

# **Draft Comprehensive Conservation Plan and Environmental Assessment**

*Arrowwood National Wildlife Refuge*

**February 2007**

*Prepared by the U.S. Fish and Wildlife Service*

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# Abbreviations

<b>Administration Act</b>	National Wildlife Refuge System Administration Act
<b>AGNPS</b>	agricultural nonpoint source (model)
<b>CCC</b>	Civilian Conservation Corps
<b>CCP</b>	comprehensive conservation plan
<b>CFR</b>	Code of Federal Regulations
<b>cfs</b>	cubic feet per second
<b>DNC</b>	dense nesting cover
<b>EA</b>	environmental assessment
<b>EIS</b>	environmental impact statement
<b>EPA</b>	Environmental Protection Agency
<b>FMP</b>	fire management plan
<b>FWS</b>	U.S. Fish and Wildlife Service
<b>GS</b>	general pay schedule
<b>HMP</b>	habitat management plan
<b>HUA</b>	hydrologic unit area
<b>Improvement Act</b>	National Wildlife Refuge System Improvement Act of 1997
<b>IPM Plan</b>	Integrated Pest Management Plan for the Arrowwood NWR Complex
<b>JAKES</b>	Juniors Acquiring Knowledge, Ethics & Skills
<b>MMRE</b>	Mainstream Missouri River ecosystem
<b>NEPA</b>	National Environmental Policy Act
<b>NDGF</b>	North Dakota Department of Game and Fish
<b>NOA</b>	notice of availability
<b>NRCS</b>	Natural Resources Conservation Service
<b>NWR</b>	national wildlife refuge
<b>OWLS</b>	outdoor wildlife learning site
<b>PL</b>	public law
<b>Reclamation</b>	Bureau of Reclamation
<b>Refuge System</b>	National Wildlife Refuge System
<b>SAMMS</b>	Service Asset Maintenance Management System
<b>Service</b>	U.S. Fish and Wildlife Service
<b>SWG</b>	State Wildlife Grant
<b>USFWS</b>	U.S. Fish and Wildlife Service
<b>USGS</b>	U.S. Geological Survey
<b>UWA</b>	North Dakota Unified Watershed Assessment
<b>VOR</b>	visual observation reading
<b>WG</b>	wage grade pay schedule
<b>WMD</b>	wetland management district
<b>WPA</b>	Works Progress Administration
<b>WUI</b>	wildland–urban interface



# Summary

Arrowwood National Wildlife Refuge, North Dakota, was established in 1935 as a refuge and breeding ground for migratory birds and other wildlife.

Alternative 3 of this environmental assessment is the proposed action of the U.S. Fish and Wildlife Service and is presented in chapter 6 as the draft comprehensive conservation plan for the refuge.

## THE REFUGE

President Franklin D. Roosevelt signed Executive Order 7168 on September 4, 1935, “establishing Arrow-wood Migratory Waterfowl Refuge.” Now known as Arrowwood National Wildlife Refuge, the 15,973-acre refuge is in east-central North Dakota. The refuge covers 14 miles of the James River Valley in Foster and Stutsman counties, approximately 30 miles north of Jamestown.

The purposes for the refuge, summarized here, are set out in the authorities for acquisition. Arrowwood National Wildlife Refuge was established for the following:

- use by migratory birds, with emphasis on waterfowl and other waterbirds
- the conservation of fish and wildlife resources
- use as an inviolate sanctuary, or for any other management purpose, for migratory birds. (Migratory Bird Conservation Act of 1929)
- a refuge and breeding ground for migratory birds and other wildlife (Executive Order 7168)



*The canvasback is a common duck at the refuge.*

## Habitat

The refuge lies on the Central Flyway migration corridor and is an important stopover for many

species of birds as they journey north and south during annual migrations. Prairie grassland and wetland complex habitats at the refuge and surrounding private lands provide nesting and feeding habitat for waterfowl in the spring and summer. In addition, hundreds of thousands of waterfowl migrate through the area and use these wetlands in the spring and fall for feeding and resting.

The refuge contains approximately 6,000 acres of native prairie; 5,340 acres of seeded grasses; 3,850 acres of wetlands (420 acres of natural wetlands); 660 acres of wooded ravines and riparian woodlands; and 125 acres of planted trees including shelterbelts.

The prairie ecosystem, of which the refuge is a part, evolved under constantly changing conditions. Grazing by large herds of animals, trampling, fire, and drought—with varied timing and intensity—resulted in diverse plant and animal communities in various successional stages. Today, large herds of grazing animals no longer exist. Tracts of prairie have been broken into smaller pieces and new habitats have been introduced (including croplands, woodlands, and brush lands).

Many of the sensitive native plant communities are suppressed with nonnative plants including smooth brome, Kentucky bluegrass, or invasive plants such as leafy spurge and Canada thistle. However, these sites still contain native plant seed sources and dormant native plants with the potential for tremendous biological diversity. Along with the waterfowl habitat, these grasslands provide important breeding habitat to a variety of ground-nesting birds, especially the declining grassland-dependent songbirds.

Approximately 3,430 acres of wetlands are in managed impoundments and pools. The remaining acres are either natural wetlands or instream wetlands created by low-head dikes on tributaries flowing into the refuge. Historically, the managed impoundments were naturally occurring riverine lakes; these lakes were modified to improve water management capabilities.

## Administrative History

In the 1930s, the Civilian Conservation Corps developed refuge impoundments designed to store water rather than facilitate drawdowns and shallow water management.

The Flood Control Act of 1944 authorized construction of the Jamestown Dam, roughly 30 miles south of the refuge, in 1954. The purpose of the dam was to provide flood control for the city of

Jamestown. The reservoir filled for the first time in 1965 and backed water onto the Arrowwood National Wildlife Refuge, preventing water management in most years. Several years later, operating levels of the reservoir were increased by 3 feet to accommodate recreation and to allow for the release of pollutant-flushing flows through Jamestown. This increased water level backed even more water onto the refuge and eliminated water management options in most years.

The Garrison Diversion Unit Reformulation Act of 1986 required mitigation for the adverse impacts to the refuge caused by the Garrison Diversion Unit project. An environmental impact statement, signed in 1997, analyzed the need to provide the refuge with water management capability to mitigate for high water levels imposed by the Jamestown Reservoir.

The preferred alternative selected from the environmental impact statement consisted of the following: downstream channel improvements; new water control structures; fish barriers; a bypass channel around Mud Lake, Jim Lake, and Depuy Marsh; a dike and water control structure at Stony Brook; and subimpoundments within Mud and Jim lakes. In addition, the alternative called for the reduction of the Jamestown Reservoir operating elevation by 1.8 feet. These features of the Arrowwood National Wildlife Refuge mitigation project are intended to mitigate past, present, and future impacts of the Jamestown Reservoir.

## Visitor Services

Public use and recreation at the refuge includes the six priority wildlife-dependent uses: hunting, fishing, wildlife observation, wildlife photography, interpretation, and education. Hunters are allowed to pursue deer, upland game birds, cottontail rabbits, and fox. Fishing is allowed on all refuge impoundments; however, current fishing opportunities are temporary and sporadic due to the predominantly low water levels in managed impoundments. The auto tour route, the Warbler Woodland Watchable Wildlife Area, and an adjacent nature trail offer numerous wildlife-viewing opportunities. The entire refuge is open to walk-in access. Interpretation consists of refuge brochures, maps, and signs. In addition, the refuge offers tours and environmental education programs for school groups, scouts, and special events.

In addition, the refuge allows recreational trapping, commercial fishing for carp and bigmouth buffalo, recreational wild food gathering, and biking and horseback riding on designated trails.

## THE PLANNING PROCESS

The comprehensive conservation planning process is a series of steps that, along with environmental

analysis and documentation, are conducted simultaneously. The U.S. Fish and Wildlife Service is engaging the public in the planning process to provide a forum for ideas and issues to be shared, reviewed, and evaluated among agency staff and the public.

Based on the analysis documented in this environmental assessment, the following decisions will be made by the U.S. Fish and Wildlife Service's regional director for region 6:

- the type and extent of management and public access that will occur on the Arrowwood National Wildlife Refuge
- whether or not the management and public access on the Arrowwood National Wildlife Refuge would have a significant impact on the quality of the human environment

Implementation of the comprehensive conservation plan will be monitored throughout its 15-year effective period (2007–2022). The U.S. Fish and Wildlife Service will annually monitor accomplishment of plan objectives. The objectives will be examined at a minimum of every 5 years to determine if revisions, additions, or deletions are necessary.

## Future Management of Arrowwood National Wildlife Refuge

As part of the planning process, the refuge staff and planning team developed the following vision statement for Arrowwood National Wildlife Refuge.

### *Vision*

*Provide quality habitat for threatened and endangered species, waterfowl, other migratory birds, and other wildlife in the Prairie Pothole Region of North Dakota. The refuge will provide an environment where a diversity of riparian, native prairie, grassland, and wetland habitats and their associated wildlife can be observed and explored. People will be able to learn about and appreciate the natural environment of the refuge and enjoy opportunities for wildlife-dependent recreation.*

### *Goals*

A goal is a descriptive, broad statement of desired future conditions that conveys a purpose, but does not define measurable units. Goals will direct work at carrying out the refuge's mandates and achieving the purposes. Each management alternative is designed to meet all the goals for the refuge.

These goals are derived from the purposes and vision statement for the refuge to reflect the refuge's contribution to the National Wildlife Refuge System. The goals reflect the core mission of the U.S. Fish and Wildlife Service to protect fish, wildlife, and plant resources while providing compatible opportunities for the public to appreciate and enjoy the natural environment of the region.

#### *Upland Goal*

Provide a diversity of grassland types that emulate the range of natural variation characteristic of the Prairie Pothole Region to benefit trust resources including waterfowl, grassland birds, and songbirds.

