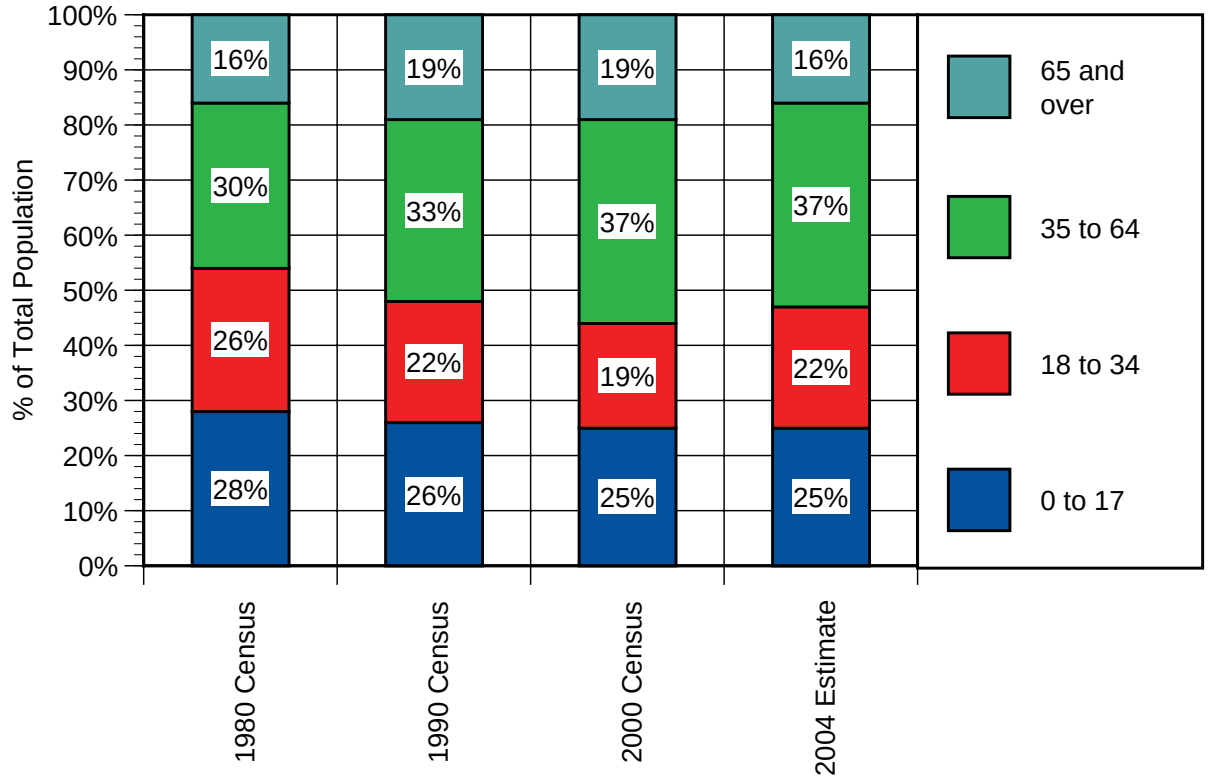


Figure 27. Age composition within the 17 counties in the Rainwater Basin.
(Source: U.S. Census Bureau, PCensus, 2006.)

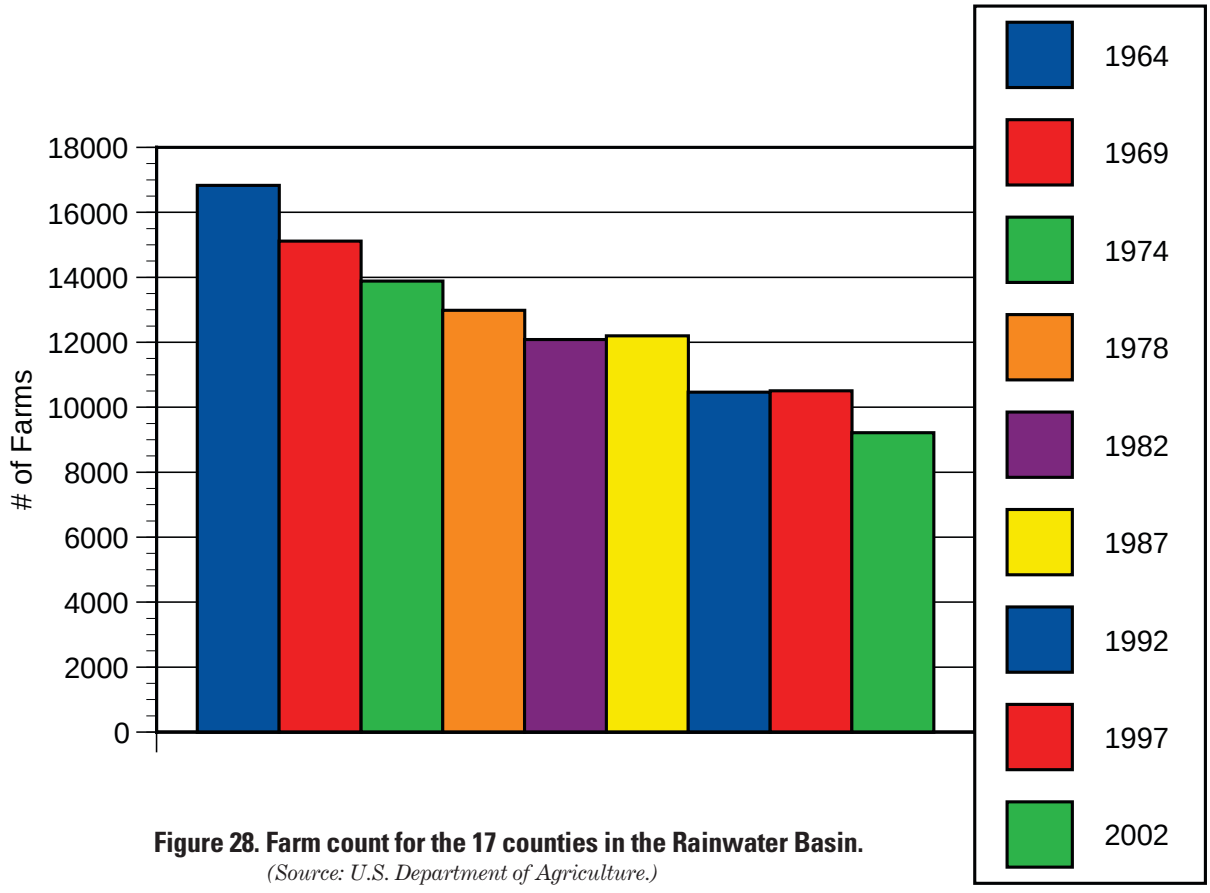


Figure 28. Farm count for the 17 counties in the Rainwater Basin.
(Source: U.S. Department of Agriculture.)

Visitor Spending

Off-site spending by visitors helps support local lodging and retail establishments in surrounding towns. Approximately 40% of the district's visitor days, or about 30,000 visitor days, are from nonlocal visitors. If 50% of these guests spend the night locally in commercial lodging or campgrounds—and, on average, nonlocal visitors spend $60 per day for lodging, food, and supplies—the district's activity spurs about $900,000 of new annual spending in the regional economy.

Other Economic Considerations

The purchase of additional farmland for conversion into wildlife habitat by the district is sometimes problematic for local governments. National legislation requires the district to receive permission from the governor before purchasing additional lands. The governor, in turn, often seeks the advice of local county commissioners. In the past, county commissioners have expressed concerns about the conversion of local farmland to wildlife habitat because the land is retired from agricultural production and local purchases for fertilizer, grain, and farming supplies are reduced. Conversion from agricultural designation to public ownership reduces tax revenue.

While county commissioners may not always wholeheartedly support public land acquisition, there has never been a formal denial of land acquisition by the Service on record. Local authorities generally balance the modest loss of business activity against the prospect of additional visitors and the business activity associated with wildlife viewing and hunting. A citizen's broader right to sell his or her personal property to whomever they choose is also a consideration.

To address the issue of lost tax revenues, Congress passed the Refuge Revenue Sharing Act (revised in 1964), which mandated ¾ of 1% of the current appraised value of land bought for use by the Service be paid to the counties in which the land was bought, a form of payments in lieu of taxes (PILT). These payments are designed to help the counties recoup lost tax revenue. The Service finances these reimbursements with revenues generated from permits sold and services rendered on Service-controlled land nationwide (such as a permit sold for the right to drill for oil on a refuge in Texas). Although land values of refuges have risen over time, the annual revenues used to reimburse the counties have not kept pace. As a result, the participants currently only receive approximately 40% of the money they are owed annually by the Service. Increased tourist spending can mitigate some of this shortfall.

4.8 OPERATIONS

The Service achieves the purposes of the district through effective use of available funding, staff, partners, and facilities.

Staff and Funding

Spring migration is the primary season of aggressive habitat management, which includes extensive water-pumping operations and shoreline habitat enhancement. Off-season management activities include (1) wetland restoration efforts on public and private agricultural lands, and (2) vegetation management using a combination of prescribed fire, grazing, haying, resting, and grassland reseeding. (BBC Research and Consulting 2006)

Current federal employment at the district is 12 permanent full-time employees and 3 seasonal employees. (BBC Research and Consulting 2006)

The district had a $1.8 million budget in fiscal year 2005. The district does not collect any fees for recreational use of its facilities and does not directly generate any basic local revenue. (BBC Research and Consulting 2006)

Law Enforcement

Refuge law enforcement officers are charged with resource protection and provision of visitor and employee safety on Service lands. Resource protection includes protection of wildlife, fish, and plants, as well as cultural resources. Common activities include (1) investigating illegal hunting, arson, theft, vandalism, dumping, and drug-related activities, and (2) answering questions and assisting visitors in the field.

The district has two dual-function refuge officers who spend 25% of their time dealing primarily with resource protection activities.

Facilities and Equipment

The district's facilities include the leased headquarters/shop building with an adjacent, fenced, equipment storage area. These facilities do not meet safety standards for personnel and do not provide adequate space to welcome visitors. The headquarters facility is difficult for visitors to find because it is located in an industrial area in the city of Kearney, which is outside the district's boundary.

The district owns and maintains two old farm sheds that serve as storage facilities. Two, surplus, mobile trailer homes provide volunteer housing. The district maintains 135 parking lots at the WPAs. The parking areas are fenced (0.2 acre) and contain native vegetation. Each fall, these parking areas are mowed to reduce the risk of wildland fire.

5 Environmental Consequences

John and Karen Hollingsworth/USFWS

Sandhill Crane.

The environmental consequences described in this chapter are the potential effects on a resource of carrying out the actions of an alternative. Chapter 3, "Alternatives," presents for each alternative the management scenario that could create the consequences described here.

This chapter contains descriptions of the (1) effects common to alternatives, (2) consequences by alternative, and (3) cumulative impacts of the alternatives. Table 3 in chapter 3 includes a summary of these consequences in relation to the actions for each alternative.

5.1 EFFECTS COMMON TO ALL ALTERNATIVES

Both alternatives would have the same effects related to environmental justice, air quality, and global warming as described below.

Environmental Justice

Neither of the alternatives would have a disproportionately high or adverse environmental effect on minority or low-income populations. Public use and access to the district's WPAs would not require a fee—these areas would be open to all members of the public.

Air Quality

No adverse effects on air quality are expected. Short-term effects on air quality from prescribed burning at the district would not vary significantly between the alternatives. District staff would plan prescribed fire operations to reduce negative effects to neighbors through ignitions that would move the smoke up and out of the vicinity quickly. Rapid mop-up would be completed to reduce overnight effects on neighbors. There are no permits (air quality or smoke management) required by the state of Nebraska or local counties. During periods of high fire danger, counties may issue burn bans to reduce the occurrence of wildland fires.

Global Warming

Both alternatives would conserve or restore land and habitat, and would thus retain existing carbon sequestration at the district's WPAs. This would contribute positively to efforts to mitigate human-induced global climate change.

The use of prescribed fire, which releases CO_2, would result in no net loss of carbon because new vegetation would quickly replace the burned-up biomass. Overall, there should be little or no net change for carbon sequestered at the district's WPAs from either management alternative.

As it relates to global climate change, the documentation of long-term changes in vegetation, species, and hydrology is an important part of research and monitoring. Adjustments in management may be necessary over time to adapt to a changing climate.

5.2 DESCRIPTION OF CONSEQUENCES BY ALTERNATIVE

The following section provides an analysis of the effects estimated to result from alternative A (no action) and alternative B (proposed action). A summary of this narrative is contained in table 3 in chapter 3.

Alternative A (No Action)

The estimated potential effects of alternative A are described by the major topics (issues) discussed throughout this document.

Habitat Management

The restoration of degraded habitats would be financially taxing to the district because the current level of habitat management would be maintained at approximately the same intensity and with the same resources (staff and funding). In addition, the scarce attention given to WPAs with good habitat conditions could cause these habitats to experience degradation over time (such as invasive plant overruns).

This would be especially true for the uplands and for the WPAs with limited waterfowl habitat, because wetlands would receive the highest management priority. Poor fencing and a lack of adequate water supplies at some WPAs would not allow the proper, grazing treatment rate to meet management objectives.

Because of a scarcity of resources to perform outreach in neighboring communities, needed management actions are likely to be misunderstood by some people. This could lead to a lack of support for important habitat management tools such as the removal of volunteer trees and shelterbelts, and the use of prescribed fire and grazing.

Wetlands

Restored wetlands would receive most of their historical watershed runoff. Only areas with high value for migratory birds would receive priority.

Uplands

Farming practices, as part of the restoration process in uplands, would cause decreases in grassland-nesting birds in the short term. However, in the end, restored grasslands would provide improved quality of habitat for upland-nesting birds. While temporary farming practices would increase pesticide use in the short term, restored fields should reduce invasive plants within uplands, which would decrease the need for future pesticide application.

USFWS

Invasive woody vegetation.

Highly degraded habitats would receive priority for management. Habitats in good condition would be treated only if resources and time allows—this could cause degradation at WPAs with adequate wildlife habitat.

Overall bird diversity would continue to remain similar to current diversity, with a slow decline in bird species associated with woodland habitat. Among these species would be the blue jay, brown thrasher, and gray catbird. Nesting success of grassland-nesting birds would slowly improve as the number of trees and shelterbelts declined.

Water and Wetland Management

Because water and wetland management would continue at the current intensity, the available staff and resources would allow only some of the WPAs to be managed each year.

Supplemental Water (Pumping)

Because water pumping would be dependent on budget rather than on wildlife needs, it is likely that not all available wetlands could be made suitable for wildlife for spring and fall use.

Currently, nonnative and undesirable plant species dominate the wetlands in poorest condition. The unattended wetlands are likely to experience degradation because of the priority of fixing wetlands in the poorest condition. Wetlands that have quality waterfowl habitat would not be given the needed management and would decline in quality until they become priorities. This is likely to directly affect the health and size of the migratory bird populations and resident wildlife populations dependent on these habitats.

There would be a beneficial effect on shorebirds and whooping cranes during their migration because pumping of water into wetlands (limited to a small number of WPAs) would sustain shallow water on large mud flats. However, the concentration of large numbers of migrating birds at a limited number of WPAs could increase the risk of an epizootic disease event.

Water Quality and Quantity

It is possible that wetlands with watersheds affected by feedlot operations would experience slow yet continual degradation in the quality of the water entering the wetlands. This could result because actions associated with water quality and feedlot runoff would be limited to only severe problems that are clearly in violation of state regulations.

The district would have little information about the quantity and quality of runoff entering wetlands. District staff would be unable to assess the effects that agricultural and feedlot runoff would have on wetlands and wildlife. Information about the role played by the Rainwater Basin's wetlands in improving surface water and groundwater quality and quantity would remain unknown. Concerns about the district's ability to protect its water sources or runoff supply would remain unresolved.

Water Rights

The Service would have an inadequate understanding about water rights held or needed by the district to achieve the vision and goals.

Invasive Plant Control

Because the district would manage invasive plants with priority on state-identified noxious weeds, areas not managed for these species could experience habitat degradation as other invasive plants overtake desirable vegetation.

The availability of mapped invasive plant areas would decrease the response time for treatment—known areas would have been identified for quick assessment and prioritization. This mapping would allow for effective monitoring, which would help to strategize for future treatment and to measure effectiveness of treatment. Ultimately, quick treatment of known infestations would help restore native vegetation and protect adjacent noninfested areas.

Wildlife Disease Control

Because the district would monitor out-of-the-ordinary bird behavior and mortality at the WPAs during migration, it is likely that epizootic disease outbreaks would be minimized and contained.

Species of Concern

Current management activities are having beneficial effects on the populations of prairie dogs and the occasional federally listed species that migrates through the basin. The effects on any known species of concern to occur in the district would be neutral or positive.

Research and Science

The limited research performed within the district would likely be of minimal value to management activities.

Habitat and Wildlife

There would be minimal benefits from the occasional research conducted within the district. The district would do limited monitoring, as staff and funding resources allow.

Socioeconomics

The district would not know the socioeconomic benefits that local communities derive from the existence and management of the district.

Land Protection

The limitations on land acquisition—to focus only on remaining wetlands that have partial district ownership—could cause valuable wildlife habitats to be subjected to land degradation. This problem would be increased if the criteria for fee acquisition remains unclear and focuses only on larger wetlands.

Cultural Resources

Only cultural resources found before habitat management activities would be identified and protected.

Visitor Services

Because there would be no change in the visitor services' programs and infrastructure, the consequences would be neutral. There could be increased visitation by wildlife enthusiasts including hunters, trappers, wildlife observers, and wildlife photographers during migrations. However, the district would have no methodology in place to determine changes in activity. Use of the current headquarters facility would make it hard for potential visitors to get district information, which could keep them from visiting the district.

Hunting

The district would continue to be a destination for avid hunters. There would be limited information about the level of use by and satisfaction of hunters.

Fishing

Fisheries would not be developed.

Wildlife Observation and Photography

Wildlife observer and wildlife photographer visits would remain at current levels because there would be limited opportunities for these activities.

Environmental Education and Interpretation

Interactions during environmental education and interpretation would remain at current levels because there would be limited opportunities for these activities.

Public Access

Visitors would not always know where the WPAs are located, which would result in the same level of use as currently occurs.

Partnerships

It would be unlikely that the district could meet the vision and goals because there would be no increase in partnerships. The lack of promotion of public use, public awareness of district wetlands, and community involvement would increase public misunderstanding and lack of support of the activities and goals of the district.

Socioeconomics

Socioeconomic consequences in the local communities would be neutral or minimal, with district expenditures and public visitation remaining near current levels.

The lack of information on visitation and use would limit the district's efforts for adequate outreach to

generate public support for conservation of wildlife and habitats in the district.

Operations

The district would manage habitats in a reactive rather than proactive way. This may lead to some degradation of habitats due to invasive plant encroachment and under-management.

Staff and Funding

The staff would remain the same.

Law Enforcement

Current levels of law enforcement would likely lead to inadequate protection of resources and wildlife.

Facilities and Equipment

The substandard facilities would create crowded and unhealthy working conditions. Shop space would be inadequate for maintenance and equipment storage needs would remain unmet.

Lack of temporary housing for researchers, volunteers, and seasonal firefighters would limit the amount of outside assistance the district could receive.

The absence of fences and livestock-watering facilities at many WPAs would limit management of invasive plants.

With the current situation, the district's resources would be drained: (1) large distances for travel would require extensive staff time; (2) moving equipment from storage to repair sites would be costly; and (3) valuable equipment would need increased maintenance and would wear out quickly.

It is possible that unprotected equipment would be vandalized.

Alternative B (Proposed Action)

The estimated potential effects of alternative A are described by the major topics (issues) discussed throughout this document.

Habitat Management

Alternative B would increase the level of habitat management in the district. Management techniques would remain the same but would occur at a greater frequency or intensity. A common problem with resource management is applying the right treatment at the right time to change wildlife habitat. There are often more places to treat than there is time.

The district would develop partnerships with more conservation groups to increase the efficiency of both partners. For example, through a partnership the district staff might be able to spray weeds on a partner's property near a WPA. In turn, the partner could control weeds at a WPA close to their property. Partnerships could also allow partners to combine several management areas into one planned grazing system. Within the basin, it is difficult to retain a livestock producer unless there is some assurance that there would be grazing on an annual basis. Outlying WPAs that need infrequent grazing could be included in a grazing system involving lands managed by partners.

Using larger herds of livestock would allow managers to apply grazing when it could be helpful or harmful to the targeted plant species. An example would be to place a large number of animals in a wetland choked with reed canarygrass. A low stocking rate creates a symbiotic relationship between the plant and the grazer, with the plant unharmed. A high stocking rate causes increase injury and demand on the plant—causing invasive plants to be reduced or eliminated.

The combination of three or four public areas (such as the federally managed WPAs and state-managed WMAs) in close proximity would provide assurance to a livestock producer that some land would be available for grazing each year. It is difficult to find local producers with large enough herds to adequately affect wetland vegetation communities. With combined areas, grazing could be rotated between wetland and upland units to benefit wildlife and give producer enough assurance to encourage them to develop herds that would fit management needs.

Aggressive management would allow treatment of a problem before it reached a level that required extensive restoration. For example, the district would remove tree seedlings before they reached a size where fire could not remove them. Once the WPAs were restored to their natural conditions, management intensity and costs would become lower.

The district staff would share information with its resource partners about the response of wildlife and vegetation to management treatments for specific problems. The added information would allow adaptive resource management to be applied more quickly to problem areas.

Wetlands

The use of grazing would improve through adaptive resource management. Expanded partnerships would allow more wetlands to be treated to achieve desirable conditions.

Wetland management would keep wetlands in an early successional stage that is dominated by seed-producing, annual, wetland species. Management treatments would include a combination of water pumping, prescribed fire, prescribed grazing, tree removal, and limited haying.

Land acquisition would become more efficient—partners would help get obtain funding or would buy the remaining portions of WPA wetlands that are in private ownership. The district staff would work

closer with the RWBJV to place the appropriate level of protection on wetlands throughout the basin. Protection would range from conservation easements to fee-title acquisition. Ownership of the easement or property would be matched with the most suited partner for the needed level of protection and type of wetland.

Uplands

Grasslands would be managed using prescribed fire, prescribed grazing, limited haying, and tree removal. Restoration activities would use a high-diversity seed mixture collected from the local area. Volunteer trees and select shelterbelts would be removed and no new shelterbelts would be planted.

Upland restoration activities would focus on previously farmed areas on newly acquired lands and on lands having heavy infestations of weeds or nonnative plants. These areas would be cropped for several years before reseeding. Farming the uplands would cause decreases in grassland-nesting birds in the short term; however, restored grasslands would provide improved habitat for upland-nesting birds.

While farming would increase herbicide use in the short term, restored fields should reduce noxious weeds within uplands and decrease the need for future chemical applications.

Partnerships would allow sharing of equipment and staff to increase the number and size of burns. For example, partners may need fall burns to meet their objectives, while the district plans spring burns. Alone, partners would only able to complete a portion of their goal. Working together, goals for both partners could be attained.

There would be a decline in woodland bird species such as the blue jay, brown thrasher, and gray catbird. There would be improved nesting success—for grassland-nesting birds such as bobolink, dickcissel, and greater prairie-chicken—as the number of trees and shelterbelts declined.

Water and Wetland Management

Wetland habitat would be improved throughout the basin, not just at wetlands in district ownership.

Supplemental Water (Pumping)

The benefits of water pumping in spring and fall would be significantly increased with the availability of contributed funds through partnerships. Increased funds and coordination would reduce the probability of areas with pumped water being clustered rather than spread throughout the district. There would be more wells and improved wells. Pumping water to wetlands would be done more effectively for the benefit of migrating shorebirds and whooping cranes.

Through partnerships and coordination, water would be pumped into select public wetlands for optimal distribution of water. A unified water-pumping partnership would get funding to pump adequate water to spring and fall habitats.

Water Quality and Quantity

The district staff would work with agencies and partners to assess and monitor water quality in the watersheds containing public wetlands and large livestock confinement areas. The district staff would work with neighboring landowners to reduce the sediment and agricultural runoff that reaches public areas.

Water Rights

Working with partners, the district staff would remove water concentration pits and ditches that prevent natural runoff from reaching public wetlands.

Invasive Plant Control

Invasive plants would be reduced to target levels. Patch size and occurrence of invasive plants would be reduced or eliminated at the WPAs. The amount of invasive plants such as reed canarygrass, crown vetch, intermediate wheatgrass, Kentucky bluegrass, and brome would decrease.

IPM would use herbicide application, biological control, mechanical control, cropping, grazing, prescribed fire, high-diversity native plant reseeding, and haying. Herbicide application would be the primary control method for noxious weeds. As areas are treated, the location and treatment type would be recorded in the GIS. The recorded information would help to evaluate treatment effects, monitor treatment success, and improve efficiency.

The district staff would work closely with partners to identify areas where it would be beneficial to exchange control responsibilities at properties. This approach would reduce the amount of overall travel to treat problem areas. The result would be decreased overall costs and increased success with control of invasive plants.

Wildlife Disease Control

Working with partners, the district staff would increase awareness of, detection of, and response to highly pathogenic diseases. During an occurrence of a wildlife disease, coordination with agencies and partners would ensure an appropriate response such as additional water pumping or temporary closures.

Species of Concern

Proper maintenance grazing would keep prairie dog populations at acceptable levels.

Increases in management intensity and coordination with resource partners would increase the occurrence and abundance of rarer species. The whooping crane and other rare migrants would benefit from the more

open, native grassland environment. Management would mimic the natural ecological processes associated with native grasslands in the central Great Plains, supporting those species that occurred historically.

Research and Science

Alternative B would increase the amount of research and monitoring.

Habitat and Wildlife

The district staff would work closer with the RWBJV, universities, and other partners to increase volunteer, internship, and graduate research programs. Priority research needs would be identified and, through partnerships, would be completed. The district would expand monitoring of upland habitats and response of grassland birds to management treatments. The results of research and monitoring would allow use of adaptive resource management in a more timely fashion.

Through the partnership with RWBJV, the district staff would be better able to determine what actions are needed to ensure natural runoff is protected from diversion or loss.

Socioeconomics

Through expanded parterships, the district staff would be able to determine the benefits that it provides to local communities and the state. Areas would be identified where visitor services could be expanded to provide more benefits to the community. More segments of the population would be reached to gain further support for conservation efforts.

Land Protection

For land acquisition, wetlands would be well matched to the appropriate acquisition program and ownership. Easements would protect wetlands from development. Grasslands acquired through easement would help control soil erosion and provide nesting habitat.

Cultural Resources

Through expanded and enhanced partnerships, the district would benefit from more data about cultural resources without having to bear the entire cost of getting the information.

The people of the United States would benefit from identification and protection of previously unknown cultural resources in the basin.

Visitor Services

Alternative B would expand opportunities for public use at the WPAs. Increased hiking trails, viewing blinds, and information kiosks would enhance visitors' experiences.

The district staff would provide the public with timely information about wetland conditions, migration status, and location of key bird populations. Improved signage at the WPAs would help visitors know which WPA they were visiting and increase awareness about WPAs.

Hunting

Through the development of a hunt plan and partnerships, the district staff would better understand hunter use, hunter satisfaction, and potential areas to improve its infrastructure to meet visitor needs.

Fishing

Fisheries would not be developed.

Wildlife Observation and Photography

Through the development of partnerships, the district staff would better understand the level of use by and satisfaction of wildlife observers and wildlife photographers.

The district would be able to identify potential areas to improve its infrastructure to meet visitor needs.

Environmental Education and Interpretation

Partnerships would help develop and increase environmental education and interpretation in schools scattered throughout the basin. The number of volunteers that would result from increased public awareness would increase dramatically, along with general public support and understanding of wetland habitats.

Public Access

Expanded and improved signage would likely lead to better recognition of the Service and the district. In addition, there may be an increase in public visitation.

Partnerships

There would be a notable increase in partnerships in the areas of public use, research and science, land acquisition, and water development (pumping). The various partnerships would increase public awareness and involvement in all aspects of district activities. Local communities would "sponsor" nearby WPAs and promote their use in environmental education and wildlife-dependent recreation. Vandalism would decrease as more people take ownership of the WPAs.

Local communities would have a better understanding of the local and national benefits of the Rainwater Basin's wetlands and likely would have increased pride in the basin's contribution to the Central Flyway migration. This could lead to new and expanded partnership opportunities to conserve the natural resources of the basin.

Socioeconomics

There would likely be long-term positive effects on the local economy. Increased visitor use is expected because of better habitat, more wildlife, and additional trails, signage, and wildlife-dependent uses. The effects, however, would not be significant in one area but would occur as a slight increase throughout the entire basin.

The district would be managed for migratory bird habitat and there would be increased investment in visitor facilities. Hunting, wildlife observation, and other priority uses would be highly encouraged. The combined effects of changes in management practices would likely increase overall visitation over time, as habitat and user facilities are improved. Hunting and wildlife viewing are the major draws at the district. Improvement in the quality of the hunting and wildlife-viewing experiences may bring in a modest number of additional visitors and additional local spending. (BBC Research and Consulting 2006)

The four additional staff persons would have a minimal effect on the local economy. Additional employment at the district would induce more federally supported spending in the local economy, but at this point only modest employment increases are expected. (BBC Research and Consulting 2006)

The improved facilities and accommodations could potentially draw additional visitors to the district. As a result, the regional economy could possibly see up to a 20% increase in visitor spending. A 20% increase in visitor spending would introduce an additional $180,000 in economic activity to the basin. These additional visitors would not only create more business for local proprietors, but increase regional tax revenues as well. (BBC Research and Consulting 2006)

Operations

The efficiency of district operations would increase dramatically.

Staff and Funding

There would be adequate staff to improve wildlife habitat, increase public use, reduce vandalism, and increase education and outreach.

Law Enforcement

There would be adequate law enforcement to protect wildlife habitat, support public use, and reduce vandalism.

Facilities and Equipment

A modern shop and office facility would increase productivity and reduce down time associated with having equipment stored at various locations. Daily work assignments would go unimpeded since staff would not have to travel a long distance to pick up a piece of equipment before traveling to a job site. The public would be provided with a better contact center to obtain information and interact with staff.

Improved water-pumping facilities would allow the district staff to spread water over a larger number of WPAs. Outside perimeter fences and livestock watering on larger properties would improve land management by being able to apply the right amount of grazing to influence plant composition.

5.3 CUMULATIVE IMPACTS

Cumulative impacts are the potential effects of each alternative in combination with past, present, and future actions. NEPA regulations define cumulative effects "as the impact on the environment which results from the incremental impact of the actions when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over time." (40 CFR 1508.7)

The cumulative effects analysis for this project is based on reasonably foreseeable future actions that, if carried out, would contribute to the effects of the alternatives.

Impacts will be monitored during implementation of the final CCP. Implementation over an extended period will reduce the likelihood of negative cumulative impacts.

The NEPA requires mitigation measures when the environmental analysis process detects possible significant impacts to habitats, wildlife, or the human environment. All activities proposed under alternative B are not expected nor intended to produce environmental impacts that would require mitigation measures. Nevertheless, the final CCP will contain the following measures to preclude significant environmental impacts from occurring:

- Federally listed species will be protected from intentional or unintentional impacts by having activities banned and/or restricted where these species occur.
- Hunting safety regulations will be closely coordinated with and enforced by personnel from the district and NGPC.
- All proposed activities will be regulated to reduce potential impacts to wildlife and plant species, especially during their sensitive reproductive cycles.
- Monitoring protocol will be established to determine goal achievement levels and possible unforeseen impacts to resources for application of adaptive management to ensure wildlife and habitat resources, as well as the human environment, are preserved.

- The final CCP can be revised and amended after 5 years of implementation, for application of adaptive management to correct unforeseen impacts that occur during the first years of the plan.

6 Implementation of the Proposed Action

This chapter presents the draft CCP—details of how the Service would carry out its proposed action (alternative B) for management of Rainwater Basin Wetland Management District.

After public review and comment on this draft CCP, the Service will select and finalize its preferred management alternative. The Service will approve the final CCP and notify the public of its decision.

The final CCP will serve as the primary management direction for the district over the next 15 years and until the CCP is formally revised. The Service would carry out the final CCP with assistance from partner agencies, organizations, and the public.

6.1 IDENTIFICATION OF THE PROPOSED ACTION

The Service's identified a proposed action (alternative B) after a determination that it does the following:

- best achieves the district's purposes, vision, and goals
- helps fulfill the Refuge System mission
- maintains and, where appropriate, restores the ecological integrity of the district and the Refuge System
- addresses the significant issues and mandates
- is consistent with principles of sound fish and wildlife management

6.2 DESCRIPTION OF ALTERNATIVE B, THE PROPOSED ACTION

Alternative B is the proposed action for the district's CCP. Through integrated restoration, the district would work to restore ecological processes where appropriate and achieve habitat conditions that require reduced management over time. This would be accomplished while recognizing (1) the role of the district in the overall landscape, and (2) the capabilities of its staff and resources to complete the proposed management actions during the next 15 years.

A high priority would be to monitor the effects of habitat management practices and to use research results to direct restoration and management. Another priority would be to increase opportunities for wildlife-dependent, compatible public use and visitor services.

USFWS

Mallard Pair.

6.3 GOALS, OBJECTIVES, STRATEGIES, AND RATIONALE

The management direction in this section meets the purposes, vision, and goals of the district. Objectives and strategies to carry out the goals would provide for resource needs and public use.

- A goal is a descriptive, broad statement of desired future conditions that conveys a purpose, but does not define measurable units.
- An objective is a concise statement of what is to be achieved, how much is to be achieved, when and where it is to be achieved, and who is responsible to achieve it.
- Strategies are ways to achieve an objective.

- Rationale for the objectives includes background information, assumptions, and technical details used to formulate the objective. The rationale provides context to enhance comprehension and facilitate future evaluations.

NOTE: The overall guidance for use of prescribed fire and management of wildland fire is in the description of the fire management program (appendix J).

Wetland Goal

Restore, enhance, and maintain the hydrology and early successional vegetation conditions essential to the conservation of migratory birds.

Wetland Objective A

Within 15 years, restore, enhance, and manage the wetland plant composition to achieve a high level of preferred moist-soil and wet-meadow vegetation. Table 7 shows the shift in plant associations.

Wetland Objective B

During the next 15 years, manage wetland vegetation to create a vegetative mix of species of various heights, with spring (February–April) habitat conditions having 20–50% of the wetland vegetation between 6 and 12 inches tall.

Wetland Objective C

During the next 15 years, improve water-pumping capabilities on wetlands that currently have water-pumping facilities; develop water-pumping facilities for 800–1,000 additional wetland acres; and increase the amount of water pumped during migration (October–April) by 50%.

Wetland Objective D

Within 15 years, acquire from willing sellers fee-title ownership on 10 adjoining portions of wetlands to complete ownership to allow for better management of individual wetlands.

USFWS

Gleason WPA (Kearney County).

Wetland Objective E

Within 15 years, acquire permanent protection from willing sellers on 15 additional wetlands within the basin.

Wetland Objective F

During the next 15 years, develop baseline information on water quality and quantity of in-flowing water into WPAs for use in developing desired conditions or standards.

Wetland Objective G

Through the duration of the CCP, apply prescribed grazing at a rate, timing, and intensity that is appropriate for management needs.

Table 7. Current, preferred, and achievable plant composition at WPA wetlands.*

Associations	*Current Composition %*	*Preferred Composition %*	*Achievable Composition %*
Nonnative undesirable vegetation	19	<1	5–10
Native undesirable vegetation	18	10	10–20
Moist-soil community	44	65	55–65
Wet meadow	17	25	20
Trees	2	<0	<1% in wetlands
Total	100		

(Source: Drahota et al. 2004).
**Although the percentages are the collective total for all the federal wetlands, it is the district's intent that each wetland has a percent composition that falls close to the preferred composition. For example, no one WPA would have most of the trees that exist on district lands. During wet years, open-water areas reduce the acreage of moist soil, native, and nonnative communities; but the percentages should stay within the achievable composition for most communities during normal years.*

Wetland Strategies

1. Annually apply grazing, fire, disking, haying and shredding on 35% of the wetland acres to create a vegetative mix of various heights.
2. Develop annual grazing plans that identify the objective and grazing method that would be used at each WPA.
3. Seasonally monitor and review the effects of grazing to determine if the objective is being met or if modifications need to be made.
4. Construct and maintain adequate boundary fences at 80% of the WPAs.
5. Develop livestock watering facilities for at least 10 WPAs to allow intense grazing treatments to reduce invasive plants and establish native plants.
6. Conduct 1,000–3,500 acres of prescribed burning in wetland habitats each year to encourage and promote the plant composition described in table 7.
7. Continue using IPM strategies to reduce noxious weeds and other invasive plants. Besides burning and grazing, use other management practices including disking, haying, flooding, and herbicide application.
8. Work with partners to increase supplemental water-pumping capacity at WPA wetlands, with a desired water depth of 2–18 inches during migration (October–April).
9. Replace antiquated water-pumping facilities with modern, energy-efficient systems.
10. Coordinate with partners to install additional water-pumping facilities and to improve water delivery in a manner that optimizes water distribution at WPAs within existing high-use areas, wetland complexes, and areas currently without water-pumping capability.
11. Delineate all WPA watersheds to determine actual hydrologic effects on each wetland, and assess the cost and feasibility of restoring each wetland.
12. Implement hydrologic improvements on 10 WPAs using one or more of the following practices: install sediment control structures; replace culverts; install water control structures; remove trees; fill water concentration pits; fill drainage ditches and drains; remove sediment and fill material; and construct dikes or berms.
13. Work with partners and private landowners within WPA watersheds to increase water quantity and quality received by implementing 120 (8 per year) of the following practices (RWBJV 1994):
    - Fill water concentration pits
    - Replace culverts
    - Install buffer areas
    - Restore grassland
    - Install sediment control structures
    - Install “Variable Flow Tailwater Recovery Systems”
    - Remove restrictions to natural runoff
    - Remove sediment and fill material
    - Fill drainage ditches and drains
14. Continue to encourage the drainage districts and county governments to abandon existing wetland drainage tiles associated with WPAs.
15. Work with partners to develop a monitoring program to document quality of water entering the wetlands after storm events.
16. Close a WPA to hunting when threatened or endangered species (such as whooping crane) occur at the WPA.

Wetland Rationale

Each spring for a short period, a significant portion of the North American waterfowl population occurs within the Rainwater Basin. The low number and low functionality of remaining wetlands place the birds at risk during their stay. Wetland vegetation and watershed management need to be done at optimal levels to meet the needs of all types of waterbirds. To increase the benefit of the basin’s wetlands for spring migration, it is critical that water occurs throughout the basin to provide more, natural wetland foods and reduce the risk of disease (Samuel et al. 2005, Smith et al. 1989, RWBJV 1993). The basin has a history of large mortality associated with avian cholera during spring migration (Gordon 1989, Samuel 1995, Samuel et al. 2005, Smith and Higgins 1990).

It is the historical nature of the basin’s wetlands to provide resting and feeding habitats for pre-nesting survival and overall annual waterfowl production (Gersib et al. 1989a, LaGrange and Dinsmore 1988). Moist soil plants such as smartweed and barnyard grass are typical early successional plants that respond quickly to disturbed areas, especially on bare soil (Fredrickson and Taylor 1982). Baldassarre and Bolen (2006) stated that the feeding ecology of waterfowl is a complex interaction of nutritional needs, resource availability, habitat quality, and waterfowl behavior. Feeding ecology is further complicated during winter (November–April) when waterfowl are migrating, preparing for production, and facing increased energy demands due to environmental stresses (Kendeigh et al. 1977, Dubovsky and Kaminski 1994, Ballard et al. 2004). Although Nebraska has an abundance of agricultural fields, waste grains lack many nutrients found in natural foods found in wetlands (Baldassarre et al. 1983, Loesch and Kaminski 1989, Krapu et al. 2004, Baldassarre and Bolen 2006).

Reid et al. (1989) found that native or naturally occurring wetland plant seeds are necessary in a duck’s diet to offset the protein and mineral deficiencies in waste grain. Ankney and MacInnes (1978), Krapu (1981), and Ankney and Afton (1988) showed a positive relationship between lipid reserves and clutch size for

various waterfowl species. Failure to meet the nutritional need of waterfowl during winter and spring migration may result in reduced recruitment (the addition of members to the overall population). This is often called the "lipid limitation hypothesis" (Ankney and Afton 1988) and is supported by Ankney and Alisauskas (1991) as a limiting factor. Lipids are an efficient form of energy storage and are more efficiently catabolized than protein, causing Petrie and Rogers (2004) to conclude that these advantages alone would explain why most studies conclude that ducks rely heavily on stored lipids during reproduction.

Heitmeyer and Fredrickson (1981), later confirmed by Kaminski and Gluesing (1987), first suggested a relationship between winter habitat conditions and duck recruitment in the following breeding season. Raveling and Heitmeyer (1989) linked increases in northern pintail populations to winter habitat conditions. LaGrange and Dinsmore (1988) went further to say those stopover areas close to breeding areas were crucial habitats for female mallards to acquire adequate nutrients. Many other authors have suggested the correlation between wintering and spring migration energetics and their implications during nesting (Krapu 1981, Rohwer 1984, Dubovsky and Kaminski 1994). This suggests that the basin's wetland habitat is important for pre-nesting survival and overall annual waterfowl production (Gersib et al. 1989a).

Food production in wetlands can be very impressive in terms of the number of seeds produced and the varieties. In a 1951 study by J.R. Singleton of the east Texas gulf coast, researchers found that salt marsh bulrush produced an average of 300 pounds (dry weight) of seeds per acre per year, and each acre produced about 5 tons of plant corms. Reinecke and others (1989) concluded that seeds provide the greatest biomass of food in moist-soil habitats, but tubers (Taylor and Smith 2005), roots, rhizomes, stems, leaves, and invertebrates can be important (Jorde 1981, Krapu 1981, Heitmeyer 1988, LaGrange 1985, Ballard et al. 2004, Bowyer et al. 2005). Anderson and Smith (1999) found managed moist soil wetlands had four to five times more ducks than unmanaged wetlands.

Reinecke et al. (1989) and Laubhan and Fredrickson (1992) synthesized seed production into metabolizable energy associated with moist soil plants, as well as daily energy requirements, allowing an estimate of duck use-days (DUDs) based on a wetland's vegetative community and seed production potential. Metabolized energy (ME) is described as a measure of available energy to waterfowl from their diet (Miller and Reinecke 1984). Kendeigh et al. (1977) describes ME as the total daily energy intake compared to the total food biomass required to supply energy needed for any individual or population. Wetland bioenergetics can be described as the relationship between seed biomass and gross energy value. The more energy a wetland can provide, the more bioenergetically efficient it is.

The average energy of moist-soil seeds is 2.5 kilocalories per gram (kcal/g). Ducks do not exploit moist-soil seeds in flooded environments when the seed mass is less than 45.1 pounds per acre (50 kilograms per hectare [kg/ha]). The minimum threshold for energy requirements of a 2.4-pound (1.1-kg) duck is 292 kcal/day (Reinecke et al. 1989). Prince (1979) and Reinecke and others (1989) proposed the calculation of DUDs as a desirable means for evaluating waterfowl habitat management. Haukos and Smith (1993) described DUDs as the number of ducks that could survive on a wetland for 1 day based on native seed availability. Cox and Davis (2002) and Fredrickson and Reid (1988) suggested that it takes larger ducks 2–3 days to replenish endogenous (produced within the body) fat reserves at 480 kcal/day in good habitat. For example, a mallard weighing 2.4 pounds (1.1 kg) would need 3 days of feeding, at a rate of 480 kcal/day, to replenish fat reserves following an 8-hour flight (figure 29).

Using Reinecke's energetics figures, a minimally suitable hectare of moist soil would yield 50,600 kcal/acre (equation 1) or 173 DUDs/acre (equation 2).

Equation 1: 45.1 lbs/acre (50kg/ha) × 2.5 kcal/g
= 50,600 kcal/acre (125,000 kcal/ha)

Equation 2: $\frac{125{,}000 \text{ kcal/ha}}{292 \text{ kcal/day}} = 173 \text{ DUDs/acre}$ (428 DUDs/ha)

As energy requirements go up (such as with weather, disturbance, and stress), the number of DUDs a wetland can provide would go down (Fredrickson and Reid 1988). The DUDs would also vary within vegetative stands since metabolizable energy can vary from 1.0 to 3.5 kcal/g, depending on what plant species are present (Sherfy and Kirkpatrick 1998). During periods when ducks need 480 kcal/day (see figure 30), only 260 DUDs/ha would be provided in the above example.

Based on recent findings from J. Drahota (personal communication) and Rabbe et al. (2004), the basin's wetlands that are dominated by moist-soil plant communities support about 1,779 DUDs/ha and wet meadow communities support 575 DUDs/ha (see figure 29). Conversely, undesirable stands such as cattail (115 DUDs/ha), reed canarygrass (102 DUDs/ha), and bulrush (*Scirpus* spp.) (23 DUDs/ha) plant associations cannot support endogenous or exogenous (produced outside the body) nutrient storage during periods of high energy demands. Drahota (2006) found that wetland management during a dry year increased seed production and the moist-soil plant association provided 8,739 DUDs/ha, compared to 3,250 DUDs/ha in a mixed moist-soil/river bulrush stand.

Estimation of duck use-days will improve when estimates of metabolized energy are available for all moist-soil plants that occur in the basin and when average seed production per stand can be estimated for a variety of environmental and management influences.

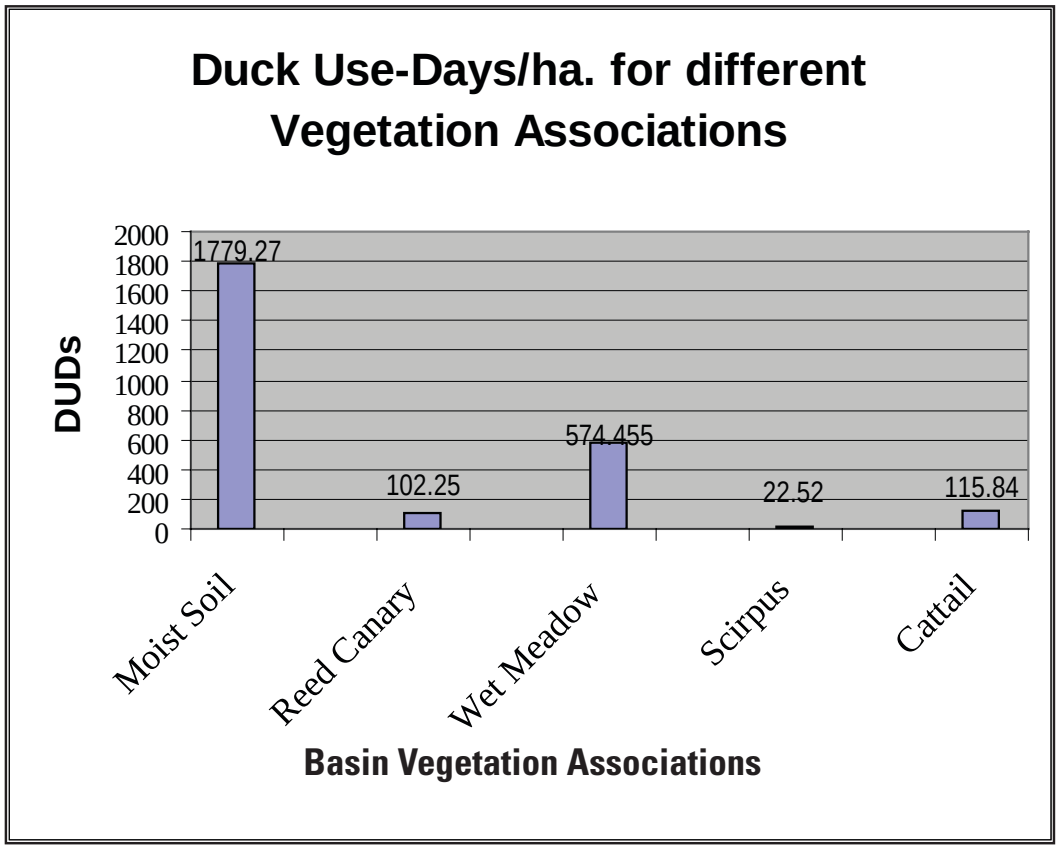


Figure 29. Rainwater Basin duck use-days.

(Calculated using metabolizable energy numbers found in Sherfy and Kirkpatrick [1998] and Checkett et al. [2002]; frequency of occurrence results were then used for each vegetation association as described in Drahota et al. [2004] to extrapolate DUDs for each community based on a daily energy requirement of 292 kcal/day.)

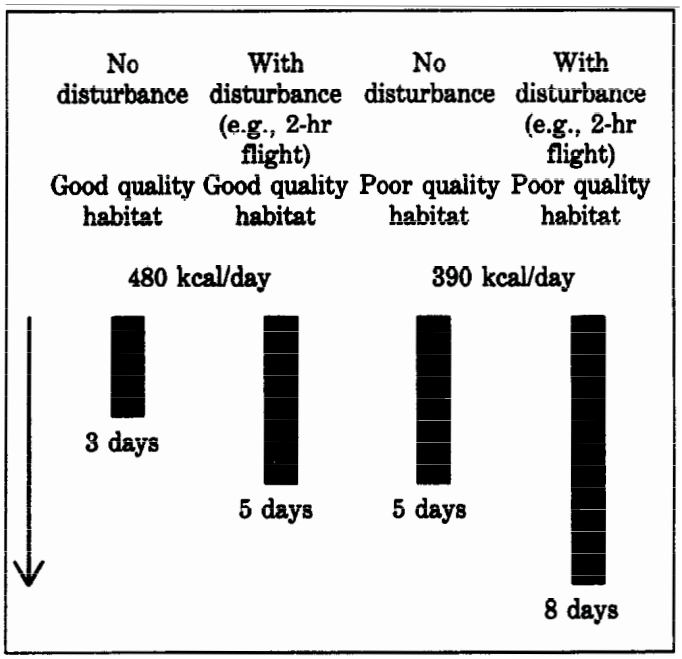


Figure 30. Time required for replenishment of endogenous fat reserves following an 8-hour migratory move.

(For a duck weighing 2.5 pounds. Taken from Fredrickson and Reid [1988]).

Native, undesirable plants such as cattail and river bulrush replace the high food-producing plants if a wetland is left undisturbed for a period of years (Reid et al. 1989). The result is a decline in seed production but an increasing amount of shelter and visual barriers for birds. Woody plants such as elm, cottonwood, and green ash can quickly invade a drying mud flat to convert a grassed wetland into a wooded wetland.

Nonnative undesirables such as reed canarygrass and Canada thistle spread quickly and can dominate or quickly turn a wetland into a monotypic stand of vegetation that is less beneficial and unattractive to waterfowl or other waterbirds (Lavergne and Molofsky 2004). Wet meadow species provide a food source but at a lesser degree (Reinecke et al. 1989, Rabbe et al. 2004).

The shallowness of the wetlands and their frequent flooding and drying make the basin's wetlands suitable for moist-soil plants. Moist-soil plants such as smartweed and barnyard grass are the typical early successional plants that respond quickly to disturbance, especially after a disturbance leaves bare mineral soil (Fredrickson and Taylor 1982).

Experience at the WPAs has shown that grazing, fire, haying, disking, and shredding create an interspersion of plant species. Annual district reports beginning in 1964 document the change in plant communities with various management practices used at the WPAs over the years. Grazing and fire were absent from the WPAs between 1966 and the late 1970s. The reports describe increasing problems with (1) smooth brome on uplands, (2) reed canarygrass and trees in wetlands, (3) vegetation-choked wetlands, and (4) noxious weed (primarily musk thistle) spread. In the late 1970s, the herbicide Rodeo® was aerially applied to cattail-choked wetlands to create open water. After about 3 years of use, it was discontinued because the cost per acre was too high. In the early 1980s, fire and grazing were used but at a conservative rate, with haying being the primary management practice. The annual reports indicate that wetland and upland improvement occurred but not enough to change plant composition. In the mid-1990s, the district increased grazing on wetlands dominated with reed canarygrass, river bulrush, and cattail. The district found that a combination of fire followed by intense grazing was the most effective management tool for changing monotypic stands of vegetation into a diverse stand of seed-producing, moist-soil plants.

Grazing has been an integral part of the prairie wetland ecosystem. Most techniques of rangeland management were developed with the idea of increasing and sustaining livestock production by decreasing the inherent variability associated with grazing (Fuhlendorf and Engle 2001). However, this is not the approach used at the WPAs. Grazing treatments are used as a vegetation management tool. Wetland grazing can reduce perennial vegetation, increase diversity, and decrease stand density to result in more wildlife use, especially by migratory waterfowl.

Animal stocking rates of two to four animals per acre in river bulrush and cattail marshes reduced the vegetative cover by 25% (USFWS 1983–93). During drought and low-water periods, livestock trampling compacts the soil, which improves the pooling of water, and tills the surface to allow seed germination. High-intensity grazing also stimulates regrowth (Ermacoff 1968). Cattle should be removed from wetlands before August 10 to allow annual plants to produce seed heads (USFWS 1983–93) if moist soil plant communities are desired. Later grazing and multiyear grazing may be needed to reduce the frequency of occurrence of undesirable species before moist-soil plants can grow.

Livestock grazing generates revenue for use to offset the costs of fencing and control of invasive plants at the WPAs. In addition, grazing provides economic benefits to the local community.

Anderson and Smith (1998) suggest intense moist-soil management for existing wetlands should increase overall nutrition available to waterfowl and other wildlife. Noted moist-soil expert, Lee Fredrickson (St. Louis, MO), confirmed this (personal communication). Fredrickson stated that increasing disturbance will increase seed production, reduce perennials, and reduce the woody component. The number of years after a disturbance occurs will also decrease the amount of seed produced. Millet seed production postdisturbance was about 50% less after 3 years and an additional 25% less after 4 years. Undesirable species like cattail and reed (*Phragmites* spp.) have a tremendous amount of belowground biomass—cattail is about 2.5 times more than aboveground biomass and reed (*Phragmites* spp.) is about 6.5 times more. The belowground biomass has to be reduced or eliminated to allow desirable species that are in the seed bank an opportunity to grow.

Effective migratory bird habitat must include a complex of habitat types that provide important food and cover resources (Reid et al. 1989). Historically within this area, wildland fire and grazing by free-roaming bison and elk herds kept wetland vegetation in an early successional stage. Today, natural disturbances have to be replaced with planned management including fire, grazing, haying, flooding, and disking. The frequency and intensity of their use depends on various factors including vegetative composition, saturation of soils, and hydrologic patterns within the wetland. Weather events usually determine the timing of treatments. However, if moist-soil plant seed production is desirable during the same growing season, treatments should be completed before August 10. Kantrud (2006) noted that further studies in wetland management need to occur due to the unknown effects of (1) fire suppression, (2) differential grazing regimes, (3) cultivation, (4) mowing, (5) changes in hydrology, (6) siltation, and (7) pesticides.

Kantrud (2006), after reviewing numerous waterfowl studies, surmised that reductions in height and density

Jeff Drahota/USFWS

White-rumped sandpipers at Johnson WPA (Phelps County).

of tall emergent plants generally increases breeding duck use. In the basin, migratory habitat has been the focus after researchers found that the basin produces relatively few waterfowl annually (Evans et al. 1967). Kantrud also stated that most waterfowl worldwide favor feeding in shallow water areas where tall emergent plants do not block sunlight.

A variety of bird species depends on plants of various heights. Height variations create structure within habitats that can accommodate greater diversity and higher use by wildlife. Research done by Brennan (2006) et al. have shown that ideal waterfowl habitat, especially for ducks, is an interspersion of tall and short vegetation to create a hemi-marsh condition when spring runoff pools in wetlands. Reinecke et al. (1989) found moist-soil impoundments provide an interspersion of open water and vegetation; a diversity of water depths was attractive to various waterfowl species.

Solid stands of tall vegetation that are greater than 12 inches above the water make areas less attractive to waterfowl (Reid et al. 1989). They may provide an abundance of food, but much of it remains unused. Scattered areas of shorter wetland plants or bare, open water increases bird use of an area. Pederson et al. (1989) stated that, during winter, freedom from harassment by predators, availability of food, and thermally protected habitats may be critical. This suggests that this type of habitat in early spring, migratory, staging areas could be similarly critical (Jorde et al. 1984). Brennan (2006) found the percent of emergent vegetation to be a positive indicator for waterbirds—intermediate levels of vegetation in wetlands have the highest species richness. The lower end of the range (6 inches) is provided as a guideline; however, most researchers have found that short vegetation increases the attractiveness to a wider range of species and provides broader benefits for these species (such as feeding, loafing, and breeding).

Wetlands that contain the mix of tall and short vegetation require less runoff or pumped water before the wetland becomes suitable for waterfowl use. Gersib et al. (1989a) noted the temporary and seasonal wetlands provided the highest feeding values to waterfowl due to seasonal fluctuations in hydrology that directly affect vegetative growth and seed production. In drier years, this becomes a critical factor in determining how much migration habitat would be available. The open-water areas would attract the birds and provide them better access to the higher food plants in the flooded, emergent-plant areas of these wetlands.

Although the intent is to have most of the wetlands fall within the category described in the objectives, a few wetlands (<20%) need to be managed for the two extremes: (1) those that have taller, denser stands of vegetation (not attractive to geese), and (2) those that are open or sparsely vegetated (attractive to geese and shorebirds). White and James (1978) found water depth and the presence of emergent vegetation to be

important factors associated with niche partitioning for wintering waterfowl species. The open-water wetlands would benefit snow geese use (Traylor 2000, Drahota 2000) and provide hunting opportunities. Past use of this strategy in the basin has shown separation of snow geese populations from other species of waterfowl. This strategy is expected to reduce the potential or extent of avian cholera. Conversely, wetlands with dense stands of emergent vegetation provide winter habitat for resident species such as pheasant (Baxter and Wolfe 1973, Gabbert et al. 1999, Bakker 2003).

Although vegetation management is critical, water management is equally so. The Great Plains GIS office assessed the Rainwater Basin's wetland conditions in spring 2004 (a year drier than normal) and found that only 14% of the original, historical basins provided any habitat. Of that amount, 91% were in private ownership but only provided 55% of the available waterfowl habitat. Those in public ownership represented only 9% and provided 45% of the available waterfowl habitat. The low number of wetlands within the basin makes it critical that as many as possible contain optimal habitat for all types of waterbirds, and it is important that these water areas be distributed throughout the basin. Rainfall is not consistent throughout the area, therefore, multiple complexes throughout the basin guarantee that there will be some water areas where water pools when scattered rainfall occurs. As birds concentrate, they quickly deplete their food supply and expose the entire population to disease outbreaks.

USFWS

New submersible pump at Harvard WPA (Clay County).

Pumping water in the fall can provide habitat for early waterfowl migrants and increase invertebrate abundance in the fall. In addition, maintenance of this water through winter into spring would substantially increase invertebrate abundance (Anderson and Smith 2000). Increased invertebrate numbers would benefit female ducks that molt the first week of March (Jorde 1981) during feather replacement. During dry years, northern pintails with higher body mass survived better in wintering areas (Fleskes et al. 2002, Moon and Haukos 2006), suggesting that quality wetland habitats along the fall migration route play a role in winter survival. Overall, increases in suitable habitat in the breeding, migration, and wintering areas potentially correspond with mallard populations (Heitmeyer and Fredrickson 1981, Bergan and Smith 1993). Fall water pumping can benefit other species such as whooping crane (Richert 1999).

Pumping water can be a major expense especially when precipitation is limited or when needed to accomplish moist-soil management objectives (Anderson and Smith 1999). Water pumping should deliver 2–18 inches of water to accommodate foraging needs of shorebirds, waterfowl, and other waterbirds (Laubhan et al. 2006). Since 2000, water-pumping costs in the district have averaged about $14 per acre. Moist-soil management practices that use fall water pumping can swell clay soil, reduce soil cracking, and slow infiltration rates (Anderson and Smith 1999).

The district has 71 wells scattered over 36 WPAs. Only 35 of these have water-pumping capability and occur at 23 WPAs. Those 35 wells have the ability to deliver water to 2,230 wetland acres (approximately 20% of the total). Each year, WPA and WMA wetlands with pumped water provide core, migrational habitat on a consistent basis. In drier years, these wetland areas need to have water pumped to them to keep the birds from concentrating on a few small reservoirs and the Platte River. Jorde et al. (1983) found that mallards in Nebraska would move to riverine habitat during winter or cold periods. Therefore, pumping water into wetlands can contribute to the overall distribution of waterfowl within south-central Nebraska.

To increase the benefit of wetlands in the basin for spring migration, it is critical that water be available throughout the basin (RWBJV 1993). Since a significant portion of the entire North American waterfowl population passes through the region, it is even more critical that those populations are not placed at risk. Krapu et al. (1995) advises that waterfowl managers in the basin provide favorable conditions by maintaining well-distributed, wetland-roosting habitat. Supplementing water would increase available habitat, provide more natural foods, and reduce risk associated with crowding (Samuel et al. 2005, Smith et al. 1989).

Each water-pumping facility has a different level of efficiency (for example, the cost per acre-foot of water, gallons per minute, and level of maintenance). Less efficient wells can only be used when wet conditions exist and only when a little supplemental water is needed to reach a desirable habitat condition. Submersible, electrical wells require minimal maintenance and can increase the flexibility of the district's water management. For example, they can be turned on during the harshest part of the winter without fear of freezing or damage, allowing more basins to be ready in the event of an early spring

migration. Submersibles also reduce the use of high-cost diesel and natural gas.

Pumping water to wetlands is dependent on various factors (RWBJV 1993). The cost of water pumping and the limited funds makes it necessary to focus water pumping to areas where it would have the most effect for the least cost. For some areas, the capability of the well is less than needed to flood the entire wetland. After a portion of the wetland is flooded, percolation and evaporation begins to equal the pumping capacity of the well.

Thirty-eight WPAs need further acquisition to complete ownership of the wetlands. Partially owned wetlands are not being managed to their full potential. Management treatments such as pumping water, prescribed fire, and grazing are limited or absent. Often the adjoining landowner has different uses or interests in their portion of a wetland. Acquisition would greatly expand the number of fully functional wetlands in Service ownership.

The RWBJV has used GIS technology to identify wetlands having the highest migratory bird value (Bishop 2005). That value is based on biological needs of waterfowl and shorebirds and the geophysical condition of the wetlands. This information would help the district and its partners target the right wetlands for the right conservation strategy—be it acquisition or enhancement of privately owned wetlands (Bishop 2005).

Natural wetland function occurs when there is a balance in the hydrology between the size of the wetland and the watershed. Alterations within the wetland and watershed change that hydrologic balance. This, in turn, changes the plant composition—often to a less preferred habitat community (Gersib et al. 1989a). In fact, Smith (1990) stated that hydrology is the most likely factor influencing plant community composition.

Much of what occurs in a WPA wetland is dependent on what happens hydrologically within its watershed. Working with private landowners not only addresses the district's hydrology objectives, but also assists landowners in meeting their needs. Pits within a watershed capture water before it reaches the wetland. That water is confined to a deep, smaller, artificial wetland that has little value for migratory waterfowl (Gersib et al. 1989a). The Great Plains GIS office inventoried water concentration pits in the district. There were 11,859 pits found, with 627 pits existing within WPA watersheds. Roads and culverts restrict or impound the natural runoff so one portion of the wetland becomes flooded while other portions receive a smaller portion—again affecting the vegetation and amount of surface water in the wetland. Restoration of watershed hydrology should increase the frequency, size, and duration of pooled water.

The Service's Partners for Fish and Wildlife Program assists the district by working with private landowners within the watersheds. Their work adheres to the practices outlined in the "Rainwater Basin Joint Venture Private Lands Program" criteria (appendix K). Using funds and expertise from various partners since 2000, 89 pits have been filled on privately owned property.

It is unknown what the full extent is and effects are of agricultural runoff in the basin's wetlands. Agricultural runoff can carry fertilizers, pesticides, and heavy silt loads to wetlands at the WPAs. Agricultural chemical exposure at WPAs can have two types of effects:

- direct effects—for example, toxic pesticides that affect nontarget species
- indirect effects—for example, habitat quality that is degraded from nutrient enrichment (Dewey 1986)

Gordon et al. (1997) reported some district wetlands had concentrations of mercury, copper, lead, iron, and zinc that exceeded water quality criteria developed by the U.S. Environmental Protection Agency (USEPA) and concluded that high pesticide and fertilizer use in the area was a likely cause. In addition, herbicides (atrazine for corn and glyphosate for soybean acres) and insecticides (organophosphates and pyrethroids) were applied to 93% and 36% of all corn acreages, respectively (NASS 2004). Many of these chemicals appear to cause serious degeneration and malformation of organs in wildlife, and could interfere with the normal function of hormonal systems in humans.

In aquatic systems, atrazine exposure can adversely affect periphyton (organisms attached to submerged plants that provide food for invertebrates) (Nelson et al. 1999), invertebrates (Dewey 1986, Dodson et al. 1999), and amphibians (Larson et al. 1998, Hayes et al. 2002). For example, Dewey (1986) found atrazine concentrations of 20 micrograms per liter decreased adult insect emergence by 90% and insect diversity by 60%. Leopard frogs in York County, Nebraska, had gonadal dysgenesis (degeneration of the reproductive organs) in 28% of the sample and testicular oocytes (abnormally occurring female eggs in a male) were found in a single male (Hayes et al. 2002). Insecticides frequently recommended for corn pests in Nebraska include the third-generation pyrethroid permethrin and fourth-generation pyrethroids including bifenthyrin, tefluthrin, gama cyhalothrin, lambda cyhalothrin, cyfluthrin, zeta cypermethrin, and esfenvalerate (UNL 2004). Recent studies by Go et al. (1999) and Kim et al. (2004) indicate that certain pyrethroid insecticides, including permethrin, may function as endocrine modulators in both wildlife and humans.

The Natural Agricultural Statistics Service (NASS) reported 95% and 76% of the district planted to corn receive applications of nitrogen and phosphorus, respectively (NASS 2004). In addition, nutrient-rich runoff can cause wetland eutrophication (overenrichment of a waterbody with nutrients, resulting in excessive growth of organisms and

depletion of oxygen) and may result in decreased foraging potential for waterfowl (Gaiser and Lang 1998).

Soil erosion and sedimentation, especially during high flows, reduces the storage capacity of wetlands and forces some of the surface water to flood nonwetland areas (increasing percolation rates) (Stutheit et al. 2004). The buildup of sediment also allows less-preferred perennial plants to survive during the hotter, drier summer period (Reid et al. 1989). Sedimentation of only 0.2 inch (0.5 cm) caused a 92% reduction in seedling emergence of hydrophytic plants and a 99.7% reduction in total invertebrate emergence in northern prairie wetlands (Gleason et al. 2003). Roads, terraces, culverts, and tile drains also reduce, delay, or redirect runoff from wetlands.

Livestock runoff is of particular concern for at least 22 WPAs that have concentrated animal-feeding operations (CAFO) within their watersheds (USFWS 2006). Mindy Meade-Vohland (personal communication) suggested more confinement might exist as enclosures that were not detectable using remote sensing techniques. Of these CAFOs, five are major operations (larger than 40 acres in size) and are within the watersheds of Theesen, Jones, Cottonwood, McMurtrey, Funk, Sinninger, and Prairie Dog waterfowl production areas.

Runoff into the WPAs from CAFOs may directly affect beneficial uses (as defined by the Nebraska Department of Environmental Quality [NDEQ]) such as aquatic life, wildlife, agricultural and municipal water supply, and aesthetics. A recent court case involved feedlot discharge into Cottonwood WPA. In that case, the owner was charged with illegal discharge that violated aesthetic standards and exceeded ammonia standards. Nebraska's water quality standard (NDEQ 2006) states the following:

> *To be aesthetically acceptable, wetlands shall be free from human-induced pollution which causes: (1) noxious odors; (2) floating, suspended, colloidal, or settleable materials that produce objectionable films, colors, turbidity, or deposits; and (3) the occurrence of undesirable or nuisance aquatic life (e.g., algal blooms). Wetlands shall also be free of junk, refuse, and discarded dead animals.*

In recent years, aesthetic violations are suspected to occur annually in association with four of the five WPAs with CAFOs (Funk, Theesen, Cottonwood, and McMurtrey WPAs). The biological integrity of wetlands is assumed to diminish when aesthetic violations occur.

Pollutants associated with CAFOs include pesticides, trace elements, salts, nutrients, cyanobacteria toxins, bacterial pathogens, hormones, and antibiotics (USEPA 2003). Studies indicate that heavy metals associated with livestock medicine may be above acceptable levels for waterfowl and other waterbirds. Schwarz et al. (2004) found water and sediments from a swine CAFO served as a source for high concentrations of nutrients, antibiotics, hormones, bacterial pathogens, and elemental contaminants (such as selenium, nickel, copper, and zinc). During large storms, contaminant flows can come from flooded wastewater treatment ponds and from runoff on fields fertilized with animal waste (Sharpley et al. 1999).

The district is working with Service contaminant specialists by providing staff time to collect data as outlined in a research proposal entitled "FY07 Environmental Contaminants Program On-refuge Investigations." This work would provide baseline information about water quality coming into and at the WPAs. Results from this study would define what kind of water quality tests should be conducted by the district.

The "Wetland Management District Ditch and Tile Maintenance Policy" in appendix L would apply to existing ditches or tiles that come onto the WPAs where there is no reservation of a drainage easement in the deed.

Upland Goal

Reestablish and maintain native grassland communities of the Rainwater Basin.

Upland Objective A

Within 15 years, restore, enhance, and manage the native grassland plant composition to achieve a high level of diversity. The accumulated, current, and desired percentages for Service lands are shown in table 8.

Upland Objective B

Through the duration of the CCP, apply prescribed grazing at a rate, timing, and intensity that is appropriate for management needs.

Upland Strategies

1. Use the "Rapid Assessment Vegetation Monitoring System" to document existing vegetation occurring with each plant community or association.
2. Harvest seed from the WPAs or other local, privately owned grasslands. Collect more than 80 species of grasses, forbs, and sedges from seed harvesting.
3. Use the seed mixes to reestablish native grassland at WPAs containing cropland or areas dominated by nonnative grasses.
4. Conduct 200–3,000 acres of prescribed burning in upland habitats each year to encourage and promote the plant composition shown in table 8.

Table 8. Current, preferred, and achievable plant composition at WPA uplands.

Associations	*Current Composition %*	*Preferred Composition %*	*Achievable Composition %*
Native grassland	64	>95	>80
Invasive grassland	27	<5	<19
Cropland	4	0	0
Trees*	5	<1	<1
Total	100		

(Source: Drahota et al. 2004).
**Although the percentages are the collective total for all the WPA uplands, it is the district's intent that each upland unit has a percent composition that falls close to the preferred composition. For example, no single WPA would have more than 1% of the trees that exist on district lands. The native grassland association includes all grasses and forbs that historically occurred within the basin (refer to table 5 and appendix I for a list of plant associations that are recorded during transect sampling). Transect data collection determines the frequency of occurrence for all vegetative associations that occur in the stand. Dominant plant communities are determined by data analysis. Plant associations that have the most occurrences within the sample area are considered dominant.*

5. Continue use of IPM strategies to reduce noxious weeds and other invasive plants.
6. Continue to remove trees to create an open grassland.
7. Develop annual grazing plans that identify the objective and grazing method that would be used at each WPA.
8. Seasonally monitor and review the effects of grazing and prescribed fires to determine if the objective is being met or if modifications need to be made.
9. Construct and maintain adequate boundary fences at 80% of the WPAs.
10. Develop livestock watering facilities for at least 10 WPAs to allow intense grazing treatments to reduce invasive plants and establish native plants.


USFWS


USFWS

District staff use prescribed fire as a tool to manage uplands at the waterfowl production areas.

Upland Rationale

Grassland plays a vital role in buffering runoff and in providing feeding, nesting, and shelter habitat for migrating and residential wildlife. Within the Rainwater Basin, agriculture and roads have replaced the tall-grass prairie in the eastern portion and the mid-grass prairie in the western portion of the basin. Steinauer and Rolfsmeier (2003) reported that more than 97% of tall-grass prairie that once covered the eastern one-third of Nebraska has been lost. Over the entire basin, less than 10% of the original grassland remains (personal communication with Ryan Reker, RWBJV, Grand Island, NE). Nearly all of the remaining grassland has been significantly altered by land use that promotes invasive cool-season plants such as smooth brome and Kentucky bluegrass.

Grassland birds have experienced dramatic declines because of the loss of grasslands. The North American Breeding Bird Survey reports that 70% of the 29 species characteristic of North American prairies have experienced a decline in population. A portion of that decline is attributed to the small acreage of remaining grassland parcels and the increasing number of trees found within the grasslands (Bakker 2003). Cowbird parasitism is especially concerning (Bakker 2003) in the district due to planted shelterbelts and scattered volunteer trees that are numerous at the WPAs.

It is within the directive of the Service to manage areas according to their historical conditions for the

benefit of multiple species of plants, animals, and insects (see habitat requirements in table 9). Because of the small amount of remaining native grassland, it is important to manage the uplands in this manner.

For most of the grassland bird species, the percentage of woody cover should be less than 5% of the plant community (McKee et al. 1998). Prairie chickens prefer less than 1% woody vegetation for lek sites (Merrill et al. 1999). McCarthy et al. (1997) found woody cover encroachment directly decreased adequate nesting cover for prairie chickens.

USFWS

Greater Prairie-chicken.

Burger et al. (1994) found prairie fragmentation directly affected predation rates on bobwhite quail, noting that nests found more than 60 meters from woody cover were three times more successful than those found less than 60 meters from woody cover. Therefore, tree and shrub removal is critically important for those WPAs that have a high percentage of trees or shrubs. Bakker (2000) recommends removing woodland habitat within or adjacent to grassland and acquiring or preserving grassland patches large enough (300–600 acres) to attract the majority of grassland-dependent species.

Native grassland responds better to natural ecological processes (including drought), which provides a more stable habitat to meet wildlife needs. It provides for a greater diversity of plants and animals.

Since the district reseeds areas with a high-diversity (80+ species), grassland seed mix, it is assumed that the species diversity of the established grassland would be greater than 50 species. High-diversity grassland is important for most of the native-grassland bird species (Bakker 2000). Native grassland management would benefit all of the species listed in table 10 (Bakker 2003); however, each has specific habitat requirements that are not the same. Grassland management treatments should provide a variety of grassland conditions that include short-vegetation grazed or hayed areas, medium-height vegetation with low thatch, tall vegetation with low thatch, and grass stands with heavy thatch (Bakker

Table 9. Habitat requirements for selected grassland birds.

Species	*Vegetation Height (inches)*	*Litter (inches)*	*Patch Size (acres)*	*Distance from Trees (feet)*
bobolink	10–18	1.3–3.6	100	150
burrowing owl	<5	minimal	10	>328
dickcissel	8–40	0.6	25	prevent woody encroachment
long-billed curlew	<12	minimal	104	avoids areas with high-density trees and shrubs
grasshopper sparrow	8–24	not available	20	164
sharp-tailed grouse	6–16	use areas that are idle for several years	150	>164
short-eared owl	12–24	2–8 years of residual cover	183	not available
upland sandpiper	1–24	1.0	250	328

(Sources: Grant 1965, Wiens 1973, Clark 1975, Duebbert and Lokemeon 1977, Redmond et al. 1981, Johnsgard 1983, Prose 1987, Renken and Dinsmore 1987, Messmer 1990, Haug et al. 1993, Herkert et al. 1993, Pampush and Anthony 1993, Helzer 1996, Hughes 1996, Madden 1996, Connelly et al. 1998, Clayton and Schmutz 1999, Helzer and Jelinski 1999, Dugger and Dugger 2002, and Laubhan et al. 2005).


USFWS

District staff mix 31,000 pounds of seed harvested during the summer. More than 100 species were collected.

2003, Sporrong 2001). High-diversity grassland can also be an important line of defense against invasive plant species. Kennedy et al. (2002) found that restoration and revegetation practices that included high-diversity seeding proved effective for exclusion of undesirable invaders.

Game birds also benefit from managed native grassland stands. Bakker (2003) noted that pheasant researchers found nesting success to increase with increasing distance from trees. Nesting success was lower in and near shelterbelts in South Dakota and Colorado (Trautman et al. 1959, Olson and Flake 1975, Snyder 1984). Heavy predation rates near shelterbelts, road ditches, and fencerows prevented successful nesting (Trautman et al. 1959). Gabbert et al. (1999) found that predation was significantly higher than severe winter mortality—suggesting that thermal cover provided by native grass stands would provide the highest winter survival rates for pheasants. Managing natural areas for grassland bird species involves providing the nesting habitat requirements and food resources essential for production and survival. These requirements include large, treeless patches that contain diverse vegetative structure (Renken and Dinsmore 1987, Johnson and Temple 1990, Volkert 1992, Helzer and Jelinski 1999, DeJong 2001, Herkert et al. 2003, Davis 2004, Fritcher et al. 2004). Management practices that favor grassland-nesting birds would benefit the grassland species of management concern shown in table 10 (Sharpe et al. 2001).

Grazing has been an integral part of the prairie ecosystem. Most techniques of rangeland management were developed with the idea of increasing and sustaining livestock production by decreasing the inherent variability associated with grazing (Fuhlendorf and Engle 2001). However, this is not the approach used at the WPAs. Grazing treatments are used as a vegetation management tool. Proper upland grazing can reduce undesirable species, maintain healthy grasslands, and promote heterogeneity (Fuhlendorf and Engle 2001).

Livestock grazing generates revenue for use to offset the costs of fencing and control of invasive plants at the WPAs. In addition, grazing provides economic benefits to the local community.

The district has mapped the uplands at the WPAs but not to the level of detail or accuracy needed to assess the status or future changes in uplands over a period of years. Currently, the district is not staffed to accurately measure the effect management tools, such as fire and grazing, is having on grassland communities. Measurements from vegetation transects would provide that information.

Table 10. Key grassland species found in the Rainwater Basin.

Grassland-nesting Species	*Partners in Flight (score is greater than 20 points)*	*USFWS Focal Species (2005)*	*BCC Bird Conservation Region 19* (2002)*	*Nebraska Tier 1 Species*
northern harrier	✓	—	✓	—
Swainson's hawk	✓	—	✓	—
upland sandpiper	✓	✓	—	✓
burrowing owl	—	✓	—	✓
short-eared owl	—	✓	—	✓
sedge wren	—	✓	—	—
lark bunting	✓	—	—	—
grasshopper sparrow	✓	✓	—	—
dickcissel	✓	—	—	—
bobolink	—	✓	—	—
eastern meadowlark	—	✓	—	—

(Source: Sharpe et al. 2001.)
**Designated by Birds of Conservation Concern, 2002; region 19 comprises central Nebraska, Kansas, Oklahoma, and Texas.*

Water Rights Goal

Develop partnerships to protect the natural hydrology of WPA watersheds and ensure the necessary water rights are in place to protect future use of both ground and surface water.

Water Rights Objective A

Within 2 years of CCP approval, complete an inventory of existing district-owned water rights and monitor changing natural resource district regulations associated with groundwater use.

Water Rights Objective B

Through the duration of the CCP, work closely with partners to obtain all necessary water rights and to protect the integrity and hydrology of district wetlands.

Water Rights Strategies

1. Work with water rights experts at the regional office to develop and perform a formal review and determination of the legal status of existing water rights.
2. Work with partners to identify threats and possible solutions to the loss of surface water runoff to district wetlands.

Water Rights Rationale

State law entitles groundwater users to "reasonable and beneficial use of the groundwater." The increase of groundwater irrigation and drought conditions has caused a decline in groundwater throughout the district. The Nebraska Ground Water Management and Protection Act, amended in 2004, requires the Nebraska Department of Natural Resources to annually determine which river basins, subbasins, or reaches are considered fully appropriated. Fully appropriated basins would cause the respective natural resource district to (1) place a moratorium on new surface and groundwater uses, and (2) develop an integrated surface water and groundwater management plan. Only WPAs located in the Tri-Basin Natural Resource District are in fully or overappropriated basins. The Upper Big Blue Natural Resource District established the goal of holding its average groundwater level above the 1978 level. If the average groundwater level drops below a level 3 feet above the 1978 average level, groundwater users would be required to report annual groundwater use.

It is uncertain what future actions would be taken by the natural resource districts or what effect those actions may have on future use of groundwater to supplement wetlands. With water becoming scarcer, there is concern that neighboring lands would capture natural runoff before it reaches the district's wetlands. It is not clear if any legislation or regulations are in place to protect public wetlands from being dried up by diversion of surface water runoff.

Invasive Plant Species Goal

Reduce and control the spread of nondesirable, nonnative plant species within wetland and upland habitats for the benefit of native plant and wildlife communities.

Invasive Plant Species Objective A

Throughout the life of the CCP, continue to monitor and control invasive plant species in wetland and upland habitats by using the appropriate treatment for each situation.

Invasive Plant Species Strategies

1. Annually map and document treatment of nonpreferred plant communities throughout the district.
2. Develop an integrated pest management approach that would include chemical, biological (such as insects), mechanical, and physical (such as fire, grazing) treatments.
3. Treat known stands of state-identified noxious weeds. Other species that degrade wetland and upland habitats would be second priority.
4. Establish healthy stands of preferred, native plants that can compete with invasive plants.
5. Develop partnerships that would find new ways to efficiently control invasive plant species by combining resources of all partners.

Invasive Plant Species Rationale

Invasive, nonnative wetland and upland plants are a serious problem affecting thousands of acres of wildlife habitat along the Platte River and within the basin. Nonnative plants such as Canada thistle and reed canarygrass can outcompete with native flora—creating a monotypic stands if left undisturbed. Native species, such as cattail and river bulrush can do the same if left unmanaged.

In 2004 7,596 acres of undesirable plant communities (includes noxious weeds, cattail, reed canarygrass, bulrush, and invasive cool-season grasses) were mapped at the WPAs.

Vegetation management is key to providing optimal wetland and upland habitat for both migratory and resident wildlife. Healthy native plant communities are better equipped to withstand weed invasions (Kennedy et al. 2002). Long-term control requires the cooperation of public and private land managers throughout the basin. A joint effort by all partners is needed to conduct research on finding the best management practices to control or eliminate individual species.

Wildlife Diseases Goal

Work with partners to prevent or control the outbreak and spread of wildlife-borne diseases to protect human and migratory bird populations.

Wildlife Diseases Objective A

Through the duration of the CCP, continue to monitor WPAs for outbreaks of various wildlife diseases, especially avian cholera and influenza.

Wildlife Diseases Objective B

Respond in an appropriate manner to contain any disease outbreak that occurs.

Wildlife Diseases Strategies

1. Work closely with the NGPC and other state and federal specialists to monitor and control all wildlife diseases at the WPAs.
2. Maintain an up-to-date disease contingency plan.
3. Follow federal and state guidelines for monitoring and control of wildlife diseases.
4. Use partnerships to increase awareness and preparedness for the monitoring, detection, and control of wildlife diseases.
5. Where possible, use management practices such as supplemental water pumping to reduce the spread or effect of disease.

Wildlife Diseases Rationale

Avian cholera was first documented in the district in 1975. It has occurred in the district every year since. The level of outbreak fluctuates from year to year. Cholera mortality in 1998 was estimated at more than 100,000 birds, primarily snow geese, while the mortality in the past 5 years has been in the low hundreds. It is not known for certainty what environmental or physiological factors trigger an outbreak, but it appears to be associated with physiologically stressed birds that are concentrated on a limited number of wetlands (Smith and Higgins 1990). Avian cholera epizootics (diseases affecting large numbers of animals) were found to be inversely related to densities of semipermanent wetland basins.

There is a growing concern that an avian influenza pandemic could occur within the next few years. What remains unknown is the possibility that other diseases could reach outbreak proportions while birds are concentrated in the district. The best approach to take is to be vigilant and prepared.

Research and Science Goal

Encourage and support research that substantially contributes to the understanding and management of the Rainwater Basin wetland and grassland ecosystem.

Research Objective A

Through the duration of the CCP, support research that furthers the understanding of the ecology, wildlife populations, socioeconomics, and hydrology within the Rainwater Basin.

USFWS

A crew of district staff, Bureau of Reclamation employees, and summer interns map vegetation at all the waterfowl production areas.

Research and Science Strategies

1. Complete baseline research that determines the watershed boundaries for the WPAs and the hydrologic events that affect wetlands. Determine what practices should be done to restore wetland hydrology.
2. Conduct an in-depth inventory of invertebrates, amphibians, reptiles, birds, and small mammals within the district.
3. Determine the baseline composition for each upland plant community using the "Rapid Assessment Vegetation Monitoring System."
4. Determine the socioeconomic effects associated with Service-owned lands: (1) property tax deficiencies, (2) increased local revenue generated from recreational opportunities provided by public access and uses, and (3) aesthetic values.
5. Conduct an invertebrate study to assess the effects of land and water management actions.
6. Identify the energetics contribution of the district to waterfowl and other migratory birds.
7. Conduct or support contaminant research associated with nonpoint and point source pollution.
8. Work with partners to continue to identify needed research, obtain funding, and support the research process.
9. Conduct district data collection to support ongoing research.

Research and Science Rationale

Smith (1998) identified the current district research needs. The district is working with the RWBJV to accomplish those needs; however, district staff and

resources are limited. Research done within the district can be divided into six categories: wetland inventory, bird inventory, habitat evaluation, bird biology, avian cholera, and hydrology.

Most of the early research involved wetland inventory. The first research assessed Clay and Fillmore counties (USFWS 1954). In the late 1960s, a more detailed inventory used soil data and field surveys to assess how many large wetlands had been drained or degraded (McMurtrey et al. 1972). Schildman and Hurt (1984) updated the McMurtrey data and found that 10% of the original wetlands and 22% of the original wetland acres remained. Raines et al. (1990) included small wetlands in their review; they noted the declining number of basins and that the frequency of degraded wetlands was increasing. An assessment in 2004 of land use in the district reported 14% of the historical wetlands have some wetland function (pooled water). Of that amount, 49% are classified as cropped wetlands (Bishop and Reker 2006).

Bird inventories started in the late 1950s with the Service counting numbers of greater white-fronted geese. Those counts were used through 1992 as a population index for the midcontinental population (Benning 1987, Solberg 1992). The district conducted aerial waterfowl surveys during spring migration (USFWS 1983–1993). The NGPC inventoried the basin for species of concern to assess the potential conflicts that may occur with the "Conservation Order for Mid-continent Light Geese" (COMLG) (NGPC 1997–1999). The Canadian Wildlife Service conducted two goose counts in 1999 to compare population numbers using the district with previous population estimates (Warner and Nieman 1999). In addition, the NGPC inventoried spring waterfowl numbers during a 4-year study that looked at effects on nontarget species during the COMLG (NGPC 2000–2003). Austin and Richert (2001) mapped and evaluated whooping crane habitat selection. Although less is known about populations of nonwaterfowl species, the wetlands provide habitat for a minimum of 200,000–300,000 shorebirds represented by over 30 species (LaGrange 2005). Jorgensen (2004) was able to summarize shorebird use in the district. Jorgensen (personal communication) is currently completing buff-breasted sandpiper research. Records of birds occasionally observed in the basin are found in "The Birds of Nebraska and Adjacent Plains States" (Johnsgard 1997).

Habitat evaluations in the basin are limited. Taylor et al. (1978) correlated landscape changes with pheasant numbers. Gersib et al. (1989a) looked at waterfowl densities and activity time-budgets for the basin's wetlands; they found that temporary and seasonal wetlands were the most valuable for spring-staging waterfowl. Gilbert (1989) sampled 47 wetlands in the basin and organized its plant communities in accordance with the dominant hydric soils that were present. Gersib et al. (1989b) also completed a functional assessment concluding that the basin's wetlands would have a high probability of providing wildlife habitat, food chain support, long-term and seasonal nutrient retention, flood storage, and sediment trapping. The NGPC (1977–1999), the Service (USFWS 1977–1999), and Richert (1999) have documented whooping crane roost sites and habitat preferences for central Nebraska. Stutheit et al. (2004) provided a comprehensive review of wetland hydrology and function in the basin. Drahota et al. (2004) mapped and sampled vegetation communities at public areas. Brennan (2006) assessed local and landscape factors influencing migratory bird use.

Duck production research by Evans and Wolfe (1967) found the district's wetlands to be intermittent, producing 10,000 birds to flight stage annually. Their findings led managers to focus more on managing for spring migration habitat rather than nesting habitat. Krapu et al. (1995) looked at habitat, food, and nutrients in white-fronted geese and concluded that fat and protein contents increased for females during spring staging in the district. Cox (1998) looked at weight gain, nutrient reserves, and habitat use by white-fronted goose, snow goose, and northern pintail. Cox and Davis (2002) used telemetry techniques to assess northern pintail habitat use, movements, and survival during spring migration and found the smaller wetlands in the basin to be the most important habitat. Farmer and Parent (1997) found that the distance between wetlands influenced use by the pectoral sandpiper. Thus, higher wetland densities provided greater variability in food resources to maximize foraging opportunities and minimize energy expenditures (Farmer and Wiens 1999). Max Post van der Burg (2005) looked at factors affecting songbird nest survival and brood size.

Numerous avian cholera studies have been completed in the district. The first avian cholera outbreak in the district was reported in 1975 (Zinkl et al. 1977). Research conducted in the 1980s and '90s had little success pinpointing the cause of outbreaks and could not develop any strategies that minimized bird loss during outbreaks (Windingstad et al. 1984, Smith et al. 1989, Smith and Higgins 1990, Smith et al. 1990). However, it was determined that the bacteria can remain in the environment for several days after an outbreak occurs (Price and Brand 1984), which potentially jeopardizes the next migrants that stop at the wetland. Samuel (1995) listed those factors that can affect cholera outbreaks and survival of the bacterium in the environment. Cox (1999) found no correlation between a bird's body condition or size and its susceptibility to cholera.

Wetland hydrology appears to be the newest frontier for research in the basin. It is clear that the cumulative hydrologic impact within the hydric footprint and within the watershed can affect pooling duration, frequency, and flooded acres. Wetlands in the basin have the potential to recharge depleted groundwater resources—soil profiles support this due to the lack of visible chloride deposits in dry wetlands (personal communication with Warren Wood, Michigan State University).

Cultural Resources Goal

Identify and evaluate the cultural resources in the district and protect those that are determined to be significant.

Cultural Resources Objective A

Within 10 years of CCP approval, complete a comprehensive cultural resources survey and overview that identifies sensitive areas and helps to preserve historic records and information within the district to ensure protection of cultural resources and compliance with state and federal cultural resources protection laws.

Cultural Resources Rationale

Protecting significant sites, buildings, structures, and objects is the primary goal of the cultural resource work in the district. Cultural resources include the material evidence of past human activities: prehistoric, historic, and architectural in addition to any traditional cultural properties that may or may not have material evidence. A resource is considered significant if it is listed, eligible, or potentially eligible for the National Register of Historic Places.

Protection of significant cultural resources is primarily accomplished through compliance with section 106 of the National Historic Preservation Act. Any project that has the potential to affect structures older than 50 years or cause ground disturbance should be evaluated for its potential to impact cultural resources. Cultural resource personnel should be notified early in the planning process so that alterations of plans can be made if necessary and delays can be avoided.

Surveys are the best tool available to determine the location of cultural resources on the district. Through surveys, both historic and prehistoric sites are identified and key information is gathered that helps for planning, research, and educational outreach. Although small surveys have been done, usually as a part of the section 106 process, large-scale surveys are needed to better understand the distribution and nature of the resources.

A cultural resource overview is needed for the district. This comprehensive study would describe the nature and extent of past cultural resource investigations, the types of resources known on the district, and the interpretive context for these resources. The document would outline specific threats to the resources and the ability of future work to address regional research questions. It would also serve as a planning tool to help encourage consideration of cultural resources during project planning.

Long-term and past employees, in addition to local residents and members of regional historical societies, can be a wealth of information concerning the history of the district and the location of specific resources. District staffs, especially maintenance personnel, often remember alterations to historic structures and know the location of unrecorded archaeological resources.

The extent and condition of historical records, maps, artifacts, and photographs at the district is unknown. This type of historical documentation can provide valuable insight into the development and changes at the district through time. A comprehensive inventory of these items is needed.

Cultural Resources Strategies

1. Notify state and federal cultural resources personnel (for example, the State Historic Preservation Office) early in planning processes so alterations of plans can be made if necessary and delays can be avoided.
2. Notify all district staff of known cultural resource locations to facilitate management and protect the resource. Identify district areas that have not been surveyed but have a high potential for cultural resources.
3. Notify cultural resource staffs (state and federal) when previously unrecorded cultural resources are found in the district.
4. Develop partnerships and work with state and federal cultural resource staffs to develop a comprehensive inventory and compilation of the cultural resources within the district.
5. Conduct cultural resource-related interviews with district staff and local residents.
6. Locate individuals with knowledge on the general history, location of sites, or alterations to various buildings and structures within the district and document this information to preserve historic records.
7. Obtain assistance from state and federal cultural resource staffs, as well as from state universities and private organizations, to carry out an analysis as to how to best stabilize and store cultural resource items for future reference and educational purposes.

Visitor Services Goal

Provide quality wildlife-dependent recreation and educational opportunities by instilling an understanding of basic ecological processes, purpose of the Rainwater Basin Wetland Management District, and mission of the Service for persons of all abilities and cultural backgrounds.

Visitor Services Objective A

Over the next 15 years, continue to provide safe and quality hunting and trapping opportunities at WPAs.

Visitor Services Objective B

Within 5 years, fund and hire a full-time outdoor recreation planner (ORP) to develop demographic, attitude, and expectation profiles of wildlife-dependent

recreational users, which will determine a long-term plan for providing quality public use opportunities.

Visitor Services Objective C

Through the duration of the CCP, work with partners to provide demonstrations, written information, and other methods of communication that inform the public about the benefits of management actions and increase and improve education, outreach, and recreational opportunities within the district. Development will be guided by the arrival of the proposed ORP and the creation of a future visitor services plan.

Visitor Services Strategies

1. Construct and maintain at least one additional handicap-accessible blind at a WPA in the eastern portion of the district.
2. Maintain parking areas and access points to meet visitor needs.
3. Continue to construct and maintain adequate parking facilities on at least 95% of the WPAs.
4. Increase the amount of signage (such as boundary, regulation, and directional) at the WPAs.
5. Post 50% of the WPAs with entrance signs that include the WPA's name.
6. Provide adequate law enforcement coverage of all hunting and trapping seasons to ensure compliance with laws and regulations while providing for public safety and welfare.
7. Establish mechanisms to work collaboratively with USGS–BRD economists, state universities' departments of agriculture and resource economics, other agencies, national and worldwide travel agencies, outfitter groups, and nongovernmental organizations to obtain the necessary data to determine travel trends to the district.
8. Work with USGS–BRD economists and state universities' departments of agriculture and resource economics to better understand the values and needs of local, national, and international visitors to the district.
9. Within 5 years of designation and funding of a full-time ORP, expand the quality and quantity of wildlife- and habitat-oriented events and programs within the district.
10. Designate five WPAs that would become focus areas, representing other WPAs in the district. An ORP position would facilitate integration of environmental education and interpretation for counties in the district.
11. Within 5 years of designation and funding of a full-time ORP, install kiosks that have interchangeable interpretive panels at focus WPAs.
12. Develop a watchable wildlife brochure that identifies the district's WPAs and state areas, as well as seasons that offer exceptional wildlife observation and photography opportunities.
13. Develop a partnership with Nebraska's visitors bureau and other similar agencies to develop and include in their existing publication and websites information about the district and wildlife observation and photography opportunities.
14. Within 3 years of developing an outreach partnership, create an outreach plan that increases the awareness of the district's assets both within and outside the Service.

Visitor Services Rationale

The WPAs are open to the public for hunting, fishing, and trapping during legal seasons. Photography, environmental education, and interpretation are allowed year-round during daylight hours.

The COMLG, approved in 1999, allows for light goose–hunting during the spring migration. To provide refuge areas during the migration, some public areas are closed to hunting and the entire district is on a day-closure schedule (hunting allowed Saturday, Sunday, Wednesday, and Thursday). Closed WPAs include Bluestem, Clark, Eckhardt, Funk, Hultine, Lindau, Massie, Nelson, Prairie Dog, Springer, Verona, and Wilkins. Closure provides safe haven for waterfowl during periods of significant public use (Delnicki and Reinecke 1986). Hunting pressure and disturbance often discourage waterfowl use on preferred wetlands (Jessen 1970, Raveling et al. 1972, Koerner et al. 1974, Raveling 1978).