#### *Wetland Goal*

Provide a diversity of wetland types that emulate the range of natural variation characteristic of the Prairie Pothole Region to benefit threatened and endangered species, waterfowl, shorebirds, wading birds, and other wetland birds.



USFWS

*Arrowwood Lake*

#### *Visitor Services Goal*

Visitors of all abilities will enjoy a refuge visit and increase their knowledge and appreciation of the prairie ecosystem and the refuge's history by participating in compatible wildlife-dependent activities.

### ***Management Alternatives***

In all alternatives, the bypass channel, dikes, and water control structures of the Arrowwood National Wildlife Refuge mitigation project would allow management of refuge water levels in all but the most extreme high water years. Managers would use the bypass channel to move large volumes of water downstream, bypassing all refuge wetlands except Arrowwood Lake. Water passing through

Arrowwood Lake and entering the bypass channel would not be filtered through the other refuge wetlands; sediment and contaminants gained in the upper watershed would have a greater chance of entering Jamestown Reservoir.

#### *Alternative 1—Current Management (No Action)*

This alternative would manage habitats, wildlife, programs, and facilities at current levels as time, staff, and funds allow. There would be emphasis on waterfowl migration and reproduction habitat. In some cases, management would be reactionary to opportunities as they present themselves. Target elevations of each wetland impoundment would be managed independently to achieve optimal habitat conditions. Interpretation, education, administration, and facilities would be maintained with minor increases or decreases based on time, funding, and staffing.

#### *Alternative 2—Enhanced Management*

This alternative would maximize the biological potential of the refuge for both wetland and upland habitats, and support a well-balanced and diverse flora and fauna representative of the Prairie Pothole Region. The Arrowwood National Wildlife Refuge mitigation project would be used to achieve wetland habitat objectives. A scientific-based monitoring program would be developed as part of the habitat management plan, a step-down plan, and carried out to monitor the habitat and wildlife population responses to management activities. Public use opportunities would be expanded with the construction of additional facilities and development of educational programs.

#### *Alternative 3—Enhanced Refuge and Watershed Management (Proposed Action)*

This alternative, in addition to the features described in alternative 2, would include a plan to improve water quality entering the refuge and reduce peak flows in the upper James River watershed during spring runoff and summer rainfall events. The watershed management component would include working with private landowners through the U.S. Fish and Wildlife Service's Partners for Wildlife Program and other federal, state, and private conservation programs. The focus would be to protect and restore wetlands and grasslands, and reduce the impacts on water quality from cropland and livestock operations. Improving the health of the upper James River watershed would not only benefit wildlife habitat in the watershed and at the refuge, it would also benefit Jamestown Reservoir and all downstream users.



# 1 Purpose and Need

This document presents an environmental assessment (EA) that evaluates alternatives for, as well as expected consequences of, management of Arrowwood National Wildlife Refuge in North Dakota (see vicinity map, figure 1). Alternative 3 of the EA is the proposed action of the U.S. Fish and Wildlife Service (Service, USFWS) and is presented in chapter 6 as the draft comprehensive conservation plan (CCP) for the refuge.

The Arrowwood National Wildlife Refuge Complex includes Arrowwood National Wildlife Refuge (NWR), Arrowwood Wetland Management District (WMD), Chase Lake WMD, and Valley City WMD. This analysis and draft CCP does not address management of areas other than Arrowwood NWR. One or more CCPs will be developed to guide management of the districts and their inclusive waterfowl production areas and refuges.

This chapter describes agency guidance, the history and purposes of Arrowwood NWR, and the purpose and need for a plan.

## AGENCY GUIDANCE

This section describes agency guidance—laws and policies—that affects national wildlife refuges. This includes guidance that requires and directs development of a CCP for a national wildlife refuge.



*Nesting Canada Goose*

Tim Bowman/USFWS

The Service is the principal agency responsible for conservation of the United States' fish, wildlife, and plant resources. The Service shares this responsibility with other federal agencies and state and tribal governments.

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

The Service manages a diverse network of more than 540 national wildlife refuges within the Refuge System, which encompasses 95 million acres of lands and waters. Arrowwood NWR is one of 60 national wildlife refuges in North Dakota and was the 70th national wildlife refuge established.

*The mission of the National Wildlife Refuge System is to administer a 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.*

## Laws

Operation and management of national wildlife refuges are influenced by a wide array of laws, treaties, and executive orders (appendix A). The primary guidance comes from these laws:

- National Wildlife Refuge System Administration Act of 1966, as amended (Administration Act)
- National Wildlife Refuge System Improvement Act of 1997 (Improvement Act)

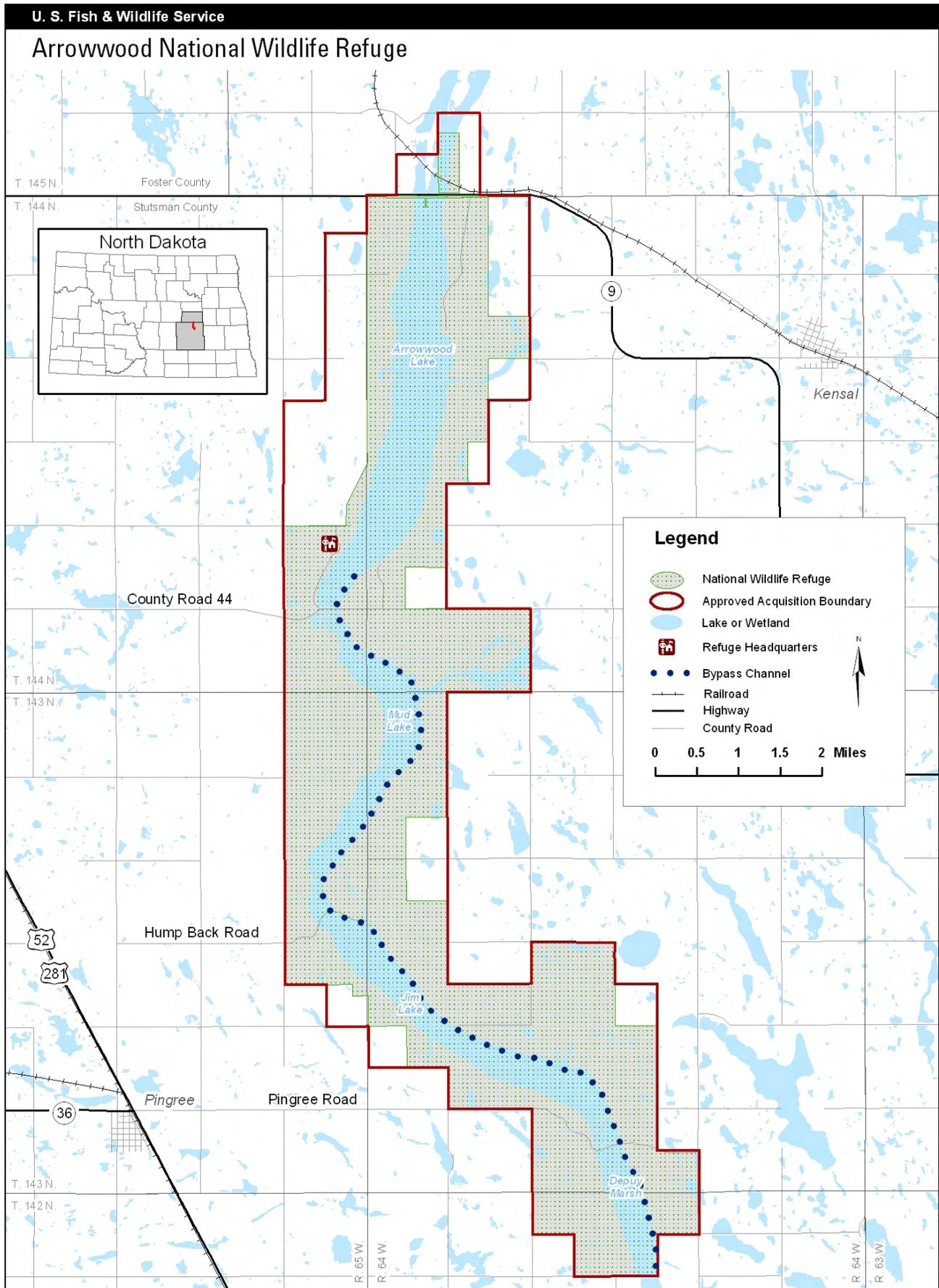


Figure 1. Vicinity map for Arrowwood NWR, North Dakota

## Policies

All national wildlife refuges are established with the following goals (*The Fish and Wildlife Service Manual*, 601 FW 1, 1.8):

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

These goals help step down the Refuge System mission and the principles of the 1997 amendments to the Administration Act. These goals articulate the foundation for stewardship of the Refuge System and define the unique niche it occupies among various federal land systems.

There are four guiding principles for management and general public use of the Refuge System established by Executive Order 12996 (appendix A):

*Public Use*—The Refuge System provides important opportunities for compatible wildlife-dependent recreational activities involving hunting, fishing, wildlife observation, wildlife photography, interpretation, and environmental education.

*Habitat*—Fish and wildlife would not prosper without high-quality habitat and, without fish and wildlife, traditional uses of refuges cannot be sustained. The Refuge System would continue to conserve and enhance the quality and diversity of fish and wildlife habitat within refuges.

*Partnerships*—America’s sportsmen and women were the first partners who insisted

on protecting valuable wildlife habitat within wildlife refuges. Conservation partnerships with other federal agencies, state agencies, tribes, organizations, industry, and the general public can make significant contributions to the growth and management of the Refuge System.

*Public Involvement*—The public should be given a full and open opportunity to participate in decisions regarding acquisition and management of our national wildlife refuges.

To maintain the health of individual refuges and the Refuge System as a whole, managers must anticipate future conditions—to avoid adverse effects and take positive actions to conserve and protect refuge resources. Effective management also depends on knowledge of larger systems and resource relationships.

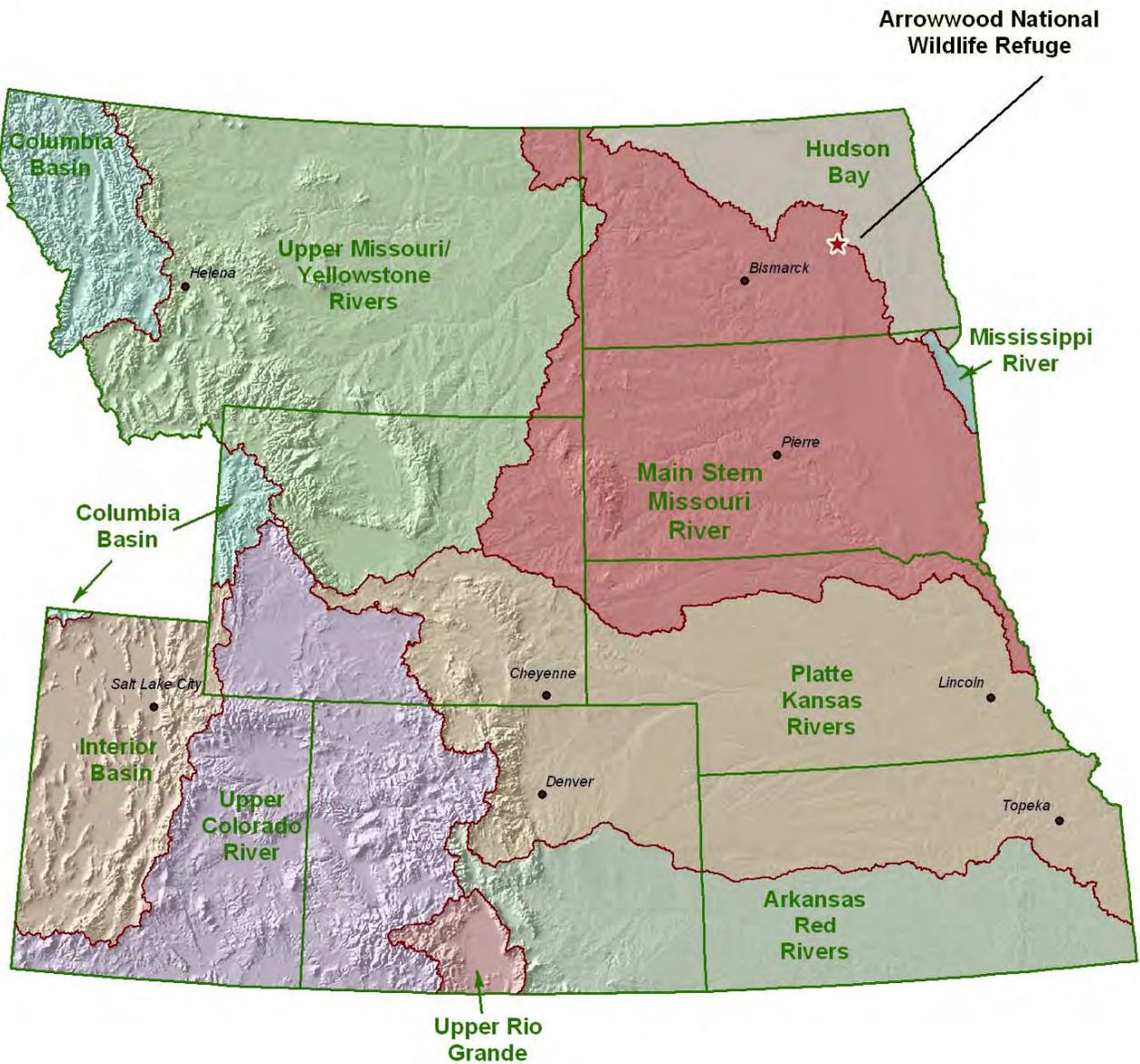
- The Service adopted an ecosystem approach to conservation to enable it to fulfill its federal trust resource responsibility with greater efficiency and effectiveness. Through this holistic approach to resource conservation, the Service can accomplish its mission.
- An ecosystem approach to fish and wildlife conservation means protecting or restoring functions, structure, and species composition of an ecosystem, while providing for its sustainable socioeconomic use. Key to carrying out this approach is recognizing that partnerships are an essential part of a diverse management to accomplish ecosystem health.
- The Service has adopted watersheds as the basic building blocks for ecosystem conservation. Arrowwood NWR is located in the “main stem Missouri River ecosystem” (MMRE), which includes North Dakota, South Dakota, and northeastern Montana (figure 2). Ecosystem planning for the MMRE sets forth visions and goals for prairie, wetland, and rivers to conserve fish and wildlife by protecting and restoring the natural ecosystem (appendix B). The habitat and wildlife goals and objectives for Arrowwood NWR contribute to the mission of the MMRE.

It is the policy of the federal government—in cooperation with other nations and in partnership with states, local governments, Indian tribes, and private organizations and individuals—to administer federally owned, administered, or controlled prehistoric and historic resources in a spirit of stewardship for the benefit of present and future generations.

U. S. Fish & Wildlife Service

# Main Stem Missouri River Ecosystem

USFWS MOUNTAIN-PRAIRIE REGION



Region 6 - Mountain Prairie Region

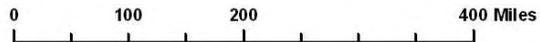
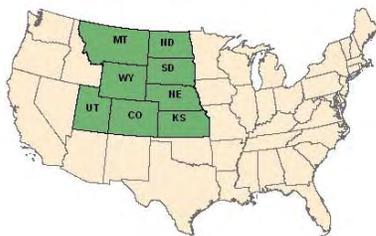


Figure 2. Main stem Missouri River ecosystem

## Guidance for Planning

The Administration Act, as amended by the Improvement Act (1997), requires that CCPs be in place for all national wildlife refuges within 15 years (2012).

A CCP does the following:

- ensures that the purpose of the refuge and mission of the National Wildlife Refuge System (Refuge System) are being fulfilled
- ensures that national policy direction is incorporated into refuge management
- ensures that opportunities are available for interested parties to participate in the development of management direction
- provides a systematic process for making and documenting refuge decisions
- establishes broad strategies for refuge programs and activities
- provides a basis for evaluating accomplishments

The Improvement Act calls for making opportunities for wildlife-dependent recreation, as long as they are compatibly managed with other purposes and do not conflict with other use. Service policy allows recreational uses that are determined compatible. A compatible use is “a proposed or existing wildlife-dependent recreational use or any other use of a national wildlife refuge, that based on sound professional judgment, would not materially interfere with or detract from the fulfillment of the National Wildlife Refuge System mission or the purpose(s) of the national wildlife refuge” (50 Code of Federal Regulations [CFR] 25.12).

A compatible use generally does one or more of the following:

- contributes to the Refuge System mission, the refuge’s major purposes, or refuge goals or objectives
- is a public priority use (fishing, hunting, wildlife observation, wildlife photography, interpretation, or environmental education)
- supports the safe and effective conduct of a priority public use

## REFUGE OVERVIEW

This overview presents descriptions of the establishment of the refuge, the history of the refuge area, and the Garrison Diversion Unit project.

### Refuge Establishment

Management is dictated, in large part, by legislation that created the refuge and defines the purposes for which the refuge was established.

Five authorities exist for the acquisition and establishment of Arrowwood National Wildlife Refuge:

- Executive Order 7168—“as a refuge and breeding ground for migratory birds and other wild life.”
- Migratory Bird Conservation Act—“for use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”
- The Fish and Wildlife Act—“for the development, advancement, management, conservation, and protection of fish and wildlife resources.”
- National Wildlife Refuge System Administration Act—“conservation, management, and ... restoration of the fish, wildlife, and plant resources and their habitats ... for the benefit of present and future generations of Americans.”
- The Refuge Recreation Act—“for (1) incidental fish and wildlife-oriented recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species.”

On September 4, 1935, President Franklin D. Roosevelt signed Executive Order 7168, establishing Arrow-wood Migratory Waterfowl Refuge. The order stated, “To effectuate the purposes of the Migratory Bird Conservation Act, it is ordered that the following described lands ... are hereby, reserved and set apart ... as a refuge and breeding ground for migratory birds and other wildlife.” In a news release dated October 30, 1935 and titled “Two More ‘Safety Islands’ for Ducks in North Dakota,” the Department of Agriculture stated, “Arrow-wood still offers annual nesting and resting attractions to large concentrations of ducks, largely canvasbacks, redheads, mallards and pintails. Canada geese, swans and white pelicans also inhabit the area ... Water ... caught (impounded) and held would be seasonably distributed to create favorable conditions for aquatic-plant production and the growth of nesting cover ... In addition to creating an ideal nesting condition for waterfowl, this development would also provide for control of flood waters of the James River.”

### History

The refuge and surrounding area were not settled until the late 1870s. Prior to that time, it was an important location along the Fort Totten Trail, a freight trail from Jamestown to Fort Totten, located near Devils Lake. Several watering stops were located along the valley and fuel wood was obtained from numerous wooded ravines.

The first Europeans to establish residence were ranchers. However, following the turn of the century, homesteaders flocked into the area and the native prairie was put to the plow. The irregular terrain prevented some of what is now refuge land from

being broken; the more level portions were in crop production prior to establishment. Most of the former cropland was heavily infested with smooth brome by the time of establishment and the first refuge manager immediately “retired” many of these fields. Although a few of these areas were seeded to introduced grasses, most of them were allowed to revert or “go back” by natural succession.

During the drought years of the thirties, extensive croplands lay idle and reverted slowly from annual weeds, forbs, and sweetclover to perennial grasses. Since the grasslands were extensively overgrazed prior to establishment of the refuge, very limited grazing of native grasslands was allowed until the early forties. At that time, it was deemed that the grasslands had recovered from the previous years of misuse. Demands for grazing land increased following World War II, and many new grazing units were set up to satisfy local needs. The stocking rates and season lengths later proved to be excessive and refuge grasslands continued to deteriorate in species composition and value for wildlife.