USFWS

A district intern assists a young bird watcher.

The district staff does not have training or responsibilities directed toward education, outreach, or public use in general. The district has always hired personnel with expertise in managing wetlands and grassland. Nearly all the work done by the district to encourage public use has focused on hunting. That work has mostly been limited to placement of boundary signs and maintenance of parking lots. Although spring and fall water pumping is done for the health of waterfowl populations, it also increases hunting opportunities.

In the last decade, informational kiosks have been constructed at 4 of the 59 WPAs. Funk WPA has a viewing and hunting blind that is accessible to people with disabilities, and there are interpretive signs. At Massie WPA, the neighboring community of Clay Center has collaborated with the district to construct and maintain an observation blind.

Although the district periodically gets requests from schools and Scout groups to provide environmental education programs, the district often declines because of lack of staff, expertise, and materials.

Partnership Goal

Promote and develop partnerships with adjacent landowners, public and private organizations, Native American tribes, and other interested individuals to protect, restore, enhance, and maintain a diverse and productive ecosystem.

Partnership Objective A

Continue to provide strong support and active participation in the RWBJV partnerships to promote activities and projects that are mutually beneficial.

Partnership Objective B

Develop more community-based partnerships that involve local individuals, groups, or organizations in the protection, management, enhancement, and enjoyment of the basin's wetlands.

Partnership Strategies

1. Provide representation on joint venture work groups and committees such as the private lands work group, acquisition work group, public lands work group, and technical committee.
2. Set priorities for Service funding and support for projects (land protection, staff, and equipment) that accomplish district objectives and use partner contributions.
3. Work with NGPC to more efficiently manage public lands that are near each other through coordinated exchange of staff, cooperators, equipment, and facilities.
4. Pursue partnerships to develop a field bird guide that is specific to the basin.
5. Pursue partnership funding for an ORP.

USFWS

This combine used to harvest native grasses was purchased through a three-way partnership—the district, NGPC, and Pheasants Forever.

6. Develop a list of high-priority and innovative projects that overlap between district and other joint venture partner needs.
7. Foster a working relationship with individual producers to enhance and maintain habitat conditions at the WPAs.
8. Develop, coordinate, and maintain working relationships with state and local law enforcement authorities and fire departments to protect district properties and trust species.
9. Develop, coordinate, and maintain working relationships with cooperating agencies and joint venture partners who conduct prescribed burns.
10. Through the Partners for Fish and Wildlife Program and other partners, develop, coordinate, and maintain working relationships with joint venture partners who also deliver private lands projects.

Partnership Rationale

The basin has a mix of wetland types. Because of their large size and water permanence, some wetlands are best for public ownership. The other wetlands would remain in private ownership and would require a partnership approach to restore or enhance them. The value of each WPA for waterfowl is dependent on its proximity to a complex of other wetlands. A WPA that is adjacent to other wetlands would be of more value to waterfowl than one that is isolated from other wetlands. It is important that the district work with its neighbors and conservation partners to improve the basin-wide landscape for the benefit of migratory birds, other wildlife, and the human environment.

Working together has been characteristic for the neighbors, agencies, and organizations in the Rainwater Basin. Partnerships have flourished because each group recognizes that it cannot "do it" alone. The RWBJV (described in chapter 1, section 1.4) is a partnership organization made up of government and conservation organizations, as well as landowners.

The RWBJV's goal is to

> *Restore and maintain sufficient wetland habitat in the Rainwater Basin area of Nebraska to assist in meeting population objectives identified in the North American Waterfowl Management Plan.*

The joint venture's objectives are in line with those of the district. The RWBJV commonly joins with nontraditional partners to (1) restore and protect additional wetlands, (2) provide reliable water to at least one-third of the protected wetlands, and (3) enhance existing wetlands.

Ducks Unlimited has identified the Rainwater Basin as a conservation priority for their organization. They are actively involved in wetland restoration and acquisition. Much of the restoration work done by Ducks Unlimited has occurred on NGPC and district lands. In recent years, they have acquired lands that are being restored and planned to be transferred to NGPC or district ownership. The U.S. Department of Agriculture's (USDA) Wetland Reserve Program has restored and protected wetlands throughout the basin. The Nature Conservancy has helped protect 1,765 acres that are currently under the Service's management. Another 466 acres are under the management of the NGPC.

Socioeconomics Goal

Obtain a better understanding of the social and economic contribution WPAs make to the people and communities within the Rainwater Basin.

Socioeconomics Objective A

Develop an economic impact analysis within 5 years of CCP approval to determine how the district's existence and management activities affect the local and state economies.

Socioeconomics Objective B

Within 5 years of CCP approval, evaluate the aesthetic and environmental benefits of the district's existence and management activities to the state and local communities.

Socioeconomics Strategies

1. Through joint venture partnerships, work collaboratively with USGS–BRD economists or state universities to develop an economic impact analysis of district management actions and the recreation that the WPAs provide.
2. Work with RWBJV partners, university and USGS–BRD ecologists, sociologists, and landscape architects to develop an environmental and aesthetical impact analysis of WPAs in the district.

Socioeconomics Rationale

The WPAs provide a service to communities and to those who visit the areas. Wetlands improve water quality, recharge groundwater, control erosion, and provide flood control. Wetlands provide habitat for many species of wildlife and offer recreational opportunities. However, it is not known to what extent the district's wetlands provide these services and benefits.

The basin is intensively farmed and many of the local citizens see wetlands as a detriment to farming operations. The loss of cropland due to seasonal flooding has caused many landowners to drain or fill the wetlands, which removes the benefits they may provide to the community. An accurate assessment of the wetlands' economic and social worth would help increase public understanding of the value of protecting wetlands.

Operations Goal

Safely and efficiently use funding, staffing, infrastructure, and partnerships to achieve the purpose and objectives of the Rainwater Basin Wetland Management District.

Operations Objective A

Within 10 years of CCP approval, build and maintain Service-owned facilities that would serve as an office, visitor contact center, maintenance shop, equipment storage, and housing for researchers, volunteers, and seasonal employees.

Operations Objective B

Within 2 years of CCP approval, construct adequate storage facilities for heavy and farm equipment currently stored at McMurtrey and Cottonwood WPAs.

Operations Objective C

Through the duration of the CCP, continue to maintain adequate housing facilities for researchers and volunteers.

Operations Objective D

Through the duration of the CCP, continue to maintain existing roads and dikes at the WPAs.

Operations Objective E

Through the duration of the CCP, continue to maintain equipment and vehicles at or above Service standards.

Operations Objective F

Within 5 years of CCP approval, strive to obtain additional funding for necessary staffing to address the needs of the district.

Operations Strategies

1. Work with partners and the regional office to obtain funding and secure a suitable site for the construction of a Service-owned facility.

2. Prioritize the building and maintenance schedule based on funding projects in the Service Asset Maintenance Management System (SAMMS). Identify an office/visitor center as the top priority construction project.
3. Schedule equipment and vehicle replacements to achieve industry standards when normal life expectancy is reached.
4. Seek mutual agreements to maintain roads that provide access to the WPAs.
5. Work with partners and the regional office to obtain funding to fill four additional positions: outdoor recreation planner, law enforcement officer (park ranger), maintenance worker, and refuge operations specialist.
6. Seek to close minimum-maintenance roads that dissect four WPAs.

Operations Rationale

The district is operating out of the same building it leased in the late 1970s. At that time, the number of properties managed and the amount of equipment and staff were significantly less than what exists today. The building was constructed as a metal warehouse. Before leasing it, a portion of the warehouse was converted to office space. In the mid-1990s, more office space was needed and the shop area was reduced to allow for three additional offices.

Since the property was first leased, the work accomplished by the district has drastically changed. Staff has changed with the addition of a wildlife biologist, two Partners for Fish and Wildlife biologists, two permanent fire specialists, and three seasonal firefighters. With more staff has come more office and field equipment. The current building is not adequate to store the additional fire engines and equipment. Heavy equipment and some of the vehicles have to be stored at two other locations: McMurtrey WPA and Cottonwood WPA. Both areas are more than 40 miles from the office/shop.

The office portion of the building has desks crowded together with limited space for filing cabinets, computers, and books. The conference room is a small room, partitioned off from the storage room, located above the offices. Because the office is contained within the warehouse, the ventilation system draws shop fumes (welding, vehicle exhaust, and chemicals) into the office area.

The facility is located within an older industrial park. The immediate neighbors include an older trailer park, auto repair shops, grain elevator, and outdoor storage yard. The location of the facility and its appearance are not inviting to the public. Visitors are primarily delivery persons and a few cooperating landowners. The visitor contact portion of the office also serves as the mailroom and photocopying room. Staff vehicles fill the small parking lot and some parking occurs on the street. Although a security fence protects the storage yard, theft and vandalism still occur.

Storage facilities for vehicles and heavy equipment are lacking. Nearly all the equipment remains exposed to extreme weather conditions.

Temporary quarters for researchers and volunteers are old, surplus mobile homes. Mice infest the mobile homes, which are located on a site that does not have potable water. In addition, the temporary quarters are located 40 miles from the office, making it difficult to arrange work schedules between volunteers and staff. In recent years, arrangements with The Nature Conservancy have allowed their rural office/home to house fire crew and volunteers. Numerous opportunities to have research studies and prescribed fires conducted in the district have not happened because the district lacks housing.

Two dual-function officers provide law enforcement operations. However, their primary responsibility is land management. The time allocated toward law enforcement is not adequate to address game violations and vandalism.

6.4 STAFF AND FUNDING

The district has a staff of 12 full-time employees. Table 11 lists these positions along with four new positions that are needed for full implementation of the CCP. Projects required to carry out the CCP are funded through two separate systems, as follows:

- The Refuge Operations Needs System (RONS) is used to document requests to Congress for funding and staffing needed to carry out projects above the existing base budget.
- The SAMMS is used to document the equipment, buildings, and other existing properties that require repair or replacement.

Lists of the RONS and SAMMS projects required to carry out this draft CCP (including maintenance of structures and equipment to a safe and productive standard for the 15 years of the CCP) are in appendix M.

6.5 STEP-DOWN MANAGEMENT PLANS

The final CCP for the Rainwater Basin Wetland Management District will be a broad umbrella plan that (1) outlines general concepts and objectives for habitat, wildlife, visitor services, cultural resources, partnerships, and operations; and (2) guides district management for the next 15 years. Step-down management plans provide greater detail for carrying out specific actions authorized by the CCP. Table 12 presents step-down management plans that are anticipated to be needed, along with their current status and next revision date.

6.6 MONITORING AND EVALUATION

Adaptive management is a flexible approach to long-term management of biotic resources. Adaptive management is directed, over time, by the results of ongoing monitoring activities and other information.

Table 11. Current and proposed staff for Rainwater Basin Wetland Management District, Nebraska.

Staff Group	*Current Positions*	*Additional Proposed Positions (Unfunded Staff)*
management	refuge project leader, GS-13 deputy project leader, GS-12 refuge operations specialist, GS-9	refuge operations specialist, GS-9
biological	wildlife biologist, GS-11 biological technician (wildlife), GS-7	no additional positions
visitor service	none	outdoor recreation planner, GS-11
administrative	administrative support assistant, GS-8	no additional positions
maintenance	maintenance worker, WG-8 biological technician (wildlife), GS-6	maintenance worker, WG-7
fire management	prescribed fire specialist, GS-9 supervisory range technician, GS-7	no additional positions
law enforcement	none	park ranger, GS-9
Partners for Fish and Wildlife	fish and wildlife biologist, GS-9 fish and wildlife biologist, GS-9	no additional positions

GS =General schedule position.
WG=Wage grade position.

Table 12. Step-down management plans for Rainwater Basin Wetland Management District, Nebraska.

Step-down Management Plan	*Completed Plan (year approved*	*New or Revised Plan, (completion year)*
disease contingency plan	2006	2013
fire management plan	1998	2009
habitat management plan	—	2010
habitat management plan (annual)	2007	2008
integrated pest management plan	2003	2008
law enforcement plan	—	2010
prairie dog management plan	2003	2011
safety plan	2004	2009
visitor services plan	—	2012
water management plan	2007	2008

More specifically, adaptive management is a process by which projects are carried out within a framework of scientifically driven experiments to test the predictions and assumptions outlined within a CCP.

To apply adaptive management, specific survey, inventory, and monitoring protocols would be adopted for the district's WPAs. The habitat management strategies would be systematically evaluated to determine management effects on wildlife populations. This information would be used to refine approaches and determine how effectively the objectives are being accomplished. Evaluations would include participation by appropriate partners. If monitoring and evaluation indicate undesirable effects for target and nontarget species or communities, alterations to the management projects would be made. Subsequently, the CCP would be revised.

6.7 PLAN AMENDMENT AND REVISION

The final CCP will be reviewed annually to determine the need for revision. A revision would occur if and when significant information becomes available. The final CCP will be supported by detailed step-down management plans to address the completion of specific strategies in support of the district's goals and objectives. Revisions to the CCP and the step-down management plans will be subject to public review and NEPA compliance. At a minimum, the final CCP will be evaluated every 5 years and revised after 15 years.

Glossary

accessible—Pertaining to physical access to areas and activities for people of different abilities, especially those with physical impairments.

adaptive resource management—Rigorous application of management, research, and monitoring to gain information and experience necessary to assess and modify management activities; a process that uses feedback from research, monitoring, and evaluation of management actions to support or modify objectives and strategies at all planning levels; a process in which policy decisions are carried out within a framework of scientifically driven experiments to test predictions and assumptions inherent in a management plan. Analysis of results helps managers determine whether current management should continue as is or whether it should be modified to achieve desired conditions.

Administration Act—National Wildlife Refuge System Administration Act of 1966.

alternative—Reasonable way to solve an identified problem or satisfy the stated need (40 CFR 1500.2); one of several different means of accomplishing refuge and district purposes and goals and contributing to the Refuge System mission (The Fish and Wildlife Service Manual, 602 FW 1.5).

amphibian—Class of cold-blooded vertebrates including frogs, toads, or salamanders.

annual—Plant that flowers and dies within 1 year of germination.

ATV—All-terrain vehicle.

acre-foot—Amount of water it takes to cover a level acre of land (43,560 square feet) to a depth of 1 foot; about 43,560 cubic feet of water or 325,851 gallons.

avian—Relating to or characteristic of birds.

baseline—Set of critical observations, data, or information used for comparison or a control.

basin—Referring to the landform that acts as a water catchment; here used generically to refer to the hydric footprint that pools water.

the basin—*See* Rainwater Basin.

bioenergetics—Study of energy transformation in living systems.

biological control—Use of organisms or viruses to control invasive plants or other pests.

biological diversity, *also* **biodiversity**—Variety of life and its processes, including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur (The Fish and Wildlife Service Manual, 052 FW 1.12B). The National Wildlife Refuge System's focus is on indigenous species, biotic communities, and ecological processes.

biotic—Pertaining to life or living organisms; caused, produced by, or comprising living organisms.

CAFO—Concentrated animal-feeding operation.

canopy—Layer of foliage, generally the uppermost layer, in a vegetative stand; midlevel or understory vegetation in multilayered stands; canopy closure (*also* **canopy cover**) is an estimate of the amount of overhead vegetative cover.

catabolized (catabolism)—Breakdown of more complex substances into simpler ones, with the release of energy.

CCP—*See* comprehensive conservation plan.

CFR—*See* Code of Federal Regulations.

Code of Federal Regulations (CFR)—Codification of the general and permanent rules published in the "Federal Register" by the executive departments and agencies of the federal government. Each volume of the CFR is updated once each calendar year.

COMLG—Conservation Order for Mid-continent Light Geese.

compatibility determination—*See* compatible use.

compatible use—Wildlife-dependent recreational use or any other use of a refuge or district that, in the sound professional judgment of the director of the U.S. Fish and Wildlife Service, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge or district (The Fish and Wildlife Service Manual, 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identified stipulations or limits necessary to ensure compatibility.

comprehensive conservation plan (CCP)—Document that describes the desired future conditions of the refuge or district and provides long-range guidance and management direction for the refuge or wetland district manager to accomplish the purposes of the refuge or district, contribute to the mission of the

Refuge System, and to meet other relevant mandates (The Fish and Wildlife Service Manual, 602 FW 1.5).

concern—*See* issue.

cool-season grasses—Grasses that begin growth earlier in the season and often become dormant in the summer. These grasses will germinate at lower temperatures.

coteau—Hilly upland including the divide between two valleys; a divide; the side of a valley.

cover, *also* **cover type, canopy cover**—Present vegetation of an area.

critical habitat—Area essential to the survival of a species; includes all air, land, and water that a species requires to carry out its normal living patterns, as well as other living things used by the species for food, shelter, or other necessary activities.

cultural resources—Remains of sites, structures, or objects used by people in the past.

CWCS—Comprehensive wildlife conservation strategy.

cyanobacteria—Blue-green algae; widely distributed group of predominantly photosynthetic prokaryotic organisms of the subkingdom Cyanophyta, resembling phototrophic bacteria, occurring singly or in colonies in diverse habitats: some species can fix atmospheric nitrogen.

dense nesting cover—Composition of grasses and forbs that allows for a dense stand of vegetation that protects nesting birds from the view of predators, usually consisting of one to two species of wheatgrass, alfalfa, and sweetclover.

the district—*See* wetland management district.

drawdown—Act of manipulating water levels in an impoundment to allow for the natural drying-out cycle of a wetland.

DUD—Duck use-day; number of days that an area can support a duck's energetics' needs.

EA—*See* environmental assessment.

ecosystem—Dynamic and interrelating complex of plant and animal communities and their associated nonliving environment; a biological community, together with its environment, functioning as a unit. For administrative purposes, the Service has designated 53 ecosystems covering the United States and its possessions. These ecosystems generally correspond with watershed boundaries and their sizes and ecological complexity vary.

emergent—Plant rooted in shallow water and having most of the vegetative growth above water such as cattail and hardstem bulrush.

endangered species, federal—Plant or animal species listed under the Endangered Species Act of 1973, as amended, that is in danger of extinction throughout all or a significant portion of its range.

endangered species, state—Plant or animal species in danger of becoming extinct or extirpated in a particular state within the near future if factors contributing to its decline continue. Populations of these species are at critically low levels or their habitats have been degraded or depleted to a significant degree.

endogenous—Stored reserves of lipids, proteins, and other nutrients; energy generated from mobilizing these reserves.

environmental assessment (EA)—Concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action and alternatives to such action, and provides sufficient evidence and analysis of impacts to determine whether to prepare an environmental impact statement or finding of no significant impact (40 CFR 1508.9).

epizootic—Pertaining to a disease that affects large numbers of animals throughout a large area and spreads with great speed.

erosion—Wearing away of the land surface by various natural processes such as wind and moving water in the form of rivers, streams, rain, and melting snow.

eutrophication—Overenrichment of a waterbody with nutrients, resulting in the excessive growth of organisms and the depletion of oxygen.

evaporation—Physical process by which a liquid or solid is transformed to a gas.

exogenous—Pertaining to a nutrient that is not stored and is readily available.

exotic—Nonnative species of plants or animals often brought into an area by human activity.

extinction—Complete disappearance of a species from the earth; no longer existing.

extirpation—Extinction of a population; complete eradication of a species within a specified area.

fauna—All the vertebrate and invertebrate animals of an area.

federal trust species—Species where the federal government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.

FGDC—Federal Geographic Data Committee.

flood—Unusual accumulation of water above the ground caused by heavy rain, melting snow, or rapid runoff; a temporary condition of partial or complete

inundation of lands that normally do not pool water throughout the entire year.

floodplain—Low-lying, nearly level area along a river or stream that is periodically subject to being flooded by water from any source.

flora—Plants, specifically plants within a particular set of boundaries that may be geographical, temporal, or biological.

flyway—Pathway taken by migrating birds to or from their nesting grounds in northern North America to their overwintering grounds in southern parts of the United States; a broad, well-defined grouping of migration corridors.

FMP—Fire management plan.

forb—Broad-leaved, herbaceous plant; a seed-producing annual, biennial, or perennial plant that does not develop persistent woody tissue but dies down at the end of the growing season.

fragmentation—Alteration of a large block of habitat that creates isolated patches of the original habitat that are interspersed with a variety of other habitat types; the process of reducing the size and connectivity of habitat patches, making movement of individuals or genetic information between parcels difficult or impossible.

geographic information system (GIS)—Computer system capable of storing and manipulating spatial data; a set of computer hardware and software for analyzing and displaying spatially referenced features (such as points, lines and polygons) with nongeographic attributes such as species and age.

GIS—*See* geographic information system.

goal—Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units (The Fish and Wildlife Service Manual, 620 FW 1.5).

groundwater recharge—Act of adding water to the aquifer by surface water movement downward through the soil.

GS—General schedule (pay rate schedule for certain federal positions).

habitat—Suite of existing environmental conditions required by an organism for survival and reproduction; the place where an organism typically lives and grows.

habitat type, *also* **vegetation type, cover type**—Land classification system based on the concept of distinct plant associations.

hemi-marsh—Wetland with a 50–50 interspersion of open-water and emergent vegetation.

hydric soil—Soil that is saturated, flooded, or pooled long enough during the growing season to develop conditions that do not require oxygen and that favor the growth and regeneration of hydrophytic vegetation; hydric soils suggest the presence of wetlands.

hydrophyte—Plant that is adapted to grow in water; a wetland plant species.

hydrophytic vegetation—Visible plants growing in water or on a substrate and periodically deficient in oxygen as a result of excessive water content.

impoundment—Body of water created by collection and confinement within a series of levees or dikes, creating separate management units although not always independent of one another.

Improvement Act—National Wildlife Refuge System Improvement Act of 1997.

indigenous—Originating or occurring naturally in a particular place.

integrated pest management (IPM)—Methods of managing undesirable species such as invasive plants; education, prevention, physical or mechanical methods of control, biological control, responsible chemical use, and cultural methods.

"interseed"—Mechanical seeding of one or several plant species into existing stands of established vegetation.

interspersion—Diversity of vegetation spread throughout a stand.

interstitial flow—Movement of surface water into the ground by flowing through individual soil grains and eventually adding to the groundwater levels.

introduced species—Species present in an area due to intentional or unintentional escape, release, dissemination, or placement into an ecosystem as a result of human activity.

invasive plant, *also* **noxious weed**—Species that is nonnative to the ecosystem under consideration and whose introduction causes, or is likely to cause, economic or environmental harm or harm to human health.

invertebrate—Animal without an backbone.

inviolate sanctuary—Place of refuge or protection where animals and birds may not be hunted.

IPM—*See* integrated pest management.

issue—Unsettled matter that requires a management decision; for example, a Service initiative, opportunity, resource management problem, a threat to the resources of the unit, conflict in uses, public concern, or the presence of an undesirable resource condition (The Fish and Wildlife Service Manual, 602 FW 1.5).

limiting factor—Chemical or physical factor that limits the growth, abundance, or distribution of the

population of a species in an ecosystem and determines whether or not an organism can survive.

lipids—Group of organic compounds including the fats, oils, waxes, sterols, and triglycerides that are insoluble in water but soluble in nonpolar organic solvents, are oily to the touch, and together with carbohydrates and proteins constitute the principal structural material of living cells.

macropore flow—Movement of surface water through large holes in the ground such as animal burrows, desiccation cracks, root tubes and solution pipes, eventually adding to the groundwater levels.

management alternative—*See* alternative.

ME—*See* metabolized energy.

metabolized energy (ME)—Energy produced by digestion.

migration—Regular extensive, seasonal movements of birds between their breeding regions and their wintering regions; to pass usually periodically from one region or climate to another for feeding or breeding.

migratory birds—Birds that follow a seasonal movement from their breeding grounds to their wintering grounds; includes waterfowl, shorebirds, raptors, and songbirds.

mission—Succinct statement of purpose or reason for being.

mitigation—Measure designed to counteract an environmental impact or to make an impact less severe.

mixed-grass prairie—Transition zone between the tall-grass prairie and the short-grass prairie dominated by grasses of medium height that are approximately 2–4 feet tall. Soils are not as rich as the tall-grass prairie and moisture levels are less.

monitoring—Process of collecting information to track changes of selected parameters over time.

NASS—Natural Agricultural Statistics Service.

national wildlife refuge (NWR)—Designated area of land, water, or an interest in land or water within the National Wildlife Refuge System, but does not include coordination areas; a complete listing of all units of the Refuge System is in the current "Annual Report of Lands Under Control of the U.S. Fish and Wildlife Service."

National Wildlife Refuge System (Refuge System)—Various categories of areas administered by the Secretary of the Interior for the conservation of fish and wildlife including species threatened with extinction, all lands, waters, and interests therein administered by the Secretary as wildlife refuges, areas for the protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas.

National Wildlife Refuge System Improvement Act of 1997 (Improvement Act)—Sets the mission and the administrative policy for all units of the National Wildlife Refuge System; defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation); establishes a formal process for determining appropriateness and compatibility; establish the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; requires a comprehensive conservation plan for each unit of the Refuge System by the year 2012. This act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

native species—Species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

NAWMP—North American Waterfowl Management Plan.

NDEQ—Nebraska Department of Environmental Quality.

NEPA—National Environmental Policy Act.

nest success—Percentage of nests that successfully hatch one or more eggs of the total number of nests initiated in an area.

NGPC—Nebraska Game and Parks Commission.

niche partitioning—Distribution of species by preference of habitat conditions and needs.

NOI—Notice of intent; published in the "Federal Register."

nongovernmental organization—Any group that is not comprised of federal, state, tribal, county, city, town, local, or other governmental entities.

noxious weed, *also* **invasive plant**—Any living stage (including seeds and reproductive parts) of a parasitic or other plant of a kind that is of foreign origin (new to or not widely prevalent in the U.S.) and can directly or indirectly injure crops, other useful plants, livestock, poultry, other interests of agriculture, including irrigation, navigation, fish and wildlife resources, or public health. According to the Federal Noxious Weed Act (PL 93-639), a noxious weed (such as an invasive plant) is one that causes disease or has adverse effects on humans or the human environment and, therefore, is detrimental to the agriculture and commerce of the United States and to public health, and is listed as such on Nebraska Noxious Weed List.

NVCS—National Vegetation Classification System.

NWR—*See* national wildlife refuge.

objective—Concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work; derived from goals and provide the basis for determining management strategies. Objectives should be attainable and time-specific and should be stated quantitatively to the extent possible. If objectives cannot be stated quantitatively, they may be stated qualitatively (The Fish and Wildlife Service Manual, 602 FW 1.5).

ORP—Outdoor recreation planner.

palustrine—Pertaining to nonflowing wetlands that can be dominated by emergent or submergent plant wetlands with less than 0.5% salinity.

patch—Area distinct from that around it; an area distinguished from its surroundings by environmental conditions.

pathogen—Agent that causes disease, especially a living microorganism such as a bacterium or fungus.

perennial—Lasting or active through the year or through many years; a plant species that has a life span of more than 2 years.

periphyton—Complex matrix of organisms such as algae and microbes that are attached to submerged plants; serves as an important food source for invertebrates and some fish; important indicator of water quality.

PILT—Payments in lieu of taxes.

PL—Public law.

plant community—Assemblage of plant species unique in its composition; occurs in particular locations under particular influences; a reflection or integration of the environmental influences on the site such as soil, temperature, elevation, solar radiation, slope, aspect, and rainfall; denotes a general kind of climax plant community, such as ponderosa pine or bunchgrass.

playa—Nearly level, flat area that is temporarily covered with water, at the bottom of an undrained basin.

PM—Particulate matter.

prescribed fire—Skillful application of fire to natural fuels under conditions such as weather, fuel moisture, and soil moisture that allow confinement of the fire to a predetermined area and produces the intensity of heat and rate of spread to accomplish planned benefits to one or more objectives of habitat management, wildlife management, or hazard reduction.

priority public use—One of six uses authorized by the National Wildlife Refuge System Improvement Act of 1997 to have priority if found to be compatible with the purposes for a refuge or district. This includes hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

proposed action—Alternative proposed to best achieve the purpose, vision, and goals of a refuge or district (contributes to the Refuge System mission, addresses the significant issues, and is consistent with principles of sound fish and wildlife management).

public—Individuals, organizations, and groups; officials of federal, state, and local government agencies; Indian tribes; and foreign nations. It may include anyone outside the core planning team. It includes those who may or may not have indicated an interest in Service issues and those who do or do not realize that Service decisions may affect them.

public involvement—Process that offers affected and interested individuals and organizations an opportunity to become informed about, and to express their opinions on, Service actions and policies. In the process, these views are studied thoroughly and thoughtful consideration of public views is given in shaping decisions for refuge and district management.

purpose of the district—Reason for and role of a district that is specified in or derived from the law, proclamation, executive order, agreement, public land order, donation document, or administrative memorandum establishing authorization or expanding a district or district subunit such as a waterfowl production area (The Fish and Wildlife Service Manual, 602 FW 1.5).

Rainwater Basin (the basin)—Geographic area in south-central Nebraska that contains closed-basin wetlands with characteristic clay soils that have very low transmissivity.

raptor—Carnivorous bird such as a hawk, a falcon, or a vulture that feeds wholly or chiefly on meat taken by hunting or on carrion (dead carcasses).

RWBJV—Rainwater Basin Joint Venture.

refuge—*See* national wildlife refuge.

Refuge Operating Needs System (RONS)—National database that contains the unfunded operational needs of each refuge and district. Projects included are those required to carry out approved plans and meet goals, objectives, and legal mandates.

Refuge System—*See* National Wildlife Refuge System.

resident species—Species inhabiting a given locality throughout the year; nonmigratory species.

rest—Free from biological, mechanical, or chemical manipulation, in reference to refuge and district lands.

restoration—Management emphasis designed to move ecosystems to desired conditions and processes, such as healthy upland habitats and aquatic systems.

riparian area *or* **riparian zone**—Area or habitat that is transitional from terrestrial to aquatic ecosystems including streams, lakes, wet areas, and adjacent plant communities and their associated soils that have free

water at or near the surface; an area whose components are directly or indirectly attributed to the influence of water; of or relating to a river; specifically applied to ecology, "riparian" describes the land immediately adjoining and directly influenced by streams. For example, riparian vegetation includes all plant life growing on the land adjoining a stream and directly influenced by the stream.

RONS—*See* Refuge Operating Needs System.

SAMMS—*See* Service Asset Maintenance Management System.

scoping—Process of obtaining information from the public for input into the planning process.

scouring—Removal of earth or rock by the action of running water or wind eroding material.

seasonally flooded—Surface water is present for extended periods in the growing season, but is absent by the end of the season in most years.

sediment—Material deposited by water, wind, and glaciers.

sedimentation—Deposit of waterborne particles, resulting from a decrease in water's transport capacity.

seeping—Movement of water into or through porous material.

Service—*See* U.S. Fish and Wildlife Service.

Service Asset Maintenance Management System (SAMMS)—National database which contains the unfunded maintenance needs of each refuge and district; projects include those required to maintain existing equipment and buildings, correct safety deficiencies for the implementation of approved plans, and meet goals, objectives, and legal mandates.

shelterbelt—Single to multiple rows of trees and shrubs planted around cropland or buildings to block or slow down the wind.

shorebird—Any of a suborder (Charadrii) of birds such as plover or snipe that frequent the seashore or mud flats.

spatial—Relating to, occupying, or having the character of space.

special status species—Plants or animals that have been identified through federal law, state law, or agency policy as requiring special protection of monitoring. Examples include federally listed endangered, threatened, proposed, or candidate species; state-listed endangered, threatened, candidate, or monitor species; Service's species of management concern; species identified by the Partners in Flight Program as being of extreme or moderately high conservation concern.

special use permit—Special authorization from the refuge or wetland district manager that is required for any refuge and district service, facility, privilege, or product of the soil provided at refuge or district expense and not usually available to the general public through authorizations in Title 50 CFR or other public regulations (Refuge Manual, 5 RM 17.6).

species of concern—Plant and animal species, while not falling under the definition of special status species, that are of management interest by virtue of being federal trust species such as migratory birds, important game species, or significant keystone species; species that have documented or apparent population declines, small or restricted populations, or dependence on restricted or vulnerable habitats.

step-down management plan—Plan that provides the details necessary to carry out management strategies identified in the comprehensive conservation plan (The Fish and Wildlife Service Manual, 602 FW 1.5).

strategy—Specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives (The Fish and Wildlife Service Manual, 602 FW 1.5).

submergent—Vascular or nonvascular hydrophyte, either rooted or nonrooted, that lies entirely beneath the water surface, except for flowering parts in some species.

succession—Natural replacement of one biotic community by another; a slow but continuous process, beginning with the invasion of a patch of open ground or newly created body of water by pioneer species. Succession continues through a series of recognizable stages known as seres, ending with the formation of a climax community in which the mix of species forming the community no longer changes with successive generations; late successional communities can also be climax communities.

SWG—State wildlife grant.

threatened species, federal—Species listed under the Endangered Species Act of 1973, as amended, that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

threatened species, state—Plant or animal species likely to become endangered in a particular state within the near future if factors contributing to population decline or habitat degradation or loss continue.

tree harvest—Commercial or private removal of trees for economic or personal benefit.

trust species—*See* federal trust species.

UNL—University of Nebraska–Lincoln.

USC—United States Code.

USDA—U.S. Department of Agriculture.

USDOE—U.S. Department of Energy.

USEPA—U.S. Environmental Protection Agency.

U.S. Fish and Wildlife Service (Service, USFWS)—Federal agency of the U.S. Department of the Interior that is responsible for conserving, protecting, and enhancing fish and wildlife and their habitats for the continuing benefit of the American people. The Service manages the 93-million-acre National Wildlife Refuge System comprised of more than 530 national wildlife refuges and wetland management districts and thousands of waterfowl production areas. It also operates 65 national fish hatcheries and 78 ecological service field stations, the agency enforces federal wildlife laws, manages migratory bird populations, restores national significant fisheries, conserves and restores wildlife habitat such as wetlands, administers the Endangered Species Act, and helps foreign governments with their conservation efforts. It also oversees the federal aid program that distributes millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

USFWS—*See* U.S. Fish and Wildlife Service.

U.S. Geological Survey (USGS)—Federal agency of the U.S. Department of the Interior whose mission is to provide reliable scientific information to describe and understand the earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

USGS—*See* U.S. Geological Survey.

USGS–BRD—Biological Research Division of the U.S. Geological Survey.

vision statement—Concise statement of the desired future condition of the planning unit, based primarily on the Refuge System mission, specific refuge or district purposes, and other relevant mandates (The Fish and Wildlife Service Manual, 602 FW 1.5).

waterfowl—Category of birds that includes ducks, geese, and swans.

watershed—Area that drains into a river, a river system, or a body of water.

wetland—Area of land that pools water long enough annually to support hydrophytic vegetation.

wetland management district (the district, WMD)—Land that the Refuge System acquires with Federal Duck Stamp funds for restoration and management primarily as prairie wetland habitat critical to waterfowl and other wetland birds.

wet meadow—Area where wetland and upland plants can occur, usually along the edge of a wetland; may have pooled water for a short period of time, usually in the spring or after a heavy rain event.

WG—Wage grade schedule (pay rate schedule for certain federal positions).

wildland fire—Free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands (Draft, The Fish and Wildlife Service Manual 621 FW 1.7).

wildlife-dependent recreational use—Use of a refuge or district involving hunting, fishing, wildlife observation, photography, environmental education, or interpretation. The National Wildlife Refuge System Improvement Act of 1997 specifies that these are the six priority general public uses of the Refuge System.

WMA—Wildlife management area.

WMD—*See* wetland management district.

woodland—Open stands of trees with crowns not usually touching, generally forming 25–60% cover.

WPA—Waterfowl production area.

Appendix A

Draft Compatibility Determinations

DISTRICT NAME

Rainwater Basin Wetland Management District

ESTABLISHING AND ACQUISITION AUTHORITIES

Migratory Bird Hunting and Conservation Stamp Act (16 USC 718 [c])

Migratory Bird Conservation Act (16 USC 715d[2], 715i[a])

Consolidated Farm and Rural Development Act (7 USC 2002 [a])

Emergency Wetlands Resources Act (16 USC 3901 [b])

Public Land Order 7206 (June 24, 1996)

Public Land Order 6979 (May 25, 1993)

DISTRICT PURPOSES

"Small areas, to be designated as 'Waterfowl Production Areas' may be acquired without regard to the limitations and requirements of the Migratory Bird Conservation Act, but all of the provisions of such Act which govern the administration and protection of lands acquired thereunder, except the inviolate sanctuary provisions of such Act, shall be applicable to areas acquired pursuant to this subsection." Migratory Bird Hunting and Conservation Stamp Act (16 USC 718 [c])

"For use as an inviolate sanctuary, or for any other management purpose, for migratory birds." Migratory Bird Conservation Act (16 USC 715d[2])

"Areas of lands, waters, or interests therein acquired or reserved pursuant to this subchapter shall … be administered … to conserve and protect migratory birds in accordance with treaty obligations with Mexico, Canada, Japan and the Union of Soviet Socialist Republics, and other species of wildlife found thereon, including species that are listed … as endangered or threatened species, and to restore and develop adequate wildlife habitat." Migratory Bird Conservation Act (16 USC 715i[a])

"For conservation purposes any real property, or interest therein … that has marginal value for agricultural production; is environmentally sensitive; or has special management importance." Consolidated Farm and Rural Development Act (7 USC 2002 [a])

"It is the purpose of this chapter to promote … the conservation of the wetlands of the Nation in order to maintain the public benefits they provide and to help fulfill international obligations in various migratory bird treaties and conventions with Canada, Mexico, Japan, the Union of Soviet Socialist Republics, and with various countries in the Western Hemisphere." Emergency Wetlands Resources Act (16 USC 3901 [b])

"The following described public lands are hereby withdrawn from settlement, sale, location or entry under the general land laws, including the U.S. mining law, but not from leasing under the mineral leasing laws, to protect waterfowl production areas. This withdrawal will expire 50 years from the effective date of this order unless … the Secretary determines that the withdrawal shall be extended." Public Land Order 7206 (June 24, 1996)

"To protect waterfowl production areas." Public Land Order 6979 (May 25, 1993)

NATIONAL WILDLIFE REFUGE SYSTEM MISSION

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

1. Description of Proposed Use: Farming, Grazing, and Haying

The district would continue upland management activities such as farming, grazing, and haying that are conducted under cooperative farming or special use permit by private individuals. Currently these economic uses are used as tools to manage habitat for wildlife.

Between 400 and 700 acres are farmed each year. Farming is conducted for the sole purpose of grassland restoration. Grazing with livestock is used as a tool for grassland and wetland management.

About two-thirds of the WPAs receive some type of grazing treatment. Grazing does not occur over the entire WPA but involves rotational grazing over portions of a WPA. Wetlands are the most common habitat grazed. Area grazed ranges between 7,000 and 9,000 acres annually over the past 5 years. Approximately 450 acres are hayed annually. Haying is sporadically used as a grassland management tool to control invasive plants and prepare areas for upland restoration and prescribed burns.

The draft CCP proposes to continue grassland restoration activities within the district. The amount of farming done would be in direct relation to the amount of land acquired and the availability of native seed. Over time, farming is expected to decrease as areas are restored to grassland. Cooperative farming activities would be compatible only at areas that do not have established stands of native grasses and forbs. Farming would allow the district to establish seedbeds relatively free of noxious plants, maximizing the likelihood that grassland restoration would be successful. Soybean is the crop generally used during farming.

The draft CCP proposes to use grazing as a management tool for wetland and upland habitats. Specific acreages have not been identified in the draft CCP because habitat conditions within wetland and upland areas can change dramatically on a yearly basis due to precipitation and temperatures. An adaptive approach would be used to prescribe grazing treatments for habitats.

Availability of Resources

The resources necessary to administer haying, grazing, and farming programs are sufficient at current staffing and funding levels. Haying, grazing, and farming programs are conducted through special use permits or cooperative farming agreements, which minimizes the need for staff time and district assets to complete work.

Anticipated Impacts of the Use

Over a 5-year period, grazing has been conducted on 7,000–9,000 acres annually. While annual acreages have not been specified in the draft CCP, it is expected that future refuge grazing would fall into this range. Farmed acres would remain in the range of 400–700 acres per year, but would slowly decrease as uplands are restored to grass. Haying is anticipated to increase as a management tool to prepare for prescribed burns and control of invasive plants. Haying is expected to increase to about 600 acres.

Without management, wetland and upland habitat conditions would deteriorate due to long periods of rest. Cool-season invasive plants would likely increase and infest additional areas without the use of spring grazing. While all these activities disturb habitat and wildlife in the short term, long-term habitat and wildlife benefits outweigh these disturbances. Farming would cause decreases in wildlife habitat availability; however, habitat conditions would improve following grassland restoration activities.

No cultural resources would be impacted. No impact to endangered species should occur.

Determination

The use of haying, grazing, and farming as habitat management tools is compatible.

Stipulations Necessary to Ensure Compatibility

- Monitor vegetation and wildlife to assess the effects of the management tools.
- Require general and special conditions for each permit to ensure consistency with management objectives.
- Restrict the use of vehicles and motorized equipment to the minimum necessary to conduct haying, grazing, and farming.
- Restrict farming permittees to a list of approved chemicals that are less detrimental to wildlife and the environment.
- Restrict haying to after August 1 to avoid disturbance to nesting birds unless the refuge manager deems it necessary to hay earlier to control invasive plants or restore grasslands.

Justification

To maintain and enhance the habitat for migratory birds and other wildlife, some habitat manipulation needs to occur. Upland and wetland habitat conditions would deteriorate without the use of a full range of management tools. Migratory bird habitat and ecological diversity would decrease as habitat suitability declined. Exotic and invasive plant species would increase and habitat diversity would decrease if grazing practices did not continue at the WPAs. Farming would provide a means to restore degraded grasslands for the benefit of grassland-dependent species.

Mandatory 15-year Reevaluation Date: 2022

2. Description of Proposed Use: Environmental Education and Interpretation

All of the district's WPAs are open to environmental education and interpretation in accordance with the Migratory Bird Hunting and Conservation Stamp Act. The district would provide opportunities for environmental education and interpretation. Environmental education would consist of activities conducted by district staff and volunteers. Interpretation would occur in less formal activities with refuge staff and volunteers or through exhibits, educational trunks, signs, and brochures. The lack of an outdoor recreation planner and the scattering of

the WPAs across 14 counties would not allow the district to adequately address education and interpretation opportunities. The draft CCP proposes to hire an outdoor recreation planner and to increase education and interpretation for all visitors through the following actions:

- Construct an additional accessible blind for people with disabilities and an interpretive trail in the eastern portion of the district.
- Construct entrance signs at 50% of the WPAs.
- Develop five WPAs as focus areas for education and interpretation.
- Develop watchable wildlife brochures.
- Construct additional interpretive panels to be placed along trails and at parking lots.

Availability of Resources

Implementing the new facilities outlined in the draft CCP is closely tied to funding requests for RONS and SAMMS projects (see appendix M). Existing programs such as district signs and brochures would be updated with available resources.

Anticipated Impacts of Use

All of the WPAs are open to environmental education and interpretation in accordance with the Migratory Bird Hunting and Conservation Stamp Act. Minimal disturbances to wildlife and wildlife habitat would result from these uses at the current and proposed levels. Some disturbance to wildlife would occur in areas frequented by visitors. There would be littering, minor damage to vegetation, and increased maintenance.

No cultural resources would be impacted. No impact to endangered species should occur.

Determination

Environmental education and interpretation are compatible.

Stipulations Necessary to Ensure Compatibility

- Prohibit vehicle access beyond parking lots.
- Prohibit permanent and overnight blinds.
- Develop trails and viewing areas that have minimal impact on wildlife and their habitats.
- Annually review environmental education and interpretation activities to ensure these activities are compatible.

Justification

Based on biological effects described previously and in the EA and draft CCP, it is determined that environmental education and interpretation within the Rainwater Basin Wetland Management District would not interfere with or detract from the purposes for which the district was established.

Environmental education and interpretation are priority public uses listed in the National Wildlife Refuge System Improvement Act of 1997. By facilitating environmental education, district visitors would gain knowledge and an appreciation of fish, wildlife, and their habitats, which would lead to increased public awareness and stewardship of natural resources. Increased appreciation for natural resources would support and complement the Service's actions in achieving the purposes of the district and the mission of the Refuge System.

Mandatory 15-year Reevaluation Date: 2022

3. Description of Proposed Use: Wildlife Observation and Photography

All of the district's WPAs are open to wildlife observation and photography in accordance with the Migratory Bird Hunting and Conservation Stamp Act. The district would provide opportunities that support wildlife-dependent recreation. Wildlife observation and photography are facilitated by one hiking trail and two wildlife observation blinds.

The draft CCP proposes to continue the above uses and add the following to improve wildlife observation and photography:

- Construct an additional accessible blind for people with disabilities and a hiking trail in the eastern portion of the district.
- Construct entrance signs at 50% of the WPAs.
- Develop a wildlife brochure/bird guide that identifies the WPAs, as well as seasons that offer exceptional wildlife observation and photography opportunities.
- Update existing interpretive kiosks.
- Develop five WPAs as focus areas for wildlife observation and photography.

Availability of Resources

Implementing the new facilities outlined in the draft CCP is closely tied to funding requests for RONS and SAMMS projects (see appendix M). Existing programs such as district signs and brochures would be updated with available resources.

Anticipated Impacts of Use

All of the WPAs are open to wildlife observation and photography in accordance with the Migratory Bird Hunting and Conservation Stamp Act. Minimal disturbances to wildlife and wildlife habitat would result from these uses at the current and proposed levels. Some disturbance to wildlife would occur in areas frequented by visitors. There would be littering, minor damage to vegetation, and increased maintenance.

No cultural resources would be impacted. No impact to endangered species should occur.

Determination

Wildlife observation and photography are compatible.

Stipulations Necessary to Ensure Compatibility

- Prohibit vehicle access beyond parking lots.
- Prohibit permanent and overnight blinds.
- Develop trails and viewing areas that have minimal impact on wildlife and their habitats.
- Annually review wildlife observation and photography activities to ensure these activities are compatible.

Justification

Based on the anticipated biological effects described previously and in the EA and draft CCP, it is determined that wildlife observation and photography at Rainwater Basin Wetland Management District would not interfere with the habitat goals and objectives or purposes for which it was established.

Wildlife observation and photography are priority public uses listed in the Improvement Act. By facilitating these uses, visitors would gain knowledge and an appreciation of fish and wildlife, which would lead to increased public stewardship of wildlife and their habitats. Increased public stewardship would support and complement the Service's actions in achieving the purposes of the district and the mission of the Refuge System.

Mandatory 15-year Reevaluation Date: 2022

4. Description of Use: Recreational Fishing

All of the district's WPAs are open to recreational fishing in accordance with the Migratory Bird Hunting and Conservation Stamp Act. The district would continue to provide for recreational fishing in accordance with state regulations.

Generally, fisheries do not exist at the WPAs. Wetlands in the Rainwater Basin are shallow, temporary or seasonal wetlands that normally are dry during the summer months. It is only during a series of excessively wet years that the wetlands support fish. Fish that have occurred in the wetlands are black bullhead and European carp. Boating with electric motors would be allowed.

Availability of Resources

The current fishing program would be administered using available resources. The draft CCP does not call for the implementation of any new fishing programs.

Anticipated Impacts of Use

Fishing and other human activities cause disturbance to wildlife. All of the WPAs would be open to recreational fishing in accordance with the Migratory Bird Hunting and Conservation Stamp Act.

Determination

Recreational fishing is compatible.

Stipulations Necessary to Ensure Compatibility

- Require that fishing follow state and federal regulations.
- Monitor existing use to ensure that facilities are adequate and disturbance to wildlife continues to be minimal.

Justification

Based on the biological effects addressed previously and in the EA and draft CCP, it is determined recreational fishing would not interfere with the habitat goals and objectives or purposes for district establishment. Fishing is a priority public use as listed in the Improvement Act.