Soon after the refuge was established, CCC and Works Progress Administration (WPA) camps were set up on the southeast side of Arrowwood Lake. The United States was just coming out of the 1930s Dust Bowl period. Arrowwood NWR was created in response to the drought, low waterfowl numbers, and an economic downturn. The CCC immediately set out to develop the refuge for water management and to benefit people. The CCC and WPA employed many local men and lasted until 1942.



*Jim Lake*

Efforts of the first refuge managers led to enhancement of the three natural water areas and creation of a fourth. Two of these (Arrowwood and Jim lakes) were relatively deep, while the other two (Mud Lake and Depuy Marsh) were shallow marshes. The initial CCC development work took place during a drought, leading to the assumption that too much water would not be a problem. Consequently, refuge impoundments were designed to store water rather

than facilitate drawdowns and dewatering to manage pools. While valid during the drought, this operation was later discovered to be impractical for obtaining maximum waterfowl use; higher water levels were not conducive to production of vegetation preferred by waterfowl.

Prior to 1945, haying activity at the refuge was limited. However, as beef prices increased and more private lands were put into crop production, the demand for hay increased and extensive acreages of refuge grasslands were cut for hay. In addition, Kentucky bluegrass seed was harvested for 10 years (1947–1957). This practice was very detrimental to nesting waterfowl since it was conducted during peak nesting season.

Management at the refuge went from more than 11,700 upland acres idle in 1935 to only about 1,000 acres by 1953. The adverse effect on wildlife production was noted and management changes were made, as follows:

- bluegrass stripping was eliminated
- hayed acres were decreased by half in 1958 and virtually eliminated by 1960
- cropped acres peaked in 1957, but were reduced by 75% soon after
- grazed acres increased and peaked at more than 9,000 acres in 1963

## Garrison Diversion Unit

In 1944, Congress passed the Flood Control Act, which was later renamed the Pick–Sloan Missouri Basin Program. This act authorized construction of a series of dams, power plants, irrigation projects, municipal water systems, and other water control features to manage the Missouri River for flood control, navigation, and power. The Garrison Diversion Unit was developed as part of this massive public works project. An early feature of the project was the Jamestown Dam, which was completed in 1954 for flood control. The Jamestown Reservoir filled for the first time in 1965; since then, backwater effects have resulted in higher water levels at Arrowwood NWR. In 1972, the summer operating level of the reservoir was raised by 3 feet to accommodate recreation and allow for the release of flushing flows through the city of Jamestown to prevent stagnation. The increase in the reservoir operating level eliminated water management options at the refuge in most years.

The James River has been called the flattest river of its length in North America. The river drops less than 0.5 foot per mile in the reach through and below the refuge. The low slope, coupled with water control structures initially designed to hold water, made elevation manipulations difficult at best. Operations of the Jamestown Reservoir further hampered refuge management.

The Garrison Diversion Unit Reformulation Act of 1986 requires mitigations for impacts to refuge operations caused by features of the Garrison Diversion Unit project. An interagency team assessed various measures to improve water management capabilities at the refuge during normal water years. An environmental impact statement (EIS), initiated in 1994 and signed in 1997, analyzed the need to provide the Arrowwood NWR with water management capability to mitigate for high water levels imposed by the Jamestown Reservoir. The EIS presents an incremental series of actions that can provide various levels of water management capability. The preferred alternative selected was the “Mud and Jim Lakes Bypass—Lower Joint Use Pool Alternative.” This alternative consists of downstream channel improvements, improved water control structures, fish barriers, a 2.5-mile channel around Jim Lake, a 7-mile channel around Mud Lake, a dike and water control structure at Stony Brook, and subimpoundments within Mud and Jim lakes. The alternative also calls for the reduction of the Jamestown Reservoir “Joint Use Pool” elevation by 1.8 feet. Once the mitigation project is completed, the features are expected to mitigate for past, current, and future impacts of the operations of the Jamestown Reservoir. The series of channels, capable of passing flood waters in 7 of 10 years, would also allow managers to perform water level manipulations on all pools independently of the other pools, both upstream and downstream.

## PURPOSE OF AND NEED FOR THE PLAN

The Improvement Act directs the Service to manage national wildlife refuges in accordance with approved CCPs. These plans must include public involvement in their development. A CCP needs to set goals and objectives that meet the establishment purposes for the refuge, as well as contribute to the mission of the Refuge System. Wildlife has first priority in the management of national wildlife refuges.

The purpose of developing the CCP is to provide the refuge manager with a 15-year management plan for the conservation of fish, wildlife, and plant resources and their related habitats, while providing opportunities for compatible wildlife-dependent recreational uses.

The CCP, when fully implemented, should do the following:

- achieve the refuge purposes
- help fulfill the Refuge System mission
- maintain and, where appropriate, restore the ecological integrity of each refuge and the refuge System

- help achieve the goals of the National Wilderness Preservation System
- meet other mandates

## Vision Statement

As part of the planning process (see chapter 2), the refuge staff and planning team developed the following vision statement for Arrowwood NWR.

*Provide quality habitat for threatened and endangered species, waterfowl, other migratory birds, and other wildlife in the Prairie Pothole Region of North Dakota. The refuge will provide an environment where a diversity of riparian, native prairie, grassland, and wetland habitats and their associated wildlife can be observed and explored. People will be able to learn about and appreciate the natural environment of the refuge and enjoy opportunities for wildlife-dependent recreation.*

## Goals

A goal is a descriptive, broad statement of desired future conditions that conveys a purpose, but does not define measurable units. Goals would direct work at carrying out the refuge’s mandates and achieving the purposes. Each management alternative is designed to meet all the goals for the refuge.

These goals are derived from the purposes and vision statement for the refuge to reflect the refuge’s contribution to the Refuge System. The goals reflect the core mission of the Service to protect fish, wildlife, and plant resources while providing compatible opportunities for the public to appreciate and enjoy the natural environment of the region.

### *Upland Goal*

Provide a diversity of grassland types that emulate the range of natural variation characteristic of the Prairie Pothole Region to benefit trust resources including waterfowl, grassland birds, and songbirds.

*Wetland Goal*

Provide a diversity of wetland types that emulate the range of natural variation characteristic of the Prairie Pothole Region to benefit threatened and endangered species, waterfowl, shorebirds, wading birds, and other wetland birds.

*Visitor Services Goal*

Visitors of all abilities will enjoy a refuge visit and increase their knowledge and appreciation of the prairie ecosystem and the refuge's history by participating in compatible wildlife-dependent activities.

## 2 The Planning Process

The Service is following the planning steps listed below—in a thorough manner that meets requirements of the National Environmental Policy Act (NEPA) and Service policies—to determine the future management of Arrowwood NWR.

The CCP process is a series of steps that are displayed sequentially (figure 3). However, CCP planning, along with the associated environmental analysis and documentation, occur simultaneously. Although public involvement is listed as part of two steps, the Service will take public input at any point in the following planning process:

- Preplan (form a planning team, review available data, organize efforts).
- Initiate public involvement and scoping (public input gathered on issues).
- Develop draft vision and goal statements.
- Develop and analyze alternatives including a proposed action with draft objectives.
- Prepare documentation of the environmental analysis, including the draft CCP (proposed action alternative).
- Conduct internal review (the Service, other federal, state, and tribal partners) and gather public input on the draft CCP and EA.
- Analyze and respond to public comments.
- Select one of the alternatives to become the final CCP.
- Make revisions as necessary and prepare the final CCP.
- Approve and carry out the CCP.
- Monitor and evaluate actions and results.

The planning team (appendix C) is comprised of representatives from various Service programs, including the refuge staff, has prepared this draft CCP and EA. Coordination with the North Dakota Department of Game and Fish (NDGF), the public, local groups, and other agencies has been essential in developing a realistic, meaningful plan. After reviewing a wide range of public comments and management needs, the Service developed a proposed action alternative (alternative 3). This alternative addresses all significant issues while determining how best to achieve the intent and purposes of the refuge. Alternative 3 is the Service's



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*The purple coneflower is one of the colorful, native prairie plants at Arrowwood NWR.*

recommended course of action for the future management of the refuge and represents the draft CCP described in detail in chapter 6.

The following sections describe the decisions to be made about management of Arrowwood NWR. In addition, there are descriptions of the public involvement and other coordination activities, followed by the issues related to management of the refuge. Step-down management plans and the CCP revision process are discussed.

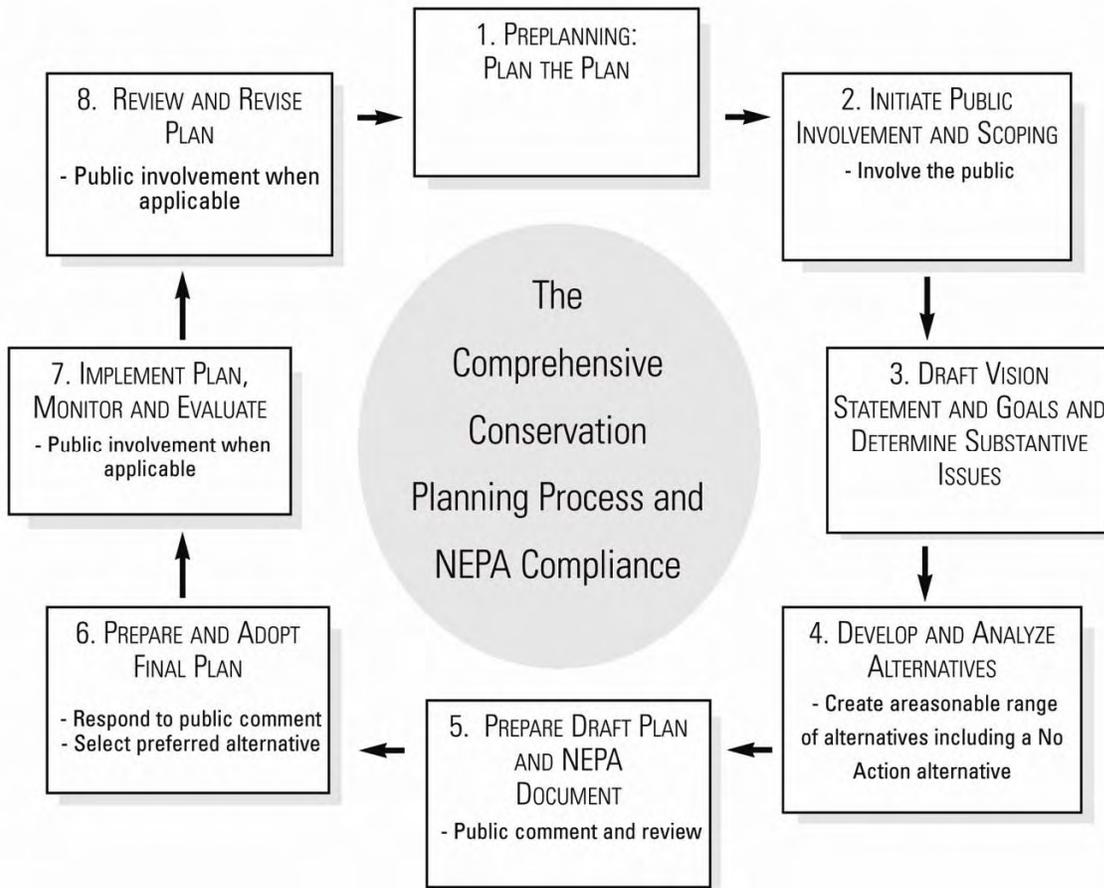
### DECISIONS TO BE MADE

Based on the environmental analysis documented in this EA, the following decisions will be made by the Service's regional director for region 6, headquartered in Lakewood, Colorado.

*The type and extent of management and public access that will occur on the Arrowwood National Wildlife Refuge.*

*Whether or not the management and public access on the Arrowwood National Wildlife Refuge will have a significant impact on the quality of the human environment.*

As part of the decision-making process, the Service developed this EA in accordance with the NEPA. Three alternatives provide options for addressing management concerns and for resolving public issues. The draft CCP for the refuge is described in alternative 3 (the Service’s proposed action) of this EA. This document displays the results of CCP planning to date. It includes a description of the existing environment at the refuge, alternatives for management, and an assessment of the effects of carrying out the alternatives.



**Figure 3. The planning process.**

## **PUBLIC INVOLVEMENT**

The Service is using the NEPA process to engage the public in refuge planning, while determining whether the proposed action for management of Arrowwood NWR will have significant effects.

Scoping is the term for requesting input from the public, in this case, regarding management of the refuge. The primary thrust for the planning process is to provide a forum for ideas and issues to be shared,

reviewed, and evaluated among agency staff and the public. Comments are reviewed to identify issues and public concerns about, or advocacies for, future management of the refuge. These issues are addressed in the draft CCP and EA, other plans, and decision documents.

Public scoping was initiated for Arrowwood NWR in a notice of intent (NOI) dated August 1, 2001. The NOI announced the availability of an issue workbook and the dates for open houses to be held for public input on management of the refuge. On

August 14 and 15, 2001, open house scoping sessions were held within the communities of Kensal, Pingree, Carrington, and Jamestown, North Dakota. A summary of those who participated in public involvement is in appendix D.

## COORDINATION WITH OTHERS

The Service coordinated with tribes, other federal agencies, and state agencies as part of the planning process. The Service provided a planning update to relevant federal, state, and county representatives (including all county chairpersons). The planning update introduced them to the CCP process for Arrowwood NWR and welcomed their comments. Interested agencies are on the planning mailing list (appendix D).

### Tribal Coordination

In the preliminary phase of planning (April 2001), the Service's director of region 6 sent an invitation letter for participation in the CCP process to the following tribes:

- Assiniboine and Sioux Tribes of the Fort Peck Indian Reservation, Montana
- Cheyenne River Sioux Tribe, South Dakota
- Crow Creek Sioux Tribe, South Dakota
- Flandreau Santee Sioux Tribe, South Dakota
- Lower Brule Sioux Tribe, South Dakota
- Santee Sioux Tribe, Nebraska
- Sisseton-Wahpeton Sioux Tribe, South Dakota
- Spirit Lake Tribe, North Dakota
- Standing Rock Sioux Tribe, North Dakota
- Yankton Sioux Tribe, South Dakota

None of the tribes contacted expressed interest in participating in the planning process.

### Federal Agency Coordination

Coordination with the Bureau of Reclamation (Reclamation) took place throughout the planning process. Reclamation representatives provided information pertinent to the development of the draft CCP and EA related to the ongoing mitigation project.

The planning team worked with representatives from the Northern Prairie Wildlife Research Center (Jamestown, North Dakota) of the U.S. Geological Survey (USGS).

### State Coordination

The NDGF is charged with managing the state's natural resources. Their mission is to "protect,

conserve, and enhance fish and wildlife populations and their habitats for sustained public consumptive and nonconsumptive uses." The state manages more than 78,000 acres in support of wildlife, recreation, and fisheries.

The Service's director of region 6 sent an invitation letter for participation in the CCP process to the director of the NDGF. The local NDGF wildlife managers and the refuge staffs maintain excellent and ongoing working relations, preceding the start of the CCP process.

### State Wildlife Grants Program

Over the past several decades, documented declines of wildlife populations have occurred nationwide. The State Wildlife Grant (SWG) program was created by Congress 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.

The State of North Dakota CWCS was reviewed and information was used during development of the CCP. The goals and objectives of the State of North Dakota CWCS are supported by the CCP through implementation of habitat goals and objectives.

## PLANNING ISSUES

Internal and public scoping meetings, an internal management review, and a review of completed issues workbooks indicated seven major issues regarding the refuge.

### Water Quantity

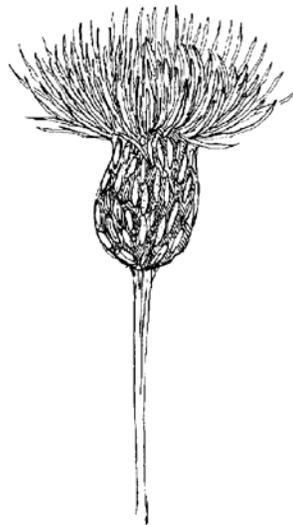
Jamestown Reservoir lies downstream of Arrowwood NWR on the James River in North Dakota. During high-water years, the reservoir backs up onto the refuge, floods pools, and eliminates

or severely reduces water management capabilities at the refuge. The refuge has experienced increased flooding and water management problems since Jamestown Reservoir filled to normal operating levels in 1965. High water levels preclude moist soil management and result in decreased productivity at the refuge during most years.

In addition, Jamestown Reservoir supports rough fish such as carp and big mouth buffalo that invade the refuge during high-water periods. Rough fish can cause extensive damage to aquatic resources important for migratory and nesting waterfowl. When wetland elevations are high, there may be no winterkill of the rough fish.

## Invasive Plants

Invasive plants are an ongoing problem at the refuge and adjacent private agricultural lands. Invasive plants at the refuge degrade the quality of croplands, uplands, and hay harvested at the refuge by cooperative farmers. Since most refuge lands are not cropped, grazed, or mowed annually, these lands are viewed as weed sources that infest nearby private croplands.



*Canada Thistle*  
© Cindie Brunner

## Visitor Services

The refuge offers a wide variety of year-round, accessible, recreational opportunities that are wildlife dependent. There is a keen interest in wildlife-dependent recreational opportunities, especially hunting and fishing. There is also interest in trapping, wildlife photography, and wildlife observation. Activities that are not dependent on the presence of wildlife are also of interest, for example, picnicking, boating, canoeing, and kayaking.

All types of recreational opportunities should be universally accessible by young and old, abled and disabled.

However, there was concern about letting public use go too far. Some residents felt recreation needs to be controlled and restricted to ensure it stays compatible with the wildlife mission of the refuge. Examples include not allowing all-terrain vehicles (ATVs), snowmobiles, or jet skis, as there are other areas nearby already developed for these activities.

## Agricultural Practices

The refuge conducts cropping, grazing, and haying—usually by private cooperators—to meet management objectives. The refuge has steadily decreased its cropland acreage, which has decreased economic benefits to cooperators.

## Wildlife Depredation

The refuge is located in a predominately small-grain, row-crop, agricultural area. Migratory birds and other wildlife such as deer feed on crops on private as well as on refuge lands; Canada geese are of particular concern. Neighboring farmers would like to see the refuge managed to attract and hold wildlife on refuge lands to keep depredation on private land crops to a minimum.

## Naturalness

Some area residents expressed a desire for the primary mission of the refuge to be restoration and protection of the natural ecosystem, including less artificial management (for example, water management) in favor of natural processes. This may include reestablishing native prairie, big game species such as elk and bison. There is concern with habitat disturbance and vegetative damage such as that caused by the Arrowwood NWR mitigation project.

## Economic Benefits

Foster and Stutsman counties, where the refuge is situated, receive annual payments under the Refuge Revenue Sharing Act. These payments are made to counties in lieu of taxes, using revenues derived from the sale of products from refuges. Local officials express concern and discontentment that the allocations are but a fraction of the entitlement.

Area farmers and ranchers benefit economically by acting as cooperators to crop, hay, or graze at the refuge. The refuge gains valuable and cost-effective habitat treatments to meet management goals while offering an additional source of income for these cooperators.