Mandatory 15-year Reevaluation Date: 2022

5. Description of Use: Recreational Hunting

The district would continue to allow hunting of all species according to state regulations. All of the WPAs are open to recreational hunting in accordance with the Migratory Bird Hunting and Conservation Stamp Act.

Availability of Resources

Currently, sufficient resources are available to carry out the proposed recreational hunting program.

Anticipated Impacts of Use

Some wildlife disturbance would occur during recreational hunting activities. All of the WPAs would be open to recreational hunting in accordance with the Migratory Bird Hunting and Conservation Stamp Act.

Determination

Recreational hunting is compatible.

Stipulations Necessary to Ensure Compatibility

- Require the use of nontoxic shot, in accordance with current regulations for migratory bird and upland game hunting.
- Prohibit vehicle access beyond parking lots.
- Prohibit permanent and overnight hunting blinds
- Prohibit the use of horses.
- Prohibit camping, overnight use, and fires.
- Require that hunting be in accordance with federal and state regulations.
- Promote sound hunting practices for hunter safety and quality experiences.
- Annually review recreational hunting activities to ensure these activities are compatible.

Justification

Hunting on Refuge System lands has been identified as a priority public use in the Improvement Act. Hunting is a legitimate wildlife management tool that can be used to manage populations. Hunting would harvest a small percentage of the renewable resources, which is in accordance with wildlife objectives and principles.

Based on the biological effects described previously and in the EA and draft CCP, it is determined that recreational hunting in the district would not interfere with or detract from the purposes for which the district was established or its habitat goals and objectives.

Mandatory 15-year Reevaluation Date: 2022

6. Description of Proposed Public Use: Timber Harvest

The district would continue timber harvest that is conducted under a special use permit by private individuals. Timber harvest would be used as a management tool to reduce the invasion of woody vegetation in grassland and wetland habitats.

Availability of Resources

The draft CCP does not propose any changes in timber harvest activities allowed with special use permits. The resources necessary to administer a timber harvest program would be sufficient at current staffing and budgetary levels.

Anticipated Impacts of the Use

Timber harvest would have short-term impacts by causing disturbance to wildlife and disturbance to ground cover. The removal of trees would reduce the effects of shading and robbing of soil moisture, and thereby encourage warm-season grassland species to grow. The absence of trees would reduce nest and chick mortality for ground-nesting birds that are commonly preyed on by raptors, raccoon, and skunk.

Determination

The use of timber harvest (under special use permit) as a habitat management tool is compatible.

Stipulations Necessary to Ensure Compatibility

- Require general and special conditions for each permit to ensure consistency with management objectives.
- Restrict the use of vehicles and motorized equipment to the minimum necessary to conduct timber harvest.
- Require trees be cut to ground level and the stumps be treated with approved herbicide to prevent regrowth.
- Require slash to be removed or piled according to the manager's discretion.

Justification

Soil and climatic conditions are suitable to grow trees on any land left undisturbed. In addition, larger, mature trees that have timber value are the primary source of seed for new seedlings. Tree removal is vital to the maintenance of quality wetlands and uplands. The spread of saplings would (1) increase the costs of vegetation management that are associated with prescribed burning and (2) reduce haying as a management option. Invasive, cool-season grasses would be commonly associated with shaded woodland areas. Bird predators such as owls, red-tailed hawk, raccoon, and skunk would benefit from shelterbelts and volunteer trees.

Mandatory 15-year Reevaluation Date: 2022

Submitted to: _____

Gene Mack, Project Leader — Date
Rainwater Basin Wetland Management District, NE

Approved by: _____

Richard A. Coleman, PhD, — Date
Assistant Regional Director
Region 6, National Wildlife Refuge System, CO

Reviewed by: _____

Rod Krey, Refuge Supervisor — Date
Region 6, National Wildlife Refuge System, CO

Appendix B

Key Legislation and Policies

Administration of units of the National Wildlife Refuge System is governed by (1) bills passed by the U.S. Congress and signed into law by the president of the United States, and (2) by regulations developed by the various branches of the government. Following are brief descriptions of some of the most pertinent laws and statutes establishing legal parameters and policy direction for the Refuge System.

In alphabetical order of the name of the act, order, or regulation.

American Indian Religious Freedom Act: Affirms the right of Native Americans to have access to their sacred places. If a place of religious importance to Native Americans may be affected by an undertaking, the act promotes consultation with Native American religious practitioners, which may be coordinated with section 106 consultation.

Americans with Disabilities Act (1992): Prohibits discrimination in public accommodations and services.

Antiquities Act (June 8, 1906; 16 USC 431–433; 34 Stat. 225): Authorizes the president to designate as national monuments objects or areas of historic or scientific interest on lands owned or controlled by the United States. Requires that a permit be obtained for examination of ruins, excavation of archaeological sites, and the gathering of objects of antiquity on lands under the jurisdiction of the Secretaries of Interior, Agriculture, and Army, and provided penalties for violations.

Archaeological Resources Protection Act (Public Law [PL] 96-95; October 31, 1979; 16 USC 470aa–470ll; 93 Stat. 721): Protects archaeological resources and sites on public (federal) lands and Native American lands. The act calls for the preservation of objects and associated records in a suitable repository once recovered from a site. The act sets guidelines for proper procedures to obtain permission and permits to excavate archaeological sites on public lands by qualified individuals.

Architectural Barriers Act (1968): Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

Archeological and Historic Preservation Act (PL 86-523; June 27, 1960; 16 USC 469–469c; 74 Stat. 220 [as amended by PL 93-291; May 24, 1974; 88 Stat. 174]): Carries out the policy established by the Historic Sites, Buildings and Antiquities Act; directs federal agencies to notify the Secretary of the Interior whenever they find a federal or federally assisted, licensed, or permitted project may cause loss or destruction of significant scientific, prehistoric, or archaeological data. Authorizes use of appropriated, donated, and transferred funds for the recovery, protection, and preservation of such data.

Clean Water Act (1977): Requires consultation with the U.S. Army Corps of Engineers for major wetland modifications.

Criminal Code of Provisions of 1940 (as amended, 18 USC 41): States the intent of Congress to protect all wildlife within federal sanctuaries, refuges, fish hatcheries, and breeding grounds. Provides that anyone (except in compliance with rules and regulations promulgated by authority of law) who hunts, traps, or willfully disturbs any such wildlife, or willfully injures, molests, or destroys any property of the United States on such land or water, shall be fined up to $500 or imprisoned for not more than 6 months or both.

Emergency Wetland Resources Act of 1986: Authorizes the purchase of wetlands from Land and Water Conservation Fund monies, removing a prior prohibition on such acquisitions. Requires the Secretary to establish a national wetlands priority conservation plan, requires the states to include wetlands in their comprehensive outdoor recreation plans, and transfers to the Migratory Bird Conservation Fund amount equal to import duties on arms and ammunition.

Endangered Species Act of 1973 and recent amendments (16 USC 1531–1543, 87 Stat. 884; as amended): Provides for conservation of threatened and endangered species of fish, wildlife, and plants by federal action and by encouraging state programs. Specific provisions include the listing and determination of critical habitat for endangered and threatened species and consultation with the Service on any federally funded or licensed project that could affect any of these agencies; prohibition of unauthorized taking, possession, sale, transport, etc., of endangered species; an expanded program of habitat acquisition; establishment of cooperative agreements and grants-in-aid to states that establish and maintain an active, adequate program for endangered and threatened species; assessment of civil and criminal penalties for violating the act or regulations.

Environmental Education Act of 1990 (PL 101-619; November 16, 1990; 20 USC 5501–5510; 104 Stat. 3325): Establishes the Office of Environmental Education within the USEPA to develop and administer a federal environmental education program. Responsibilities of the office include developing and supporting programs to improve understanding of the natural and developed environment and the relationships between humans and their environment; supporting the dissemination of educational materials; developing and supporting training programs and environmental education seminars; managing a federal grant program; and administering an environmental internship and fellowship program. Requires the office to develop and support environmental programs in consultation with other federal natural resource management agencies including the Service.

EO 11644—Use of Off-road Vehicles on Public Lands (1972): Provides policy and procedures for regulating off-road vehicles.

EO 11988—Floodplain Management (May 24, 1977): Prevents federal agencies from contributing to the "adverse impacts associated with occupancy and modification of floodplains" and the "direct or indirect support of floodplain development." In the course of fulfilling their respective authorities, federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains."

EO 11990—Protection of Wetlands.

EO 12996—Management and General Public Use of the National Wildlife Refuge System (1996): Defines the mission, purpose, and priority public uses of the Refuge System; presents four principles to guide management of the system.

EO 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.

Federal Noxious Weed Act (1990): Requires the use of integrated management systems to control or contain undesirable plant species, and an interdisciplinary approach with the cooperation of other federal and state agencies.

Federal Records Act (1950): Requires the preservation of evidence of the government's organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

Federal Water Pollution Control Act of 1972, Section 401 (PL 92-500, USC 1411, 86 Stat. 816.33): Requires any applicant for a federal license or permit to conduct any activity which may result in a discharge into navigable waters to obtain a certification from the state in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over navigable waters at the point where the discharge originates or will originate, that the discharge will comply with applicable effluent limitations and water quality standards. Requires that a certification obtained for construction of any facility must also pertain to subsequent operation of the facility.

Federal Water Pollution Control Act of 1972, Section 404 (PL 92-500, 86 Stat. 816): Authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearing, for discharge of dredged or fill material into navigable waters of the United States, including wetlands, at specified disposal sites. Requires that selection of disposal sites be in accordance with guidelines developed by the Administrator of the USEPA in conjunction with the Secretary of the Army. States that the Administrator can prohibit or restrict use of any defined area as a disposal site whenever she/he determines, after notice and opportunity for public hearings, that discharge of such materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, wildlife, or recreational areas.

Fish and Wildlife Act of 1956 (16 USC 742a–742j, 70 Stat. 1119; as amended): Establishes a comprehensive fish and wildlife policy and directs the Secretary of the Interior to provide continuing research and extension and conservation of fish and wildlife resources.

Fish and Wildlife Conservation Act of 1980 (PL 96366; September 29, 1980; 16 USC 2901–2911; as amended 1986, 1988, 1990, and 1992): Creates a mechanism for federal matching funding of the development of state conservation plans for nongame fish and wildlife. States that subsequent amendments to this law require that the Secretary monitor and assess migratory nongame birds, determine the effects of environmental changes and human activities, identify birds likely to be candidates for endangered species listing, and identify conservation actions that would prevent this from being necessary. In 1989, Congress also directed the Secretary to identify lands and waters in the Western Hemisphere, the protection, management, or acquisition of which would foster conservation of migratory nongame birds. All of these activities are intended to assist the Secretary in fulfilling the Secretary's responsibilities under the Migratory Bird Treaty Act and the Migratory Bird Conservation Act, and provisions of the Endangered Species Act implementing the Convention on Nature Protection and Wildlife Preservation in the Western Hemisphere.

Fish and Wildlife Coordination Act (1958): Allows the U.S. Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

Fish and Wildlife Improvement Act of 1978: Improves the administration of fish and wildlife programs and amends several earlier laws including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. Authorizes the Secretary to accept gifts and bequests of real and personal property on behalf of the United States. Authorizes the use of volunteers for Service projects and appropriations to carry out volunteer programs.

Historic Sites, Buildings and Antiquities Act (August 21, 1935; 16 USC 461–462, 464–467; 49 Stat. 666; known as the "Historic Sites Act" [as amended by PL 89-249; October 9, 1965; 79 Stat. 971]): Declares it a national policy to preserve historic sites and objects of national significance, including those located at refuges and districts. Provides procedures for designation, acquisition, administration, and protection of such sites. Provides for designation of National Historic and Natural Landmarks.

Land and Water Conservation Fund Act of 1965: Provides funds from leasing bonuses, production royalties, and rental revenues for offshore oil, gas, and sulphur extraction to the Bureau of Land Management, the USDA Forest Service, the U.S. Fish and Wildlife Service, and state and local agencies for purchase of lands for parks, open space, and outdoor recreation.

Migratory Bird Conservation Act of 1929 (16 USC 715–715d, 715e, 715f–715r): Establishes the Migratory Bird Conservation Commission, which consists of the Secretaries of the Interior (chair), Agriculture, and Transportation; two members from the House of Representatives; and an ex-officio member from the state in which a project is located. States that the commission approves acquisition of land and water, or interests therein, and sets the priorities for acquisition of lands by the Secretary of the Interior for sanctuaries or for other management purposes. Requires that, to acquire lands or interests therein, the state concerned must consent to such acquisition by legislation. Such legislation has been enacted by most states.

Migratory Bird Conservation Act of 1929 (16 USC 715s, 45 Stat. 1222, as amended): Authorizes acquisition, development, and maintenance of migratory bird refuges; cooperation with other agencies in conservation; and investigations and publications on North American birds. Authorizes payment of 25% of net receipts from administration of national wildlife refuges to the country or counties in which such refuges are located.

Migratory Bird Hunting and Conservation Stamp Act of 1934 (March 16, 1934; 16 USC 718–718h; 48 Stat. 51; known as The "Duck Stamp Act"; as amended): Requires each waterfowl hunter 16 years of age or older to possess a valid federal hunting stamp. Authorizes the requirement of an annual stamp for the hunting of waterfowl; proceeds go toward the purchase of habitat for waterfowl and other wildlife. Duck stamps are also purchased (1) for entry into some refuges, (2) by conservationists, and (3) for stamp collections. Receipts from the sale of the stamp are deposited in a special Treasury account known as the Migratory Bird Conservation Fund and are not subject to appropriations.

Migratory Bird Treaty Act of 1918 (16 USC 703–711; 50 CFR, subchapter B; as amended): Implements treaties with Great Britain (for Canada) and Mexico for protection of migratory birds whose welfare is a federal responsibility. Provides for regulations to control taking, possession, selling, transporting, and importing of migratory birds and provides penalties for violations. Enables the setting of seasons and other regulations (including the closing of areas, federal or nonfederal) related to the hunting of migratory birds.

National and Community Service Act of 1990 (PL 101-610; November 16, 1990; 42 USC 12401; 104 Stat. 3127): Authorizes several programs to engage citizens of the United States in full and part-time projects designed to combat illiteracy and poverty, provide job skills, enhance educational skills, and fulfill environmental needs. Provides for grants to states for the creation of programs for citizens over 17 years of age. Programs must be designed to fill unmet educational, human, environmental, and public safety needs. Initially, participants will receive postemployment benefits of up to $1,000 per year for part-time participants and $2,500 for full-time participants.

Several provisions are of particular interest to the Service:

American Conservation and Youth Service Corps: As a federal grant program established under subtitle C of the law, the corps offers an opportunity for young adults between the ages of 16 and 25, or in the case of summer programs, between 15 and 21, to engage in approved human and natural resources projects that benefit the public or are carried out on federal or Indian lands. To be eligible for assistance, natural resources programs will focus on improvement of wildlife habitat and recreational areas, fish culture, fishery assistance, erosion, wetlands protection, pollution control, and similar projects. A stipend of not more than 100% of the poverty level will be paid to participants. A commission established to administer the Youth Service Corps will make grants to states, the Secretaries of Agriculture and Interior, and the Director of ACTION to carry out these responsibilities.

Thousand Points of Light: Creates a nonprofit Points of Light Foundation to administer programs to encourage citizens and institutions to volunteer to solve critical social issues, discover new leaders, and develop institutions committed to serving others.

National Environmental Policy Act of 1969 (PL 91-190; January 1, 1970; 42 USC 4321–4347; 83 Stat. 852 [as amended by PL 94-52; July 3, 1975; 89 Stat. 258] [as amended by PL 94-83; August 9, 1975; 89 Stat. 424]): Requires all agencies, including the Service, to examine the environmental impacts of their actions, incorporate environmental information, and use public participation in the planning and the implementation of all actions, federal agencies must integrate the act with other planning requirements, and to prepare appropriate documents to facilitate better environmental decision making (40 CFR 1500). Declares national policy to encourage a productive and enjoyable harmony between humans and their environment.

Section 102 of that act directs that "to the fullest extent possible the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this act, and all agencies of the Federal Government shall ... insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision making along with economic technical considerations."

Section 102(2)c of the NEPA requires all federal agencies, with respect to major federal actions significantly affecting the quality the quality of the human environment, to submit to the Council on Environmental Quality a detailed statement of the environmental impact of the proposed action; any adverse environmental effect that cannot be avoided should the proposal be implemented; alternatives to the proposed action; the relationship between local short-term uses of the environment and the maintenance and enhancement of long-term productivity; any irreversible and irretrievable commitments of resources that would be involved in the proposed action, should it be implemented.

National Historic Preservation Act of 1966 (PL 89-665; October 15, 1966; 16 USC 470–470b, 470c–470n; 80 Stat. 915; and repeatedly amended): Instructs federal agencies to consider the effect their undertakings have on cultural resources. The act is comprehensive legislation with many components, with the most important aspect to management being section 106. The purpose of section 106 is stated in 36 CFR 800.1: "The section 106 process seeks to accommodate historic preservation concerns with the needs of Federal undertakings through consultation among the agency official and other parties with an interest in the effects of the undertaking on historic properties." Historic property is defined in 36 CFR 800.16(l) as "any prehistoric or historic district, site, building, structure, or object in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior." Another important section, section 110, directs federal agencies to inventory cultural resources on public lands—not necessarily in relationship to a project or undertaking—so cultural resources can be evaluated and managed.

National Wildlife Refuge System Administration Act of 1966 (PL 89-669; 16 USC 668dd–668ee; 80 Stat. 929; as amended): Defines the Refuge System as including wildlife refuges, areas for protection and conservation of fish and wildlife that are threatened with extinction, wildlife ranges, game ranges, wildlife management areas, and waterfowl production areas. Authorizes the Secretary to permit any use of an area provided such use is compatible with the major purposes for which such area was established. States that purchase considerations for rights-of-way go into the Migratory Bird Conservation Fund for the acquisition of lands. By regulation, up to 40% of an area acquired for a migratory bird sanctuary may be opened to migratory bird hunting unless the Secretary finds that the taking of any species of migratory game birds in more than 40% of such area would be beneficial to the species. Requires an act of Congress for the divestiture of lands in the system, except for (1) lands acquired with Migratory Bird Conservation Commission funds, and (2) lands that can be removed from the System by land exchange, or if brought into the System by a cooperative agreement, then pursuant to the terms of the agreement.

National Wildlife Refuge System Improvement Act of 1997 (PL 105-57; October 9, 1997; Amendment to the National Wildlife Refuge System Administration Act of 1966): Sets the mission and the administrative policy for all units in the Refuge System. Clearly defines a unifying mission for the Refuge System; establishes the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation); establishes a formal process for determining appropriateness and compatibility; establishes the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; and requires a CCP for each refuge by the year 2012. Also amended portions of the Refuge Recreation Act and the National Wildlife Refuge System Administration Act of 1966.

Key provisions include the following:

- a requirement that the Secretary of the Interior ensures maintenance of the biological integrity, diversity, and environmental health of the Refuge System;
- the definition of compatible wildlife-dependent recreation as "legitimate and appropriate general public use of the [National Wildlife Refuge] System";
- the establishment of hunting, fishing, wildlife observation, photography, environmental education, and interpretation as "priority public uses" where compatible with the mission and purpose of individual national wildlife refuges;
- the refuge managers' authority to use sound professional judgment in determining which public uses are compatible at national wildlife refuges and whether or not they will be allowed

(a formal process for determining "compatible use" is currently being developed);

- the requirement of open public involvement in decisions to allow new uses of national wildlife refuges and renew existing ones, as well as in the development of CCPs for national wildlife refuges.

National Wildlife Refuge Regulations (50 CFR 25-35, 43 CFR 3103.2 and 3120.3–3): Provides regulations for administration and management of national wildlife refuges including mineral leasing, exploration, and development.

Rights-of-way General Regulations (50 CFR 29.21; 34 CFR 19907, December 19, 1969): Provides for procedures for filing applications. Provides terms and conditions under which rights-of-way over, above, and across lands administered by the Service may be granted.

National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act of 1998 (PL 105-242, 112 Stat. 1575): Encourages the use of volunteers to assist the Service in the management of refuges within the Refuge System. Facilitates partnerships between the Refuge System and nonfederal entities to promote public awareness of the resources of the Refuge System and public participation in the conservation of those resources. Encourages donations and other contributions by persons and organizations to the Refuge System.

Native American Graves Protection and Repatriation Act: Provides a process for museums and federal agencies to return certain Native American cultural items—human remains, funerary objects, sacred objects, and objects of cultural patrimony—to lineal descendants, culturally affiliated Indian tribes, and Native Hawaiian organizations.

North American Wetlands Conservation Act (PL 101-233; December 13, 1989; 16 USC 4401–4412; 103 Stat. 1968): Provides for the conservation of North American wetland ecosystems, waterfowl and other migratory birds, fish, and wildlife that depend on such habitats. Establishes a council to review project proposals and provided funding for the projects. Provides funding and administrative direction for implementation of the North American Waterfowl Management Plan and the Tripartite Agreement on wetlands between Canada, United States, and Mexico. Converts the Pittman–Robertson account into a trust fund, with the interest available without appropriation through the year 2006 to carry out the programs authorized by the act, along with an authorization for annual appropriation of $15 million plus an amount equal to the fines and forfeitures collected under the Migratory Bird Treaty Act. Available funds may be expended, upon approval of the Migratory Bird Conservation Commission, for payment of not to exceed 50% of the United States share of the cost of wetlands conservation projects in Canada, Mexico, or the United States (or 100% of the cost of projects on federal lands). At least 50% and no more than 70% of the funds received are to go to Canada and Mexico each year.

Refuge Recreation Act of 1962: Authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the areas' primary purposes. Authorizes construction and maintenance of recreational facilities and the acquisition of land for incidental fish- and wildlife-oriented recreational development or protection of natural resources. Authorizes the charging of fees for public uses.

Refuge Recreation Act of 1966 (PL 87-714, 16 USC 460k et seq., 76 Stat. 653–654): Authorizes appropriate, incidental, or secondary recreational use at conservation areas administered by the Secretary of the Interior for fish and wildlife purposes.

Refuge Recreation Act of 1969 [16 USC 460k–460k4], as amended.

Refuge Revenue Sharing Act, Section 401 (June 15, 1935; 16 USC 715s; 49 Stat. 383): Provides for payments to counties in lieu of taxes, using revenues derived from the sale of products from refuges. Related legislation follows:

PL 88-523 (August 30, 1964; 78 Stat. 701): Makes major revisions by requiring that all revenues received from refuge products such as animals, timber and minerals, or from leases or other privileges, be deposited in a special Treasury account and net receipts distributed to counties for public schools and roads.

PL 93-509 (December 3, 1974; 88 Stat. 1603): Requires that monies remaining in the fund after payments be transferred to the Migratory Bird Conservation Fund for land acquisition under provisions of the Migratory Bird Conservation Act.

PL 95-469 (October 17, 1978; 92 Stat. 1319): Expands the revenue-sharing system to include national fish hatcheries and Service research stations. Includes in the Refuge Revenue Sharing Fund receipts from the sale of salmonid carcasses. Establishes payments to counties as follows:

On acquired land, the greatest amount calculated on the basis of 75 cents per acre, ¾ of 1% of the appraised value, or 25% of the net receipts produced from the land.

- On land withdrawn from the public domain, 25% of net receipts and basic payments under PL 94-565 (31 USC 1601–1607, 90 Stat. 2662), payment in lieu of taxes on public lands.
- This amendment also authorizes appropriations to make up any difference between the amount in the fund and the amount scheduled for payment in any year. The stipulation that payments be used for schools and roads was

removed, but counties were required to pass payments along to other units of local government within the county that suffer losses in revenues due to the establishment of Service areas.

Refuge Revenue Sharing Act of 1978 (PL 95-469; October 17, 1978; amended 16 USC 715s; 50 CFR, part 34): Changes the provisions for sharing revenues with counties in a number of ways. Makes revenue sharing applicable to all lands administered by the Service, whereas previously it was applicable only to areas in the Refuge System. Makes payments available for any governmental purpose, whereas the old law restricted the use of payments to roads and schools. For lands acquired in fee simple, provides a payment of 75 cents per acre, ¾ of 1% of fair market value or 25% of net receipts, whichever is greatest, whereas the old law provided a payment of ¾ of 1% adjustment cost or 25% of net receipts, whichever was greater. Makes reserve (public domain) lands entitlement lands under PL 94-565 (16 USC 1601–1607) and provides for a payment of 25% of net receipts. Authorizes appropriations to make up any shortfall in net receipts, to make payments in the full amount for which counties are eligible. The old law provided that if net receipts were insufficient to make full payment, payment to each county would be reduced proportionality.

Refuge Trespass Act of June 28, 1906 (18 USC 41, 43 Stat. 98; 18 USC 145): Provides the first federal protection for wildlife at national wildlife refuges. Makes it unlawful to hunt, trap, capture, willfully disturb, or kill any bird or wild animal, or take or destroy the eggs of any such birds, on any lands of the United States set apart or reserved as refuges or breeding grounds for such birds or animals by any law, proclamation, or executive order, except under rules and regulations of the Secretary. The act also protects government property on such lands.

Refuge Trespass Act of June 25, 1948 (18 USC 41, Stat. 686; Section 41 of the Criminal Code, Title 18): Consolidates the penalty provisions of various acts from January 24, 1905 (16 USC 684–687, 33 Stat. 614) through March 10, 1934 (16 USC 694–694b, 48 Stat. 400) and restates the intent of Congress to protect all wildlife within federal sanctuaries, refuges, fish hatcheries, and breeding grounds. Provides that anyone (except in compliance with rules and regulations promulgated by authority of law) who hunts, traps, or willfully disturbs any wildlife on such areas, or willfully injures, molests, or destroys any property of the United States on such lands or waters, shall be fined, imprisoned, or both.

Rehabilitation Act of 1973 (October 1, 1973; 29 USC 794 [as amended by PL 93-112, Title 5; 87 Stat. 355]): Prohibits discrimination on the basis of handicap under any program or activity receiving federal financial assistance.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act of 1948: Provides that, upon 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 the Interior if the land has particular value for migratory birds, or to a state agency for other wildlife conservation purposes.

U.S. Department of the Interior Order No. 3226 (January 19, 2001): Directs bureaus and offices of the Department to analyze the potential effects on climate change when undertaking long-range planning, when setting priorities for scientific research, and when making major decisions about use of resources.

Wilderness Act of 1964 (PL 88-577; September 3, 1964): Directs the Secretary of the Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within the Refuge System and National Park Service for inclusion in the National Wilderness Preservation System.

Wilderness Preservation and Management (50 CFR 35; 16 USC 1131-1136; 43 USC 1201; 78 Stat. 890): Provides procedures for establishing wilderness units under the Wilderness Act of 1964 at units of the Refuge System.

Appendix C

Public Involvement

Public scoping was completed in December 2005. Four public meetings were held throughout the Rainwater Basin, as follows:

- Kearney, NE; December 5, 2005
- York, NE; December 6, 2005
- Clay Center, NE; December 7, 2005
- Holdrege, NE; December 8, 2005

Of the 51 people who attended these meetings, 38 were non-Service individuals. Written comments were received from 17 individuals. Comments received identified biological, recreational, and economic concerns about management of the district.

The following mailing list was developed for this CCP planning effort.

FEDERAL OFFICIALS

U.S. Senator Chuck Hagel, Washington DC;
Area director, Lincoln, NE

U.S. Senator Ben Nelson, Washington DC;
Area director, Lincoln, NE

U.S. Representative Adrian Smith, Washington DC;
Area director, Grand Island, NE

FEDERAL AGENCIES

Bureau of Reclamation

National Park Service—Homestead National Monument, Beatrice, NE; Lewis and Clark National Trail, Omaha, NE

U.S. Army Corps of Engineers; Kearney, NE

USDA, Forest Service; Chadron, NE

USDA, Natural Resources Conservation Service in Nebraska—Holdrege Service Center, Grand Island Service Center, Clay Center Service Center, Hastings Service Center, Franklin Service Center, Elwood Service Center, York Service Center, Aurora Service Center, Geneva Service Center, Wilbur Service Center

USFWS in Nebraska—Ecological Services, Grand Island, NE; Crescent Lake NWR, North Platte NWR, Fort Niobrara NWR, Valentine NWR

USFWS–Northern Prairie Waterfowl Research Center

USFWS—regional offices of regions 1–7 and 9; National Conservation Training Center

USGS–Fort Collins Science Center, Fort Collins, CO; Northern Prairie Research Center; Jamestown, ND

NEBRASKA STATE OFFICIALS

Senator Greg Adams, York
Senator Ray Aguilar, Grand Island
Senator Carroll Burling, Kenesaw
Senator Tom Carlson, Holdrege
Senator Annette Dubas, Fullerton
Senator Ray Janssen, Nickerson
Senator Joel Johnson, Kearney
Senator Russ Karpisek, Wilber
Senator Chris Langemeier, Schuyler

STATE GOVERNMENT

NDEQ, Lincoln
Nebraska Corn Board, Lincoln
Nebraska Department of Agriculture, Lincoln
Nebraska Department of Natural Resources, Lincoln
Nebraska Department of Roads, Lincoln
Nebraska Department of Water Resources
Nebraska Emergency Management Agency, Lincoln
Nebraska Environmental Trust, Lincoln
Nebraska Forest Service, Lincoln
Nebraska State Historical Society
Nebraska State Historic Preservation Office
NGPC, Lincoln

LOCAL GOVERNMENT

Buffalo County Weed Board
Central Nebraska Public Power Irrigation District
Central Platte NRD
Clay County Highway Department
Fillmore County Roads Department
Gosper County Weed Control
Hamilton County Board of Supervisors
Little Blue NRD
Lower Loup NRD
Lower Niobrara NRD
Meat Animal Research Center
Phelps County Road Department
Seward County Highway Department
Tri-Basin NRD
Upper Big Blue NRD

LOCAL ORGANIZATIONS AND BUSINESS AND CIVIC GROUPS

The 1980 Anawalt Family Trust
Abengo Energy
A C Feedyards Inc.
Agnes E. Johnson Farms
Audubon Society
Boyd Kaiser Trust
BSL LLC
Burt Partners
Clarence W. Schmidt Trust
Clay Center Critter Care
Crane Meadows Nature Center
C & R Hendrickson Farms Inc.
Cudmore–Kneifl Construction Company Inc.
Daniel R. Stengel Revocable Trust
Dannehl Farms Inc.
Darleen Nielsen Trust
David B. Huber Revocable Trust
David High Farms Ltd.
Donald D. Lovegrove Trust
Donna Linder Trust
Dorothy I. Ebert Estate
Ducks Unlimited
Earl W. Frazier Revocable Trust
Flinthill Farms Ltd.
Gene Lundeen Inc.
Gladys W. Scharmann Trust
H–D Management Company
Kathleen M. Swartz Revocable Trust No. 1
Lauer Ag Inc.
Lazy T Milliron Inc.
Lipovsky Farm Corporation
L & K Irrevocable Living Trust
Marvin W. Volzke Trust
Max A. Gemar Family Trust
M & C Stadler Inc.
ME LLC
The Nature Conservancy
Nebraska Cattlemen
Nebraska Environmental Trust
Nebraska Farm Bureau
Nebraska Farmer
Nebraska Groundwater Foundation
Nebraska Hunters Connection
Nebraska State Historical Society
Nielsen Family Farms LLC
Ostgren Construction Company
Pheasants Forever
Playa Lakes Joint Venture
Prairie Plains Institute
Rainwater Basin Joint Venture
R Lazy K Inc.
R L Kaliff Ranch Company
Rosetta Nelson Family Farms LLC
Ruby L. Real Trust
Semco Land Inc.
Standard Farms of Nebraska Inc.
Stuckey Grandchildren Partnership
Submerged Land Co. Inc.
Sylvia L. Schmidt Irrevocable Trust
Thelma J. Arneson Trust
Thunderbird Farms Inc,
Triple E Farms Inc.
VCK Farms LLC
Whooping Crane Trust
William Seng Trust

NATIONAL ORGANIZATIONS

American Bird Conservancy, VA
American Rivers, Washington DC
Defenders of Wildlife, Washington DC
Ducks Unlimited, TN
Isaac Walton League, MD
National Audubon Society; NY, Washington DC
National Trappers Association Inc., WV
National Wildlife Federation, VA
National Wildlife Refuge Association, Washington DC
The Nature Conservancy, CO
Sierra Club, CA
U.S. Humane Society, Washington DC
The Wilderness Society, Washington DC
Wildlife Management Institute; CO, OR, Washington DC

MEDIA

Aurora News-Register
Bertrand Herald
Blue Hill Leader
Clay County News
Doniphan Herald
Franklin County Chronicle
Friend Sentinel
Gibbon Reporter Office
GI Family Radio
Grand Island Independent
Henderson News
Holdrege Daily Citizen
Kearney Hub
KGFW Radio
KHAS-TV
KOLN/KGIN-TV
KRVN Radio
Lincoln Star Journal
Milford Times
Minden Courier
Nebraska Signal
NTV Network
Omaha World Herald
Tribune-Newspaper
Seward County Independent Newspaper
Shelton Clipper
York News Times/Advantage

UNIVERSITIES AND COLLEGES

University of Nebraska–Lincoln, Cooperative Unit

INDIVIDUALS

352 persons

Appendix D

Preparers

This draft CCP and EA is the result of the efforts by members of the planning team for the Rainwater Basin Wetland Management District.

Name	*Title*	*Agency*
Mike Artmann	GIS specialist	USFWS
Susann Cayouette	administrative officer	USFWS
Jeff Drahota	wildlife biologist	USFWS
Mark Ely	GIS specialist	USFWS
Bernardo Garza	planning team leader	USFWS
Kyle Graham	private lands biologist	USFWS
Steve Karel	refuge operations specialist	USFWS
Brad Krohn	biological technician	USFWS
Brice Krohn	supervisory range technician	USFWS
Ted LaGrange	wetland program manager	NGPC
Gene Mack	project leader	USFWS
Mindy Meade	private lands biologist	USFWS
Steve Moran	RWBJV coordinator	USFWS
Paul Nelson	maintenance worker	USFWS
Mark Pfost	biological technician	USFWS
Ryan Reker	GIS specialist	USFWS
Ronnie Sanchez	deputy project leader	USFWS
Richard Schroeder	wildlife biologist/ecologist	USGS–BRD
Mark Vrtiska	waterfowl program manager	NGPC
Bruce Winter	prescribed fire specialist	USFWS

Appendix E

Black-tailed Prairie Dog Management Plan

BLACK TAILED PRAIRIE DOG MANAGEMENT PLAN
Rainwater Basin Wetland Management District

Written and Revised in 2003 by
Tom Koerner, Deputy Refuge Manager
&
Jeff Drahota, Wildlife Biologist

Approvals and Concurrence

Rainwater Basin Wetland Management District:

Project Leader

Gene D. Mack

Signature Date

Mountain-Prairie Regional Office:

National Wildlife Refuge System

Refuge Supervisor, Nebraska, Kansas & Colorado:

Ron Shupe

Signature Date

Regional Wildlife Biologist:

Wayne King

Signature Date

BLACK TAILED PRAIRIE DOG MANAGEMENT PLAN

Rainwater Basin Wetland Management District

Kearney, Nebraska

INTRODUCTION

In July 1998, the National Wildlife Federation petitioned the U.S. Fish and Wildlife Service (USFWS) to list the black-tailed prairie dog as threatened under the Endangered Species Act. In February 2000, the USFWS concluded that this species does warrant listing, but is precluded from being listed due to other higher priority species concerns and resource constraints.

This action has led us to believe we need to develop a management plan to guide us in management of black-tailed prairie dogs on Federal Waterfowl Production Areas (WPA) found throughout the Rainwater Basin Wetland Management District (WMD).

Station Mission: To protect, restore and manage wetlands and prairie grassland habitat in support of the North American Waterfowl Management Plan; provide resting, nesting, feeding, and staging habitat for waterfowl and other migratory birds; protect endangered and threatened species and their habitats; restore the natural flora and fauna (as practical) for tall-grass prairie ecosystems; and increase public opportunities for outdoor recreation and environmental education.

Station Goals:

1. Enhance wetland habitat for migratory birds.
2. Improve habitat for the propagation and protection of endangered and threatened species.
3. Protect wetlands through fee-title and easement acquisition, and coordination with other conservation programs, protect wetlands from degradation through drainage, erosion, siltation, and farming practices.
4. Reestablish native flora and bio diversity of tall grass prairie ecosystems.
5. Expand the Rainwater Basin Joint Venture to maintain, enhance, and create new partnerships that further the goals of the station.
6. Provide opportunities for public participation in a wide range of outdoor recreation and interpretation activities.

Introduction

Description

The scientific name for the black-tailed prairie dog is *Cynomys ludovicianus. "L*udovicianus," is the Latin form of Ludwig or Louis, relating back to the Lewis and Clark expedition of 1804-1806, when prairie dogs were first collected for science.

The prairie dog is a burrowing member of the order Rodentia, the largest group of mammals in the world. An adult black-tailed prairie dog is between 12 and 16 inches long and generally weighs between 1.5 and 2.5 pounds. Its tail is covered with hair and is about one-fourth of the animal's total length. Its body is tan to pale brown in color, its underparts are white to buffy white, and its tail is tipped with black. The prairie dog's legs are short, but its feet are large and have well-developed claws, especially on the forefeet. Its head is broad and rounded, and its eyes are fairly large.

Distribution and Abundance

The black-tailed prairie dog is one of five species of prairie dogs found in North America. It is the most abundant and widely distributed species and is the only prairie dog found in Nebraska. It is found throughout the Great Plains from southern Canada to just inside Mexico. The western edge of its range is along the Rocky Mountains, and the eastern edge follows the natural boundary between tall and mid-grass prairie. In Nebraska, prairie dogs are found roughly in the western two-thirds of the state. Historic towns have been documented on a number of WPAs throughout the WMD; however, the most active towns are found in the west half of the WMD.

Black-tailed prairie dogs live in colonies or "towns" that range in size from as small as one acre to several thousand acres. The largest prairie dog colony on record was in Texas, and was about 100 miles wide, 250 miles long and contained an estimated 400 million animals. It is estimated that in the late 1800s, some 700 million acres of North American rangeland were inhabited by prairie dogs. Habitat changes and extensive eradication efforts have reduced the acreage by about 90 to 95 percent from historic levels.

We believe that on WPAs, the cessation of regular grazing on these towns led to the eventual loss of the town due to the creation of unsuitable habitat. This factor becomes more important the farther east one travels. Increasing precipitation levels, resulting in higher vegetative growth without grazing may results in less suitable habitat.

Habitat and Home

Areas of short and mid-grass rangeland that are heavily grazed by livestock are the prairie dog's preferred habitat. Prairie dog colonies are most recognizable by the mounds and holes at their burrow entrances. A colony will typically have 30 to 50 burrow entrances per acre.

The animal's burrow system can be quite complex and extensive. Mounds of excavated soil around the burrow entrance are generally cone-shaped and vary from one to three feet in height and from three to 10 feet in diameter. These mounds serve as lookout points and serve to prevent water from entering the burrow system. Tunnels are generally three to six feet below the surface and about 15

feet long, although burrows have been reported to reach depths of 15 feet. Burrow systems typically include several chambers, including one near the entrance where the prairie dog can sit and listen for activity above ground, and one or more nest chambers where they sleep and care for their young.

Habits

The fact that prairie dogs live in colonies indicates they are highly social animals. The largest social unit is the colony or town. Towns are often divided into "wards" by topographical barriers such as roads, ridges or trees, and are generally five to 10 acres in size. Although prairie dogs in one ward may be able to see and hear animals of an adjacent ward, movement among wards is unusual. Wards are divided into several smaller prairie dog social units, called "coteries." Each coterie generally consists of one adult male, one to four adult females, and any offspring less than two years old. Members of one coterie defend their territory from invasion by members of other coteries.

Prairie dogs are active during the day, usually from about sunrise to sunset, and during summer they spend about one-third to one-half of the daylight hours feeding. Another third is involved in social interactions with other colony members as well as working on burrows and mounds and responding to alarm calls. The remainder of daylight is spent underground, especially during midday when temperatures above ground are high. The black-tailed prairie dog is active all year. In winter, it remains underground for several days when weather is severe, but comes out on sunny afternoons to look for food and bask in the sun.

Black-tailed prairie dogs exhibit an elaborate communication system. At least 11 separate calls have been identified, and a variety of postures and displays are utilized. Calls range from signals of alarm to "all-clear." Physical contact is another method of prairie dog communication. Mouth-to-mouth contact is used to identify coterie members from strangers, and grooming among coterie members is common.

Food

Grasses are the preferred food of the prairie dog, and generally makes up about three fourths of its diet. In the fall, broadleaf forbs become more important as green grass is less available. In winter, any available green vegetation is consumed. In the spring and summer, each prairie dog consumes up to two pounds of vegetation per week.

In addition to the vegetation it eats, the prairie dog also clips much of the vegetation within its colony. This is probably done to keep the vegetation clipped short to provide an unobstructed view of approaching predators. Over a period of time, clipping, foraging and digging activities can alter the composition of the vegetation in a prairie dog town. Short, native grass like buffalograss and blue grama is favored when present.

Reproduction

A prairie dog reaches sexual maturity after its first winter and has one litter per year. Breeding takes place in March and early April, and a litter of 4-6 young is born 30 to 35 days later. Young prairie dogs are born hairless, helpless, and with their eyes closed. They remain underground for about six weeks and first emerge from the den in May or June. They are weaned at this time and begin feeding on green vegetation. They reach adult size by fall.

Mortality

Although the prairie dog has been known to live for at least eight years in captivity, its average life span in the wild is usually three to four years. In addition to actions of man, the prairie dog faces many natural predators. Badgers are probably the main predators, but coyotes, weasels, golden eagles, hawks, swift fox, and other predators take prairie dogs. Bullsnakes and rattlesnakes take young prairie dogs but generally not adults. The black-footed ferret was once a primary prairie dog predator, but it is now considered an endangered species and no wild ferrets have been verified in Nebraska since the 1940s.

A prairie dog is susceptible to a number of diseases, the most notable being plague. Plague is an infectious disease transmitted by the bite of an infected flea. Plague can devastate prairie dog populations, wiping out entire colonies in some areas. This disease was known as "black death" in the 1300s when about one-third of Europe's human population was lost. Although it can be transmitted to humans through the bite of an infected flea, plague has not been found in prairie dogs in Nebraska and is now treatable in humans.

Importance

In many ways, a prairie dog town can be considered a biological oasis. Many wildlife species associate with prairie dogs. Some species feed on prairie dogs, but others utilize the burrow systems or the unique habitat to fulfill their needs. Vacant burrows are used by cottontail rabbits, several species of small rodents, tiger salamanders, and by burrowing owls. Our most active towns have had successful nesting by burrowing owls. Meadowlarks, grasshopper sparrows, and other birds are found in greater numbers in prairie dog towns than in the surrounding rangeland because they are attracted to the open spaces, where seeds and insects are more accessible. In addition to their importance to other wildlife species, prairie dogs are also important to wildlife observers and photographers.

SITE DESCRIPTION

Originally, the Rainwater Basin in south central Nebraska contained more than 3,900 wetland basins within a 17-county area. The Basin region covers 4,200 square miles of flat to gently rolling Peorial Loess Plains. Wetland basins are generally large, shallow depressions with deep clay layers in the wetland basin–creating an impervious water barrier. The name Rainwater Basin

comes from the basins' ability to go from dry to flooded conditions quickly–following heavy rainstorms and snow melts. Continual siltation problems result from rapid runoff carrying heavy silt loads from agricultural land resulting in poor water quality. Soils surrounding the basins are very fertile, consisting of heavy silt loams and silty clay. Deep beneath the soil lies the Ogallala Aquifer, which is the source of water for the extensive amount of irrigated corn and soybeans. Water from the Platte River, lying north of the region, is delivered by irrigation canals to irrigate the southwest portion of the region. Agricultural and rural development has destroyed more than 90 percent of the original number of wetlands.

The Fish and Wildlife Service began acquiring wetlands in 1963 with the purchase of Massie Waterfowl Production Area (WPA). By 1966, 7,000 acres were acquired and a management office was established in Hastings, Nebraska. In 1976, the office was moved to its present location: Kearney, Nebraska.

The Rainwater Basin Wetland Management District (WMD) currently manages 63 tracts of land, 61 of which are Waterfowl Production Areas (WPA) totaling 23,059 acres. One of the remaining two areas is McMurtrey Wildlife Management Area that was transferred from the military. Its 1052 acres are closed to public use. The other tract is the Platte River National Wildlife Management Area (438 acres). This property is owned by the state of Wyoming and managed through a memorandum of understanding. WPAs are small isolated tracts of land scattered throughout the District. Most WPAs contain only one large wetland. All WPAs are managed as a grassland/wetland ecosystem. Wetland management is focused toward providing optimum waterfowl and shorebird habitats. The uplands are managed for a high diversity of native tall and mid-grass plant species. Thirty-eight FmHA conservation easements totaling 2350 acres are managed by this office as well.

Spring migration is the primary focus of the Rainwater Basin WMD. Each spring, about six million snow geese, one million Canada geese, 90 percent of the mid-continent white-fronted goose population, millions of ducks, and one-half million sandhill cranes use these wetlands and associated Platte River areas. Habitat becomes very critical during this time of year. Extensive pumping and aggressive wetland management are needed to maintain quality habitat for resting and staging.

In addition, we manage habitats to provide habitat for many other species of migratory birds and resident wildlife which utilize these grasslands and adjacent uplands.

Soils

Soils throughout the Rainwater Basin vary. In general, they are characterized as Peorial Loess. The soils formed under tall and mid-grass prairies and are characterized as deep, well drained, and fertile. The wetland or hydric soils are scattered throughout the WMD and are generally believed to have formed through a combination of wind and water erosion. Scouring events created a depression and rainfall events caused the migration of clays to the bottom of the basin. These hydric soils (Massie, Scott, and Fillmore soils) have a clay layer from 1 to 10 feet thick. They create an impermeable layer and restrict movement of water.

Surrounding Land Uses

The major industry and source of income throughout the WMD is crop and livestock production. Nearly every acre has been converted to agricultural use. Small to medium sized communities (25,000 residents) are scattered across the WMD.

Current Status of Black-tailed Prairie Dogs on WPAs

We currently have 5 WPAs with known active black-tailed prairie dog towns (see Figure 1). These are Prairie Dog (see Figure 2), Atlanta (see Figure 2), McMurtrey (see Figure 4), Hultine (see Figure 5), and Clark (see Figure 6) WPAs. These were surveyed in 1999 and again in 2003. McMurtrey, Atlanta, and Prairie Dog WPAs appear to have viable populations at this time. Atlanta WPA currently has the largest dog town at 24 acres yet, most are less than 8 acres.

On Prairie Dog WPA, a number of abandoned burrows were re occupied after initiating grazing on the sites. Likely, individuals from the active burrows relocated into these abandoned burrows.

The town on Atlanta WPA has remained relatively the same size, and has not expanded outside of the electric fence lines placed to control grazing access. The population on McMurtrey NWR, appears to be well established from re-introductions made in 2001.

The towns on Clark and Hultine WPAs established after several years of heavy grazing. The newly established towns on both sites are small, containing less than 12 burrows each in the summer of 2003. They both have the potential to expand into previously occupied burrows.

REINTRODUCTION

Reintroduction

A number of additional WPAs have evidence that historic black-tailed prairie dog towns (see Figure 7). Old burrows and mounds can still be found. We propose that re-introductions of black-tailed prairie dogs be made into these historic sites. In addition, several high public use sites on Harvard, Massie, Mallard Haven, and Funk WPAs that have the potential for environmental education and interpretation along with establishing a viable population, are proposed release sites. Although no evidence in the form of mounds or burrows exists at these sites, it is believed that historically black-tailed prairie dogs could be found in the immediate vicinity of these sites. Currently, seven release sights including both historic and new dog towns are proposed (see Figure 8) and will be populated as circumstance allow. We propose re-introductions of black- tailed prairie dogs into these sites under the following conditions:

1. All landowners immediately adjacent to the proposed reintroduction site have been contacted to discuss our intent, management options, and concerns.
2. Private rangeland is not located immediately adjacent to the proposed release site and/or an adequate cultivated barrier exists to minimize movement from the re-introduction site and discourage colonization on adjacent private land.
3. Suitable habitat exists at the time of release. Suitable habitat includes poor stands of grass commonly dominated by introduced grasses.