## STEP-DOWN MANAGEMENT PLANS

A CCP is intended as a broad umbrella plan that provides general concepts and specific wildlife, habitat, endangered species, visitor services, and

partnership objectives. Step-down management plans provide detail to managers and staff who carry out specific actions authorized in a CCP. Based on this draft CCP and EA, table 1 presents plans needed for Arrowwood NWR.

## CCP REVISION

Plans are dynamic—management strategies need to be reviewed and updated periodically. The Service will review the final CCP at least annually to determine if the plan requires any revisions. The CCP and associated step-down plans will be modified whenever this review or other monitoring

and evaluation determine changes are needed to achieve the refuge's purposes, vision, and goals.

Monitoring and evaluation will determine whether management activities are achieving the refuge's purposes, vision, and goals. The CCP can be revised when significant new information becomes available, ecological conditions change, major refuge expansions occur, or other needs are identified.

Revision will occur, at a minimum, every 15 years. If the plan requires a major revision, the CCP process starts anew. CCP revisions require NEPA compliance. The public will continue to be informed of and involved with any revision to the CCP for Arrowwood NWR.

**Table 1. Step-down management plans for Arrowwood NWR, North Dakota.**

<i>Plan</i>	<i>Status</i>
Disease Contingency Plan	To be completed in 2006
Environmental Management Plan	Completed in 2003; revised annually
Fire Management Plan	Completed in 2001; revised annually
Habitat Management Plan (HMP)	To be completed in 2008
Integrated Pest Management Plan (IPM Plan)	Completed in 2005
Law Enforcement Plan	To be completed in 2008
Visitor Services Plan	To be completed after the CCP is final
Predator Management Plan	Completed in 2006
Safety Plan	Completed in 1991; revised annually
Water Use Plan	Completed in 2006; revised annually



# 3 Affected Environment



John and Karen Hollingsworth/USFWS

*The western meadowlark is a Neotropical migrant that nests in upland habitats at Arrowwood NWR.*

Located in the glacial drift plain of east-central North Dakota, the Arrowwood NWR lies in the center of the Prairie Pothole Region. The 15,973-acre refuge occupies 14 miles of the James River Valley in Foster and Stutsman counties. The refuge is in the Central Flyway migration corridor and is an important stopover for many species of birds as they journey north and south during annual migrations.

This chapter describes the refuge's setting, as follows:

- physical resources
- biological resources
- cultural resources
- special management areas
- visitor services
- aesthetics
- socioeconomic environment
- staffing
- partnerships and other public outreach

## PHYSICAL RESOURCES

The climate, air, soils, minerals, and water resources at the refuge are described in this section.

### Climate

The Arrowwood NWR has a continental climate characterized by relatively warm, short summers; long cold winters; and rapidly changing weather patterns. January is the coldest month and July is the warmest. The average growing season ranges from 98 to 106 days.

The average daily summer temperature is in the mid to upper 60s (°F), with the average high temperature in the upper 70s to low 80s. The average winter low temperature ranges from -1°F to -5°F. The coldest temperatures vary from -40°F to -60°F, with summertime highs up to 112°F. Annual temperature ranges can be as much as 150°F.

Average annual precipitation is 18.36 inches, more than half of which falls between May and July. Recorded amounts vary greatly, from less than 10 inches to more than 30 inches. The average annual snowfall ranges from 30 to 40 inches, but can vary from 7 inches to more than 100 inches. In the winter, snow and high winds bring frequent blizzard conditions to the area. The frost-free season generally runs from May 20 to September 15.

## Air Quality

Visibility and clean air are primary resource values. Based on North Dakota's most current data, the state has relatively clean air. North Dakota is 1 of only 14 states to comply with all federal ambient air quality standards. The levels of ozone, sulfur, and nitrogen dioxide did not exceed federal or state standards at any monitoring site in 2004. In addition, levels of inhalable PM<sub>2.5</sub> and inhalable continuous PM<sub>10</sub> did not exceed federal standards during the year.

Prescribed burning is the refuge management activity that has the greatest effect on air quality (find more information in the description of the fire management program in appendix E). The management of smoke is incorporated into planning prescribed burns and, to the extent possible, in suppression of wildfires. Sensitive areas are identified and precautions are taken to safeguard visitors and local residents. Smoke dispersal is a consideration in determining whether a prescribed burn is within prescription. Generally, the fine grass fuels and small burn size (80–600 acres) generate low volumes of smoke for short durations (4–5 hours).

## Soils

Soils within Stutsman County have been inventoried and mapped, published copies of which are available. Arrowwood NWR contains soils formed in glacial drift. The advancing glacier picked up rocks and soil, ground and mixed them, and deposited the material as the ice melted from the receding glacier. Soils such as Barnes and Svea formed in unsorted material, or glacial till. Soils such as Bearden and Fargo formed in glaciolacustrine deposits, or glacial material deposited by water in glacial lakes. Other soils such as Divide and Sioux, were formed in glaciofluvial deposits or material deposited by glacial meltwater.

The soils in Stutsman County formed mainly under grassland vegetation. Grasses provide a plentiful supply of organic matter, which improves the chemical and physical properties of the soil. The fibrous roots of these grasses penetrate the soil to a depth of several feet, making it more porous and more granular. As a result of these changes in the

soil, less water runs off the surface and more moisture is available for increased microbiological activity.

The slope of the soils range from level to very steep. The degree of slope and the shape of the surface affect each soil type through their effects on runoff and internal drainage. On Buse and other soils on steep slopes, much of the precipitation is lost as runoff. Vegetation is sparse, leaching is restricted, and profile development is slow. Svea and other soils in the lower areas receive runoff from the Buse and other soils because of their position on the landscape.

Soils formed in depressions vary widely in profile development, depending on the degree of wetness. Tonka soils, which are in shallow depressions, exhibit an advanced degree of horizonation (distinct horizons or layers) because of the alternate wet and dry cycles that occur in depressions. Because of increased moisture in the depressions, Tonka soils exhibit properties much like soils in areas of much higher precipitation. Southam soils, which are in deep depressions, are nearly continuously wet and have a thick surface layer and carbonates throughout. The horizonation in these soils is mostly the result of sedimentary processes resulting from the glacier and depositions within the James River floodplain.

Approximately 10,000–12,000 years have passed since the glacier receded from Stutsman County. In geological terms, the soils in the county and at the refuge are young.

## Mineral Resources and Reserved Rights

During the withdrawal of lands establishing the refuge in 1935, and as additional lands were acquired, there were reservations of surface or subsurface mineral rights outstanding to third parties on lands acquired in fee title by the federal government. Later purchase of additional land tracts were subject to outstanding mineral rights and existing rights-of-way at the time of acquisition. These rights-of-way include four road easements to the state of North Dakota.

## Water Resources

Figure 4 shows the water resources of Arrowwood NWR. The refuge has four major water impoundments, which cover 3,064 acres:

Arrowwood Lake (1,671 acres)

Mud Lake (359 acres)

Jim Lake (723 acres)

Depuy Marsh, which is comprised of two units: Depuy Marsh (230 acres) and North Depuy subimpoundment (81 acres)

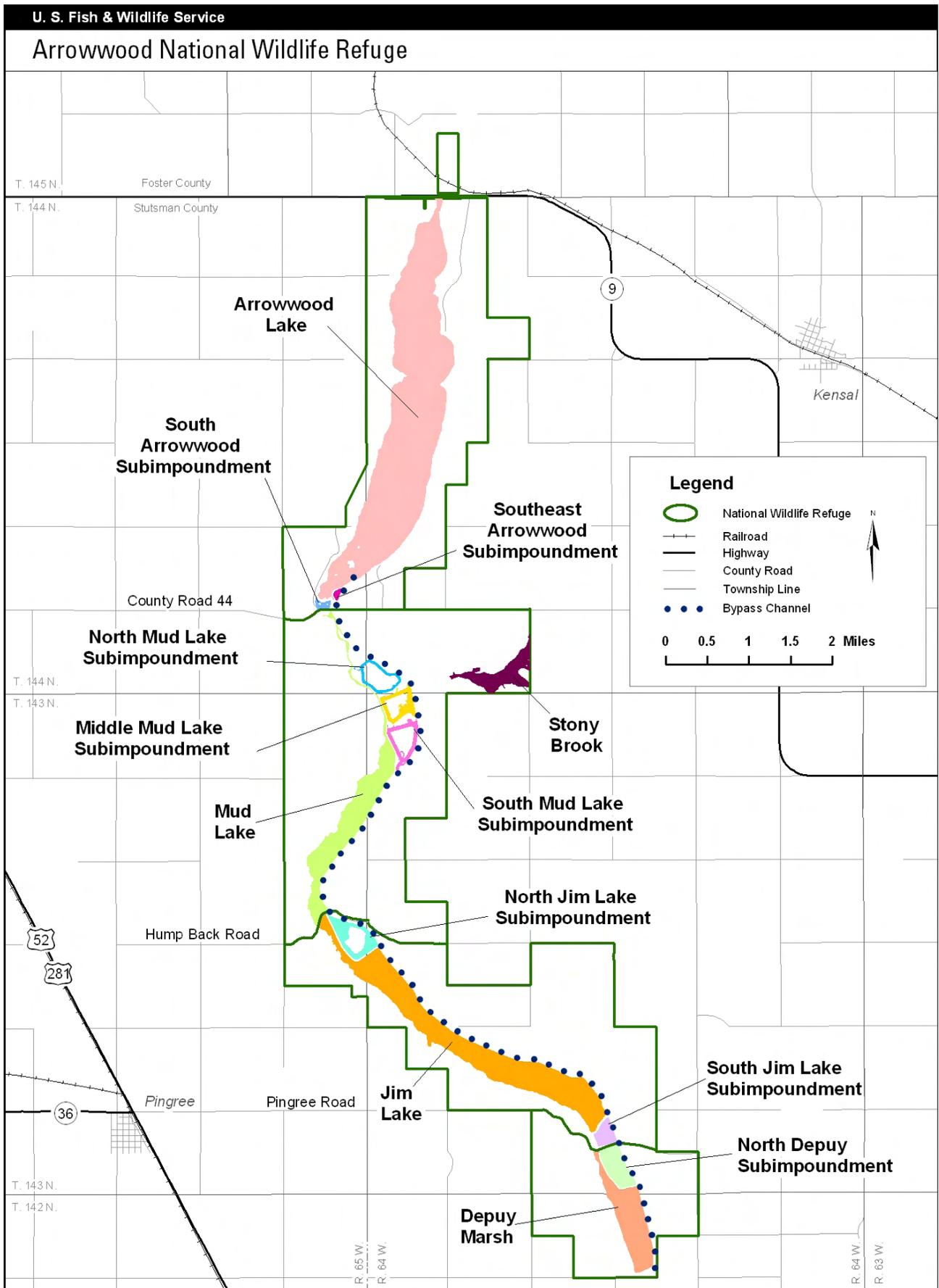


Figure 4. Water impoundments at Arrowwood NWR, North Dakota

With completion of the Arrowwood NWR mitigation project, there are eight other managed water subimpoundments:

- South Arrowwood (11 acres)
- Southeast Arrowwood (6 acres)
- Mud Lake North (28 acres)
- Mud Lake Middle (47 acres)
- Mud Lake South (44 acres)
- North Jim Lake (69 acres)
- South Jim Lake (37 acres)
- Stony Brook (125 acres)

The three northernmost pools (Arrowwood, Mud, and Jim lakes) are natural lakes that were modified by the CCC with low-level dikes and water control structures to retain more water. Depuy Marsh, on the south end of the refuge, was also a CCC project to create additional wetlands. The Arrowwood NWR mitigation project constructed a bypass channel that starts at the south end of Arrowwood Lake. The channel runs along the east side of Mud Lake, Jim Lake, and Depuy Marsh to the southern boundary of the refuge. There is a water control structure located at the southern end of the channel that controls the water level in the channel. A second water control located at the head of the bypass channel controls the amount of water entering the channel. There are water control turnouts and outlets in each impoundment that allow water elevations to be controlled independently of other impoundments.



*The view looking north over Jim Lake shows the bypass channel hugging the eastern edge of the lake.*

Based on historical runoff records, this system of water control structures and the bypass channel allows managers to reach target elevations an average of 7 out of 10 years. The other 30% of the time would be flood years when water levels would overtop water control structures and dikes, and the refuge would not be able to manage water until the Jamestown Reservoir level was lowered.

## Hydrology

The James River, a tributary of the Missouri River, originates in central North Dakota. The headwaters flow generally eastward to the town of New Rockford and then southward to the South Dakota border. Arrowwood NWR is part of the upper James River watershed (figure 5). Most runoff occurs between March and July with very little runoff occurring between November and February, so average monthly stream flows vary widely throughout the year.

The upper James River watershed consists of a poorly defined series of small ponds and marshes. In the rest of the watershed, the 20- to 40-foot-wide river channel meanders across a flat-bottomed, steep-sided valley. The river valley varies from a few hundred feet to approximately 2 miles wide. Channel capacity varies from 30 cubic feet per second (cfs) in the upper reaches to 10,000 cfs in the lower reaches in South Dakota. In the headwaters of the James River, the maximum bankfull flow is 250 cfs with an average velocity of 0.87 foot per second. Rocky Run Creek, Kelly Creek, and Juanita Lake are the only tributaries to the upper James River. (Bureau of Reclamation 1997)

Winter snowmelt and spring rains often combine in March and April to form the runoff that replenishes refuge impoundments and wetland basins. Intense thunderstorms occur frequently in summer.

## Water Quality

Before Arrowwood NWR was established, shallow, slowly draining wetlands served as natural wildlife areas in this flat terrain. The primary factors affecting water quality were hydrology and natural impediments to drainage. After construction of the dikes and water control structures, deeper and more permanent wetlands formed. The pools are eutrophic (depleted of oxygen by decay of organic matter) and highly productive. External nutrient inputs include agricultural runoff, bird droppings, decaying plants, and rough fish. At times, the refuge traps nutrients; however, during high-water events, the opposite is true and the refuge “exports” excess nutrients to Jamestown Reservoir.

Backwater effects of Jamestown Reservoir became apparent after the reservoir filled in 1965, resulting in further increases in refuge pool depths. In particular, flood control operations result in prolonged periods of high water at the refuge during the spring and early summer. This is undesirable since this period is critical for the establishment of submerged aquatic plants such as sago pondweed. High water, in combination with turbidity, limits light availability for plant growth. Blue-green algae usually dominate in years when submergent plants do not become well established.

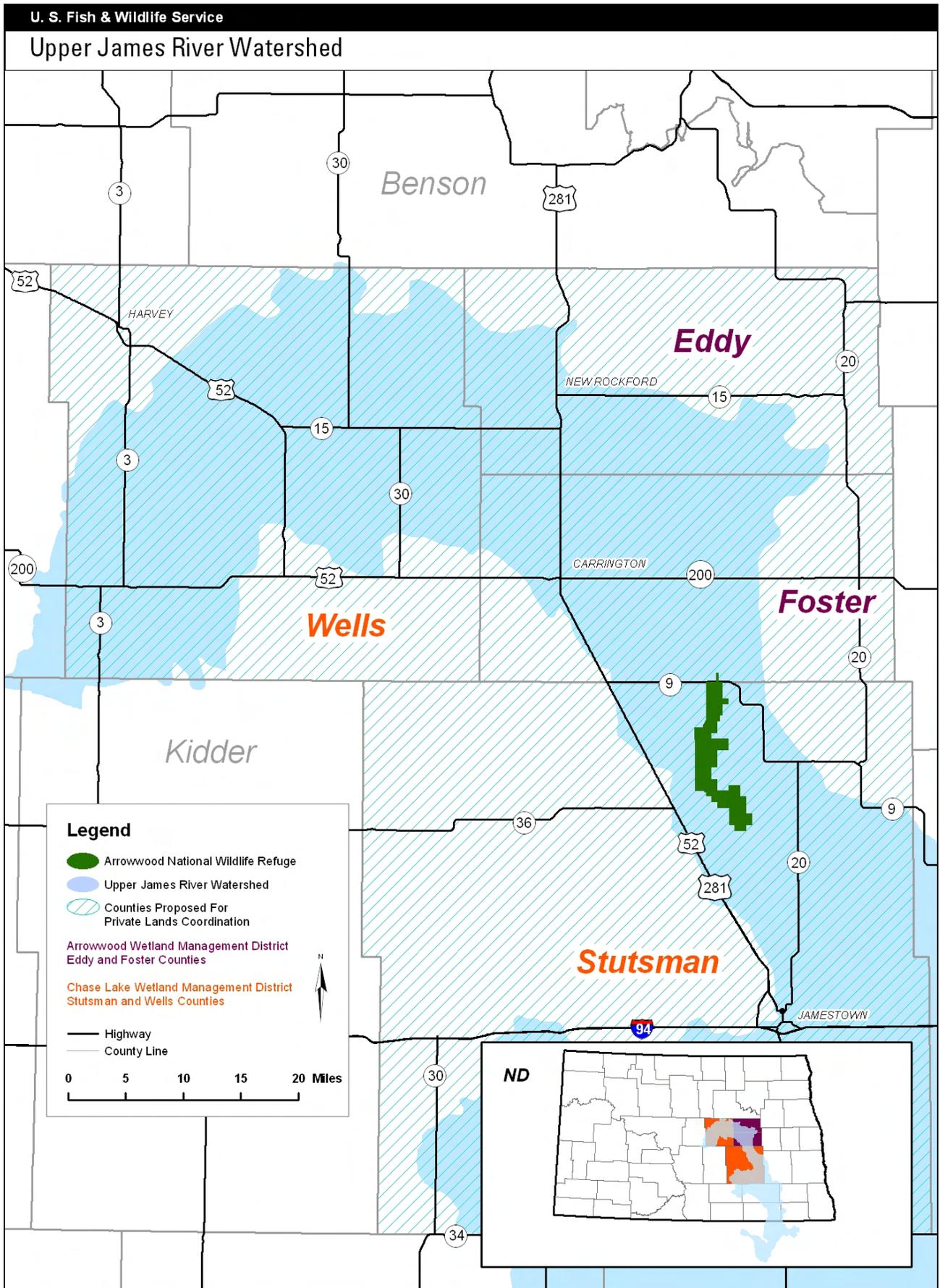


Figure 5. Upper James River watershed

Water quality upstream of the refuge is determined in large part by land use practices as well as the flushing and hydrology of the watershed. Draining natural wetlands and channeling watercourses increase water quality degradation caused by row cropping and associated use of fertilizers and herbicides. Livestock confinement facilities that drain into the watershed are also responsible for lower water quality. Snowmelt and large rainfall events flush the watershed; however, periods with little or no flow are frequent, and the river may dry up entirely during a drought.

In 1997, Vice President Gore directed federal agencies to develop an action plan for clean water on the 25th anniversary of the 1972 Clean Water Act. The Clean Water Action Plan provided guidelines to restore and protect the water resources of the United States. One of the requirements of the Clean Water Action Plan was the North Dakota Unified Watershed Assessment (UWA). The UWA was issued September 25, 1998, and classified North Dakota's 50 hydrologic unit areas (HUA) into four categories, as follows:

Category I—watersheds in need of restoration

Category II—watersheds meeting goals, but needing action to sustain water quality

Category III—watersheds with pristine or sensitive aquatic systems on lands administered by federal, state, or tribal agencies

Category IV—watersheds with insufficient data to make an assessment

Nineteen data elements were used to categorize and rank each HUA. It was determined early in the evaluation that there were no watersheds in the state that met all of the goals of the Clean Water Act; therefore, all 50 HUAs were either classified as category I or IV. Eight were classified as category IV and the remaining 42 as category I. There were 14 HUAs identified as high-priority watersheds. The James River headwaters HUA was classified as medium priority for restoration and was ranked number 20 in the state.