Intended release sites should provide suitable black-tailed prairie dog habitat at the time of release. This would include vegetation 3" or less in height and a minimum of one “burrow” for every four animals released. The vegetation could be grazed, or mowed if grazing were not possible, through the growing season to keep it short. Burrows could be present from a historic town, or they could be drilled in with the 6" auger attachment on the Bobcat. Drill one burrow for every two dogs released. Both of these conditions will reduce the likelihood that the prairie dogs will abandon the site upon release and would likely result in a higher survival rate of released animals.

Pre-Capture

We are occasionally contacted by individuals wishing to remove prairie dogs from their property. They would be willing to allow these prairie dogs to be live trapped for relocation. If we have a suitable re-introduction site where all three conditions stated above have been met, we may consider accepting these prairie dogs for reintroduction purposes. Each proposal will be evaluated on a case by case basis, giving preference to those sites closest to the proposed reintroduction site. If our staff will be required to conduct the trapping and relocation, time budgets of the staff will be given priority and will only be conducted when our workload allows.

Prior to trapping, the prairie dog town that will be trapped should be surveyed for indications of

disease. A walk through should be done looking for signs of dead animals including other species. Remote monitoring of animals should be done using a spotting scope for one hour during midday (at least three hours after sunrise and two hours before sunset) on a sunny day. It is recommended that all burrows be treated 10 days prior to trapping with Delta Dust to kill fleas currently inhabiting the colony. If dead animals are found, two options can be taken: 1) bag the animal and send to the disease lab to determine cause of death; 2) find another trapping sight.

Pre-baiting with should start three days before trapping begins. Live traps can be placed within 3 feet of active burrows and locked open during pre-baiting. Trapping should start after June 1 and can be done until sub-freezing temperatures occur.

Monkey pox was recently a high profile news story with regards to handling of prairie dogs. The origin of the outbreak was traced to a shipment of prairie dogs in the pet trade. These prairie dogs then infected humans which handled them. USDA APHIS immediately placed restrictions on the trade and handling of prairie dogs. At this time, it does not appear that these restrictions apply to the US Fish and Wildlife Service with regards to ongoing research and/or management of wild populations of prairie dogs. This new outbreak should reinforce the need to research the background of any potential capture sites and exclude any that may have had captive black- tailed prairie dogs released on site.

Capture

New bait but smaller portions should be used during the trapping stage. Traps should be unlocked with bait placed on the pan or just behind the pan. If needed, flagging should be used to mark traps since they may be difficult to monitor from a distance so not to disturb the colony unless animals have been captured. Traps should not be left unlocked if they cannot be checked at least every 24 hours.

Once animals have been captured, they should be dusted with flea powder (the product Seven is recommended) before the trap is moved. Long gloves should be used to prevent fleas from bitting around the wrist. Traps can then be placed in the back of a pickup and removed from the site and taken to the quarantine site.

A 24-hour quarantine is required after trapping. Captured animals should be left in the traps they were captured in. They should be placed in a cool and dry area such as a pole barn or well ventilated shed. If a longer quarantine is used, apple slices can be used to sustain the animals and will meet their food and water requirements.

Any dead animals found during the quarantine should be handled with extreme caution. These animals should be sent to the disease lab for analysis. If plague is found, these animals should not

be used for reintroduction.

Post Release

After release, the site will be periodically surveyed to determine presence or absence of prairie dogs, if vegetation is conducive to expansion, limiting expansion, or maintaining populations. Currently, 8-10 acre prairie dog towns appear to be manageable. Larger towns could be maintained on a few WPA's as long as the station's mission and goals are not jeaprodized. Three or four areas could have up to 30 acre prairie dog towns if further expansion is controllable and the threat of colonization on adjacent land is minimal. It is also necessary to monitor adjacent cropland for potential foraging impacts due to overcrowding, expansion, or changes in forage quantity on WPA's.

MANAGEMENT

Management includes any activity conducted to control the size of the prairie dog town, maintain the habitat suitability for black-tailed prairie dogs, and/or ensure its long term viability.

Hunting black-tailed prairie dogs on Federal Waterfowl Production Areas in the Rainwater Basin WMD was closed as of 01/01/2003. We propose to leave this closure in place indefinitely. This decision was made based upon the relatively small size of the towns, small populations, and relative isolation from other active towns. Although significant harvest was not believed to be occurring before the closure, changes in local interest in prairie dog shooting along with decreasing opportunities would likely have led to an increase in harvest.

Active prairie dog towns on Atlanta, Prairie Dog, McMurtrey, Clark, and Hultine WPAs have been managed primarily through heavy grazing over the last four seasons. Grazing cooperators are instructed to place water tanks on the town site. This results in short, clipped vegetation which is more suited to maintaining a viable town. We have interseeded buffalo grass and blue grama on these sites, with the expectation that increased grazing pressure will result in establishment of these two, low growing grasses. Although not widely distributed in the mid and tall grass prairie, buffalo grass and blue grama can be found in areas which are heavily grazed. We plan to continue grazing at a rate sufficient to maintain a vegetative height less than 3" on active towns. If grazing is not an option in some years, mowing may be considered as a possible alternative.

Management

Historic black-tailed prairie dog towns may be re-occupied without re-introductions simply by providing suitable habitat. Prairie dogs, especially the first year class, have been documented to disperse into suitable habitat located several miles away. By grazing these historic towns at a rate sufficient to provide suitable habitat, it is conceivable they may be re-occupied at some point. This is what we believe occurred on Clark and Hultine WPAs.

Our land acquisition program has the potential to acquire new WPAs that may contain active black-tailed prairie dog towns. Should we acquire lands with an active black-tailed prairie dog town, we will manage the sites in a similar fashion to maintain a viable town within a defined boundary.

It has been demonstrated that fence placement alone has been sufficient to prevent the spread of a town outside of the defined boundary on Prairie Dog and Atlanta WPAs (see Figure 2 & 3). We feel that this phenomenon will hold true across the WMD. The grassland vegetation in these precipitation zones grows faster than the prairie dogs can cut it, resulting in unsuitable habitat. If private pasture exists adjacent to the release site, it is conceivable to believe that some prairie dogs would relocate to this pasture and cause damage by their burrowing activities. That is why release under these circumstances will be carefully considered. The majority, however, have adjacent cropland. The annual tillage and tall growth eliminate cropland as potential black- tailed prairie dog habitat.

Control

In the event that our assumptions are wrong and that the black- tailed prairie dogs spread outside of the defined boundaries, control measures will be taken. All legal and effective methods for prairie dog control may be considered, excluding the use of any toxicants.

Some options considered but are not limited too:

Box traps	Although relatively ineffective at capturing large numbers, this may be considered where individual animals may want to be salvaged for some purpose.
Leghold traps	Placed in front of burrow entrances, may be relatively effective at reducing a small number of animals.

Management

Visual barriers	The use of snow fence, hay bales, or other visual obstructions have proven successful in some places with reducing or eliminating the spread of prairie dogs from a defined boundary.
Raptors	The installation of raptor perches along the perimeter of prairie dog towns has proven successful at some locations for reducing the spread of the town.
Shooting	Shooting individual animals which have spread outside of the designated boundaries could prove effective. This could be accomplished by US Fish and Wildlife Service staff or by an individual through a Special Use Permit.

REFERENCES

Black-tailed Prairie Dog Surveys for 1999 and 2003. Rainwater Basin Wetland Management District. Unpublished report.

Boddicker, Major L. Prevention and Control of Wildlife Damage. B-75 to B-84 Prairie Dogs.

Hyngstrom, Scott E., and Dallas R. Virchow. Prairie Dogs and the Prairie Ecosystem.

Luce, Bob, et. al. A Multi-State Conservation Plan for the Black-tailed Prairie Dog, *Cynomys ludovicianus*, in the United States. 2002.

Nebraska Game and Parks Commission Website:
http://www.ngpc.state.ne.us/wildlife/pdogs.html

Van Pelt, William E. The Black-tailed Prairie Dog Conservation Assessment and Strategy.

.

References

2003 Active Prairie Dog Towns on WPAs

Figure 1

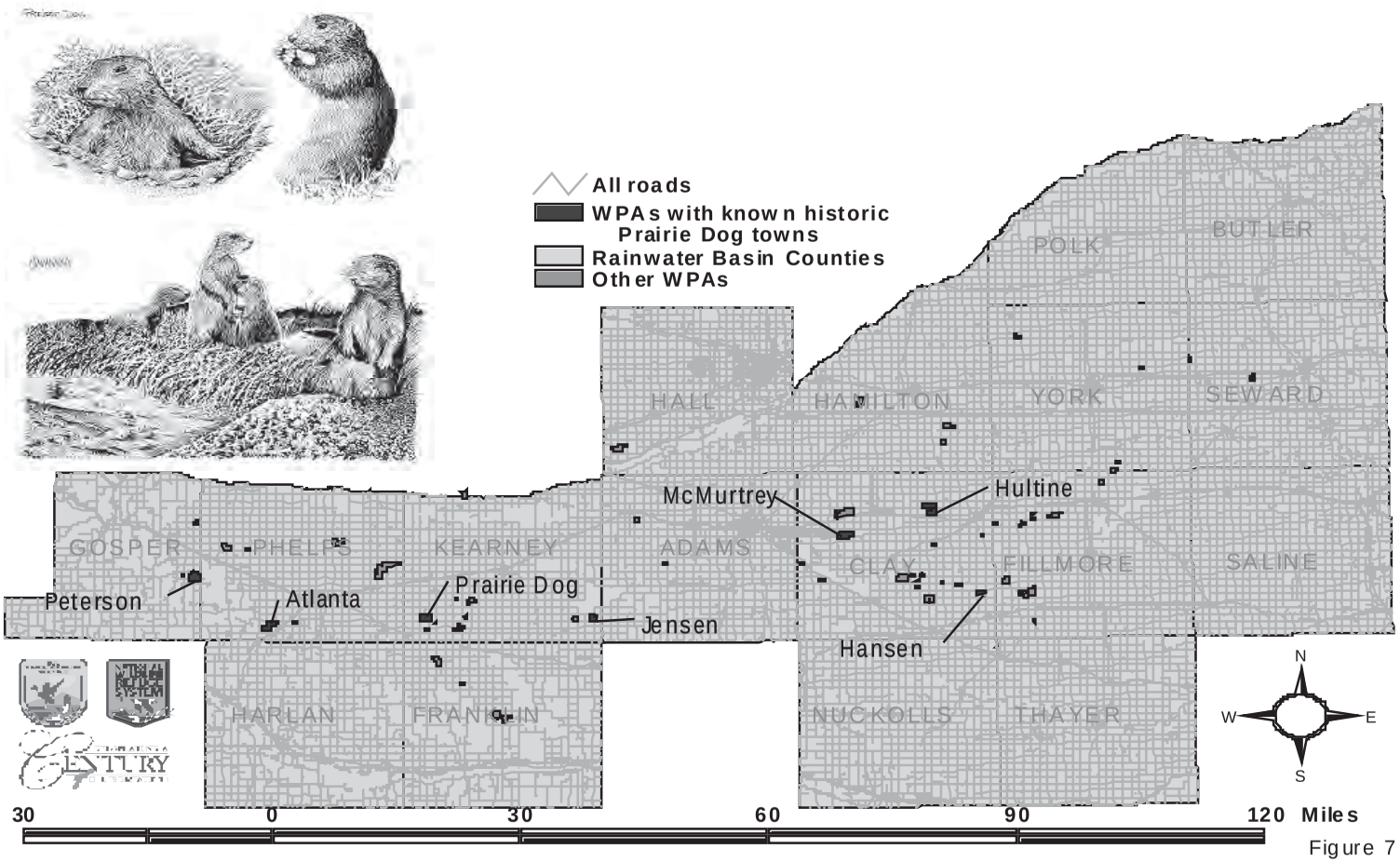

Historic Black-tailed Prairie Dog Towns on WPAs
All roads
WPAs with known historic Prairie Dog towns
Rainwater Basin Counties
Other WPAs
POLK
BUTLER
HALL
HAMILTON
YORK
SEWARD
McMurtrey
Hultine
GOSPER
PHELPS
KEARNEY
ADAMS
CLAY
FILLMORE
SALINE
Peterson
Atlanta
Prairie Dog
Jensen
Hansen
HARLAN
FRANKLIN
NUCKOLLS
THAYER
N
W
E
S
30
0
30
60
90
120 Miles

Figure 7

Proposed Black-tailed Prairie Dog Release Areas

Figure 8

Appendix F

List of Plants

The Service maintains a list of plant species at <http://www.fws.gov/nwi/bha/list88.html> that occur in wetlands. The following list of plants for WPAs managed by the Rainwater Basin Wetland Management District was generated using the region 5 map (1,523 plant species) from this website. The USDA Plants website at <http://plants.usda.gov> listed 9,485 plant species for Nebraska. Both the USDA Plants website and the NatureServe Explorer website at <http://www.natureserve.org/explorer> were used to verify scientific names, common names, and habits for those species not listed on the Service website.

SCIENTIFIC NAME

Scientific name is the genus and species applied to the taxon by the National List of Scientific Plant Names (1982), USDA Plants, NatureServe Explorer (2006).

NATIONAL RANGE OF INDICATORS

The national indicators reflect the range of estimated probabilities (expressed as a frequency of occurrence) of a species occurring in wetland versus nonwetland across the entire distribution of the species. A frequency, for example, of 67%–99% (facultative wetland) means that 67%–99% of sample plots containing the species randomly selected across the range of the species would be wetland. A question mark (?) following an indicator denotes a tentative assignment based on the botanical literature and not confirmed by regional review. When two indicators are given, they reflect the range from the lowest to the highest frequency of occurrence in wetlands across the regions in which the species is found. A positive (+) or negative (–) sign was used with the facultative indicator categories to more specifically define the regional frequency of occurrence in wetlands. The positive sign indicates a frequency toward the higher end of the category (more frequently found in wetlands), and a negative sign indicates a frequency toward the lower end of the category (less frequently found in wetlands).

National Wetland Indicator (Indicator Categories)

Obligate Wetland (OBL). Occur almost always (estimated probability >99%) under natural conditions in wetlands.

Facultative Wetland (FACW). Usually occur in wetlands (estimated probability 67%–99%), but occasionally found in nonwetlands.

Facultative (FAC). Equally likely to occur in wetlands or nonwetlands (estimated probability 34%–66%).

Facultative Upland (FACU). Usually occur in nonwetlands (estimated probability 67%–99%), but occasionally found on wetlands (estimated probability 1%–33%).

Obligate Upland (UPL). Occur in wetlands in another region, but occur almost always (estimated probability >99%) under natural conditions in nonwetlands on the region specified. If a species does not occur in wetlands in any region, it is not on the National List.

The wetland indicator categories should not be equated to degrees of wetness. Many obligate wetland species occur in permanently or semipermanently flooded wetlands, but a number of obligates also occur and some are restricted to wetlands that are only temporarily or seasonally flooded. The facultative upland species include a diverse collection of plants that range from weedy species adapted to exist in a number of environmentally stressful or disturbed sites (including wetlands) to species in which a portion of the gene pool (an ecotype) always occurs in wetlands. Both the weedy and ecotype representatives of the facultative upland category occur in seasonally and semipermanently flooded wetlands.

Region 5 Wetland Indicator (Regional Indicator for 5—Central Plains NE, KS, CO [Eastern])

The regional indicator reflects the estimated probability (likelihood) of a species occurring in wetlands versus nonwetlands in the region. Regional indicators reflect the unanimous agreement of the Regional Interagency Review Panel. If a regional panel was not able to reach a unanimous decision on a species, NA (no agreement) was recorded on the regional indicator field. An NI (no indicator) was recorded for those species for which insufficient information was available to determine an indicator status. A nonoccurrence (NO) designation indicates that the species does not occur in that region. An asterisk (*) following a regional indicator identifies tentative assignments based on limited information from which to determine the indicator status.

HABIT

Habit indicates the plant characteristics and life forms assigned to each species in the National List of Scientific Plant Names (1982) and by the Soil

Conservation Service. Family names are listed alphabetically under specific life forms restricted to these families. The habit symbols are combined to describe the life form of the species (for example, ANG means annual native grass and IT means introduced tree).

Habit Symbol	*Characteristic or Life Form*	
A	Annual	
B	Biennial	
C	Clubmoss	Lycopodiaceae Selaginellaceae
E	Emergent	
F	Forb	
/	Floating	
F3	Fern	Adiantaceae Aspleniaceae Blechnaceae Cyatheaceae Davalliaceae Dennstaedtiaceae Dryopteridaceae Gleicheniaceae Grammitidaceae Hymenophyllaceae Lomariopsidaceae Marattiaceae Ophioglossaceae Osmundaceae Parkeriaceae Polypodiaceae Psilotaceae Pteridaceae Schizaeaceae
G	Grass	Poaceae
GL	Grasslike	Cyperaceae Juncaceae
H	Partly woody	
HS	Half shrub	
H2	Horsetail	Equisetaceae
I	Introduced	
N	Native	
P	Perennial	
+	Parasitic	
P3	Pepperwort	Marsileaceae
Q	Quillwort	Isoetaceae
S	Shrub	
–	Saprophytic	
Z	Submerged	
$	Succulent	
T	Tree	
V	Herbaceous vine	
W	Waterfern	Azollaceae Salviniaceae
WV	Woody vine	

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Abutilon theophrasti	velvetleaf	UPL–FACU–	UPL	AIF
Achillea millefolium	common yarrow	FACU	FACU	PNF
Agropyron elongatum	tall wheatgrass	FAC,FACU*	NI	PNG*
Agropyron smithii	western wheatgrass	FACU	UPL,FAC–	PNG
Agrostis hyemalis (A. antecedens)	ticklegrass	FACU	FACU,FACW	PNG
Agrostis gigantea	redtop	FAC+,FACW	FAC+	PNG
Alisma plantago-aquatica	European water plantain	OBL	OBL	PNEF
Alisma subcordatum	American water plantain	OBL	OBL	PNEF
Allium canadense	meadow onion	FACU–,FACU	FACU	PNF
Allium canadense var. *lavendulare*	meadow onion	FACU–,FACU	FACU	PNF
Alopecurus carolinianus	Carolina foxtail	FACW	FAC+,FACW	ANG
Amaranthus arenicola	sandhill amaranth	UPL,FAC	FACU	ANF
Amaranthus retroflexus	redroot amaranth	FACU	FACU–,FAC–	ANF
Amaranthus rudis	amaranth	FACW	FACU–, FACW	ANF
Ambrosia artemisiifolia	annual ragweed	FACU	FACU–,FACU+	ANF
Ambrosia grayi	woollyleaf burr ragweed	FAC	FAC,FACW	PNF
Ambrosia psilostachya	naked-spike ragweed	FAC	FACU–, FAC	PNF
Ambrosia trifida	great ragweed	FACW	FAC,FACW	ANF
Ammannia coccinea	valley redstem	OBL	FACW+,OBL	ANF
Amorpha canescens	leadplant	FAC*	NI	PNF*
Andropogon gerardii	big bluestem	FAC–	FACU,FAC	PNG
Apocynum cannabinum	clasping-leaf dogbane	FAC	FACU,FAC+	PNF
Argemone spp. *(polyanthemos)*	crested pricklypoppy	UPL		PNF
Aristida oligantha	three-awn grass	FACU*	NI	PNG*
Artemisia ludoviciana	white sagebrush	FACU–	UPL,FACU	PNFH
Asclepias stenophylla	slim-leaved milkweed	FACU*	NI	PNF*
Asclepias syriaca	common milkweed	FACW–*	NI	PNF
Asclepias verticillata	whorled milkweed	UPL		PNF
Asclepias viridiflora	woolly milkweed	UPL		PNF
Asclepias viridis	green antelopehorn	UPL		PNF
Aster junciformis	rush aster	OBL	OBL	PNF
Aster spp. (see *Symphyotrichum)*	wild aster	UPL,OBL*	NI	PINF*
Astragalus canadensis	Canadian milkvetch	FACU	FACU,FACW–	PNF
Astragalus crassicarpus	groundplum milkvetch	UPL		PNF

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Azolla mexicana	Mexican mosquito fern	OBL	OBL	PN/W
Bacopa rotundifolia	disk water-hyssop	OBL	OBL	PNF
Baptisia bracteata	long-bract indigo	UPL		PNF
Berula erecta	water parsnip	OBL	OBL	PIF
Bidens cernua	nodding beggar-ticks	OBL	FACW+,OBL	AIF
Bidens comosa	leafy-bract beggar-ticks	FACW	FACW	ANF
Bidens frondosa	devil's beggar-ticks	FACW	FACW,FACW+	ANF
Bidens vulgata	big devil's beggar-ticks			ANF
Boltonia asteroides	white boltonia	FACW	FACW,OBL	PNF
Bouteloua curtipendula	sideoats grama	FACU*	NI	PNG*
Bouteloua gracilis	blue grama	UPL*	NI	PNG*
Brickellia eupatorioides	false boneset	UPL		PNF*
Bromus inermis	smooth brome	UPL*	NI	PNG*
Bromus japonicus	Japanese brome	FACU	FACU,UPL	AIG
Bromus tectorum	downy brome	UPL*	NI	ANG*
Bryophyte spp.	moss	NI	NI	NI
Buchloe dactyloides	buffalograss	FACU	FACU–,FACU	PNG
Calamagrostis canadensis	bluejoint	OBL	FAC,OBL	PNG
Calamovilfa longifolia	prairie sandreed	UPL		PNG
Callirhoe alcaeoides	light poppymallow	UPL		PNF
Callirhoe involucrata	purple poppymallow	UPL		PNF
Calylophus serrulatus	yellow sundrops	UPL		PNF
Calystegia sepium (Convolvulus sepium)	hedge false bindweed	FAC		PNFV
Cannabis sativa	hemp	FAC+*	NI	ANF*
Capsella bursa-pastoris	common shepherd's purse	FACU	FACU,FAC	AIF
Cardus nutans	musk thistle	UPL		B/PIF*
Carex bicknellii	Bicknell's sedge	FACU,FACW	FACU	PNGL
Carex brevior	short-beak sedge	FAC	UPL,OBL	PNEGL
Carex cristatella	crested sedge	FACW	FAC,FACW+	PNGL
Carex gravida	heavy sedge	OBL*		PNGL
Carex laeviconica	smooth-cone sedge	OBL	OBL	PNEGL
Carex lanuginosa (C. pellita)	woolly sedge	OBL	OBL	PNGL
Carex tribuloides	blunt broom sedge	FACW,OBL	FACW	PNGL
Carex vulpinoidea	fox sedge	OBL	OBL	PNEGL

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Carex × stipata	stalk-grain sedge	OBL	OBL	PNGL
Cassia chamaecrista	showy partridge pea	UPL		ANF
Ceanothus americanus	New Jersey tea	UPL		PNF
Ceanothus herbaceus	Jersey tea	UPL		PNS
Celtis occidentalis	hackberry			PNT
Celtis occidentalis	common hackberry	UPL		PNT
Cenchrus longispinus	sandbur	FAC*	NI	ANG*
Chenopodium album	lambsquarters	FAC	FACU,FAC	AIF
Chenopodium desiccatum	aridland goosefoot	UPL		ANF
Chenopodium leptophyllum	narrowleaf goosefoot	NI	UPL,FAC	ANF
Cichorium intybus	chicory			BPIF
Circaea spp.	enchanter's nightshade	FACW,UPL		PNF
Cirsium altissimum	roadside thistle	FAC*	NI	BNF*
Cirsium arvense	Canada thistle	FACU	FACU–,FAC	PIF
Cirsium canescens	prairie thistle	UPL		BNF*
Cirsium flodmanii	Flodman's thistle	NI	FACU?	PNF
Cirsium ochrocentrum	yellowspine thistle	UPL		BPNF
Cirsium spp.	thistles	FAC+*	NI	ABINF*
Cirsium undulatum	wavy-leaf thistle	FACU	FACU,FAC	BPNF
Cirsium vulgare	bull thistle	UPL	UPL,FAC	BIF
Comandra umbellata	umbellate bastard toad-flax	UPL,FACU	UPL	PN+F
Convolulus spp.	field bindweed	FAC*	NI	PNF*
Convolvulus arvense	field bindweed	FAC*	NI	PNF*
Conyza canadensis	Canada horseweed	FACU–	UPL,FAC	ANF
Conyza ramosissima	dwarf horseweed	FAC*	NI	ANF
Coreopsis tinctoria	golden tickseed	FAC	FACU,FAC	ANF
Crepis runcinata	hawksbeard dandelion	FAC	FACU,FACW	PNF
Cyperus acminatus	short-point flatsedge	OBL	OBL	ABPNGL
Cyperus aristatus	awned flatsedge	OBL	FACW+,OBL	ANGL
Cyperus erythrorhizos	redrooted cyperus	OBL	FACW+,OBL	APNEGL
Cyperus esculentes	chufa	FACW	FAC,FACW	PNGL
Cyperus lupulinus	Houghton flatsedge	FACU		PNG
Dalea candida	white prairie clover	UPL		PNF
Dalea purpurea	violet prairie clover	UPL		PNF

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Dalea villosa	silky prairie clover	UPL		PNFHS
Delphinium carolinianum	Carolina larkspur	UPL		PNF
Delphinium virescens	prairie larkspur	UPL		PNF
Desmanthus illinoensis	prairie bundleflower	FACU	UPL,FAC	PNF
Desmodium canadense	showy tick-trefoil	FAC	FACU,FAC	PNF
Desmodium illinoense	Illinois tick-trefoil	UPL		PNF
Dianthus armeria	Deptford pink	UPL		PNF
Dichanthelium acuminatum	panic grass	FAC,FACW	FAC	PNG
Dichanthelium oligosanthes	Heller's witchgrass	FACU	FACU,FAC	PNG
Digitaria sanguinalis	hairy crabgrass	FACU	FACU–,FAC–	AIG
Echinacea angustifolia	blacksamson echinacea	UPL		PNG
Echinochloa crusgalli	barnyard grass	FACW	FACU,FACW	AIG
Echinochloa muricata	rough barnyard grass	OBL	FAC,OBL	ANG
Elatine rubella	red waterwort			ANF
Eleocharis compressa	flat-stem spikerush	FACW	FACW, FACW+	PNEGL
Eleocharis erythropoda	bald spikerush	OBL	OBL	PNGL
Eleocharis obtusa	blunt spikerush	OBL	OBL	APNEGL
Eleocharis ovata	ovate spikerush	OBL	OBL	ANEGL
Eleocharis palustris	creeping spikerush	OBL	OBL	PNEGL
Eleocharis smallii	Small's spikerush	OBL	OBL	PNGL
Elymus canadensis	nodding wild rye	FACU	FACU, FAC+	PNG
Elymus smithii	western wheatgrass	FACU		PNG
Elymus trachycaulus	slender wheatgrass	FACU		PNG
Elymus virginiana	Virginia wild rye	FAC	FAC,FACW	PNG
Eragrostis spectabilis	purple lovegrass	FACU	UPL,FACU	PNG
Erigeron annuus	white-top fleabane	FACU	FACU,FAC	ANF
Erigeron philadelphicus	Philadelphia fleabane	FACU	FACU,FAC	ANF
Erigeron strigosus	prairie fleabane	FAC	FACU,FAC	ANF
Eupatorium perfoliatum	common boneset	OBL	FACW+,OBL	PNF
Euphorbia cyathophora	fire-on-the-mountain	UPL		NAPF
Euphorbia dentata	toothed spurge	UPL		AIF
Euphorbia maculata (Chamaesyce maculata)	spotted broomspurge	FACU–	UPL,FACU	ANF
Euphorbia marginata	snow-on-the-mountain	UPL,FACU	FACU	ANF
Euphorbia nutans	eyebane broomspurge	FACU–,FACU	FACU–	AIF

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Festuca arundinacea	Kentucky fescue	FACU	UPL,FACW–	PIG
Festuca saximontana	Rocky Mountain fescue			NPG
Fragaria virginiana	Virgina strawberry	UPL,FAC	FACU	PNF
Fraxinus pennsylvanica	green ash	FACW	FAC,FACW	NT
Gaillardia pulchella	blanketflower	UPL		PNF
Galium aparine	catchweed bedstraw	FACU	FACU,FAC–	ANF
Gaura coccinea	scarlet gaura	UPL		PNS/F
Gaura parviflora	velvet-leaf butterfly-weed	FACU?	NI	ANF
Gleditsia triacanthos	honey-locust	FAC	FACU,FAC	NTS
Glyceria striata	fowl mannagrass	OBL	OBL	PNEG
Glycine max	soybean	UPL*	NI	AI*
Glycyrrhiza lepidota	American licorice	FACU	UPL,FAC+	PNF
Grindelia squarrosa	curly-cup gumweed	FACU–	UPL,FACU	ABPNF
Gutierrezia sarothrae	broom snakeweed	UPL		PNS/F
Hedeoma hispida	rough false pennyroyal	UPL		ANF
Helianthus annuus	common sunflower	FACU	FACU,FAC	ANF
Helianthus grosseserratus	saw-tooth sunflower	FACW	FAC,FACW	PNF
Helianthus maximiliani	Maximilian's sunflower	UPL	UPL,FACU	PNF
Helianthus petiolaris	prairie sunflower	UPL		ANF
Helianthus rigidus	stiff sunflower	UPL		PNF
Hesperis matronalis	dames rocket			IBPF
Hesperostipa spartea	porcupinegrass	UPL		PNG
Hesperostipa viridula	green needlegrass	UPL		NG
Heteranthera limosa	blue mud-plantain	OBL	OBL	ANEF
Heteranthera multiflora	bouquest mud-plantain	OBL		ANF
Heterotheca villosa	hairy goldaster	UPL		PNF
Hieracium longipilum	hairy hawkweed	FACU		PNF
Hordeum jubatum	fox-tail barley	FACW	FAC,FACW	PNG
Hordeum pusillum	little barley	FAC	FACU,FAC	ANG
Hypoxis hirsuta	eastern yellow stargrass	FAC,FACW	FACW	PNF
Ipomoea hederacea	ivyleaf morning-glory	FACU,FAC	FACU	AIV
Ipomoea leptophylla	bush morning-glory	UPL		PNF
Ipomoea pandurata	wild sweet-potato vine	FACU,FAC–	FAC–	PNF
Ipomoea purpurea	common morning-glory	UPL,FAC	FACU	AIV

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Juncus dudleyi	Dudley rush			PNG
Juncus interior	inland rush	FAC	FACU,FACW	PNGL
Juncus spp.	rush	FACW*	NI	PNGL*
Juniperus virginiana	eastern red cedar	FACU–	FACI–,FACU	NT
Kochia scoparia	Mexican summer-cypress	FACU	UPL,FAC	AIF
Koeleria macrantha	prairie Junegrass	UPL		PNG
Kuhnia eupatoriodes	false boneset	FAC,FACU*	NI	PNF*
Lactuca canadensis	tall yellow lettuce	FACU	FACU–,FAC+	ABNF
Lactuca ludoviciana	biannual lettuce	FAC	UPL,FAC	BPNF
Lactuca serriola	prickly lettuce	FAC	FACU,FAC	ABIF
Lactuca tatarica	blue lettuce	FAC		BPNF
Leersia oryzoides	rice cutgrass	OBL	OBL	PNG
Lemna minor	lesser duckweed	OBL	OBL	PN/F
Lemna trisulca	star duckweed	OBL	OBL	PN/F
Lepidium densiflorum	common pepperweed	FAC		ABNF
Lepidium virginicum	Virginia pepperweed	UPL,FAC–	FACU	ABNF
Leptochloa fascicularis	bearded sprangletop	OBL	FACW,OBL	ANG
Lespedeza capitata	round-head bushclover	UPL	UPL,FACU	PNF
Liatris punctata	dotted gayfeather	FACU		PNF
Liatris pycnostachya	cattail gayfeather	FAC	FACU,FAC+	PNF
Limosella aquatica	northern mudwort	OBL	OBL	APNEF
Lindernia dubia	yellowseed false pimpernel	OBL	OBL	ANF
Linum rigidum	stiffstem flax			APNF
Lithospermum incisum	narrow-leaved puccoon	UPL		PNF
Lomatium foeniculaceum	wild parsley	UPL		PNF
Lotus corniculatus	bird's-foot trefoil	FACU	FACU–,FAC	PIF
Lotus purshianus	prairie trefoil	FACU*	NI	ANF*
Lotus unifoliolatus	American bird's-foot trefoil			ANF
Ludwigia palustris	marsh seedbox	OBL	OBL	PNEF
Lycopus americanus	American bugleweed	OBL	OBL	PNF
Lygodesmia juncea	rush skeletonplant	UPL		PNF
Lythrum salicaria	purple loosetrife	FACW+,OBL	OBL	PIF
Marsilea vestita	hairy water fern	OBL	OBL	PNEP3
Medicago sativa	alfalfa			APIF

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Melilotus alba	white sweetclover	FACU	FACU–,FACU+	ABIF
Melilotus officinalis	yellow sweetclover	FACU	FACU–,FACU+	ABIF
Mirabilis linearis	narrowleaf four o'clock			PNFHS
Mirabilis nyctaginea	heartleaf four o'clock	UPL	UPL,FACU	PNF
Mollugo verticillata	green carpet-weed	FAC	FAC–,FAC	ANF
Monarda fistulosa	wild bergamot	UPL,FAC+	FACU–	PNF
Morus alba	white mulberry	UPL,FAC	FAC	IT
Morus rubra	red mulberry	FACU	FACU, FAC	NT
Muhlenbergia mexicana	Mexican muhly	FACW	FAC,FACW	PNG
Muhlenbergia racemosa	green muhly	FACW	FACU,FACW	PNG
Myosurus minimus	tiny mouse-tail	FACW	FACW–OBL	ANF
Nepeta cataria	catnip	FACU	FACU–,FACW–	PIF
Oenothera biennis	common evening-primrose	FACU	FACU–,FACU+	BIF
Oenothera villosa	hairy evening-primrose	FAC	FACU,FACW	BPNF
Oligoneuron rigidum	goldenrod	UPL		PNF
Oxalis dillenia	gray-green woodsorrel	FACU*	NI	PNF*
Oxalis stricta	yellow woodsorrel	FACU*		PNF
Oxalis violacea	violet woodsorrel	UPL		PNF
Panicum capillare	witchgrass	FAC	FACU,FAC	ANG
Panicum dichotomiflorum	fall panic grass	FAC	FAC,FACW	ANG
Panicum virgatum	switchgrass	FAC	FAC,FACW	PNG
Parientaria pensylvanica	Pennsylvania pellitory	FAC	FACU–,FACW–	ANF
Penstemon grandiflorus	large-flower beardtongue	UPL		PNF
Phalaris arundinacea	reed canarygrass	FACW+	FACW,OBL	PNG
Phleum pratense	timothy	FACU	FACU	PIG
Phyla cuneifolia	wedgeleaf fog-fruit	FAC		PNS/F
Physalis heterophylla	clammy groundcherry	UPL		PNF
Physalis longifolia	longleaf groundcherry	UPL		PNF
Physalis spp.	groundcherry	FAC*	NI	AP*
Physalis virginiana	Virginia groundcherry	UPL		PNF
Poa compressa	Canada bluegrass	FACU	FACU–,FAC	PIG
Poa pratensis	Kentucky bluegrass	FACU	FACU,FAC–	PNG
Polygala alba	white milkwort			PNF
Polygonum arenastrum	knotweed	UPL*	NI	APNF*

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Polygonum bicorne (P. pensylvanicum)	pink smartweed	FACW+	FACW–,OBL	ANEF
Polygonum coccineum	water smartweed	OBL	OBL	PNE/F
Polygonum hydropiper	swamp smartweed	OBL	OBL	PNEF
Polygonum lapathifolium	curlytop knotweed	OBL	FAC,OBL	ANF
Polygonum persicaria	spotted ladysthumb	OBL	FAC,OBL	AIF
Polygonum punctatum	dotted smartweed	OBL	FACW,OBL	PNEF
Polygonum ramosissimum	bushy knotweed	FAC	FACU–,FACW	ANF
Populus deltoides	eastern cottonwood	FAC	FAC,FACW	NT
Portulaca oleracea	common purslane	FAC	FACU,FAC	AN$F
Potamogeton gramineus	variable pondweed	OBL	OBL	PNZF
Potamogeton nodosus	longleaf pondweed	OBL	OBL	PNZF
Potentilla arguta	tall cinquefoil	FACU	UPL,FACU+	PNF
Potentilla norvegica	Norwegian cinquefoil	FAC	FACU,FAC	ABPNF
Potentilla recta	sulphur cinquefoil	FACU*	NI	PNF*
Prenanthes racemosa	glaucous rattlesnake-root	FAC	FACU–,FACW	PNF
Prunella vulgaris	heal-all	FAC	FACU,FACW	PIF
Prunus americana	American plum	UPL	UPL,FACU	NST
Prunus virginiana	chokecherry	FACU	FACU–,FAC	NST
Psoralea argophylla	silver-leaf scurfpea	FACU*	NI	PNF*
Psoralea tenuiflora	few-flowered scurfpea	UPL		PNF
Psoralidium lanceolatum	lemon scurfpea	UPL		PNF
Pulsatilla patens	pasqueflower	UPL		PNF
Ranunculus flabellaris	yellow water buttercup	OBL	OBL	PNEF
Ranunculus longirostris	longbeak buttercup	OBL	OBL	PNZ/F
Ranunculus pensylvanicus	Pennsylvania buttercup	FACW,OBL	OBL	APNEF
Ranunculus sceleratus	cursed buttercup	OBL	OBL	APNEF
Ratibida columnifera	upright prairie coneflower	UPL		PNF
Rhus glabra	smooth sumac	UPL		NT
Riccia fluitans	liverwort			
Robinia pseudoacacia	black locust	UPL	UPL,FAC	NT
Rorippa palustris	bog yellowcress	OBL	FAC,OBL	ANEF
Rorippa sessiliflora	stalkless yellowcress	OBL	FACW+,OBL	ANEF
Rorippa sinuata	spreading yellowcress	FACW	FAC+,FACW	PNF
Rosa arkansana	wild prairie rose	NI	FAC?	NSH

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Rosa multiflora	multiflora rose	UPL,FACU	UPL	IS
Rosa woodsii	Woods' rose	UPL,FAC–	FACU	NS
Rudbeckia hirta	black-eyed susan	FACU–,FACU	FACU	BPNF
Rumex altissimus	pale dock	FAC	FAC,FACW+	PNF
Rumex crispus	curly dock	FACW	FACU,FACW	PIF
Sagittaria brevirostra	shortbeak arrowhead	OBL	OBL	PNEF*
Sagittaria calycina	hooded arrowhead	OBL	OBL	PNEF
Sagittaria cuneata	arumleaf arrowhead	OBL	OBL	PNEF*
Sagittaria graminea	grassy arrowhead	OBL	OBL	PNEF
Sagittaria latifolia	broadleaf arrowhead	OBL	OBL	PNEF*
Sagittaria longiloba	longbarb arrowhead	OBL	OBL	PNEF
Sagittaria rigida	sessilefruit arrowhead	OBL	OBL	PNEF
Salix amygdaloides	peach-leaf willow	FACW	FACW	NT
Salsola kali	Russian thistle	FACU–,FACU+	FACU	AIF
Salvia azurea	blue sage	UPL		PNF
Schizachyrium scoparium	little bluestem	FACU	FACU–,FACU+	PNG
Schoenoplectus fluviatilis	river bulrush	OBL	OBL	PNEGL
Schoenoplectus heterochaetus	slender bulrush	OBL	OBL	PNEGL
Schoenoplectus pungens	three-square bulrush	FACW+,OBL	OBL	PNEGL
Scirpus acutus	hard-stem bulrush	OBL	OBL	PNEGL
Scirpus validus	soft-stem bulrush	OBL	OBL	PNEGL
Scutellaria parvula	small skullcap	UPL,FACU	FACU	PNF
Senecio plattensis	prairie groundsel	UPL,FACU	FACU	BPNF
Setaria glauca	yellow foxtail grass	FACU,FAC	FAC	AIG
Setaria pumila	yellow bristle grass	FAC	FACU,FAC	AIG
Setaria viridis	green foxtail	FAC*	NI	ANG*
Silene antirrhina	sleepy silene	UPL		ANF
Silphium integrifolium	wholeleaf rosinweed	UPL		PNF
Silphium laciniatum	compassplant	UPL		PNF
Silphium perfoliatum	cup-plant	FACU,FACW	FAC	PNF
Sinapis alba	white mustard	UPL		AIF
Sinapis arvensis	corn mustard			AIF
Sisyrinchium campestre	blue-eyed grass	UPL		PNF
Sisyrinchium montanum	strict blue-eyed grass	FACU,FACW	FAC	PNF

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Solanum carolinense	Carolina nightshade	UPL,FACU	UPL	NSF
Solanum interius	inland nightshade			ANF
Solanum ptycanthum	black nightshade	FAC+*	NI	ANF*
Solanum rostratum	buffalobur nightshade	FAC*	NI	ANF*
Solidago canadensis	Canada goldenrod	FACU	FACU,FACU+	PNF
Solidago gigantea	giant goldenrod	FAC,FACW	FACW	PNF
Solidago graminifolia (Euthamia graminifolia)	flat-top goldenrod	UPL		PNF
Solidago missouriensis	Missouri goldenrod	FACU*	NI	PNF
Solidago rigida	stiff goldenrod	FACU	UPL,FACU	PNF
Sonchus arvensis	field sowthistle	UPL,FAC	FAC	PIF
Sonchus oleraceus	common sowthistle	UPL,FACU	FACU	AIF
Sorghastrum nutans	Indiangrass	FACU	UPL,FACW	PNG
Sorghum bicolor	milo	UPL*	NI	AIG*
Sparganium eurycarpum	giant burreed	OBL	OBL	PNEF
Spartina pectinata	prairie cordgrass	FACW	FACW,OBL	PNG
Sphaeralcea coccinea	false red mallow			BPNFHS
Sphenopholis obtusata	prairie wedgegrass	FAC–,FACW+	FACW	APNG
Spirodela polyrrhiza	greater duckweed	OBL	OBL	PNF
Sporobolus asper	tall dropseed	UPL,FACU	FACU	PNG
Sporobolus cryptandrus	sand dropseed	FACU–	UPL,FACU	PNG
Sporobolus vaginiflorus	poverty dropseed	FACU	UPL,FACU	ANG
Stachys palustris	marsh hedgenettle	FACW,OBL	OBL	PIF
Strophostyles leiosperma	slickseed fuzzybean			ANFV
Symphoricarpos occidentalis	western snowberry			PNS
Symphoricarpos orbiculatus	coralberry	UPL,FAC–	FACU–	NS
Symphyotrichum ericoides	white heath aster	FACU	UPL,FACU	PNF
Symphyotrichum lanceolatum	panicled aster	FACW	FACW	PNF
Symphyotrichum novae-angliae	New England aster	FACW	FACW–, FACW	PNF
Symphyotrichum praealtum var. *nebraskense*	Nebraska aster	FACW	FACW–, FACW	PNF
Tamarix ramosissima	saltcedar	FAC,FACW	FACW	IT
Taraxacum officinale	common dandelion	FACU	FACU–,FACU+	PIF
Teucrium canadense (T. occidentale)	American germander	FACW	FAC+,FACW	PNEF
Thalictrum dioicum	early meadow-rue	FACU+,FACW	FAC	PNF
Thinopyrum intermedium	intermediate wheatgrass	UPL		PIG

Scientific Name	*Common Name*	*Region 5 Wetland Indicator*	*National Wetland Indicator*	*Habit*
Thlaspi arvense	field pennycress	FACU?	NI	AIF
Toxicodendron radicans	poison ivy	FACU,FACW	FACU	NWVS
Toxicodendron rydbergii	Rydberg poison ivy	FACU,FACW	FAC	NHS
Tradescantia bracteata	longbract spiderwort	UPL,FAC	FAC	PNF
Tragopogon dubius	goatsbeard	FACU*	NI	BIF*
Tribulus terrestris	punctureVine	UPL		AIF
Trifolium pratense	red clover	FACU	FACU–,FAC	BPIF
Trifolium repens	white clover	FACU	FACU–,FAC	PIF
Triodanis perfoliata	claspleaf Venus' looking-glass	UPL,FAC	FAC	ANF
Tripsacum dactyloides	eastern gama grass	FAC,FACW	FAC	PNG
Typha angustifolia	narrowleaf cattail	OBL	OBL	PNEF
Typha latifolia	broadleaf cattail	OBL	OBL	PNEF
Typha × glauca	hybrid cattail	OBL	OBL	PNEF
Ulmus americana	American elm	FAC,FACW	FAC	NT
Ulmus pumila	Siberian elm	FACU*	NI	IT*
Utricularia vulgaris	bladderwort	OBL	OBL	PNZF
Verbascum thapsus	common mullein	UPL		PNF
Verbena bracteata	prostrate vervain	FACU	UPL,FACW	APNF
Verbena hastata	blue vervain	FAC,FACW+	FACW	PNF
Verbena urticifolia	white vervain	UPL,FAC+	UPL	APNF
Verbena stricta	hoary vervain	FAC,FACU*	NI	PNF*
Vernonia baldwinii	Baldwin's ironweed	UPL,FACW–	FACW–	PNF
Vernonia fasciculata	prairie ironweed	FAC	FAC,FACW	PNF
Veronica peregrina	purslane speedwell	FACU–,OBL	OBL	ANEF
Vicia americana	American purple vetch	FAC?	NI	PNFV
Viola pedatifida	prairie violet	UPL,FACU	FACU	PNF
Viola pratincola	blue prairie violet	FACU,FAC	FAC–	PNF
Wolffia columbiana	Columbian watermeal	OBL	OBL	PN/F
Xanthium strumarium	rough cocklebur	FAC	FAC–, FAC+	ANF
Yucca gloriosa	moundlily yucca	FAC	NI	NT
Zea mays	corn			AIF

Appendix G

List of Amphibians, Reptiles, and Mammals

AMPHIBIANS

Common Name	*National Status in Nebraska*
American toad	critically imperiled
Great Plains toad	secure
Woodhouse's toad	secure
northern cricket frog	secure
Cope's gray treefrog	secure
western chorus frog	secure
Great Plains narrowmouth toad	imperiled
plains leopard frog	secure
bullfrog	secure
northern leopard frog	secure
smallmouth salamander	critically imperiled
tiger salamander	secure

REPTILES

Common Name	*National Status in Nebraska*
snapping turtle	secure
smooth softshell	secure
spiny softshell	secure
yellow mud turtle	vulnerable
painted turtle	secure
Blanding's turtle	apparently secure
false map turtle	vulnerable
western box turtle	secure
lesser earless lizard	secure
greater short-horned lizard	vulnerable
sagebrush lizard	critically imperiled
fence/prairie/plateau lizard	secure
six-lined racerunner	secure
five-lined skink	critically imperiled
many-lined skink	secure
Great Plains skink	vulnerable
prairie skink	secure
slender glass lizard	critically imperiled
glossy snake	imperiled
worm snake	secure
racer	secure
ringneck snake	secure
corn snake	apparently secure

Common Name	*National Status in Nebraska*
western ratsnake	apparently secure
fox snake	secure
western hognose snake	secure
eastern hognose snake	apparently secure
prairie kingsnake	vulnerable
common kingsnake	imperiled
milk snake	secure
smooth green snake	critically imperiled
coachwhip	vulnerable
northern water snake	secure
gopher snake	secure
Graham's crayfish snake	imperiled
brown snake	vulnerable
redbelly snake	critically imperiled
plains black-headed snake	critically imperiled
western terrestrial garter snake	apparently secure
western ribbon snake	imperiled
plains garter snake	secure
common garter snake	secure
lined snake	secure
copperhead	critically imperiled
western rattlesnake	apparently secure

MAMMALS

Common Name	*National Status in Nebraska*
Townsend's big-eared bat	critically imperiled
big brown bat	secure
silver-haired bat	secure
eastern red bat	secure
hoary bat	secure
western small-footed myotis	apparently secure
little brown bat	apparently secure
northern myotis	vulnerable
fringed myotis	critically imperiled
fringe-tailed myotis	critically imperiled
long-legged myotis	imperiled
evening bat	vulnerable
eastern pipistrelle	critically imperiled
Brazilian free-tailed bat	unranked
black-tailed prairie dog	apparently secure
woodchuck	apparently secure
eastern fox squirrel	secure
Wyoming ground squirrel	possibly extirpated
Franklin's ground squirrel	secure
spotted ground squirrel	apparently secure
thirteen-lined ground squirrel	secure
least chipmunk	vulnerable

Common Name	*National Status in Nebraska*
American beaver	secure
plains pocket gopher	secure
northern pocket gopher	apparently secure
hispid pocket mouse	secure
Ord's kangaroo rat	secure
olive-backed pocket mouse	vulnerable
plains pocket mouse	secure
silky pocket mouse	apparently secure
meadow jumping mouse	secure
prairie vole	secure
meadow vole	secure
woodland vole	vulnerable
house mouse	exotic
muskrat	secure
northern grasshopper mouse	secure
white-footed mouse	secure
deer mouse	exotic
Norway rat	exotic
western harvest mouse	secure
plains harvest mouse	apparently secure
hispid cotton rat	vulnerable
southern bog lemming	apparently secure
northern short-tailed shrew	vulnerable
short-tailed shrew	vulnerable
least shrew	apparently secure
prairie shrew	apparently secure
Merriam's shrew	critically imperiled
eastern mole	secure
Virginia opossum	secure
mule deer	secure
white-tailed deer	secure
black-tailed jackrabbit	secure
white-tailed jackrabbit	secure
European rabbit	exotic
eastern cottontail	secure
coyote	secure
swift fox	imperiled
red fox	secure
bobcat	secure
northern river otter	imperiled
long-tailed weasel	secure
black-footed ferret	extirpated
least weasel	secure
American mink	secure
American badger	secure
striped skunk	secure
eastern spotted skunk	secure
northern raccoon	secure

Appendix H

List of Birds

The order of bird species follows the AOU Check-list of North American Birds (American Ornithological Union 2004).

Seasonal abundance codes follow each species name, in order of seasons (spring, summer, fall, winter). The letter "*m*" is used to indicate that the species is not present during a particular season. For example, "American coot *acar*" (abundant in spring, common summer, abundant in fall, and rare in Winter) or "California gull *omom*" (occasional in spring, not present in summer or winter, and occasional in fall).

Nesting species documented at the WPAs are marked with an asterisk (*) in front of the species name. Species accounts may indicate presence during the nesting season, but may not be marked as nesting. For example, frequent nesters in the area such as northern rough-winged swallow are not marked as nesters because WPAs do not provide preferred nesting habitat. For the most part, cavity nesters are excluded (the red-bellied woodpecker prefers mature, natural woodlands) due to the absence of mature or dying trees that typically provide cavities. The district's WPAs are managed as grassland–playa lake ecosystems. Nonnative trees and shrubs have been removed at most WPAs. Due to remaining shelterbelts at WPAs, a few woodland nesters are marked as nesting if they are known to use shelterbelts.

SEASONAL ABUNDANCE DEFINITIONS

Seasons are listed below. Seasonal abundance codes for some species such as shorebirds may be misleading because their fall migration starts in July or August (summer). For example, "pectoral sandpiper *cccm*" (common in spring, summer due to peak migration occurring mid-August, and fall; not present in winter).

SEASONS

Spring (March–May)
Summer (June–August)
Fall (September–November)
Winter (December–February)

SEASONAL ABUNDANCE

a = abundant (occur in large numbers)
c = common (certain to be seen in suitable habitat)
u = uncommon (present, but not certain to be seen)
o = occasional (seen only a few times during the season)
r = rare (seen at intervals of 2–5 years)
h = hypothetical (within normal range, but never documented)
x = outside normal range (but has been documented)

SWANS, GEESE, AND DUCKS

black-bellied whistling-duck *xxxm*
bean goose *xmmm*
greater white-fronted goose *arao*
emperor goose *xmmm*
snow goose *aoao*
Ross' goose *crco*
*Canada goose *auac*
brant *rmrm*
trumpeter swan *hxmh*
tundra swan *omrm*
wood duck *cucm*
*gadwall *cuco*
Eurasian wigeon *rmrm*
*American wigeon *aoao*
American black duck *rmrr*
*mallard *acac*
*blue-winged teal *acar*
*cinnamon teal *uoum*
*northern shoveler *acar*
*northern pintail *auao*
garganey *xmmm*
*green-winged teal *aoao*
canvasback *umum*
*redhead *cucm*
ring-necked duck *crum*
greater scaup *umrm*
lesser scaup *cocm*
white-winged scoter *xmmm*
black scoter *xmmm*
bufflehead *cmcm*
common goldeneye *omum*
Barrow's goldeneye *mmxm*
hooded merganser *urum*
common merganser *omoo*
*ruddy duck *cucm*

GALLINACEOUS BIRDS

*ring-necked pheasant *cccc*
sharp-tailed grouse *rhro*
*greater prairie-chicken *ooou*
*northern bobwhite *cccc*

LOONS

common loon *omrm*

GREBES

Clark's grebe *xmrm*
*pied-billed grebe *cccm*
horned grebe *uhrm*
red-necked grebe *hmrm*
*eared grebe *cocm*
western grebe *rmrm*

PELICANS

American white pelican *cocm*

CORMORANTS

double-crested cormorant *cucm*

BITTERNS, HERONS, AND EGRETS

*American bittern *ucum*
*least bittern *uuom*
*great blue heron *cccr*
great egret *omom*
snowy egret *uuum*
little blue heron *orrm*
tricolored heron *hrrm*
cattle egret *uoum*
*green heron *cucm*
*black-crowned night-heron *cocm*
yellow-crowned night-heron *rmrm*

IBISES AND SPOONBILLS

white ibis *hxxm*
glossy ibis *xmmm*
white-faced ibis *uurm*
roseate spoonbill *mxmm*

NEW WORLD VULTURES

black vulture *mxmm*
turkey vulture *cucm*

OSPREY, KITES, HAWKS, AND EAGLES

osprey *omom*
white-tailed kite *xmxm*
Mississippi kite *xmxm*
bald eagle *cmco*
*northern harrier *cucu*
sharp-shinned hawk *uruu*
Cooper's hawk *umur*
northern goshawk *rmrr*
red-shouldered hawk *mrrx*
broad-winged hawk *mxmm*
*Swainson's hawk *cuur*
*red-tailed hawk *cucu*
ferruginous hawk *uxuo*
rough-legged hawk *uhuu*
golden eagle *omoo*

FALCONS AND CARACARAS

*American kestrel *cccc*
merlin *umuo*
gyrfalcon *mmmr*
peregrine falcon *omor*
prairie falcon *omou*

RAILS

yellow rail *rmrm*
black rail *xxmm*
king rail *rrmm*
*Virginia rail *uuum*
*sora *cccm*
purple gallinule *xmmm*
*common moorhen *uurm*
*American coot *acar*

CRANES
*sandhill crane *crum*
common crane *xmmm*
whooping crane *omom*

PLOVERS
black-bellied plover *umum*
American golden-plover *umum*
snowy plover *rrmm*
semipalmated plover *umum*
piping plover *rhrm*
*killdeer *cccm*

STILTS AND AVOCETS
*black-necked stilt *rrrm*
*American avocet *urum*

SANDPIPERS AND PHALAROPES
greater yellowlegs *cocm*
lesser yellowlegs *cucm*
solitary sandpiper *ccum*
willet *uoum*
spotted sandpiper *cccm*
*upland sandpiper *uuum*
Eskimo curlew *hmhm*
whimbrel *omrm*
long-billed curlew *rmrm*
Hudsonian godwit *umxm*
marbled godwit *umrm*
ruddy turnstone *rmrm*
red knot *xmrm*
sanderling *omom*
semipalmated sandpiper *aucm*
western sandpiper *room*
least sandpiper *cccm*
white-rumped sandpiper *coom*
Baird's sandpiper *acum*
pectoral sandpiper *cccm*
sharp-tailed sandpiper *mmxm*
dunlin *umum*
curlew sandpiper *mxmm*
stilt sandpiper *accm*
buff-breasted sandpiper *uuum*
ruff *xmxm*
short-billed dowitcher *uurm*
long-billed dowitcher *aucm*
*Wilson's snipe (common) *cocm*
American woodcock *rmrm*
*Wilson's phalarope *aocm*
red-necked phalarope *rmrm*
red phalarope *mxmm*

SKUAS, JAEGERS, GULLS, AND TERNS
laughing gull *xmmm*
Franklin's gull *arcm*
Bonaparte's gull *rmrm*
mew gull *rmmm*
ring-billed gull *acco*
California gull *omom*
herring gull *umuu*
common tern *umum*
Forster's tern *cucm*
least tern *rrrm*
*black tern *acam*

PIGEONS AND DOVES
rock pigeon *cccc*
European collared-dove *oooo*
white-winged dove *mrmm*
*mourning dove *aaao*
Inca dove *mmxm*

CUCKOOS AND ANIS
black-billed cuckoo *ooom*
*yellow-billed cuckoo *uuum*

BARN OWLS
barn owl *oooo*

TYPICAL OWLS
eastern screech-owl *uuuu*
*great horned owl *cucu*
snowy owl *mmmx*
*burrowing owl *uuum*
barred owl *rrrr*
long-eared owl *oroo*
short-eared owl *uruu*
boreal owl *mmxm*

NIGHTJARS
*common nighthawk *cccm*
chuck-will's-widow *mrmm*

SWIFTS
chimney swift *aacm*

HUMMINGBIRDS
ruby-throated hummingbird *ooom*
broad-tailed hummingbird *hrrm*
rufous hummingbird *mmrm*

KINGFISHERS
belted kingfisher *uuur*

WOODPECKERS
Lewis' woodpecker *rmxm*
*red-headed woodpecker *ccco*
red-bellied woodpecker *uuuu*
*downy woodpecker *cccc*
hairy woodpecker *cccr*
*northern flicker *cccc*

TYRANT FLYCATCHERS
olive-sided flycatcher *omom*
eastern wood-pewee *ooom*
yellow-bellied flycatcher *rmrm*

Acadian flycatcher *rmrm*
alder flycatcher *rmrm*
willow flycatcher *orom*
least flycatcher *umum*
Hammond's flycatcher *mmxm*
eastern phoebe *uuum*
Say's phoebe *urrm*
*great crested flycatcher *cocm*
*western kingbird *cccm*
*eastern kingbird *cccm*
*scissor-tailed flycatcher *rxrm*

SHRIKES

*loggerhead shrike *cccc*
northern shrike *mmuu*

VIREOS

white-eyed vireo *rmmm*
*Bell's vireo *uoum*
yellow-throated vireo *rxrm*
*warbling vireo *cucm*
Philadelphia vireo *umum*
red-eyed vireo *urum*

CROWS, JAYS, AND MAGPIES

*blue jay *cccc*
pinyon jay *mmmx*
*black-billed magpie *uuuu*
*American crow *aoac*

LARKS

*horned lark *acaa*

SWALLOWS

purple martin *cucm*
tree swallow *cocm*
violet-green swallow *xmmm*
northern rough-winged swallow *cccm*
bank swallow *uuum*
cliff swallow *ccam*
barn swallow *aaam*

TITMICE AND CHICKADEES

*black-capped chickadee *cccc*
tufted titmouse *xxxm*

NUTHATCHES

red-breasted nuthatch *mxmo*
white-breasted nuthatch *ooou*

CREEPERS

brown creeper *mooo*

WRENS

Carolina wren *roor*
Bewick's wren *xmmm*
*house wren *cccm*
winter wren *rmro*
*sedge wren *rurm*
*marsh wren *uuur*

KINGLETS

golden-crowned kinglet *umur*
ruby-crowned kinglet *omom*

OLD WORLD WARBLERS

blue-gray gnatcatcher *orom*

THRUSHES

*eastern bluebird *cucr*
mountain bluebird *omor*
Townsend's solitaire *rmro*
veery *rmmm*
gray-cheeked thrush *umrm*
Swainson's thrush *cmum*
hermit thrush *rmrm*
wood thrush *rmrm*
*American robin *acac*

MIMIC THRUSHES

*gray catbird *uuur*
northern mockingbird *uuum*
*brown thrasher *cccr*

STARLINGS

*European starling *aaac*

WAGTAILS AND PIPITS

American (water) pipit *cmcr*
Sprague's pipit *omom*

WAXWINGS

Bohemian waxwing *mmmr*
cedar waxwing *cucu*

WOOD WARBLERS

golden-winged warbler *rmmm*
Tennessee warbler *cmcm*
orange-crowned warbler *cmcm*
Nashville warbler *umum*
northern parula *umrm*
*yellow warbler *cccm*
chestnut-sided warbler *umum*
magnolia warbler *umum*
black-throated blue warbler *rmrm*
yellow-rumped warbler *cmcm*
black-throated gray warbler *xmmm*
black-throated green warbler *omom*
Townsend's warbler *rmrm*
Blackburnian warbler *omom*
yellow-throated warbler *rmrm*
pine warbler *hmrm*
prairie warbler *rmrm*
palm warbler *omrm*

bay-breasted warbler *omom*
blackpoll warbler *cmrm*
black-and-white warbler *cmum*
American redstart *cocm*
prothonotary warbler *rmrm*
ovenbird *umum*
northern waterthrush *umum*
Louisiana waterthrush *rmhm*
Kentucky warbler *rmhm*
Connecticut warbler *rmxh*
mourning warbler *rmhm*
MacGillivray's warbler *omrm*
*common yellowthroat *cccm*
hooded warbler *rmrm*
Wilson's warbler *umum*
Canada warbler *rmrm*
yellow-breasted chat *ooom*

TANAGERS

summer tanager *rmxm*
scarlet tanager *omom*

SPARROWS AND TOWHEES

green-tailed towhee *rmrm*
spotted towhee *uoum*
eastern towhee *umum*
Cassin's sparrow *xmmm*
American tree sparrow *aoaa*
*chipping sparrow *aoar*
clay-colored sparrow *chcr*
Brewer's sparrow *rmrm*
field sparrow *cucr*
*vesper sparrow *cocx*
lark sparrow *cccm*
*lark bunting *ouom*
Savannah sparrow *cmch*
*grasshopper sparrow *cccm*
Baird's sparrow *umum*
Henslow's sparrow *rrrm*
Le Conte's sparrow *umcm*
Nelson's sharp-tailed sparrow *rmum*
fox sparrow *omor*
song sparrow *cucu*
Lincoln's sparrow *crcm*
*swamp sparrow *uoum*
white-throated sparrow *cour*
Harris' sparrow *cocu*
white-crowned sparrow *cruo*
golden-crowned sparrow *rmrm*
dark-eyed junco *cmca*
McCown's longspur *rmrm*
Lapland longspur *amaa*
Smith's longspur *omur*
chestnut-collared longspur *omom*
snow bunting *rmro*

CARDINALS, GROSBEAKS, AND ALLIES

*northern cardinal *cccc*
rose-breasted grosbeak *uurm*
black-headed grosbeak *crcm*
*blue grosbeak *uuum*
lazuli bunting *xmxm*
indigo bunting *uuum*
painted bunting *rmxm*
*dickcissel *cacm*

BLACKBIRDS AND ORIOLES

*bobolink *cccm*
*red-winged blackbird *acao*
*eastern meadowlark *uuuo*
*western meadowlark *acac*
*yellow-headed blackbird *aocr*
rusty blackbird *cour*
*Brewer's blackbird *cuco*
*common grackle *aaao*
*great-tailed grackle *cccr*
*brown-headed cowbird *acar*
orchard oriole *cccm*
*Baltimore oriole *cccm*
Scott's oriole *mxmm*

FINCHES

pine grosbeak *xmxm*
purple finch *umuo*
*house finch *cccc*
red crossbill *mrmo*
common redpoll *ormo*
pine siskin *uouu*
*American goldfinch *cccc*
evening grosbeak *rmrr*

OLD WORLD SPARROWS

*house sparrow *aaaa*

Appendix I

Rainwater Basin Vegetation Classification

The National Vegetation Classification System (NVCS) for the United States was used to classify vegetation communities at the Rainwater Basin Wetland Management District in 2004. The NVCS is the system mandated by the USGS–National Park Service Vegetation Mapping Program. In addition, the Federal Geographic Data Committee (FGDC) adopted the NVCS to the formation level as a standard for federal agencies (FGDC 1997). This system provides a national (versus regional, state, or local) vegetation classification system that facilitates resource stewardship by ensuring the same plant associations get the same names throughout the Refuge System. The strengths of the NVCS include the following:

- is vegetation based
- uses a systematic approach to classify a continuum
- emphasizes natural and existing vegetation
- uses a combined physiognomic–floristic hierarchy
- identifies vegetation units based on both qualitative and quantitative data
- is appropriate for mapping at multiple scales

The NVCS was established primarily by The Nature Conservancy and is being implemented and updated by NatureServe in support of the network of natural heritage programs (Grossman et al. 1998). Development and refinement of the classification is an ongoing process and proposed revisions are reviewed both locally and nationally. The Nature Conservancy published two volumes describing the classification of United States vegetation as of April 1997 (Grossman et al. 1998). This publication can be found on the Internet at <http://www.natureserve.org/publications/icec/index.html>. NatureServe posts regular updates to the list of plant associations in the United States and Canada on their online database server at <http://www.natureserve.org/explorer>.

CLASSIFICATION PROCEDURE

The procedure for classifying vegetation followed guidelines described in the "vegetation classification standard" (FGDC 1997), which was derived from the NVCS. The NVCS is a species-based, hierarchical system with seven levels (Grossman et al. 1998). The highest—"coarse"—levels of the hierarchy have a broad geographic perspective and use physiognomic features to distinguish among groups of plant communities. The lowest—"finest"—levels have a local and site-specific perspective and are based on floristic features (figure I-1). The finest level (association) was used in the "Rainwater Basin Vegetation and Monitoring Project."

The association is defined as "a plant community of definite floristic composition, uniform habitat conditions, and uniform physiognomy" (see Flahault and Schroter 1910 in Moravec 1993). Associations are separated from alliances through the use of total floristic composition and are named by the most dominant or indicator species. If two or more dominant species occur in the same stratum, a dash (–) is used between the names. If the species occur in different strata, a slash (/) is used. Parentheses ( ) indicate that a diagnostic species is not always present.

Alliances are physiognomically uniform groups of plant associations that share dominant or diagnostic species, usually found in the uppermost stratum of the vegetation. For forested types, the alliance is roughly equivalent to the "cover type" of the Society of American Foresters. Alliances also include nonforested types.

Unlike classifications based on habitat types or potential vegetation, the NVCS strives to describe existing vegetation, whether natural or cultural vegetation. However, due in part to the conservation focus of The Nature Conservancy and NatureServe, the classification of natural vegetation types is often better developed than that of cultural or modified types. The NVCS is unique in that the association is the basic unit, with the higher levels of the hierarchy representing aggregations of units in the lower levels. This differs from other types that work from the top down.

PREPARING THE DATA FOR ANALYSIS

The vegetation classification for the Rainwater Basin began with the vegetation mapping team completing a literature review of all associations identified in Nebraska and the Great Plains region to identify associations that were present in the basin. From this list, the associations that occurred at WPAs were identified. This was done by bringing together all biologists working in the area and having them identify the known associations, as well as creating map units to delineate species of management concern. The following summaries show the lineage for each plant community for the basin starting with the NVCS community names (see also table I-1).

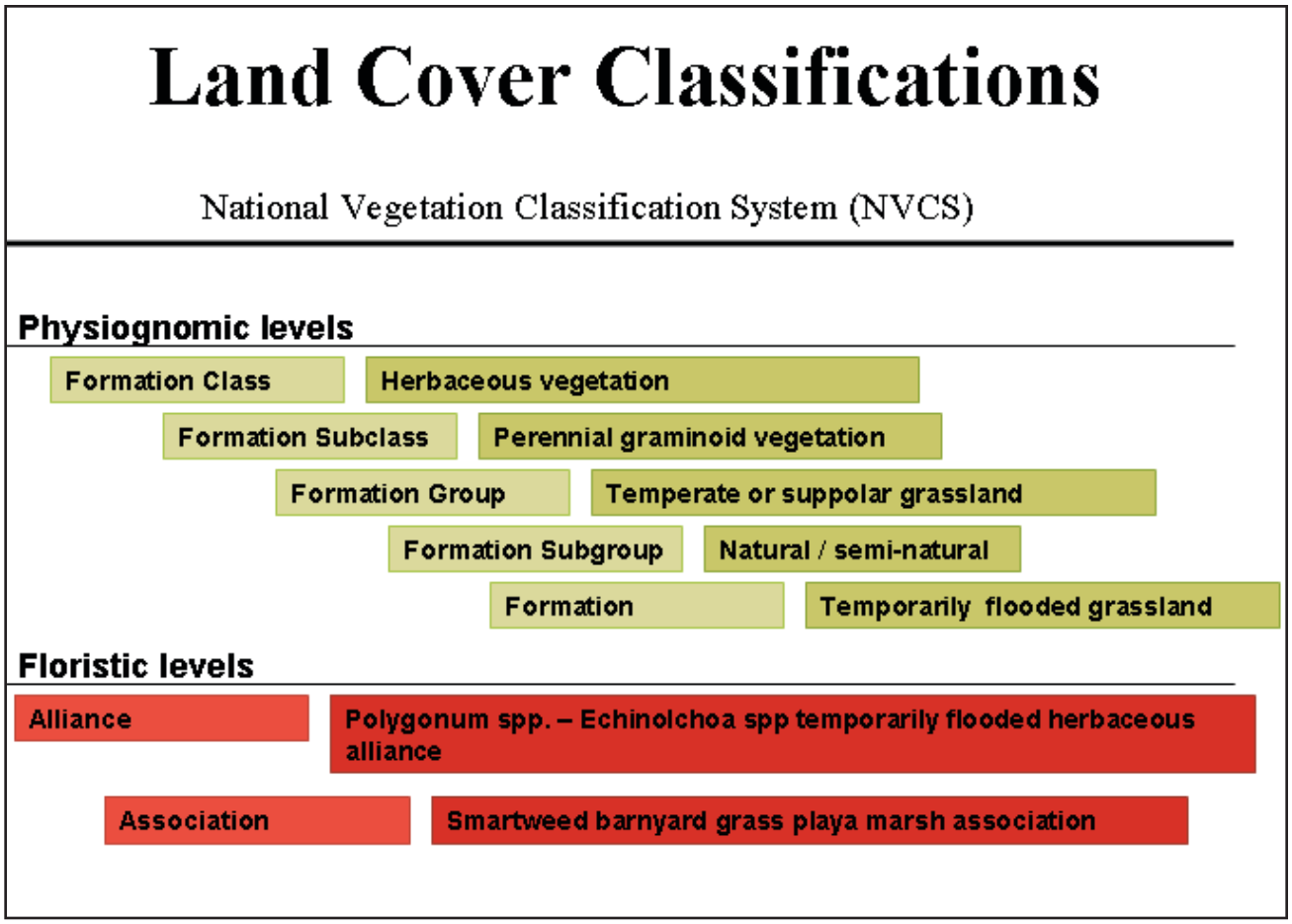


Figure I-1. An example of the NVCS physiognomic–floristic classification hierarchy.

Table I-1.

Formation Name	*Alliance Name*	*Alliance Code*	*Unique Identifier*	*Association Name*	*Association Code*	*Common Name*
Formation Class/Subclass: Shrubland/Deciduous Shrubland						
Temporarily flooded, cold-deciduous shrubland	*Salix* (*exigua*, *interior*) temporarily flooded shrubland	III.B.2.N.d.6	CEGL001203	*Salix exigua*/mesic graminoids shrubland	d.6	sandbar willow/ mesic graminoids shrubland
Temporarily flooded, cold–deciduous shrubland	*Cornus sericea* temporarily flooded shrubland	III.B.2.N.d.27	CEGLOO5219	*Cornus drummondii*–*Amorpha fruiticosa*–*Cornus sericea* shrubland	d.27	sumac–dogwood shrubland
Formation Class/Subclass: Woodland/Deciduous Woodland						
Temporarily flooded, cold–deciduous woodland	*Populus deltoides* temporarily flooded woodland	II.B.2.N.b.4	CEGL000659	*Populus deltoides*–(*Salix amygdaloides*)/ *Salix* (*exigua*, *interior*) woodland	b.4	cottonwood–peachleaf willow, floodplain woodland
Formation Class/Subclass: Herbaceous Vegetation/Perennial Graminoid Vegetation						
Semipermanently flooded, temperate or subpolar grassland	*Carex pellita* seasonally flooded herbaceous vegetation	V.A.5.N.k.53	CEGL005272	*Carex* spp.–(*Carex pellita*, *Carex vulpinoidea*) herbaceous vegetation	k.53	central Midwest, sedge meadow
Semipermanently flooded, temperate or subpolar grassland	*Eleocharis palustris* seasonally flooded herbaceous vegetation	V.A.5.N.k.61	CEGL001833	*Eleocharis palustris* herbaceous vegetation	k.61	creeping spikerush, wet meadow
Semipermanently flooded, temperate or subpolar grassland	*Pascopyrum smithii* intermittently flooded herbaceous vegetation	V.A.5.N.i.1	CEGL002038	*Pascopyrum smithii*–*Buchloe dactyloides*–(*Phyla cuneifolia*, *Oenothera canescens*) herbaceous vegetation	i.1	wheatgrass, playa grassland
Semipermanently flooded, temperate or subpolar grassland	*Phalaris arundinacea* seasonally flooded herbaceous vegetation	V.A.5.N.k.20	CEGL001474	*Phalaris arundinacea* western herbaceous vegetation	k.20	reed canarygrass, wet meadow
Semipermanently flooded, temperate or subpolar grassland	*Polygonum* spp.–*Echinochloa* spp. temporarily flooded herbaceous vegetation	V.A.5.N.j.12	CEGL002039	*Polygonum* spp.–*Echinochloa* spp.–*Distichlis spicata* playa lake, herbaceous vegetation	j.12	playa marsh

Table I-1.

Formation Name	*Alliance Name*	*Alliance Code*	*Unique Identifier*	*Association Name*	*Association Code*	*Common Name*
Semipermanently flooded, temperate or subpolar grassland	*Typha* (*angustifolia*, *latifolia*)–(*Schoenoplectus* spp.) semipermanently flooded, herbaceous vegetation	V.A.5.N.l.9	CEGL002389	*Typha* spp. Great Plains, herbaceous vegetation	l.9	northern Great Plains, cattail marsh
Semipermanently flooded, temperate or subpolar grassland	*Typha* spp.–(*Schoenoplectus* spp., *Juncus* spp.) seasonally flooded vegetation	V.A.5.N.k.33	CEGL002026	*Schoenoplectus tabernaemontani*–*Typha* spp.–(*Sparganium* spp., *Juncus* spp.) herbaceous vegetation	k.33	bulrush–cattail–burreed, shallow marsh
Semipermanently flooded, temperate or subpolar grassland	*Potamogeton* spp.–*Ceratophyllum* spp.–*Elodea* spp. permanently flooded, herbaceous vegetation	V.C.2.N.a.14	CEGL002044	*Potamogeton* spp.–*Ceratophyllum demersum* Great Plains herbaceous, central Midwest vegetation	a.14	Great Plains, pondweed, submerged, aquatic wetland
Short-sod, temperate or subpolar grassland	*Bouteloua gracilis* herbaceous alliance	V.A.5.N.e.9	CEGL001756	*Bouteloua gracilis*–*Buchloe dactyloides* herbaceous vegetation	e.9	blue grama–buffalograss, short-grass prairie
Tall-sod, temperate grassland	*Andropogon gerardii*–(*Sorghastrum nutans*) herbaceous alliance	V.A.5.N.a.2	CEGL002025	*Andropogon gerardii*–*Sorghastrum nutans*–*Hesperostipa spartea* loess hills, herbaceous vegetation	a.2	central tall-grass, big bluestem, loess prairie
Medium- to tall-sod, temperate or subpolar grassland	*Schizachyrium scoparium*–*Bouteloua curtipendula* herbaceous alliance	V.A.5.N.c.20	CEGL002035	*Schizachyrium scoparium*–*Bouteloua curtipendula*–*Bouteloua hirsuta*–(*Yucca glauca*) herbaceous vegetation	c.20	loess hills, little bluestem, dry prairie

Association (Scientific) Name: *Carex* spp. (*Carex pellita, Carex vulpinoidea*) Herbaceous Vegetation

Translated Scientific Name: Sedge species (woolly sedge, fox sedge) herbaceous vegetation

Common Name: Central Midwest sedge meadow

Unique Identifier: CEGL005272

Classification Code: V.A.5.N.k.53

Association Classification Confidence Level: Weak

Association Summary: This sedge, wet meadow type is found in the central midwestern United States. Stands occur on nearly level floodplains, often in bands surrounding channels, or in basins. Soils are poorly drained, silty and clay loams formed in alluvium. Stands are flooded for much of the growing season, but may dry out in late summer. The vegetation cover is quite dense and may be patchy. The structure is dominated by graminoids 20–60 inches (0.5–1.5 m) tall. Typical species include *Carex cristatella*, *Carex molesta*, *Carex pellita (=Carex lanuginosa)*, *Carex stipata*, *Carex tribuloides*, and *Carex vulpinoidea* (a dominant in southeast Nebraska meadows). Other frequent emergent graminoids include *Eleocharis* spp., *Juncus interior*, *Juncus torreyi* and *Scirpus atrovirens*. *Leersia oryzoides* may be common where the stand borders a marsh. Forbs are common and may be conspicuous. Among the more common are *Apocynum cannabinum*, *Symphyotrichum lanceolatum (=Aster lanceolatus)*, *Lycopus americanus*, *Lythrum alatum*, and *Verbena hastata*. *Phalaris arundinacea* may invade this community to the point of excluding many of the native species.

Association (Scientific) Name: *Bouteloua gracilis–Buchloe dactyloides* Herbaceous Vegetation

Translated Scientific Name: Blue grama–buffalograss herbaceous vegetation

Common Name: Blue grama–buffalograss, short-grass prairie

Unique Identifier: CEGL001756

Classification Code: V.A.5.N.e.9

Association Classification Confidence Level: Moderate

Association Summary: This blue grama–buffalograss, short-grass prairie type is common across much of the central and southern Great Plains of the United States. Stands occur on flat to rolling uplands. The surface soil may be sandy loam, loam, silt loam, or loamy clay. The subsoil is often finer than the surface soil. This community is characterized by a moderate to dense sod of short grasses with scattered mid-grasses and forbs. The dominant species are *Bouteloua gracilis* and *Buchloe dactyloides*. The foliage of these species is 2.8–7.6 inches (7–19 cm) tall, while the flowering stalks of *Bouteloua gracilis* may reach 18 inches (45 cm). The mid-grasses are usually stunted by the arid conditions and often do not exceed 28 inches (0.7 m). Other short graminoids found in this community are *Bouteloua hirsuta*, *Carex duriuscula*, *Carex inops*, *Carex heliophila*, and *Carex filifolia* (in Nebraska). Several mid-grasses occur regularly, such as *Aristida purpurea*, *Bouteloua curtipendula*, *Pascopyrum smithii*, *Schizachyrium scoparium*, *Elymus elymoides*, *Sporobolus cryptandrus*, *Hesperostipa comata* (=*Stipa comata*), and *Vulpia octoflora*. Forbs such as *Astragalus* spp., *Gaura coccinea*, *Machaeranthera pinnatifida* var. *pinnatifida*, *Opuntia polyacantha*, *Plantago patagonica*, *Psoralidium tenuiflorum*, *Ratibida columnifera*, and *Sphaeralcea coccinea* are common throughout this community. Shrubs are very rare except in the southern part of this community's range where scattered individuals may occur. In Oklahoma, other characteristic species include *Ambrosia artemisiifolia*, *Aristida oligantha*, *Machaeranthera tanacetifolia*, *Melampodium leucanthum*, *Muhlenbegria torreyi*, *Sporobolus compositus*, *Sporobolus cryptandrus*, and *Zinnia grandiflora*. In Texas, associated species include *Prosopis glandulosa*, *Bouteloua curtipendula*, and *Sporobolus cryptandrus*.

Association (Scientific) Name: *Andropogon gerardii–Sorghastrum nutans–Hesperostipa spartea* Loess Hills Herbaceous Vegetation

Translated Scientific Name: Big bluestem–yellow Indiangrass–porcupine grass, loess hills, herbaceous vegetation

Common Name: Central tall-grass, big bluestem, loess prairie

Unique Identifier: CEGL002025

Classification Code: V.A.5.N.a.2

Association Classification Confidence Level: Moderate

Association Summary: This big bluestem, tall-grass prairie type is found in the west-central, tall-grass prairie region of the United States, including the Loess Hills. Stands occur on moderately steep mid- to upper slopes of loess hills and along ridges. It is most common on southern and western aspects. The soil is well-drained, acidic to neutral, and shallow to deep loess (16–40 inches [40-100 cm]). The parent material is a deep loess or glacial till and other deeply weathered substrates. This community is virtually lacking in shrubs and trees. Woody vegetation that is present, such as *Amorpha canescens*, is usually less than 20 inches (0.5 m) tall. The dominant vegetation is tall grasses. Of the dominant species, *Andropogon gerardii*, *Sorghastrum nutans*, and *Hesperostipa spartea* (=*Stipa spartea*) typically exceed 40 inches (1 m). *Schizachyrium scoparium*, also very common, is shorter. In Missouri, some other species that are usually found in this community are *Echinacea pallida*, *Potentilla arguta*, *Silphium laciniatum*, and *Sporobolus compositus* var. *compositus*.

Association (Scientific) Name: *Schizachyrium scoparium–Bouteloua curtipendula–Bouteloua hirsuta–(Yucca glauca)* Herbaceous Vegetation

Translated Scientific Name: Little bluestem–sideoats grama–hairy grama–(soapweed yucca) herbaceous vegetation

Common Name: Loess hills, little bluestem, dry prairie

Unique Identifier: CEGL002035

Classification Code: V.A.5.N.c.20

Association Classification Confidence Level: Moderate

Association Summary: This bluestem–grama grass, dry prairie type is found on the loess bluffs along the east side of Missouri River in the central midwestern United States. The soil is somewhat rapidly drained and very shallow (0–16 inches [0–40 cm]). The vegetative structure is comprised of a single layer of dominant grasses intermixed with forbs. Shrubs, especially *Yucca glauca*, are sometimes present. This community is a short- to midgrass prairie dominated by the bunchgrasses *Andropogon gerardii*, *Bouteloua curtipendula*, and *Schizachyrium scoparium*. *Bouteloua hirsuta* can be common. *Sporobolus cryptandrus*, *Dalea leporina*, *Dalea candida*, *Dalea enneandra*, *Astragalus lotiflorus*, and *Astragalus missouriensis* can also be common. Other herbaceous species include *Pulsatilla patens* ssp. *multifida* (=*Anemone patens*), *Symphyotrichum sericeum* (*Aster sericeus*), *Buchloe dactyloides*, *Bouteloua gracilis*, *Delphinium carolinianum*, *Gaura coccinea*, and *Pediomelum argophyllum*, and the lichens *Dermatocarpon lachneum* and *Psora decipiens*.

Association (Scientific) Name: *Eleocharis palustris* Herbaceous Vegetation

Translated Scientific Name: Marsh spikerush, herbaceous vegetation

Common Name: Creeping spikerush, wet meadow

Unique Identifier: CEGL001833

Classification Code: V.A.5.N.k.61

Association Classification Confidence Level: Strong

Association Summary: This spikerush, wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States. Stands occur in small depressions in intermittent streambeds or depression ponds that flood early in the season and may dry out by summer. Stands comprise submersed and emergent rooted vegetation under 40 inches (1 m) tall that is dominated by *Eleocharis palustris*, often in nearly pure stands. Soils are generally fine-textured.

Association (Scientific) Name: *Pascopyrum smithii–Buchloe dactyloides*–(*Phyla cuneifolia, Oenothera canescens*) Herbaceous Vegetation

Translated Scientific Name: Western wheatgrass–buffalograss–(wedgeleaf frogfruit, spotted evening-primrose) herbaceous vegetation

Common Name: Wheatgrass, playa grassland

Unique Identifier: CEGL002038

Classification Code: V.A.5.N.i.1

Association Classification Confidence Level: Moderate

Association Summary: This wheatgrass, playa grassland community represents the common vegetation type of playa lake basins (depressional wetlands) under rangeland conditions in the southern and central Great Plains of the United States. In the central plains soils are dense silts and clays, occasionally loess-derived, that flood in winter and dry out by early summer. Perennial herbaceous graminoids and forbs less than 40 inches (1 m) tall dominate the community, with composition varying depending on water levels. In the central plains *Pascopyrum smithii* is most abundant, with *Agrostis hyemalis*, *Eleocharis palustris*, *Eleocharis macrostachya*, *Elymus virginicus*, and *Hordeum jubatum* locally abundant. *Buchloe dactyloides* can be abundant in grazed sites. Early season ephemeral annuals include *Alopecurus carolinianus*, *Elatine rubella*, *Myosurus minimus*, *Veronica peregrina* ssp. *xalapensis*, and, more westward, *Limosella aquatica* and *Plagiobothrys scouleri*. Perennial forbs including *Ambrosia grayi*, *Phyla cuneifolia*, *Oenothera canescens*, *Rorippa sinuata*, and *Vernonia fasciculata* are conspicuous in places. In the southern plains, species characteristic of the type include *Buchloe dactyloides*, *Distichlis spicata*, and *Panicum obtusum*.

Association (Scientific) Name: *Potamogeton* spp.–*Ceratophyllum demersum* Great Plains Herbaceous Vegetation

Translated Scientific Name: Pondweed species–coontail, Great Plains herbaceous vegetation

Common Name: Great Plains pondweed, submerged aquatic wetland

Unique Identifier: CEGL002044

Classification Code: V.C.2.N.a.14

Association Classification Confidence Level: Weak

Association Summary: This community type is found in the Great Plains of the United States in shallow to relatively deep (40 inches [1 m]) freshwater basins or bands in marshes or bays that remain flooded in all but the driest years. Vegetation varies from sparse to dense, with submersed rooted and free-floating macrophytes. Species composition varies with substrate, water depth, water chemistry, turbidity, water temperatures, and other factors, but these are poorly understood. Dominant species in Nebraska include narrow-leaved pondweeds (*Potamogeton foliosus*, *Stuckenia pectinata (=Potamogeton pectinatus)*, *Potamogeton pusillus*, *Najas guadalupensis*, and *Zannichellia palustris*. *Ceratophyllum demersum* and *Utricularia macrorhiza* can be locally abundant. In quiet bays, *Potamogeton nodosus* and *Lemna* spp. are common. In clear water with sandy bottoms *Chara* spp. may also be common.

Association (Scientific) Name: *Phalaris arundinacea* Western Herbaceous Vegetation

Translated Scientific Name: Reed canarygrass, western herbaceous vegetation

Common Name: Reed canarygrass, wet meadow

Unique Identifier: CEGL001474

Classification Code: V.A.5.N.k.20

Association Classification Confidence Level: Strong

Association Summary: This association is reported from throughout Washington, Colorado, Nebraska, Montana, Idaho, and into northeastern Utah, and is likely more widespread in the western United States. Its distribution as a natural type is complicated because this native species is widely cultivated as a forage crop

and has escaped and established in wetlands and riparian areas, displacing the local flora. Elevations range from near sea level to 5,576 feet (1,700 m). Stands are found along riparian areas, pond and lake margins, wet meadows, and intermittent drainages. Soils are commonly fine-textured and may be flooded for brief to extended periods. The vegetation is characterized by a dense, tall herbaceous layer (often greater than 80% canopy cover and 60–80 inches [1.5–2 m] tall) that is dominated by *Phalaris arundinacea*, which tends to occur in monocultures. Associated species may include *Equisetum arvense*, *Muhlenbergia asperifolia*, *Mentha arvensis*, *Schoenoplectus acutus (=Scirpus acutus)*, and many other species in trace amounts where disturbed. Introduced species such as *Lepidium latifolium*, *Cirsium arvense*, *Sonchus oleraceus*, *Euphorbia esula*, and *Phleum pratense* are common in some stands.

Association (Scientific) Name: *Polygonum* spp.–*Echinochloa* spp.–*Distichlis spicata* Playa Lake Herbaceous Vegetation

Translated Scientific Name: Smartweed species–barnyard grass species–saltgrass playa lake herbaceous vegetation

Common Name: Playa marsh

Unique Identifier: CEGL002039

Classification Code: V.A.5.N.j.12

Association Classification Confidence Level: Weak

Association Summary: This wetland community is found in the central Great Plains of the United States, where it occurs in shallow depressions on gently to moderately sloping topography. Soils are deep to moderately deep loams or clay loams underlain by a dense clay sublayer. Ponds often draw down periodically in these playa-type habitats. Annual herbaceous graminoids and forbs, mostly less than 40 inches (1 m) tall, dominate the exposed mud flats, and species composition and extent of the community fluctuate from site to site and year to year. In Nebraska, graminoids include *Cyperus acuminatus*, *Eleocharis engelmannii*, and *Echinochloa muricata*, and forbs include *Bacopa rotundifolia*, *Coreopsis tinctoria*, *Elatine rubella*, *Heteranthera limosa*, *Limosella aquatica*, *Lindernia dubia*, *Mollugo verticillata*, *Polygonum pensylvanicum (=Polygonum bicorne)*, *Polygonum lapathifolium*, *Rumex stenophyllus*, and *Sagittaria calycina*. In Kansas, graminoids include *Hordeum jubatum*, and forbs include *Ambrosia grayi*, *Symphyotrichum subulatum (=Aster subulatus)*, and *Chenopodium berlandieri*. The frequent water fluctuations and thick clay pan prevent establishment of most perennial hydrophytes, such as *Schoenoplectus* spp. (=*Scirpus* spp.) and *Typha* spp.

Association (Scientific) Name: *Typha* spp. Great Plains Herbaceous Vegetation

Translated Scientific Name: Cattail species, Great Plains herbaceous vegetation

Common Name: Northern Great Plains cattail marsh

Unique Identifier: CEGL002389

Classification Code: V.A.5.N.l.9

Association Classification Confidence Level: Moderate

Association Summary: This cattail community type is found throughout the northern Great Plains of the United States and Canada. Stands occur in shallow (less than 20 inches [0.5 m]) or deep depressions, stock ponds, and seepy drainages. The vegetation is dominated by relatively pure stands of *Typha* spp., either *T. latifolia* or *T. angustifolia* or both. Many associates can occur including *Eleocharis* spp. and *Sagittaria latifolia*. This type may simply be a less diverse variation of *Typha* spp.–*Schoenoplectus* spp.–mixed herbs, Great Plains herbaceous vegetation (CEGL002228) that arises in disturbed wetland areas.

Association (Scientific) Name: *Schoenoplectus tabernaemontani*–*Typha* spp.–(*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation

Translated Scientific Name: Softstem bulrush–cattail species–(burreed species, rush species) herbaceous vegetation

Common Name: Bulrush–cattail–burreed shallow marsh

Unique Identifier: CEGL002026

Classification Code: V.A.5.N.k.33

Association Classification Confidence Level: Weak

Association Summary: This shallow marsh, mixed emergent community ranges broadly over the midwestern United States and adjacent Canada. It is found in basin-like depressions, backwater areas of floodplains, and shallow margins of lakes or ponds. Soils are shallow to deep, very poorly drained, consisting of peats, mucks, or mineral materials, and often found in alluvium. Vegetation varies from zones dominated by tall emergents 40–80 inches (1–2 m) tall to those with hydrophytic annual and perennial forbs less than 40 inches (1 m) tall. In the tall emergent zone, *Schoenoplectus tabernaemontani (=Scirpus tabernaemontani)*, *Schoenoplectus fluviatilis (=Scirpus fluviatilis)*, *Schoenoplectus acutus (=Scirpus acutus)*, *Typha angustifolia*, and *Typha latifolia* may dominate, mixed with a variety of other herbaceous species such as *Leersia oryzoides*, *Eleocharis palustris*, *Juncus* spp., and *Sparganium* spp. The hydrophytic annual and perennial forb zone is dominated by *Alisma subcordatum*, *Alisma plantago-aquatica*, *Sagittaria latifolia*, *Sparganium eurycarpum*, and *Pontederia cordata*, along with *Bacopa rotundifolia* and *Heteranthera limosa*. Occasional floating-leaved aquatics are sometimes present including *Azolla caroliniana*, *Lemna* spp., *Spirodela polyrrhiza*, and *Utricularia macrorhiza*.

Association (Scientific) Name: *Populus deltoides*–(*Salix amygdaloides*)/*Salix* (*exigua, interior*) Woodland

Translated Scientific Name: Eastern cottonwood–(peachleaf willow)/(coyote willow, sandbar willow) woodland

Common Name: Cottonwood–peachleaf willow floodplain woodland

Unique Identifier: CEGL000659

Classification Code: II.B.2.N.b.4

Association Classification Confidence Level: Moderate

Association Summary: This cottonwood–willow woodland is found widely in the central Great Plains of the United States. Stands occur on recently deposited alluvial material along rivers and streams. The soils are derived from alluvial sand, silt, and clay and are poorly developed. The water table fluctuates with the level of the adjacent river or stream. *Populus deltoides* is the dominant species in this community, although *Salix exigua* and/or *Salix interior* is generally more dominant in the initial stage following a major flood event. *Salix amygdaloides* is rare to codominant. The shrub/sapling layer is conspicuous, especially near the streambank, and consists mainly of *Salix exigua*, *Populus deltoides*, and *Salix amygdaloides*, or occasionally *Salix lutea*. In the more easterly parts of the range, *Salix interior* may replace *Salix exigua*. On the older margins of this community *Fraxinus pennsylvanica* is often found as a sapling or small canopy tree. The herbaceous stratum is variable. Graminoids typical of undisturbed sites include *Carex emoryi*, *Carex pellita (=Carex lanuginosa)*, *Pascopyrum smithii*, and *Spartina pectinata*. *Equisetum arvense* and *Glycyrrhiza lepidota* are common forbs in these sites. Widely distributed species that are adapted to these sites include *Ambrosia psilostachya*, *Artemisia campestris* ssp. *caudata*, *Artemisia ludoviciana*, *Calamovilfa longifolia*, *Cenchrus longispinus*, *Chamaesyce serpyllifolia (=Euphorbia serpyllifolia)*, *Euphorbia esula*, *Grindelia squarrosa*, *Helianthus petiolaris*, *Heterotheca villosa*, *Phyla lanceolata (=Lippia lanceolata)*, *Opuntia macrorhiza*, *Poa pratensis*, and *Sporobolus cryptandrus*. These sites are prone to invasion by exotic grasses and forbs, the most widely established being *Agrostis stolonifera*, *Bromus tectorum*, *Cirsium arvense*, *Bassia scoparia (=Kochia scoparia)*, *Melilotus* spp., *Taraxacum officinale*, and *Tragopogon dubius*.

Association (Scientific) Name: *Salix exigua*/Mesic Graminoids Shrubland

Translated Scientific Name: Coyote willow/mesic graminoids shrubland

Common Name: Sandbar willow/mesic graminoids shrubland

Unique Identifier: CEGL001203

Classification Code: III.B.2.N.d.6

Association Classification Confidence Level: Strong

Association Summary: This riparian association is found primarily in the central Great Plains, but also occurs in parts of the Rocky Mountains and the Intermountain Region's semidesert areas. It generally occurs along backwater channels and other perennially wet, but less scoured sites such as floodplain swales and irrigation ditches. In Nebraska, this community is found on sandbars, islands, and shorelines of stream channels and braided rivers. The vegetation is characterized by the dominance of *Salix exigua* in a moderately dense tall-shrub canopy with a dense herbaceous layer dominated by graminoids. Other common shrubs include saplings of *Populus deltoides* or *Salix amygdaloides*, *Salix eriocephala*, *Salix lutea*, and *Amorpha fruticosa*. Tall perennial grasses can appear to codominate the stand when *Spartina pectinata*, *Panicum virgatum*, or other tall grasses are present. Other mesic graminoids such as *Carex* spp., *Eleocharis* spp., *Juncus* spp., *Pascopyrum smithii*, *Schoenoplectus pungens (=Scirpus pungens)*, and *Sphenopholis obtusata* may be present. Common forb species include *Bidens* spp., *Lobelia siphilitica*, *Lycopus americanus*, *Lythrum alatum*, *Polygonum* spp., and *Xanthium strumarium*. Diagnostic features of this association include the nearly pure stands of *Salix exigua* shrubs, with a dense herbaceous layer of at least 30% cover of mesic graminoids.

FIELD VEGETATION ASSOCIATION PLANT COMMUNITY SUMMARY

The NVCS clearly defines plant communities that can be discriminated on the landscape and at the association level is of fine enough detail to allow evaluation of management actions.

NVCS Associations in the Rainwater Basin Wetland Complex

The following is a listing of the NVCS associations as they are used in the GIS data layer for plant communities that occur in the Rainwater Basin. The categories were divided into five representative classes: wet meadow, wetland plants, shrubs, trees, and uplands.

Wet Meadow

k.53 *Carex* spp.–(*C. pellita, C. vulpinoidea*) herbaceous vegetation (sedge species–[woolly sedge, fox sedge] herbaceous vegetation)

This sedge wet meadow type is found in the central midwestern United States. Stands occur on nearly level floodplains, often in bands surrounding channels, or in basins. Soils are poorly drained silty and clay loams formed in alluvium. Stands are flooded for much of the growing season, but may dry out in late summer. The vegetation cover is quite dense and may be patchy. The structure is dominated by graminoids 20–60 inches (0.5–1.5 m) tall. Typical species include *Carex cristatella*, *Carex molesta*, *Carex pellita (=Carex lanuginosa)*, *Carex stipata*, *Carex tribuloides*, and *Carex vulpinoidea* (a dominant in southeast Nebraska meadows). Other frequent emergent graminoids include *Eleocharis* spp., *Juncus interior*, *Juncus torreyi* and *Scirpus atrovirens*. *Leersia oryzoides* may be common where the stand borders a marsh. Forbs are common and may be conspicuous. Among the more common are *Apocynum cannabinum*, *Symphyotrichum lanceolatum (=Aster lanceolatus)*, *Lycopus americanus*, *Lythrum alatum*, and *Verbena hastata*. *Phalaris arundinacea* may invade this community to the point of excluding many of the native species.

k.61 *Eleocharis palustris* herbaceous vegetation (creeping spikerush, wet meadow)

This spikerush, wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States. Stands occur in small depressions in intermittent streambeds or depression ponds that flood early in the season and may dry out by summer. Stands are composed of submersed and emergent rooted vegetation under 40 inches (1 m) tall that is dominated by *Eleocharis palustris*, often in nearly pure stands. Soils are generally fine-textured.

i.1 *Pascopyrum smithii–Buchloe dactyloides–*(*Phyla cuneifolia, Oenothera canescens*) herbaceous vegetation, western wheatgrass–buffalograss–(wedgeleaf frogfruit, spotted evening-primrose) herbaceous vegetation

This wheatgrass, playa grassland community represents the common vegetation type of playa lake basins (depressional wetlands) under rangeland conditions in the southern and central Great Plains of the United States. In the central plains, soils are dense silts and clays, occasionally loess-derived, that flood in winter and dry out by early summer. Perennial herbaceous graminoids and forbs less than 40 inches (1 m) tall dominate the community, with composition varying depending on water levels. In the central plains, *Pascopyrum smithii* is most abundant with *Agrostis hyemalis*, *Eleocharis palustris*, *Eleocharis macrostachya*, *Elymus virginicus*, and *Hordeum jubatum* locally abundant. *Buchloe dactyloides* can be abundant in grazed sites. Early season ephemeral annuals include *Alopecurus carolinianus*, *Elatine rubella*, *Myosurus minimus*, *Veronica peregrina* ssp. *xalapensis*, and more westward *Limosella aquatica* and *Plagiobothrys scouleri*. Perennial forbs including *Ambrosia grayi*, *Phyla cuneifolia*, *Oenothera canescens*, *Rorippa sinuata*, and *Vernonia fasciculata* are conspicuous in places. In the southern plains, species characteristic of the type include *Buchloe dactyloides*, *Distichlis spicata*, and *Panicum obtusum*.

Wetland Plants

k.20 *Phalaris arundinacea* western herbaceous vegetation (reed canarygrass, western herbaceous vegetation)

This association is reported from throughout Washington, Colorado, Nebraska, Montana, Idaho, and into northeastern Utah, and is likely more widespread in the western United States. Its distribution as a natural type is complicated because this native species is widely cultivated as a forage crop and has escaped and established in wetlands and riparian areas, displacing the local flora. Elevations range from near sea level to 5,576 feet (1,700 m). Stands are found along riparian areas, pond and lake margins, wet meadows, and intermittent drainages. Soils are commonly fine-textured and may be flooded for brief to extended periods. The vegetation is characterized by a dense, tall herbaceous layer (often >80% canopy cover and 60–80 inches [1.5–2 m] tall) that is dominated by *Phalaris arundinacea*, which tends to occur in monocultures. Associated species may include *Equisetum arvense*, *Muhlenbergia asperifolia*, *Mentha arvensis*, *Schoenoplectus acutus (=Scirpus acutus)*, and many other species in trace amounts where disturbed. Introduced species such as *Lepidium latifolium*, *Cirsium arvense*, *Sonchus oleraceus*, *Euphorbia esula*, and *Phleum pratense* are common in some stands.

j.12 *Polygonum* spp.–*Echinochloa* spp.–*Distichlis spicata* playa lake, herbaceous vegetation (smartweed species–barnyard grass species–saltgrass, playa lake, herbaceous vegetation)

This wetland community is found in the central Great Plains of the United States, where it occurs in shallow depressions on gently to moderately sloping topography. Soils are deep to moderately deep loams or clay loams underlain by a dense clay sublayer. Ponds often draw down periodically in these playa-type habitats. Annual herbaceous graminoids and forbs, mostly less than 40 inches (1 m) tall, dominate the exposed mud flats, and species composition and extent of the community fluctuate from site to site and year to year. In Nebraska, graminoids include *Cyperus acuminatus*, *Eleocharis engelmannii*, and *Echinochloa muricata*. Forbs include *Bacopa rotundifolia*, *Coreopsis tinctoria*, *Elatine rubella*, *Heteranthera limosa*, *Limosella aquatica*, *Lindernia dubia*, *Mollugo verticillata*, *Polygonum pensylvanicum (=Polygonum bicorne)*, *Polygonum lapathifolium*, *Rumex stenophyllus*, and *Sagittaria calycina*. In Kansas, graminoids include *Hordeum jubatum* and forbs include *Ambrosia grayi*, *Symphyotrichum subulatum (=Aster subulatus)*, and *Chenopodium berlandieri*. The frequent water fluctuations and thick clay pan prevent establishment of most perennial hydrophytes, such as *Schoenoplectus* spp. (=*Scirpus* spp.) and *Typha* spp.

l.9 *Typha* spp. Great Plains herbaceous vegetation (CEGL002389) (cattail species, Great Plains herbaceous vegetation)

This cattail community type is found throughout the northern Great Plains of the United States and Canada. Stands occur in shallow (less than 20 inches [0.5 m]) or deep depressions, stock ponds, and seepy drainages. The vegetation is dominated by relatively pure stands of *Typha* spp., either *T. latifolia* or *T. angustifolia* or both. Many associates can occur, including *Eleocharis* spp. and *Sagittaria latifolia*. This type may simply be a less diverse variation of *Typha* spp.–*Schoenoplectus* spp.–mixed herbs, Great Plains herbaceous vegetation (CEGL002228) that arises in disturbed wetland areas.

k.33 *Schoenoplectus tabernaemontani–Typha* spp.–(*Sparganium* spp., *Juncus* spp.) herbaceous vegetation (softstem bulrush–cattail species–[burreed species, rush species] herbaceous vegetation)

This shallow marsh, mixed emergent community ranges broadly over the midwestern United States and adjacent Canada. It is found in basin-like depressions, backwater areas of floodplains, and shallow margins of lakes or ponds. Soils are shallow to deep, very poorly drained, consisting of peats, mucks, or mineral materials, and often found in alluvium.

Vegetation varies from zones dominated by tall emergents 40–80 inches (1–2 m) tall to those with hydrophytic annual and perennial forbs less than 40 inches (1 m) tall. In the tall emergent zone, *Schoenoplectus tabernaemontani (=Scirpus tabernaemontani)*, *Schoenoplectus fluviatilis (=Scirpus fluviatilis)*, *Schoenoplectus acutus (=Scirpus acutus)*, *Typha angustifolia*, and *Typha latifolia* may dominate, mixed with a variety of other herbaceous species such as *Leersia oryzoides*, *Eleocharis palustris*, *Juncus* spp., and *Sparganium* spp. The hydrophytic annual and perennial forb zone is dominated by *Alisma subcordatum*, *Alisma plantago-aquatica*, *Sagittaria latifolia*, *Sparganium eurycarpum*, *Pontederia cordata*, along with *Bacopa rotundifolia* and *Heteranthera limosa*. Occasional floating-leaved aquatics are sometimes present, including *Azolla caroliniana*, *Lemna* spp., *Spirodela polyrrhiza*, and *Utricularia macrorhiza*.

a.14 *Ceratophyllum demersum* Great Plains herbaceous vegetation (Great Plains pondweed, submerged aquatic wetland)

This community type is found in the Great Plains of the United States in shallow to relatively deep (40 inches [1 m]) freshwater basins or bands in marshes or bays that remain flooded in all but the driest years. Vegetation varies from sparse to dense, with submersed rooted and free-floating macrophytes. Species composition varies with substrate, water depth, water chemistry, turbidity, water temperatures, and other factors, but these are poorly understood. Dominant species in Nebraska include narrow-leaved pondweeds (*Potamogeton foliosus*, *Stuckenia pectinata (=Potamogeton pectinatus)*, *Potamogeton pusillus)*, *Najas guadalupensis*, and *Zannichellia palustris*. *Ceratophyllum demersum* and *Utricularia macrorhiza* can be locally abundant. In quiet bays, *Potamogeton nodosus* and *Lemna* spp. are common. In clear water with sandy bottoms *Chara* spp. may also be common.

Trees

b.4 *Populus deltoides*–(*Salix amygdaloides*)/*Salix* (*exigua, interior*) woodland (eastern cottonwood–[peachleaf willow]/[coyote willow, sandbar willow] woodland)

This cottonwood–willow woodland is found widely in the central Great Plains of the United States. Stands occur on recently deposited alluvial material along rivers and streams. The soils are derived from alluvial sand, silt, and clay and are poorly developed. The water table fluctuates with the level of the adjacent river or stream. *Populus deltoides* is the dominant species in this community, although *Salix exigua* and/or *Salix interior* is generally more dominant in the initial stage following a major flood event. *Salix amygdaloides* is rare to codominant. The shrub/sapling layer is conspicuous, especially near the streambank, and consists mainly of *Salix exigua*, *Populus deltoides*, and *Salix amygdaloides*, or occasionally *Salix lutea*. In the more easterly parts of the range, *Salix interior* may replace *Salix exigua*. On the older margins of this community *Fraxinus pennsylvanica* is often found as a sapling or small canopy tree. The herbaceous stratum is variable. Graminoids typical of undisturbed sites include *Carex emoryi*, *Carex pellita (=Carex lanuginosa)*, *Pascopyrum smithii*, and *Spartina pectinata*. *Equisetum arvense* and *Glycyrrhiza lepidota* are common forbs in these sites. Widely distributed species that are adapted to these sites include *Ambrosia psilostachya*, *Artemisia campestris* ssp. *caudata*, *Artemisia ludoviciana*, *Calamovilfa longifolia*, *Cenchrus longispinus*, *Chamaesyce serpyllifolia (=Euphorbia serpyllifolia)*, *Euphorbia esula*, *Grindelia squarrosa*, *Helianthus petiolaris*, *Heterotheca villosa*, *Phyla lanceolata (=Lippia lanceolata)*, *Opuntia macrorhiza*, *Poa pratensis*, and *Sporobolus cryptandrus*. These sites are prone to invasion by exotic grasses and forbs, the most widely established being *Agrostis stolonifera*, *Bromus tectorum*, *Cirsium arvense*, *Bassia scoparia (=Kochia scoparia)*, *Melilotus* spp., *Taraxacum officinale*, and *Tragopogon dubius*.

Shrubs

d.6 *Salix exigua*/mesic graminoids shrubland (coyote willow/mesic graminoids shrubland)

This riparian association is found primarily in the central Great Plains, but also occurs in parts of the Rocky Mountains and Intermountain Region's semidesert areas. It generally occurs along backwater channels and other perennially wet, but less scoured, sites such as floodplain swales and irrigation ditches. In Nebraska, this community is found on sandbars, islands, and shorelines of stream channels and braided rivers. The vegetation is characterized by the dominance of *Salix exigua* in a moderately dense tall-shrub canopy with a dense herbaceous layer dominated by graminoids. Other common shrubs include saplings of *Populus deltoides* or *Salix amygdaloides*, *Salix eriocephala*, *Salix lutea*, and *Amorpha fruticosa*. Tall perennial grasses can appear to codominate the stand when *Spartina pectinata*, *Panicum virgatum* or other tall grasses are present. Other mesic graminoids, such as *Carex* spp., *Eleocharis* spp., *Juncus* spp., *Pascopyrum smithii*, *Schoenoplectus pungens (=Scirpus pungens)*, and *Sphenopholis obtusata*, may be present. Common forb species include *Bidens* spp., *Lobelia siphilitica*, *Lycopus americanus*, *Lythrum alatum*, *Polygonum* spp., and *Xanthium strumarium*. Diagnostic features of this association include the nearly pure stands of *Salix exigua* shrubs, with a dense herbaceous layer of at least 30% cover of mesic graminoids.

Uplands

e.9 *Bouteloua gracilis–Buchloe dactyloides* herbaceous vegetation (blue grama–buffalograss)/purple three-awn, sideoats grama, sixweeks fescue

This blue grama–buffalograss, short-grass prairie type is common across much of the central and southern Great Plains of the United States. Stands occur on flat to rolling uplands. The surface soil may be sandy

loam, loam, silt loam, or loamy clay. The subsoil is often finer than the surface soil. This community is characterized by a moderate to dense sod of short grasses with scattered mid-grasses and forbs. The dominant species are *Bouteloua gracilis* and *Buchloe dactyloides*. The foliage of these species is 2.8–7.6 inches (7–19 cm) tall, while the flowering stalks of *Bouteloua gracilis* may reach 18 inches (45 cm). The mid-grasses are usually stunted by the arid conditions and often do not exceed 28 inches (0.7 m). Other short graminoids found in this community are *Bouteloua hirsuta*, *Carex duriuscula*, *Carex inops* ssp. *heliophila*, and *Carex filifolia* (in Nebraska). Several mid-grasses occur regularly, such as *Aristida purpurea*, *Bouteloua curtipendula*, *Pascopyrum smithii*, *Schizachyrium scoparium*, *Elymus elymoides*, *Sporobolus cryptandrus*, *Hesperostipa comata* (=*Stipa comata*), and *Vulpia octoflora*. Forbs such as *Astragalus* spp., *Gaura coccinea*, *Machaeranthera pinnatifida* var. *pinnatifida*, *Opuntia polyacantha*, *Plantago patagonica*, *Psoralidium tenuiflorum*, *Ratibida columnifera*, and *Sphaeralcea coccinea* are common throughout this community. Shrubs are very rare except in the southern part of this community's range where scattered individuals may occur. In Oklahoma, other characteristic species include *Ambrosia artemisiifolia*, *Aristida oligantha*, *Machaeranthera tanacetifolia*, *Melampodium leucanthum*, *Muhlenbegria torreyi*, *Sporobolus compositus*, *Sporobolus cryptandrus*, and *Zinnia grandiflora*. In Texas, associated species include *Prosopis glandulosa*, *Bouteloua curtipendula*, and *Sporobolus cryptandrus*.

a.2 *Andropogon gerardii–Sorghastrum nutans–Hesperostipa spartea* loess hills herbaceous vegetation (big bluestem–yellow Indiangrass)

Stands occur on moderately steep mid- to upper slopes of loess hills and along ridges. It is most common on southern and western aspects. The soil is well-drained, acidic to neutral, and shallow to deep loess (16–40 inches [40–100 cm]). The parent material is a deep loess or glacial till and other deeply weathered substrates. This community is virtually lacking in shrubs and trees. Woody vegetation that is present, such as *Amorpha canescens*, is usually less than 20 inches (0.5 m) tall. The dominant vegetation is tall grasses. Of the dominant species, *Andropogon gerardii*, *Sorghastrum nutans*, and *Hesperostipa spartea* (=*Stipa spartea*) typically exceed 40 inches (1 m). *Schizachyrium scoparium*, also very common, is shorter. In Missouri, some other species that are usually found in this community are *Echinacea pallida*, *Potentilla arguta*, *Silphium laciniatum*, and *Sporobolus compositus* var. *compositus*.

c.20 *Schizachyrium scoparium–Bouteloua curtipendula–Bouteloua hirsuta–*(*Yucca glauca*) herbaceous vegetation (little bluestem–sideoats grama)–hairy grama–(soapweed yucca) herbaceous vegetation

This bluestem–grama grass, dry-prairie type is found on the loess bluffs along the east side of Missouri River in the central midwestern United States. The soil is somewhat rapidly drained and very shallow (0–16 inches [0–40 cm]). The vegetative structure comprises a single layer of dominant grasses intermixed with forbs. Shrubs, especially *Yucca glauca*, are sometimes present. This community is a short- to midgrass prairie dominated by the bunchgrasses *Andropogon gerardii*, *Bouteloua curtipendula*, and *Schizachyrium scoparium*. *Bouteloua hirsuta* can be common. *Sporobolus cryptandrus*, *Dalea leporina*, *Dalea candida*, *Dalea enneandra*, *Astragalus lotiflorus*, and *Astragalus missouriensis* can also be common. Other herbaceous species include *Pulsatilla patens* ssp. *multifida* (=*Anemone patens*), *Symphyotrichum sericeum* (*Aster sericeus*), *Buchloe dactyloides*, *Bouteloua gracilis*, *Delphinium carolinianum*, *Gaura coccinea*, and *Pediomelum argophyllum*, and the lichens *Dermatocarpon lachneum* and *Psora decipiens*.

VEGETATION TRANSECT NOMENCLATURE

The final method of delineating plant communities was to use common name plant associations found within the basin. These communities were grouped into 11 categories. These categories then have representative plant communities commonly found in the basin.

Field codes that provide land managers with common names that they are familiar with were added to this hierarchy, allowing easy data recording during transect data collection. Table I-2 shows all of the local plant associations in the basin.

Table I-2. Rainwater Basin vegetation mapping polygon descriptions.

Field Code	*Examples or Includes*	*NVCS Code*
annual weed	sunflower, foxtail	weeds
building	McMurtrey, Cottonwood	infrastructure
Canada thistle	dominated by Canada thistle	noxious weed
cattail	native and hybrid	l.9
cedar tree	planted and volunteer cedars with multiple trees averaging 6 feet or taller and <32.5 feet (10 m) basal proximity	introduced
cropland	farmed, row crops	crop
introduced forb	perennial forbs, alfalfa, sweetclover, vetch	introduced
invasive cool-season plant	downy brome, Japanese brome, Kentucky bluegrass, smooth brome, intermediate	introduced
leafy spurge	mapped all patches regardless of size	noxious weed
moist-soil plant	annual early successional plants	j.12
musk thistle	dense patches that can be mapped	noxious weed
native grassland	untilled remnant prairie with mostly native, warm- or cool-season species	a.2, c.20, e.9
newly seeded vegetation	<2 years old with annual weeds or wild rye	a.2, c.20, e.10
parking lot	——	infrastructure
reed (*Phragmites* spp.)	all mapped patches of reed (*Phragmites* spp.)	noxious weed
planted, high-diversity, seeded vegetation	seeded native grass with 70+ native species included in mix	a.2, c.20, e.9
planted, native, cool-season vegetation	dike mix, other small patches	a.2, c.20, e.9
planted, native, warm-season vegetation	five species, old plantings with low diversity	a.2, c.20, e.9
prairie dog town	active dog towns	e.9
reed canarygrass	——	k.20
road	McMurtrey, well roads	infrastructure

Table I-2. Rainwater Basin vegetation mapping polygon descriptions.

Field Code	*Examples or Includes*	*NVCS Code*
bulrush *(Scirpus* spp.)	*Schoenoplectus fluviatilis* (three square)	k.33
shrub	American plum, chokecherry, dogwood, sumac	d.6, d.27
tree	cottonwood, green ash, willow	b.4
water or mud flat	dirt, water, mud, void of vegetation (submergent plant communities)	a.14, or other dominant plants
wet meadow	rushes, sedges, or western wheatgrass	k.53, k.61, i.1

Appendix J

Fire Management Program

The U.S. Fish and Wildlife Service has management and administrative responsibility, including fire management, for approximately 24,000 acres of waterfowl production areas in the Rainwater Basin Wetland Management District.

FIRE—A CRITICAL NATURAL PROCESS

In prairie ecosystems of the Great Plains, vegetation has evolved under periodic disturbance and defoliation from herbivores and fire, with minor weather events such as drought. This periodic disturbance is what kept the ecosystem diverse and healthy while maintaining significant biodiversity for thousands of years.

Historically natural fire, which includes Native American ignitions, has played an important disturbance role in many ecosystems: (1) removal of fuel accumulations; (2) decrease in undesirable plant communities; and (3) reduction in encroachment potential including trees, stimulating regeneration, cycling critical nutrients, and providing a diversity of habitats for wildlife. Higgins (1984) pointed out that 73% of historical lightning fires were started between July and August; the remaining 27% were started between April and June. Native American–set fires occurred mostly from February to June (most in April) and from July to November (most in October) (Higgins 1986).

When fire is excluded on a broad scale (over several decades) as it has been in many areas, the unnatural accumulation of living and dead fuel can contribute to degraded plant communities and wildlife habitats. These fuel accumulations often change the fire regime characteristics. Fuel accumulations have created the potential for uncharacteristically severe wildland fires in many areas across the country. These catastrophic wildland fires often pose risks to the safety of the public and firefighters. In addition, wildland fires threaten property and resource values such as wildlife habitat, grazing opportunities, timber, soils, water quality, and cultural resources.

Return of fire is essential for healthy vegetation and wildlife habitat in grassland and wetland ecosystems. When integrated back into an ecosystem, fire can help restore and maintain healthy systems. To facilitate fire's natural role in the environment, fire must be integrated into land and resource management plans on a broad scale.

Fire can do the following:

- improve waterfowl habitat through reduction of plant density, removal of organic material, and maintenance of early successional vegetation
- promote sediment removal in wetlands by wind scouring
- sustain biological diversity
- improve soil fertility
- improve the quality and amount of livestock forage
- reduce invasive plant communities including nonnative trees
- reduce the susceptibility of plants (caused by moisture and nutrient stress) to insects and disease
- improve water yield from off-site areas

WILDLAND FIRE MANAGEMENT POLICY AND GUIDANCE

In 2001, the Secretaries of Interior and Agriculture completed and approved an update of the 1995 Federal Fire Policy. The 2001 Federal Wildland Fire Management Policy directs federal agencies to achieve a balance between (1) fire suppression to protect life, property, and resources and (2) fire use to regulate fuels and maintain healthy ecosystems. In addition, it directs agencies to use the appropriate management response for all wildland fires regardless of the ignition source. This policy provides eight guiding principles that are fundamental to the success of the fire management program:

- Firefighter and public safety is the first priority in every fire management activity.
- The role of wildland fires as an essential ecological process and natural change agent will be incorporated into the planning process.
- Fire management plans (FMPs), programs, and activities support land and resource management plans and their implementation.
- Sound risk management is a foundation for all fire management activities.
- Fire management programs and activities are economically viable, based on values to be protected, costs, and land and resource management objectives.

- FMPs and activities are based on the best available science.
- FMPs and activities incorporate consideration of public health and environmental quality. Federal, state, tribal, local, interagency, and international coordination and cooperation are essential.
- Standardization of policies and procedures among federal agencies is an ongoing objective.

Fire management considerations, guidance, and direction should be addressed in land use, resource management plans (such as a CCP). FMPs are step-down processes from the land use plans and habitat plans, with more detail on fire suppression, fire use, and fire management activities.

MANAGEMENT DIRECTION

The Rainwater Basin Wetland Management District will protect life, property, and other resources from wildland fire by safely suppressing all wildland fires. Fire is an important management tool that can be used to accomplish habitat management objectives. If not used properly, fire can also quickly damage or destroy natural resources, equipment, buildings, and property and hurt or kill those that work with it. Prescribed fire and manual or mechanical fuels treatments will be used to reduce hazardous fuels and on district lands to reduce the intensity and severity of wildland fires. Special attention will be given to wildland–urban interface areas, both on Service-owned and adjacent lands, to reduce the risk of wildland fires to communities and improvements.

Prescribed fire and manual or mechanical fuel treatments will be used in an ecosystem management context for habitat management and to protect federal and private property. Fuel reduction activities will be applied where needed, especially in areas with a higher proportion of residences that may be considered "wildland–urban interface" areas. The prescribed fire program is outlined in the Rainwater Basin Fire Monitoring Plan.

All aspects of the fire management program will be conducted in a manner consistent with applicable laws, policies, and regulations. The district will maintain an FMP and carry out the plan to accomplish resource management objectives. Prescribed fire and fuel treatments will be applied in a scientific way under selected weather and environmental conditions to restore and maintain desired habitat conditions and control nonnative vegetation and the spread of woody vegetation. Up to approximately 6,500 acres of grasslands and wetlands will be treated annually to help accomplish habitat management objectives.

Fire Management Goal

Use fire as an ecosystem process within wetland and grassland habitats and reach the needed level of prescribed fire management at the WPAs to control invasive plants, encourage desirable native plants, and maintain productive wetlands that can benefit migratory birds.

Fire Management Objective A

Through the duration of this CCP, increase the use of prescribed fire to 5,000–7,000 acres. Its use would shift from being a management tool to control woody and other undesirable invasive plants to being a management tool to maintain healthy grassland and wetland habitats.

Fire Management Objective B

Through the duration of this CCP, increase the public's awareness and support of fire as a management tool.

Fire Management Objective C

Through the duration of this CCP, increase the number of fire-qualified partners and interagency prescribed burning.

Fire Management Strategies

- Use strategies and tactics that consider public and firefighter safety as well as resource values at risk.
- Apply fire at a rate and intensity that takes the district from a restoration need (every 1–3 years) to a historical level of fire frequency (every 5–7 years).
- Apply fire in a mosaic pattern that leaves portions of treated WPAs unburned.
- Allow fire to travel through select shelterbelts to reduce cool-season grasses and litter.
- Work with district partners to provide demonstrations, written information, and other methods of communication to inform the public of the benefits of prescribed fire.
- Work with professional instructors and local colleges and universities to conduct classes in basic firefighter training.
- Work with the appropriate agencies to develop interagency agreements that would allow mutual assistance on prescribed burns.
- Develop detailed prescribed burn plans that describe the following:
  - burn units and their predominant vegetation;
  - the primary objectives for the units and specific objectives of the fire
  - acceptable range of results
  - site preparation requirements
  - weather requirements
  - safety considerations and measures to protect sensitive features
  - burn-day activities
  - communications and coordination for burns
  - ignition techniques

- smoke management procedure
- postburn monitoring

Methods (manual or mechanical means, timing, and monitoring) for wildland fire suppression, wildland fire use, and prescribed fire can be found in a more detailed list in the district's step-down FMP.

Fire Management Rationale

Fire frequency in south-central Nebraska has been estimated to have occurred once every 5–7 years. Madden et al. (1999) assessed the effects of fire on grassland. They found that maximal grassland bird diversity is best attained by creating a mesic, mixed-grass prairie with areas of varying fire return intervals. Grassland birds such as Baird's sparrow, bobolink, grasshopper sparrow, and western meadowlark responded to burned areas. Other species such as common yellowthroat and clay-colored sparrow preferred prairie unburned for 8–10 years. The settlement of the Rainwater Basin has suppressed fire across the landscape.

Current fire at the WPAs is not frequent enough to control invading trees and shrubs. Past burns at the WPAs have shown that it takes three to four consecutive spring burns to remove woody plant invasion. This level of application is needed at approximately 20 WPAs, covering over 3,000 acres.

One of the problems that keep the district from reaching a greater fire frequency is the limited personnel available. A burn that is close to heavy fuel such as a shelterbelt requires a large fire crew to conduct the burn. Removal of shelterbelts would not only benefit grassland wildlife but would (1) eliminate the need to establish fire lines, (2) reduce the needed size of a fire crew, and (3) reduce hazardous fuels.

Prescribed fire temporarily reduces air quality by reducing visibility and releasing several components through combustion. The four major components are carbon monoxide, carbon dioxide, hydrocarbons, and particulates. Varying amounts of particulate content are generated in different types of fuels, for example, wildlife habitat improvement burns versus fuel reduction burns. The district will meet the Clean Air Act emission standards by adhering to the requirements of the Nebraska State Implementation Plan during all prescribed fire activities.

FIRE MANAGEMENT ORGANIZATION, CONTACTS, AND COOPERATION

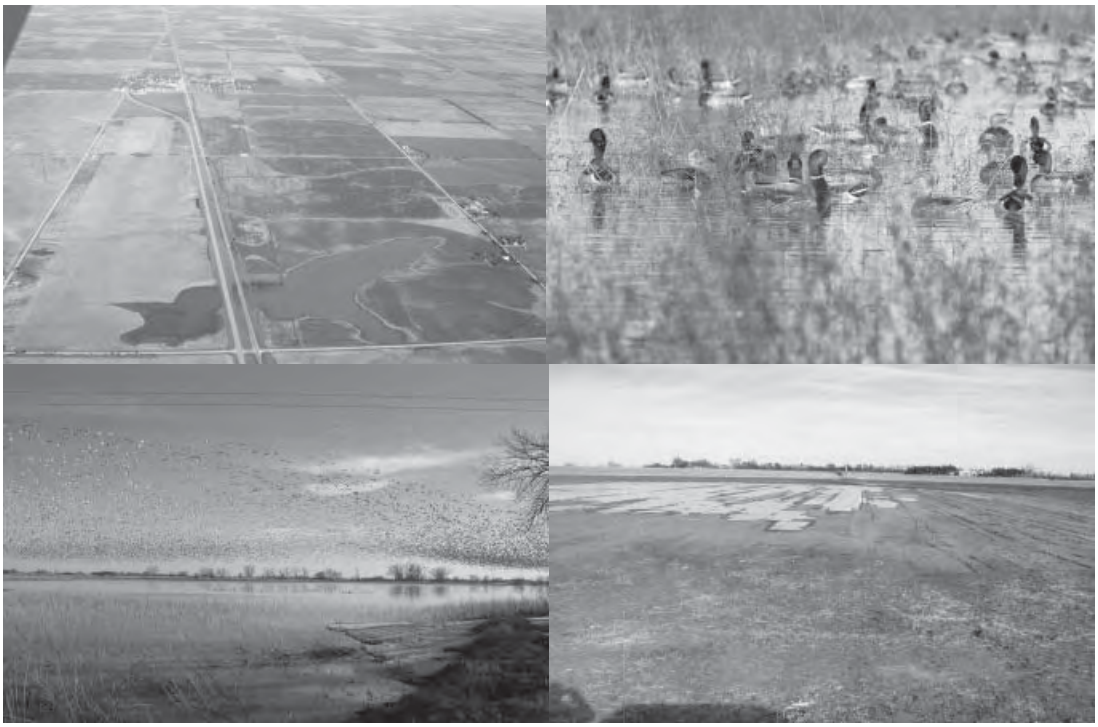
Region 6 has established qualified, technical oversight and support for fire management using the "fire management district" approach. Under this approach, an established modeling system (based on the fire management workload of a group of refuges and possibly even that of interagency partners) has determined an appropriate fire management staffing organization. The fire management workload consists of (1) historical wildland-fire suppression activities and (2) historical and planned fuels treatment workload. Depending on funds, fire management staff and support equipment may be located at the district or at other units in the district and shared between all units.

Wherever possible, fire management activities will be conducted in a coordinated and collaborative manner with federal and nonfederal partners.

Appendix K

Rainwater Basin Joint Venture Private Lands Program: Best Management Practices Eligibility Criteria and Cost Share

Rainwater Basin Joint Venture Private Lands Program
Best Management Practices Eligibility Criteria and Cost Share



Compiled by the Rainwater Basin Joint Venture
Private Lands Workgroup

Approved by the Rainwater Basin Joint Venture Management Board
March 14, 2006

RAINWATER BASIN
JOINT VENTURE

The Rainwater Basin Joint Venture Private Lands Workgroup developed the following programs and criteria to assist in the delivery and evaluation of Joint Venture (JV) programs on private lands. The proposed programs and criteria were developed with the JV objectives in mind, and will help ensure consistent and effective wetland habitat benefits through JV offerings. The Private Lands Work Group also recognizes that many wetland projects will not fit all of the criteria for a certain program, and will evaluate those projects with unique situations and information on a case-by-case basis to determine the program eligibility, applicable practices, and landowner benefits.

(1) Wetland Stewardship Program

This program targets non-cropped wetland areas ***only*** and provides incentives to landowner's that maintain and manage these habitats.

Wetland Criteria:

1) Wetland is functioning properly. No hydrologic restoration is needed.
2) Vegetative community is mostly native species with less than 5% of the wetland dominated by invasives (e.g. trees, reed canary grass, noxious weeds).
3) Wetland has not been cropped since 1985.
4) Eligible wetland area will be determined by state and federal biologists using tools such as, but not limited to, historic photos, hydric soil maps, topography information, presence of hydric vegetation, etc.
5) Areas determined to be cropland ***are not*** eligible for stewardship payment.

Practices:

✓ Landowner will maintain wetland hydrology, no hydrologic alteration is allowed.
✓ Landowner will continue to manage and maintain the native plant community.
✓ Landowner will manage and control invasive species.

Benefits:

1) A $25/acre/year stewardship payment for the hydric footprint (wetland area) over the 10-year agreement period with a $500 minimum/year.
2) Landowner continues to manage the land.
3) Landowner controls hunting access.
4) This program includes technical assistance from JV partners during the agreement period.
5) No minimum wetland size.

(2) Restoration and Management Program

This is a 10-year program that focuses on ***restoring and managing*** quality wetland habitat.

Wetland Criteria:

1) Landowner must be willing to restore hydrology to the maximum extent feasible within the basin and the vegetative community on non-cropped areas via pit filling, ditch plugs, water

control structures, fill or sediment removal, tree removal, installation of a variable flow tail water recovery system, etc.

2) Landowner enters a 10-year agreement that allows the Joint Venture Partners to manage the wetland for the duration of the agreement.

Practices:

- ✓ Landowner is given the first opportunity to perform actual management on the property.
- ✓ Reimbursement Rates:
  - Haying/Shredding: $10/acre
  - Grazing Incentives: $10/acre/year

  Grazing must be concentrated in the wetland with preferred grazing during the growing season. Grazing payments only made when JV asks cooperator to graze wetland with specific timing/rate/goals.

  These grazing cost-share incentives may be possible:

  i. Fencing
     1. Standard electric
     2. High tensile electric
     3. Permanent barbed wire

  ii. Water source for cattle

  iii. Mineral blocks/tubs

  - Prescribed Fire: $15/acre or donation to local fire department.
  - Disking: $15/acre/pass with minimum of 2 passes using a standard farm disk.
  - Heavy Disking: $35/acre/pass with a minimum of 2 passes using a >30" heavy construction disk.
  - Chemical Applications: Negotiated based on chemical cost. Labor and equipment rates determined by NRCS docket.
- ✓ Landowner has the right to defer management actions to a private contractor. The JV will help facilitate hiring the contractor to accomplish the objectives.

Benefits:

1) Landowner receives a "land use payment" for wetland restoration and vegetation management according to the following table:

Current Landuse	Fm, Fo	Sc, Sd	Ma, M,	Buffer
Cropped	$60/A	$50/A	$50/A	$60/A
Non-cropped	$50/A	$50/A	$50/A	$50/A

Payment is in exchange for the right of JV partners to restore the wetland and direct management on the project area for the 10-year agreement period. Land use payments are made annually and are not contingent on the amount of management during that year. They are contingent on the landowner's willingness to participate. Wetland area may be over 25 acres in size; however land use payment will be capped at $1,250/year (based on available funding). Management cost share will be available for the entire wetland area.

2) Landowner is allowed to continue farming if the area has previously been cropped. ***Exception***: grasslands, pasture, or native prairie may not be brought into production.
3) Landowner may perform management on the project area without requesting permission from the JV. Grazing wetlands is encouraged as a way to supplement farm income.
4) Landowner controls hunting access. Access payments may be available from other partners.
5) Includes technical assistance from JV partners during the agreement period.
6) Center pivots are permitted as long as wheel crossing(s) do not interfere with wetland hydrology.

(3) Hydrology Restoration Program (HRP-Pilot)

The purpose of this program is to restore wetland hydrology to the fullest extent possible targeting temporary and seasonal wetlands. To participate, the landowner would agree to restore wetland hydrology and sign a 10-year agreement in exchange for an annual land use payment. Due to funding limitations, two focus areas have been identified for this ***pilot program***. Maps of the focus areas have been made available to staff working directly with private landowners in these areas.

Wetland Criteria:

1) Only high priority wetlands (as determined by the RWB-JV Wetland Prioritization Model) are eligible. If all landowners owning the highest priority wetlands (red) are enrolled and funding still remains, landowners owning wetlands in the second highest priority level (salmon) will be contacted.
2) During the pilot period, basins that are 20 acres or smaller will be targeted.
3) Wetlands with severely altered hydrology (e.g. drains, pits) will be targeted first. These wetlands should have either no, or a low functionality.
4) Hydrology within the basin must be restored.

Practices:

✓ JV partners will provide economic and technical assistance necessary to restore the wetland.

Benefits:

1) Annual payments begin once restoration is complete. Payment rates follow the HRP table below.
2) JV partners provide restoration cost share.
3) No use restrictions for the project area.
4) Landowner controls hunting access.

HRP-Pilot Payment Rates

Current Land Use	Fm, Fo	Sc, Sd	Ma, M,	Buffer
Irrigated cropped	$128/A	$96/A	$64/A	$128/A
Dryland cropped	$60/A	$50/A	$50/A	$60/A
Pasture managed	$15/A	$15/A	$15/A	$15/A

(4) Seasonal Habitat Improvement Program (SHIP)

This program targets cropped wetland and allows the landowner to maintain cropping during the growing season. SHIP takes advantage of an opportunity to provide wetland habitat during times that the producer is not growing a crop. Ponding water on hydric soils during the winter months has little effect on the crop production of these sites. On hydric soils most crop loss occurs during May through July primarily due to saturation after rainfall events even if wetland drainage has occurred. This program provides a financial incentive to landowners who provide at least the opportunity to pond water on cropped areas during the off season.

Wetland Criteria:

1) Wetland or area to be flooded must be drained, but be capable of holding water utilizing a control structure.
2) On cropland, the landowner must allow natural runoff to pond in the area immediately following harvest. Water on the cropped area may be released after March 31 of each year. On pastureland, the landowner must allow natural runoff to pond on the area beginning November 1. Water may then be released after April 30 of each year. Instances where a SHIP occurs on both cropland and pasture, the water control structure can be adjusted on March 31 so that water is not held on the cropland acres.
3) The landowner understands that during the duration of this 10-year agreement, there is an inherent risk associated with late rains after March 31 that may prevent him from planting during some years.

Practices:

- ✓ Water control structure installation and associated dirt work.
- ✓ Cropland areas should have boards placed in control structure after harvest and remain in place at least until March 31.
- ✓ Pastureland should have boards placed in control structure on November 1 and remain in place at least until April 30.

Benefits:

1) The landowner, in consultation with the JV Partners, will determine an acceptable pool elevation based on a topographic survey.
2) Annual payment of $50/acre/year for cropland area determined by landowner. This establishes an agreed upon pool elevation. Annual payment of $25/acre/year for grassland and pastureland.
3) Includes technical assistance and restoration cost share provided by JV partners during the agreement period.
4) Center pivots are permitted.
5) Landowner controls hunting access.

(5) CRP 23A Incentive Bonus Program - Conservation Reserve Enhancement Program

This is a one-time signing bonus to promote enrollment and full restoration of wetlands under CP-23A. This program differs from the Hydrology Restoration Program in that landowners loose the right to crop the property for the duration of the CREP agreement.

Wetland Criteria:

1) Must sign up for CRP 23A (CREP would be included).
2) Cropland areas are eligible for incentive if the hydrology is restored (full hydrology restoration on applicant's property).
3) No prioritization needed in order to get as many wetlands restored as possible utilizing USDA funding.
4) Bonus payment paid on March 31 following completion of restoration.
5) Existing wetlands in the RWB that are currently in CRP are eligible for a bonus payment if the wetland hydrology is restored. Payment is based on # years remaining/# years in contract x $500/acre (e.g. 8 yrs remain on a 10 yr contract = 0.8 x $500 = $400/acre).

Practices:

- ✓ JV partners, in conjunction with the USDA, will provide economic and technical assistance necessary to restore the wetland.
- ✓ Eligible practices can be found in the CRP contract.

Benefits:

1) One-time payment of up to $500/acre. All acres enrolled in the CRP CP23a contract are eligible for the payment. This includes uplands and wetlands. Bonus payment will not be made until restoration is complete. The bonus payment will be made on March 31 following restoration.
2) Cost share is available to assist with restoration costs not payable by the USDA.
3) Pivot can cross the CRP unless otherwise indicated by the USDA.
4) Landowner controls hunting access.

(6) Short Term Vegetation Management Program

This program differs from the Restoration Management Program in that it does not require wetland restoration. The Short Term Vegetation Management Program does not provide an annual land use payment, or any type of land access fee. The length of the agreement is negotiable.

Wetland Criteria:

1) Trees, cattail, reed canary grass, or river bulrush must be a component of the plant community.
2) Landowner allows access to the property for management treatment.
3) Landowner signs a negotiated-length agreement that allows the Joint Venture Partners access for treatment.
4) Financial assistance is limited to reimbursement for treatments only (no incentive payments).
5) Grazing must be concentrated in the wetland with preferred grazing during the growing season.

Practices:

- ✓ Landowner agrees to allow any or all of the following: disking, chemical application, haying/shredding, prescribed burning, grazing, silt removal, pit filling, and tree removal activities.
  Reimbursement Rates:
  - Haying/Shredding: $10/acre
  - Intensive Wetland Grazing: $10/acre/year
  - Prescribed Burning: $15/acre
  - Disking: $15/acre/pass with minimum of 2 passes using a standard farm disk.
  - Heavy Disking: $35/acre/pass with a minimum of 2 passes using >30" heavy construction disk.
  - Chemical Applications: Negotiated based on specific chemical cost; labor and equipment rates determined by NRCS docket.

Benefits:

1) Will add functional value to the wetland.
2) Additional grazing incentives may be possible such as fencing, installation of a water source, or purchase of mineral block(s).

(7) General Joint Venture Cost Share Activities

The Joint Venture partners accept certain practices on their own, or in combination with the programs outlined above. Cost share is available for these activities if they provide benefits to wildlife habitat with emphasis on migratory birds, or improve watershed hydrology with direct benefits to a protected wetland. A 10-year agreement is required for cost share assistance.

Wetland Improvements

1) Sediment Control Structures
2) Fencing to encourage long term grazing in wetlands
3) Grazing (includes deferments)
4) Variable Flow Tail Water Recovery System
5) Close and Remove Roads
6) Vegetation Management
7) Junk Pile Removal
8) Water Development (wells, pivots, pipe, livestock)
9) Re-size/add/replace culverts
10) Water Control Structures
11) Wetland Creation
12) Wetland Seeding
13) Earthwork
    - ✓ Pit fills
    - ✓ Drain fills
    - ✓ Silt/sediment removal
    - ✓ Filling road/drainage ditches
    - ✓ Power line burial
    - ✓ Pipeline burial
    - ✓ Dikes/berms

- ✓ Tile drain removal

Watershed Improvements

1) Pit fills
2) Resize/add/replace culverts
3) Buffers
4) Grassland Restoration
5) Sediment Control Structures
6) Variable Flow Tail Water Recovery System
7) Removing Flow Restrictions
8) Terrace Removal
9) Close and Remove Roads
10) Tile Drain Removal

(8) Easements

An easement program remains under development until enough properties are secured that an actual program can be evaluated and implemented. JV easements will be prioritized for functioning wetlands without hydrologic modification that are not eligible for NRCS's Wetland Reserve Program. The goal of easement offerings, as with all other JV programs, is to meet wetland protection needs that cannot be met through existing programs. At this time we will follow this format:

A. Hydrologic Restoration/Protection

Provide for on-site restoration of the wetland hydrology, prevent future hydrologic alterations and non-agricultural land use, and place no restrictions on agricultural land use.

B. Pasture/Protection Easement

Provide for on-site restoration of the wetland hydrology, prevent development of any kind, prevent excavation or filling which impacts hydrology, limits land use to pasture, but does not dictate management.

C. Protection/Restoration/Management

Provide for on-site restoration of the wetland hydrology, prevent any hydrologic alterations and non-agricultural land use, and place restrictions on land use and activities for the purpose of assuring maximum wetland habitat values.

The value of the easement will be determined through an appraisal of the value of those rights to be purchased. The minimum length of the easement terms will be 25 years and will be agreed to by the landowner and the entity holding the easement. The USFWS has expressed an interest in holding perpetual restoration easements (example A above). The easement must not restrict the landowner's agricultural rights to the land. In other words, if he is cropping it now he may still try to crop it once the wetland is restored. These easements would have to be perpetual in length.

Appendix L

Wetland Management District Ditch and Tile Maintenance Policy

This policy applies to existing constructed ditches or tiles that come onto waterfowl production areas (WPAs) where no reservation of a drainage easement exists in the WPA title or deed. If there is a drainage reservation in the deed, the Service will follow the terms of that reservation.

- No new wetland or upland drainage facility will be allowed within a WPA.
- Existing drainage cannot be improved beyond the original construction.
  - Tile may not be replaced with a larger tile.
  - Ditches may not be cleaned out beyond their original depth, width, or length.
  - Ditches may not be replaced with tile lines except where the tile is installed at the same or higher elevation than the original ditch bottom or in other rare exceptions to solve severe erosion.
- All materials cleaned out of a ditch will be removed from the WPA.
- All construction sites at WPAs will be seeded down to a grass mix specified by the Service.
- Cleanout activities will not be allowed during the waterfowl-breeding season (April 1–August 1).
- If silt deposition is a concern, the Service will request that a grassed waterway or silt basin be installed upstream of Service property to help reduce future siltation.
- Cleanout of natural (never ditched) drainage ways will not be allowed.
- Ditch and tile maintenance work at WPAs will only be done after the wetland district manager has approved the project and issued a special use permit. (Note: Compatibility determinations are not necessary since the Service does not control maintenance of the system; the Service only controls the timing and scope of maintenance.)
- Landowners may still be subject to the Swampbuster Provisions and the U.S. Army Corps of Engineers' rules on maintenance and abandonment of ditches.
- Mowing or spraying of approved herbicide in a ditch after August 1 may be permitted in lieu of excavation.
- If the ditch has not been cleaned or a tile has not functioned for more than 25 years, or the watershed above the ditch has been substantially altered since the Service bought the property (significant increase in flows or degradation of water quality), a formal right-of-way request maybe required as determined by the wetland district manager.

Appendix M

RONS and SAMMS Projects

Refuge Operating Needs System (RONS)

Project Number	*Project Description*	*First-year Need ($1000s)*	*Recurring Base Need ($1000s)*	*Personnel (FTEs)*
97005	Control exotic species invasion.	132	30	0
97007	Improve water management on new waterfowl production areas.	341	30	0
00001	Establish water rights on refuge lands.	109	5	0
00004	Livestock confinements and intensive agriculture's effect on water quality.	162	10	0
97012	Increase public use of refuge lands.	140	75	1
00008	Private lands coordinator for Nebraska Sandhills.	169	104	1
99002	Archaeological review of refuge lands.	70	0	0
99005	Livestock fencing.	78	23	0
97002	Wetland restoration on refuge lands.	158	66	1
97010	Endangered species restoration.	140	75	1
99001	Law enforcement and property protection.	140	75	1
99004	Interpretive and recreational access to public lands.	99	10	0
00003	Snow goose impact on migratory bird populations within Rainwater Basin (NE).	258	10	0
97001	Habitat and population surveys.	70.5	38	0.5
97009	Wetland restoration on private lands.	161.5	90	1
00006	Expand prescribed fire program.	140	75	1
06006	Water delivery to create wetland habitat in CO, NE, ND, MT, and KS.	380	0	0

Service Asset Maintenance Management system (SAMMS)

Project Number	*Project Description*	*Cost ($1000s)*
Deferred Maintenance		
00105716	Repair worn pump engine and gear head at Smith unit, Harvard WPA.	32
02120249	Replace water-pumping station at Clark WPA.	51
02120162	Replace boundary fences at Clay County WPAs.	42
00105719	Replace worn pump engine and gear head on well at Hultine WPA.	30
02120273	Replace water-pumping station at Spring WPA, south.	51
02120166	Replace fences at six WPAs in Fillmore County.	28
02120254	Repair water-pumping station at Cottonwood WPA.	37
02120271	Replace water-pumping station at Heron WPA.	51
02120169	Replace fences at three WPAs in Phelps County.	73
00105713	Replace worn pump engine and gear head on well at Prairie Dog WPA.	35
00105710	Replace worn pump engine and gear head on well at Massie WPA.	28
00105714	Repair worn pump engine and gear head on east well at McMurtrey WPA.	32
02120170	Replace fences at three WPAs in Franklin County.	57
02120199	Replace water-pumping station at Mallard Haven WPA.	26
00105715	Repair worn pump engine and gear head on well at Harvard WPA, north.	30
00105717	Replace worn pump engine and gear head on Knudson well at Harvard WPA.	38
02120201	Repair worn pump and engine on south well at Krause WPA.	29
02120200	Repair worn-out pump and engine on north pumping station at Krause WPA.	26
02120198	Replace worn water-pumping station at Hanson WPA.	47
02120257	Replace water-pumping station at Johnson WPA, east.	39
00105712	Replace worn pump engine and gear head on well at Eckhardt WPA.	30
00105718	Replace worn pump engine and gear head on well at Mallard Haven WPA.	17
00105711	Replace worn pump engine and gear head on north well at Youngson WPA.	22
02120206	Replace water-pumping station at Lindau WPA.	49
98105704	Repair rutted gravel road.	43
02120195	Repair water-pumping station at north well at Hultine WPA.	33
02120158	Repair earthen dike at Springer WPA.	37
98109671	Repair dike.	278
Heavy Equipment		
91105702	Replace worn front-end loader.	200
04133918	Replace Bobcat skid steer loader.	40
99105705	Replace worn 1981 dump truck.	51
01116415	Replace 1990 well maintenance truck.	51
01116225	Replace 1967 bulldozer.	195
01116255	Replace Clark 4x4 hinged tractor–dozer.	275

Service Asset Maintenance Management system (SAMMS)

Project Number	*Project Description*	*Cost ($1000s)*
99105707	Replace worn equipment truck.	110
04133810	Replace 1966 Cuece 1/2 Kaiser jeep.	50
01116249	Replace WABCO earthmoving scraper.	264
01116227	Replace 1996 Caterpillar bulldozer.	195
01116250	Replace Westinghouse model earthmoving scraper.	264
01116411	Replace worn John Deere tractor.	90
05139000	Replace 2003 Freightliner semi-truck.	200
05139017	Replace 1979 flatbed dump truck.	60
Small Equipment		
01116271	Replace 1992 Dodge pickup.	30
01116409	Replace 1993 Chevrolet Blazer.	30
01116407	Replace worn Jeep.	31
01116273	Replace 1994 Ford 1/2-ton pickup.	29
01116219	Replace worn heavy-duty disc used for invasive plant control.	19
04133805	Replace 2001 F-150 Ford pickup.	31
04133817	Replace 2002 Chevrolet Silverado 1/2-ton pickup.	31
04133809	Replace 2001 F-450 Ford fire truck.	40
04133820	Replace 2002 F-250 Ford pickup.	37
04133811	Replace 2002 Chevrolet Suburban.	37
04133829	Replace 2002 F-450 Ford flatbed truck.	37
04133816	Replace 2002 Chevrolet Impala automobile.	22
04133830	Replace 2002 F-250 Ford pickup.	31
04133831	Replace 2004 F-350 Ford pickup.	37
99105693	Replace worn 12-foot farm disc.	22
99105696	Replace worn 4x4 ATV.	14
98105703	Replace worn backhoe utility tractor.	38
01116212	Replace 1991 Panther 16-foot airboat.	24
01116216	Replace crane on well repair truck.	14
01116241	Replace 16-inch Crisafulli pump.	15
01116244	Replace mobile 12-inch gator pump.	15
01116254	Replace John Deere tractor, model 6400.	58
01116256	Replace lowboy trailer.	18
01116259	Replace airboat trailer.	9
01116260	Replace airboat trailer.	8
01116262	Replace worn dump trailer.	31
01116266	Replace 1998 Ford 1-ton pickup.	31

Service Asset Maintenance Management system (SAMMS)

Project Number	*Project Description*	*Cost ($1000s)*
01116267	Replace 1999 Ford 1-ton fire engine.	37
01116406	Replace 1995 Ford pickup.	31
01116410	Replace 1998 Dodge 4x4 pickup.	31
01116412	Replace 2001 Dodge 4x4 pickup.	37
01116413	Replace 2000 Ford crew cab truck.	37
01116414	Replace John Deere tractor, model 5310.	42
04133800	Replace 1997 sport utility vehicle.	30
05138982	Replace 2001 Ford 4x4 fire truck.	36
05138987	Replace 2001 Ford 4x4 2-ton truck.	40
05138989	Replace John Deere tractor, model 5410.	65
05138990	Replace Hyster forklift, model H60XL.	60
05138991	Replace incinerator.	25
05138995	Replace American Eagle forklift, model AE8122.00.	100
05138997	Replace 2002 Chevrolet 2-ton truck.	40
05138999	Replace Caterpillar road grader.	220
05139001	Replace semi-truck trailer, lowboy model.	45
05139004	Replace 2003 mule ATV.	8
05139005	Replace 2004 Ford crew cab truck.	40
05139007	Replace 2004 Ford super crew 4x4 truck.	45
05139010	Replace 2005 Ford Hybrid Escape automobile.	30
05139012	Replace 2005 Ford cab/chassis.	28
05139014	Replace 2005 Ford super cab 4x4 truck.	35
05139016	Replace 1979 flatbed dump truck.	50
05139018	Replace 1998 Chevrolet 3/4-ton truck.	35
Roads and Parking Lots (TEA 21)		
03126571	PE/CN* (parking lots 9001–3, 9009–16, 9033, 9121–23, 9071–74).	306
03126572	PE/CN (parking lots 9054–61, 9120, 9077–82, 9084–90).	380
03126573	PE/CN (parking lots 9062–69, 9091–9102, 9116–19).	470
03126574	PE/CN (route 100, 0.3 mile; parking lots 9004–08, 9017–32, 9034–42, 9044–53).	595
Small Construction		
01116196	Replace aged storage shed damaged by storm.	90
04133864	Replace fence at Peterson WPA.	41
02120274	Replace water-pumping station at Rauscher WPA.	51
Large Construction		
00109809	Construct new office building [p/d/cc].	2400

** PE/CN = preliminary engineering and construction.*

Bibliography

[AOU] American Ornithological Union. 2004. American Ornithological Union's Check-list of North American Birds. 7th ed. [Place of publication unknown]. [Number of pages unknown].

Anderson, J.T.; Smith, L.M. 1998. Protein and energy production in playas: implications for migratory bird management. Wetlands 18:437–46.

———. 1999. Carrying capacity and diel use of managed playa wetlands by nonbreeding waterbirds.Wildlife Society Bulletin 27:281–91.

Anderson, J.T.; Smith, L.M. 2000. Invertebrate response to moist-soil management of playa wetlands. Ecological Applications 10(2):550–8.

Ankney, C.D.; Afton, A.D. 1988. Bioenergetics of breeding northern shovelers: diet, nutrient reserves, clutch size, and incubation. Condor 90:459–72.

Ankney, C.D.; Alisauskas, R.T. 1991. Nutrient-reserve dynamics and diet of breeding female gadwalls. Condor 93:799–810.

Ankney, C.D.; MacInnes, C.C. 1978. Nutrient reserves and reproductive performance of female lesser snow geese. Auk 95:459–71.

Austin, J.E.; Richert, A.L. 2001. A comprehensive review of observational and site evaluation data of migrant whooping cranes in the United States, 1943–99. U.S. Geological Survey Report. Jamestown, ND: U.S. Geological Survey, Northern Prairie Wildlife Research Center. 156 p.

Bakker, K.K. 2000. Avian occurrence in woodlands and grasslands on public areas throughout eastern South Dakota [PhD dissertation]. Brookings, SD: South Dakota State University. [Number of pages unknown].

———. 2003. The effect of woody vegetation on grassland nesting birds: an annotated bibliography. In: The Proceedings of the South Dakota Academy of Sciences; [Place and date of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 82:119–41.

Baldassarre, G.A.; Bolen, E.G. 2006. Waterfowl ecology and management. 2nd ed. [City of publication unknown], FL: Krieger Publishing Company. 567 p.

Baldassarre, G.A.; Whyte, R.J.; Quinlan, E.E. [et al.] 1983. Dynamics and quality of waste corn available to postbreeding waterfowl in Texas. Wildlife Society Bulletin 11:25–31.

Ballard, B.M.; Thompson, J.E.; Petrie, M.J. [et al.] 2004. Diet and nutrition of northern pintails wintering along the southern coast of Texas. Journal of Wildlife Management 68(2):371–82.

Baxter, W.L.; Wolfe, C.W. 1973. Life history and ecology of the ring-necked pheasant in Nebraska. Lincoln, NE: Nebraska Game and Parks Commission. 58 p.

BBC Research & Consulting. 2006. Rainwater Basin Wetland Management District socioeconomic impact analysis: preliminary report. Unpublished report on file at Rainwater Basin Wetland Management District, NE. 9 p.

Benning, D.S. 1987. Coordinated mid-continent white-fronted goose survey. Washington DC: U.S. Department of the Interior, Fish and Wildlife Service. U.S. Fish and Wildlife Service annual report. 7 p.

Bergan, J.F.; Smith, L.M. 1993. Survival rates of female mallards wintering in the Playa Lakes Region. Journal of Wildlife Management 57:570–7.

Bishop, A.A. 2005. Rainwater Basin Joint Venture waterfowl habitat use model (Rainwater Basin Joint Venture GIS layer). Unpublished report on file at Rainwater Basin Wetland Management District, Grand Island, NE. 27 p.

Bishop, A.A.; Reker, R. 2006. Landcover within the RWB: a GIS layer created with 2004 data. Unpublished reports on file at Rainwater Basin Wetland Management District, Grand Island, NE.

Bowyer, M.W.; Stafford, J.D.; Yetter, A.P. [et al.] 2005. Moist-soil plant seed production for waterfowl at Chautauqua National Wildlife Refuge, Illinois. The American Midland Naturalist: 154(2):331–41.

Brennan, E.K. 2006. Local and landscape level variables influencing migratory bird abundance, diversity, behavior, and community structure in Rainwater Basin wetlands [PhD dissertation]. [Place of publication unknown]: Texas Technological University. 180 p.

Burger, L.D.; Burger, L.W., Jr.; Faaborg, J. 1994. Effects of prairie fragmentation predation on artificial nests. Journal of Wildlife Management 58(2):249–54.

Butcher, Greg. [Date unknown]. Central mixed-grass prairie executive summary. Partners in Flight. <http://www.blm.gov/wildlife/pl_34sum.htm> [Date of access unknown].

Checkett, J.M.; Drobney, R.D.; Petrie, M.J. [et al.] 2002. True metabolizable energy of moist soil seeds. Wildlife Society Bulletin 30(4):1113–19.

Clark, R.J. 1975. A field study of the short-eared owl, *Asio flammeus* (Pontoppidan), in North America. Wildlife Monographs 47:1–67.

Clayton, K.M.; Schmutz, J.K. 1999. Is the decline of burrowing owls *Speotyto cunicularia* in prairie Canada linked to changes in Great Plains ecosystems? Bird Conservation International 9:163–85.

Connelly, J.W.; Gratson, M.W.; Reese, K.P. 1998. Sharp-tailed grouse (*Tympanuchus phasianellus*). In: Poole, A.; Gill, F.; editors. The Birds of North America, No. 354 [doi:10.2173/bna.354]. Philadelphia: The Academy of Natural Sciences; Washington DC: The American Ornithologists' Union. [Pages unknown].

Cox, R.R., Jr. 1998. Spring-staging ecology of greater white-fronted geese, lesser snow geese, and northern pintails in the central Platte River valley and Rainwater Basin of Nebraska. Northern Prairie Wildlife Research Center preliminary progress report. [Unpublished report]. 4 p.

———. 1999. Spring-staging ecology of waterfowl in Nebraska—then versus now. Waterfowl 2000 12(2):18. Jamestown, ND: Northern Prairie Wildlife Research Center Online. <http://www.npwrc.usgs.gov/resource/birds/ssecol/index.htm> (Version 02DEC99) [Date of access unknown].

Cox, R.R., Jr.; Davis, B.E. 2002. Habitat use, movements, and survival of female northern pintails during spring migration in Nebraska and subsequent potential breeding-site selection in the Prairie Pothole Region [progress report]. Bismarck, ND: U.S. Geological Survey, Northern Prairie Wildlife Research Center. 150 p.

Cox, R.R., Jr.; Samuel, M.D.; Church, K.E. 1999. Body condition of adult lesser snow geese killed by avian cholera [progress report]. 20 p.

Dai, X.; Boutton, T.W.; Hailemichael, M. [et al.] 2006. Soil carbon and nitrogen storage in response to fire in a temperate mixed-grass savanna. Journal of Environmental Quality 35:1620–8.

Davis, S.K. 2004. Area sensitivity in grassland passerines: Effects of patch size, patch shape, and vegetation structure on bird abundance and occurrence in southern Saskatchewan. The Auk 121(4):1130–45.

DeJong, J.R. 2001. Landscape fragmentation and grassland patch size effects on non-game grassland birds in xeric mixed-grass prairies of western South Dakota. Brookings, SD: South Dakota State University. [Pages unknown].

Delnicki, D.; Reinecke, K.J. 1986. Mid-winter food use and body weights of mallards and wood ducks in Mississippi. Journal of Wildlife Management 50:43–51.

Dewey S.L. 1986. Effects of the herbicide atrazine on aquatic insect community structure and emergence. Ecology 67:148–62.

Dodson, S.I.; Merritt, C.M.; Shannahan, J.P. [et al.] 1999. Low exposure concentrations of atrazine increase male production in *Daphnia pulicaria*. Environmental Toxicology and Chemistry 18(7): 1568–73.

Drahota, J. 2000. Results of ground survey 2000 [unpublished report]. On file at Rainwater Basin Wetland Management District. 7 p.

———. 2006. A case for managing Rainwater Basin wetlands [unpublished report]. On file at Rainwater Basin Wetland Management District. 11 p.

Drahota, J.; Bishop, A.; Walters, R. 2004. Rainwater Basin wetland complex south-central Nebraska 2003–2004 vegetation mapping and monitoring project [unpublished report]. On file at Rainwater Basin Wetland Management District, Kearney, NE. 53 p.

Dubovsky, J.A.; Kaminski, R.M. 1994. Potential reproductive consequences of winter-diet restriction in mallards. Journal of Wildlife Management 58(4): 780–6.

Duebbert, H.F.; Lokemoen, J.T. 1977. Upland nesting of American bitterns, marsh hawks, and short-eared owls. The Prairie Naturalist 9(3–4):33–40.

Dugger, B.D.; Dugger, K.M. 2002. Long-billed curlew (*Numenius americanus*). In: Poole, A.; Gill, F.; editors. The Birds of North America, No. 628 [doi:10.2173/bna.628]. Philadelphia, PA: The Academy of Natural Sciences; Washington DC: The American Ornithologists' Union. [Pages unknown].

Ekstein, J.D.; Hygnstrom, S.E. 1996. Fate of wetlands associated with the Central Nebraska Irrigation Canal System. Great Plains Research 6:41–60.

Ermacoff, N. 1968. Marsh and habitat management practices at the Mendota Wildlife Area. [Place of publication unknown]: California Department of Fish and Game. Game Management Leaflet No. 12. 10 p.

Evans, R.D.; Wolfe, C.W., Jr. 1967. Waterfowl production in the Rainwater Basin area of Nebraska. Journal of Wildlife Management 33(4):788–94.

Farmer, A.H.; Parent, F. 1997. Effects of landscape on shorebird movements at spring migration stopovers. Condor 99: 698–707.

Farmer, A.H.; Wiens, J. 1999. Models and reality: time-energy trade-offs in pectoral sandpiper migration. Ecology 80:2566–80.

Farrar, J. 1982. The Rainwater Basin, Nebraska's vanishing wetlands. NEBRASKAland. March [updated and reprinted 1988 February]. Nebraska Game and Parks Commission. 15 p.

———. 1996a. Nebraska's Rainwater Basin. NEBRASKAland. March. Nebraska Game and Parks Commission. 18–35.

———. 1996b. The Troester tunnel: notes from the field. NEBRASKAland. May. Nebraska Game and Parks Commission. 6–7.

Federal Geographic Data Committee. 1997. FGDC vegetation classification and information standards. Reston, VA: [Publisher name unknown]. [Pages unknown].

Fleskes, J.P.; Jarvis, R.L.; Gilmer, D.S. 2002. September–March survival of female northern pintails radiotagged in San Joaquin Valley, California. Journal of Wildlife Management 31:212–9.

Frankforter, J.D. 1996. Nebraska wetland resources. In: Fretwell, J.D.; Williams, J.S.; Redman, P.J.; editors. National water summary of wetland resources. [Place of publication unknown]: U.S. Department of the Interior, U.S. Geological Survey. U.S. Geological Survey Water Supply Paper 2425. 261–6.

Fredrickson, L.H.; Reid, F.A. 1988. Waterfowl use of wetland complexes. [Place of publication unknown]: U.S. Department of the Interior, Fish and Wildlife Service. U.S. Fish and Wildlife Service Leaflet 13.2.1. [Pages unknown].

Fredrickson, L.H.; Taylor, T.S. 1982. Management of seasonally flooded impoundments for wildlife. Washington DC: U.S. Department of the Interior, Fish and Wildlife Service. U.S. Fish and Wildlife Service Resource Publication 148. 29 p.

Fritcher, S.C.; Rumble, M.A.; Flake, L.D. 2004. Grassland bird densities in several stages of mixed-grass prairie. Journal of Range Management 57:351–7.

Fuhlendorf, S.D.; Engle, D.M. 2001. Restoring heterogeneity on rangelands: ecosystem management based on evolutionary grazing patterns. Bioscience 51: 625–32.

———. 2004. Application of the fire–grazing interaction to restore a shifting mosaic on tallgrass prairie. Journal of Applied Ecology 41:604–14.

Gabbert, A.E.; Leif, A.P.; Purvis, J.R. [et al.] 1999. Survival and habitat use by ring-necked pheasants during two disparate winters in South Dakota. Journal of Wildlife Management 63:711–22.

Gaiser, E.E.; Lang, K.L. 1998. Distribution of cladoceran zooplankton among prairie pothole wetlands in northwest Iowa. Lake and Reservoir Management 14(1):37–51.

Gersib, R.A. 1991. Nebraska wetlands priority plan. [Place of publication unknown]: Nebraska Game and Parks Commission. [Pages unknown].

Gersib, R.A.; Cornely, J.; Trout, A. [et al.] 1990. Concept plan for waterfowl habitat protection, Rainwater Basin area of Nebraska. Lincoln, NE: Nebraska Game and Parks Commission. 71 p.

Gersib, R.A.; Dinan, K.F.; Kauffeld, J.D. [et al.] 1992. Looking to the future: an implementation plan for the Rainwater Basin Joint Venture. Lincoln, NE: Nebraska Game and Parks Commission. 56 p.

Gersib, R.A.; Elder, B.; Dinan, K.F. [et al.] 1989a. Waterfowl values by wetland type within Rainwater Basin wetlands with special emphasis on activity time budget and census data. Lincoln, NE: Nebraska Game and Parks Commission; Grand Island, NE: U.S. Department of the Interior, Fish and Wildlife Service. 105 p.

Gersib, R.A.; Raines, R.R.; Rosier, W.S. [et al.] 1989b. A functional assessment of selected wetlands within the Rainwater Basin area of Nebraska. Lincoln, NE: Nebraska Game and Parks Commission. 41 p.

Gilbert, M.C. 1989. Ordination and mapping of wetland communities in Nebraska's Rainwater Basin region. CEMRO Environmental Report 89-1. Omaha, NE: U.S. Army Corps of Engineers, Omaha District. 105 p.

Gleason, H.R.; Euliss, N.H., Jr.; Hubbard, D.E. [et al.] 2003. Effects of sediment load on emergence of aquatic invertebrates and plants from wetland soil egg and seed banks. Wetlands 23:26–34.

Go, V.; Garey, J.; Wolff, M.S. [et al.] 1999. Estrogenic potential of certain pyrethroid compounds in the MCF-7 human breast carcinoma cell line. Environmental Health Perspectives 107(3):173–7.

Gordon, C.C. 1989. The relationship of wetland characteristics to avian cholera (*Pasteurella multocida*) outbreaks in the Rainwater Basin area of Nebraska [master's thesis]. Brookings, SD: South Dakota State University. 126 p.

Gordon C.C.; Flake, L.D.; Higgins, K.F. 1997. Trace metals in water and sediments of wetlands in the Rainwater Basin area of Nebraska. In: The Proceedings of the South Dakota Academy of Sciences; [Place and date of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 76:253–61.

Grant, R.A. 1965. The burrowing owl in Minnesota. The Loon (3):2–17.

Grossman, D.H.; Faber-Langendoen, D.; Weakley, A.W. [et al.] 1998. International classification of ecological communities: terrestrial vegetation of the United States. Vol. 1 of The National Vegetation Classification Standard. Arlington, VA: The Nature Conservancy. [Pages unknown].

Haug, E.A.; Millsap, B.A.; Martell, M.S. 1993. Burrowing owl (*Speotyto cuniculari*) In: Poole, A.; Gill, F.; editors. The Birds of North America, No. 61 [doi:10.2173/bna.61]. Philadelphia: The Academy of Natural Sciences; Washington DC: The American Ornithologists' Union. [Pages unknown].

Haukos, D.A.; Smith, L.M. 1993. Moist-soil management of playa lakes for migrating and wintering ducks. Wildlife Society Bulletin 21:288–98.

Hayes T.B.; Haston, K.; Tsui, M. [et al.] 2002. Atrazine induced hermaphroditism at 0.1 ppb in American leopard frogs (*Rana pipiens*): laboratory and field evidence. Environmental Health Perspectives 111: 568–75.

Heitmeyer, M.E. 1988. Body composition of female mallards in winter in relation to annual cycle events. Condor 90:669–80.

Heitmeyer, M.E.; Fredrickson, L.H. 1981. Do wetland conditions in the Mississippi delta hardwoods influence mallard recruitment? In: Transactions, North American Wildlife and Natural Resources Conference; [Date and location of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 46:44–57.

Helzer, C.J. 1996. The effects of wet meadow fragmentation on grassland birds [master's thesis]. Lincoln, NE: University of Nebraska–Lincoln. [Pages unknown].

Helzer C.J.; Jelinski, D.E. 1999. The relative importance of patch area and perimeter-area ratio to grassland breeding birds. Ecological Applications 9(4):1448–58.

Herkert, J.R.; Reinking, D.L.; Wiedenfeld, D.A. [et al.] 2003. Effects of prairie fragmentation on the nest success of breeding birds in the mid-continental United States. Conservation Biology 17(2):587–94.

Herkert, J.R.; Szafoni, R.E.; Kleen, V.M. [et al.] 1993. Habitat establishment, enhancement and management for forest and grassland birds in Illinois. Springfield, IL: Illinois Department of Conservation, Division of Natural Heritage. Natural Heritage Technical Publication 1. [Pages unknown].

Higgins, K.F. 1984. Lightning fires in grasslands in North Dakota and in pine savanna lands in nearby South Dakota and Montana. Journal of Range Management 37:100–3.

———. 1986. Interpretation and compendium of historic fire accounts in the northern Great Plains Washington DC: U.S. Department of the Interior, Fish and Wildlife Service. Resource Publication 161. [Pages unknown].

Hughes, J.P. 1996. The effect of vegetative structure and landscape composition on avian abundance and reproductive success in CRP fields in northeastern Kansas [master's thesis]. Manhattan, KS: Kansas State University. [Pages unknown].

Jessen, R.L. 1970. Mallard population trends and hunting losses in Minnesota. Journal of Wildlife Management 34:93–105.

Johnsgard, P.A. 1983. The grouse of the world [PhD dissertation]. Lincoln, NE: University of Nebraska–Lincoln. [Pages unknown].

———. 1997. The birds of Nebraska and adjacent plains states. Lincoln, NE: Nebraska Game and Parks Commission. Nebraska Ornithologist's Union Occasional Papers, No. 6. [Pages unknown].

Johnson, R.G.; Temple, S.A. 1990. Nest predation and brood parasitism of tallgrass prairie birds. Journal of Wildlife Management 54:106–11.

Jorde, D.G. 1981. Winter and spring staging ecology of mallards in south central Nebraska [master's thesis]. [City of publication unknown], ND: University of North Dakota. 116 p.

Jorde, D.G.; Krapu, G.L.; Crawford, R.D. 1983. Feeding ecology of mallards wintering in Nebraska. Journal of Wildlife Management 47:1044–53.

Jorde, D.G.; Krapu, G.L.; Crawford, D.C. [et al.] 1984. Effects of weather on habitat selection and behavior of mallards wintering in Nebraska. The Condor 86:258–65.

Jorgensen, J.G. 2004. An overview of shorebird migration in the eastern Rainwater Basin, Nebraska. Lincoln, NE: Nebraska Game and Parks Commission. Nebraska Ornithologist's Union Occasional Papers, No. 8. [Pages unknown].

Kaminski, R.M.; Gluesing, E.A. 1987. Density and habitat-related recruitment in mallards. Journal of Wildlife Management 51:141–8.

Kantrud, H.A. 2006. Cattail management symposium—history of cattails on the prairies: wildlife impacts. <http://www.npwrc.usgs.gov/resource/plants/cattail/kantrud.htm> [Access date unknown].

Keech, C.F.; Dreeszen, V.H. 1959. Geology and groundwater resources of Clay County, Nebraska. Washington DC: U.S. Department of the Interior, U.S. Geological Survey. U.S. Geological Survey Water Supply Paper 1468. 57 p.

Kendeigh, S.C.; Dol'nik, V.R.; Gavrilov, V.M. 1977. Avian energetics. In: Pinowski, J.; Kendeigh, S.C.; editors. Granivorous birds in ecosystems. New York: Cambridge University Press. 127–204.

Kennedy, T.A.; Naeem, S.; Howe, K.M. [et al.] 2002. Biodiversity as a barrier to ecological invasion. Nature 417:636–8.

Kim, I.Y.; Shin, J.H.; Kim, H.S. [et al.] 2004. Assessing estrogenic activity of pyrethroid insecticides using in vitro combination assays. The Journal of Reproduction and Development 50(2):245–55.

Koerner, J.W.; Bookout, T.A.; Denarik, K.E. 1974. Movements of Canada geese color-marked near southwestern Lake Erie. Journal of Wildlife Management 38:275–89.

Krapu, G.L. 1981. The role of nutrient reserves in mallard reproduction. Auk 98:29–38.

Krapu, G.L.; Brandt, D.A.; Cox, R.R., Jr. 2004. Less waste corn, more land in soybeans, and the switch to genetically modified crops: trends with important implications for wildlife management. Wildlife Society Bulletin 32:127–36.

Krapu, G.L.; Reinecke, K.J.; Jorde, D.G. [et al.] 1995. Spring staging ecology of midcontinent greater white-fronted geese. Journal of Wildlife Management 59:736–46.

Kuzila, M.S. 1984. Genesis and morphology of soils in and around large depressions in Clay County, Nebraska [PhD dissertation]. Lincoln, NE: University of Nebraska–Lincoln. [Pages unknown].

———. 1994. Inherited morphologies of two large basins in Clay County, Nebraska. Great Plains Research 4:51–63.

Kuzila, M.S.; Lewis, D.T. 1993. Soils in rain basins of south central Nebraska—properties, genesis and classification. Soil Science American Journal 37:155–61.

LaGrange, T.G. 1985. Habitat use and nutrient reserves dynamics of spring migratory mallards in central Iowa [master's thesis]. [City of publication unknown], IA: Iowa State University. 81 p.

———. 2005. A guide to Nebraska's wetlands and their conservation needs. Lincoln, NE: Nebraska Game and Parks Commission. 59 p.

LaGrange, T.G.; Dinsmore, J.J. 1988. Nutrient reserve dynamics of female mallards during spring migration through central Iowa. In: Waterfowl in Winter. Minneapolis: University of Minnesota Press. 287–97.

Larson, D.L.; McDonald, S.; Fivizzani, A.J. [et al.] 1998. Effects of the herbicide atrazine on *Ambystoma tigrinum* metamorphosis: duration, larval growth, and hormonal response. Physiological Zoology 71(6): 671–9.

Laubhan, M.L.; Fredrickson, L.H. 1992. Estimating seed production of common plants in seasonally flooded wetlands. Journal of Wildlife Management 56(2):329–37.

Laubhan, M.L.; Gleason, R.A.; Knutsen, G.A. [et al.] 2006. A preliminary biological assessment of Long Lake National Wildlife Refuge Complex, North Dakota. Washington DC: U.S. Department of the Interior, Fish and Wildlife Service. Biological Technical Publication, BTP R6006-2006. [Pages unknown].

Laubhan, Murray K.; Koerner, T.M.; Sprenger, M.D. [et al.] 2005. A preliminary biological assessment of Lacreek National Wildlife Refuge, Martin, South Dakota, USA. Jamestown, ND: U.S. Department of the Interior, U.S. Geological Survey. [Pages unknown].

Lavergne, S.; Molofsky, J. 2004. Reed canarygrass (*Phalaris arundinacea* L.) as a biological model in the study of plant invasions. Critical Reviews in Plant Sciences 23:415–29.

Loesch, C.R.; Kaminski, R.M. 1989. Winter body-weight patterns of female mallards fed agricultural seeds. Journal of Wildlife Management 53:1081–7.

Madden, E.M. 1996. Passerine communities and bird-habitat relationships on prescribe-burned, mixed-grass prairie in North Dakota [master's thesis]. Bozeman, MT: Montana State University. [Pages unknown].

Madden, E.M.; Hansen, A.J.; Murphy, R.K. 1999. Influence of prescribed fire history on habitat and abundance of passerine birds in northern mixed-grass prairie. Canadian Field-Naturalist 113(4): 627–40.

McCarthy, C.; Pella, T.; Link, G. [et al.] 1997. Greater prairie chicken nesting habitat, Sheyenne National Grassland, North Dakota. [Place of publication unknown]: U.S. Department of Agriculture, Forest Service. General Technical Report RM-GTR-298. [Pages unknown].

McKee, G.M.; Ryan, R.; Mechlin, L.M. 1998. Predicting greater prairie-chicken nest success from vegetation and landscape characteristics. Journal of Wildlife Management 62:314–21.

McMurtrey, M.D.; Craig, R.; Schildman, G. 1972. Nebraska wetland survey. [City of publication unknown], NE: Nebraska Game and Parks Commission. Habitat Work Plan K-71. 78 p.

Messmer, T.A. 1990. Influence of grazing treatments on non-game birds and vegetation structure in south central North Dakota [PhD dissertation]. Fargo, ND: North Dakota State University. [Pages unknown].

Merrill, M.D.; Chapman, K.A.; Poiani, K.A. [et al.] 1999. Land-use patterns surrounding greater prairie-chicken leks in northwestern Minnesota. Journal of Wildlife Management 63:189–98.

Miller, M.R.; Reinecke, K.J. 1984. Proper expression of metabolizable energy in avian energetics. Condor 86(4):396–400.

Mollhoff, W.J. 2001. The Nebraska breeding bird atlas, 1984–89. Lincoln, NE: Nebraska Game and Parks Commission. Nebraska Ornithologist's Union Occasional Papers, No. 7. 233 p.

Moon, J.A.; Haukos, D.A. 2006. Survival of female northern pintails wintering in the Playa Lakes region of northwestern Texas. Journal of Wildlife Management 70:777–83.

Moravec, J. 1993. Syntaxonomic and nomenclatural treatment of Scandinavian-type associations and sociations. Journal of Vegetation Science 4:833–8.

[NASS] National Agricultural Statistics Service. 2004. Agricultural chemical usage 2003 field crops summary. <http://www.nass.usda.gov/Statistics_by_Subject/Environmental/index.asp> [Access date unknown].

[NDEQ] Nebraska Department of Environmental Quality. 2006. Title 117, Nebraska surface water quality standards. In: Water quality standard for wetlands. [Place of publication unknown]. [Pages unknown]. Chapter 4.

[NGPC] Nebraska Game and Parks Commission. 1977–99 unpublished reports. Lincoln, NE. [Pages unknown].

———. 1997–99 unpublished reports. Lincoln, NE. [Pages unknown].

———. 2000–03 unpublished reports. Lincoln, NE. [Pages unknown].

Nelson K.J.; Esmoil, B.J. 1999. Background contaminants evaluation of Fort Niobrara and Valentine National Wildlife Refuge. Grand Island, NE: U.S. Department of the Interior, Fish and Wildlife Service. U.S. Fish and Wildlife Service Contaminant Report. [Pages unknown].

Olson, R.A.; Flake, L.D. 1975. Nesting of ring-necked pheasants in eastern South Dakota. In: The Proceedings of the South Dakota Academy of Science; [Place and date of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 54:126–36.

Pampush, G.J.; Anthony, R.G. 1993. Nest success, habitat utilization and nest-site selection of longbilled curlews in the Columbia Basin, Oregon. Condor 95:957–67.

Pederson, R.L.; Jorde, D.G.; Simpson, S.G. 1989. Northern Great Plains. In: Smith, L.M.; Pederson, R.L.; Kaminski, R.M.; editors. Habitat management for migrating and wintering waterfowl in North America. Lubbock, TX: Texas Technological University Press. 281–310.

Petrie, S.A.; Rogers, K.H. 2004. Nutrient-reserve dynamics of white-faced whistling-ducks breeding in a semiarid South Africa. Canadian Journal of Zoology 82:1082–90.

Price, J.I.; Brand, C.J. 1984. Persistence of *Pasteurella multocida* in Nebraska wetlands under epizootic conditions. Journal of Wildlife Diseases 20(2):90–4.

Prince, H.H. 1979. Bioenergetics of postbreeding dabbling ducks. In: Bookhout, T.A.; editor. Waterfowl and wetlands—an integrated review. Proceedings of a symposium of the North Central Section of The Wildlife Society; [Date and location of symposium unknown]. La Crosse, WI: La Crosse Printing. 103–17.

Prose, B.L. 1987. Habitat suitability index models: plains sharp-tailed grouse. Washington DC: Natural Ecology Center. U.S. Fish and Wildlife Service Biological Report 82. [Pages unknown].

Rabbe, M.; Drahota, J.; Bishop, A. 2004. Estimating duck use-days in the Rainwater Basin wetlands—a baseline model for management implications [unpublished report]. On file at Rainwater Basin Wetland Management District, Kearney, NE. [Pages unknown].

Raines, R.R.; Gilbert, M.C.; Gersib, R.A. [et al.] 1990. Regulatory planning for Nebraska's Rainwater Basin wetlands (advanced identification of disposal areas). Prepared for the Rainwater Basin advanced identification study. Kansas City, KS: U.S. Environmental Protection Agency, region 7; Omaha, NE: U.S. Army Engineer District. 46 p.

[RWBJV] Rainwater Basin Joint Venture. 1993. Water management options for wetland development in the Rainwater Basin. [Place of publication unknown]: [Publisher name unknown]. 16 p.

———. 1994. Best management practices for Rainwater Basin wetlands. [Place of publication unknown]: [Publisher name unknown]. Public Lands Work Group. 41 p.

Raveling, D.G. 1978. Dynamics of distribution of Canada geese in winter. In: Transactions, North American Wildlife and Natural Resources Conference; [Date and place of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 42:206–25.

Raveling, D.G.; Crews, W.E.; Klimstra, W.D. 1972. Activity patterns of Canada geese during winter. Wilson Bulletin 84:278–95.

Raveling, D.G.; Heitmeyer, M.E. 1989. Relationships of population size and recruitment of pintails to habitat conditions and harvest. Journal of Wildlife Management 53:1088–103.

Redmond, R.L.; Bicak, T.K.; Jenni, D.A. 1981. An evaluation of breeding season census techniques for long-billed curlews (*Numenius americanus*). Studies in Avian Biology 6:197–201.

Reid, F.R.; Kelley, J.R., Jr.; Taylor, T.S. [et al.] 1989. Upper Mississippi Valley wetlands: refuges and moist-soil impoundments. In: Smith, L.M.; Pederson, R.L.; Kaminski, R.M.; editors. Habitat management for migrating and wintering waterfowl in North America. Lubbock, TX: Texas Technological University Press. 181–202.

Reinecke, K.J.; Kaminski, R.M.; Moorehead, D.J. [et al.] 1989. Mississippi alluvial valley. In: Smith, L.M.; Pederson, R.L.; Kaminski, R.M.; editors. Habitat management for migrating and wintering waterfowl in North America. Lubbock, TX: Texas Technological University Press. 203–47.

Renken, R.B.; Dinsmore, J.J. 1987. Nongame bird communities on managed grasslands in North Dakota. Canadian Field-Naturalist 101(4):551–57.

Richert, A. 1999. Multiple scale analyses of whooping crane habitat in Nebraska [master's thesis]. Lincoln, NE: University of Nebraska–Lincoln. [Pages unknown].

Rohwer, F.C. 1984. Patterns of egg laying in prairie ducks. Auk 101:603–5.

Samuel, M.D. 1995. Physical and biological factors associated with avian cholera in wetland ecosystems [program report]. Madison, WI: National Wildlife Health Center. [Pages unknown].

Samuel, M.D.; Shadduck, D.J.; Goldberg, D.R. [et al.] 2005. Avian cholera in waterfowl: the role of lesser snow and Ross's geese as disease carriers in the Playa Lakes region. Journal of Wildlife Diseases 41(1):48–57.

Schildman, G.; Hurt, J. 1984. Update of Rainwater Basin wetland survey. Survey of habitat work plan K-83. W-15-R-40. [Place of publication unknown]: Nebraska Game and Parks Commission. 13 p.

Schneider, R.; Humpert, M.; Stoner, K. [et al.] 2005. The Nebraska Natural Legacy Project: A comprehensive wildlife conservation strategy. Lincoln, NE: Nebraska Game and Parks Commission. 245 p.

Schwarz, M.S.; Echols, K.R.; Wolcott, M.J. [et al.] 2004. Environmental contaminants associated with swine concentrated animal feeding operation and implications for McMurtrey National Wildlife Refuge. Grand Island, NE: U.S. Department of the Interior, Fish and Wildlife Service. U.S. Fish and Wildlife Service Contaminant Report. [Pages unknown].

Sharpe, R.S.; Silcock, W.R.; Jorgensen, J.G. 2001. Birds of Nebraska: their distribution and temporal occurrence. Lincoln, NE: University of Nebraska Press. 520 p.

Sharpley, A.N.; Daniel, T.; Sims, T. [et al.] 1999. Agricultural phosphorus and eutrophication. Washington DC: U.S. Department of Agriculture, Agricultural Research Service. ARS-149. [Pages unknown].

Sherfy, M.H.; Kirkpatrick, R.L. 1998. Nutritional value and management of waterfowl and shorebird foods in Atlantic coastal moist-soil impoundments [master's thesis]. <http://scholar.lib.vt.edu/theses/available/etd-033199-130907/unrestricted/chapter1.pdf> [Access date unknown]. [Pages unknown].

Singleton, J.R. 1951. Production and utilization of waterfowl food plants on the east Texas Gulf Coast. Journal of Wildlife Management 15(1):46–56.

Smith, B.J.; Higgins, K.F. 1990. Avian cholera and temporal changes in wetland numbers and densities in Nebraska's Rainwater Basin area. Wetlands 10:1–5.

Smith, B.J.; Higgins, K.F.; Gritzner, C.F. 1989. Land use relationships to avian cholera outbreaks in the Nebraska Rainwater Basin area. Prairie Naturalist 21(3):125–36.

Smith, B.J.; Higgins, K.F.; Tucker, W.L. 1990. Precipitation, waterfowl densities and mycotoxins: their potential effect on avian cholera epizootics in the Nebraska Rainwater Basin area. In: Transactions of North American Wildlife and Natural Resources Conference; [Date and place of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 55:269–82.

Smith, L.M. 1989. Effects of grazing and burning on nutritive quality of cattail in playas. Journal of Aquatic Plant Management 27:51–3.

———. 1990. Waterfowl habitat management and research in North America. In: Transactions of the 19th International Union of Game Biologist Congress; [Date of congress unknown]; Trondheim, Norway. [Place of publication unknown]: [Publisher name unknown]. 2:468–76.

———. 1998. Research needs for the Rainwater Basin of Nebraska: a hierarchical approach. Lincoln, NE: Nebraska Game and Parks Commission. 22 p.

Snyder, W.D. 1984. Ring-necked pheasant nesting ecology and wheat farming on the high plains. Journal of Wildlife Management 48:878–88.

Solberg, J.W. 1992. Coordinated mid-continent white-fronted goose survey. [Place of publication unknown]: U.S. Department of the Interior, Fish and Wildlife Service. U.S. Fish and Wildlife Service annual report. 6 p.

Sporrong, J.M. 2001. Response of nongame birds and terrestrial invertebrates to restoration of upland grasslands in the Rainwater Basin region, Nebraska [master's thesis]. Eau Claire, WI: University of Wisconsin–Eau Claire. 108 p.

Starks, P.J. 1984. Analysis of rainbasin depressions of Clay County, Nebraska [master's thesis]. Omaha, NE: University of Nebraska. 90 p.

Steinauer, G.; Rolfsmeier, S. 2003. Terrestrial natural communities of Nebraska. [Place of publication unknown]: Nebraska Game and Parks Commission. 143 p.

Stutheit, R.G.; Gilbert, M.C.; Whited, P.M. [et al.]; editors. 2004. A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of Rainwater Basin depressional wetlands in Nebraska. ERDC/EL TR-04-4. Vicksburg, MS: U.S. Army Engineer Research and Development Center. 118 p.

Taylor, J.P.; Smith, L.M. 2005. Migratory bird use of belowground foods in moist-soil managed wetlands in the Middle Rio Grande Valley, New Mexico. Wildlife Society Bulletin 33(2):574–82.

Taylor, M.W.; Wolfe, C.W.; Baxter, W.L. 1978. Land use change and ring-necked pheasants in Nebraska. Wildlife Society Bulletin 6:226–30.

Trautman, C.G.; Dahlgren, R.B.; Seubert, J.L. 1959. Pheasant nesting. South Dakota Conservation Digest 26:18–21.

Traylor, Susan S. 2000. Waterfowl migration in south central Nebraska, February–March 2000 [unpublished report]. Lincoln, NE: University of Nebraska; Nebraska Game and Parks Commission. [Pages unknown].

[UNL] University of Nebraska–Lincoln. 2004. Biology and treatment recommendations for field crop pests. Lincoln, NE: Department of Entomology. <http://entomology.unl.edu/fldcrops/pestipm.htm#Item2> [Access date unknown].

———. 2006a. Groundwater map—drought 2000–2006. Lincoln, NE: Institute of Agriculture and Natural Resources, School of Natural Resources, Conservation and Survey Division. <http://csd.unl.edu/csd-esic/GWMapArchives/2006GWMaps/drought2000to2006-300dpi.tif> accessed 25 June 2007.

———. 2006b. Groundwater map—predevelopment to spring 2006. Lincoln, NE: Institute of Agriculture and Natural Resources, School of Natural Resources, Conservation and Survey Division. <http://csd.unl.edu/csd-esic/GWMapArchives/2006GWMaps/predev06-300dpi.tif> accessed 25 June 2007.

U.S. Census Bureau. 2000–2007. State and county quickfacts: Nebraska. <http://quickfacts.census.gov/qfd/states/31000.html> [Access date unknown].

(USDOE) U.S. Department of Energy. 1999. Carbon sequestration research and development. Report No. DOE/SC/FE-1. U.S. Department of Energy, Office of Science, Office of Fossil Energy. <www.osti.gov/bridge/servlets/purl/810722-9s7bTP/native/810722.pdf>. 289 p.

[USFWS] U.S. Department of the Interior, Fish and Wildlife Service. 1954. Wetlands inventory of Nebraska. U.S. Fish and Wildlife Service, Billings, MT. 31 p.

———. 1977–99 unpublished reports. Grand Island, NE. [Pages unknown].

———. 1981. The Platte River ecology study special research report. Jamestown, ND: Northern Prairie Wildlife Research Center Online. <http://www.npwrc.usgs.gov/resource/habitat/plriveco/index.htm> (Version16JUL97) [Access date unknown].

———. 1983–93. Unpublished annual reports. Rainwater Basin Wetland Management District, Kearney, NE. [Pages unknown].

———. 1995. updated 2005. Migratory nongame birds of management concern in the United States: the 1995 list. Washington DC: Office of Migratory Bird Management. 22 p.

———. 2000. [No title]. <http://mountain-prairie.fws.gov/reference/briefing_book_nd_ 2000.pdf> [Access date unknown].

———. 2001. The biological integrity, diversity, and environmental health policy. <http://policy.fws.gov/library01fr3809.pdf> [Access date unknown].

———. 2006. Livestock confinement [Rainwater Basin GIS layer]. Data on file at Rainwater Basin Wetland Management District.

[USFWS et al.] U.S. Department of the Interior, Fish and Wildlife Service; Canadian Wildlife Service; Mexican Ministry of Environment, Natural Resources, and Fisheries. 1998. North American waterfowl management plan, 1998 update—expanding the vision. Washington DC: [Publisher name unknown]. 32 p.

[USFWS and NGPC] U.S. Department of the Interior, Fish and Wildlife Service; Nebraska Game and Parks Commission. 1986. Rainwater Basin of Nebraska migratory bird habitat acquisition plan [unpublished plan]. On file at Rainwater Basin Wetland Management District. 30 p.

[USEPA] U.S. Environmental Protection Agency. 2003. National pollutant discharge elimination system permit regulation and effluent limitation guidelines and standards for concentrated animal feeding operations (CAFOs). Federal Register 68(29):7177–269. <http://cfpub.epa.gov/npdes/afo/cafofinalrule.cfm> [Access date unknown].

van der Burg, Max Post. 2005. Factors affecting songbird nest survival and brood parasitism in the Rainwater Basin region of Nebraska [master's thesis]. Lincoln, NE: University of Nebraska–Lincoln. 71 p.

Volkert, W.K. 1992. Response of grassland birds to a large-scale prairie planting project. The Passenger Pigeon 54(3):191–6.

Warner, K.D.; Nieman, D.J. 1999. [Unpublished preliminary report]. Saskatoon, SK: Canadian Wildlife Service. 4 p.

White, D.H.; James, D. 1978. Differential use of fresh water environments by wintering waterfowl of coastal Texas. Wilson Bulletin 90:99–111.

Wiens, J.A. 1973. Pattern and process in grassland bird communities. Ecological Monographs 43:236–70.

Windingstad, R.M.; Hurt, J.J.; Trout, A.K. [et al.] 1984. Avian cholera in Nebraska's Rainwater Basin. In: Transactions of North American Wildlife and Natural Resources Conference; [Date and location of conference unknown]. [Place of publication unknown]: [Publisher name unknown]. 49:577–83.

Wood, W.W. 2000. Ground-water recharge in the southern high plains of Texas and New Mexico. [Place of publication unknown]: [Publisher name unknown]. U.S. Geological Survey Publication FS-127-99. 4 p.

Zinkl, J.G.; Dey, N.; Hyland, J.M. [et al.] 1997. An epornitic of avian cholera in waterfowl and common crows in Phelps County, Nebraska, in the spring, 1975. Journal of Wildlife Diseases 13:194–8.