As authorized under Title III Section 303(d) of the Clean Water Act, the Environmental Protection Agency (EPA) lists impaired waters of each state. These waters do not meet the water quality standards established for their intended purposes, which include public water supply; recreation; and fish, shellfish, and wildlife protection and propagation. Upstream of the refuge, the reach of the James River from the confluence of Big Slough downstream to the confluence with Rocky Run is listed as threatened for recreation because it exceeds standards for total coliform bacteria. At the refuge, the reach between Arrowwood Lake and Mud Lake is listed as threatened for fish, shellfish, and wildlife

protection and propagation because it does not meet EPA standards for dissolved oxygen. Downstream of the refuge, the Jamestown Reservoir is listed as threatened for recreation due to excessive levels of nutrients.

Annual water quality patterns at Arrowwood NWR are typical of shallow lakes in the Prairie Pothole Region of North Dakota. The depth of the refuge pools and the resulting warm temperatures and light availability for photosynthesis are primary factors affecting productivity. Usually, highly productive summer conditions are followed by anoxic (absence of oxygen) winter conditions due to shallow depths and freeze out. During summer, respiration, photosynthesis, and mixing due to wave action can cause dissolved oxygen to fluctuate widely on a daily basis. During winter, limited photosynthesis and decaying organic matter under the snow and ice frequently deplete dissolved oxygen.

Concentrations of nutrients are similar to values reported from other refuges in North Dakota and South Dakota. Major constituents, chlorophyll, pH, conductivity, and dissolved oxygen show seasonal variations consistent with data reported from other prairie wetlands. An examination of trace elements in the water column revealed the presence of elements (arsenic, selenium, mercury, lead) that can, in high concentrations, cause reproductive problems in waterfowl. However, the concentrations of these elements at the refuge are low and should not pose a threat to aquatic biota.

Trace elements present in the sediments at the refuge are considered to be naturally occurring with the exception of arsenic. Elevated arsenic levels may be the result of treatments for grasshopper infestations during the 1930s. Although some persistent organic compounds such as pesticides have been detected in sediment samples from the refuge, the concentrations were within acceptable limits.

## Water Rights

Water rights for Arrowwood NWR were filed September 1, 1934. These water rights provide 16,000 acre-feet annually or as much as it takes to fill the impoundments to spillway elevations. An additional water right of 10,000 acre-feet is allowed to maintain these elevations throughout the year.

## BIOLOGICAL RESOURCES

This section describes the existing habitat and wildlife at Arrowwood NWR. Figure 6 shows existing habitat conditions.

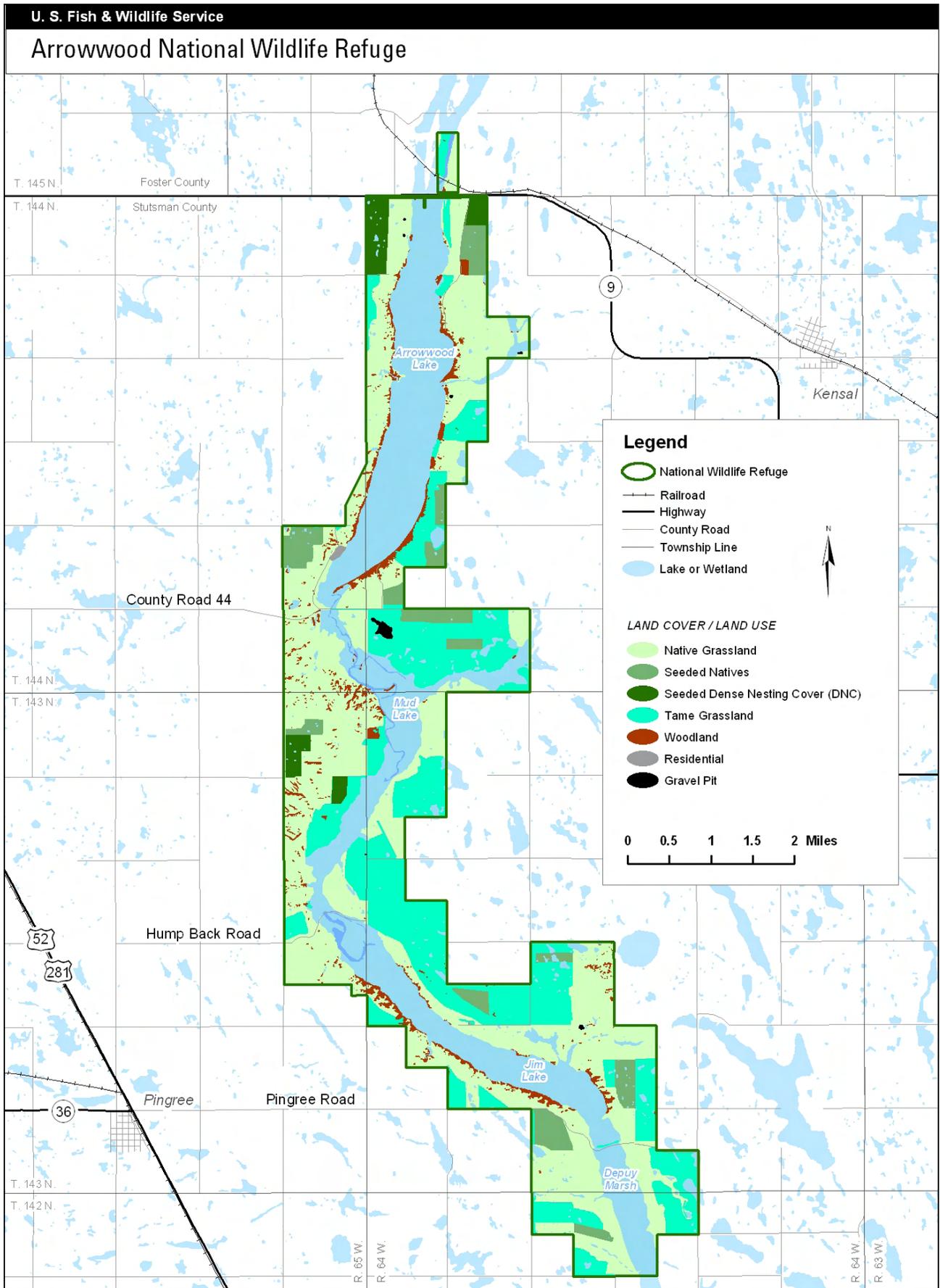


Figure 6. Habitats at Arrowwood NWR, North Dakota

## Habitat

The refuge provides, protects, and manages habitat for resident and migratory species, as well as federal- and state-listed threatened and endangered species. The refuge provides production habitat and resting and feeding areas for thousands of waterfowl and other migratory birds. The refuge historically has been particularly important as a major staging area in North Dakota with specific importance to fall populations of canvasbacks.



© Jennifer Jewett

*Native forbs and grasses abound in the uplands.*

The refuge contains approximately 6,000 acres of native prairie (unbroken sod); 5,340 acres of seeded grasses; 3,430 acres of enhanced wetlands; 420 acres of natural wetlands; 660 acres of wooded ravines and riparian woodlands; and 125 acres of planted trees (figure 6).

Upland vegetation makes up almost 12,000 acres of the 15,973-acre refuge. Deterioration of grassland habitats occurred for many years prior to and, in some cases, after acquisition by the Service. Many tracts have histories of tillage or overgrazing. Farming eliminated many native plant species. Even native grasslands that do not have farming histories face threats from the introduction of exotic plant species. In addition to tillage and overgrazing, many of the native plant communities were altered by other refuge management practices such as fire suppression or excessive rest, which provides exotic species an opportunity to outcompete native grasses. Many of these acres are invaded with nonnative plants such as smooth brome and Kentucky bluegrass, or invasive plants such as leafy spurge and Canada thistle. These nonnative species continue to alter the species composition and structure of grassland ecosystems, reducing their value as wildlife habitat. However, these sites still contain native plant seed sources and dormant native plants with the potential for tremendous biological diversity.

Nearly 90% of wetland habitats are contained within managed impoundments and pools. The remaining wetland acres are natural wetlands or

wetlands created by low-head dikes on tributaries flowing into the refuge. The managed impoundments are natural riverine lakes that have been modified to enhance water management capabilities. The recent construction of the bypass canal and subimpoundments allow for the management of a variety of wetland habitats.

The prairie grassland and wetland complex habitats on and adjacent to the refuge provide nesting and feeding habitat for waterfowl in the spring and summer as well as important breeding habitat for a variety of other ground-nesting birds, especially the declining grassland-dependent songbirds. In addition, hundreds of thousands of birds passing through this area during spring and fall migration rely on these habitats for feeding and resting.

A list of refuge plant species is in appendix F.

### *Upland Vegetation*

Uplands at the refuge are categorized as follows:

- native grass (within unbroken sod areas)
- “go-back” or old cropland from the 1930s allowed to naturally succeed
- seeded natives
- dense nesting cover (DNC), which is usually a mixture of introduced cool-season wheatgrass species, alfalfa, and sweetclover
- old DNC-seeded areas that are now predominately smooth brome and Kentucky bluegrass
- riparian habitat of native prairie interspersed with deciduous tall shrubs and trees, wooded ravines, and shelterbelts

### *Native Grassland*

The refuge is comprised of 7,000 acres of native grasses (1,000 acres of which is “go-back”), 800 acres of seeded native grass species, and 660 acres within riparian corridors and wooded draws. The native prairie habitat is predominantly a cool-season, needlegrass-wheatgrass, mixed-grass prairie that primarily occurs on the steep bluffs on either side of the James River.



© Jennifer Jewett

*Milkweed is one of the native prairie plant species.*

Vegetation of the mixed-grass prairie is characterized by grasses and forbs ranging from 2 to 4 feet tall. Grasses are a mixture of western wheatgrass,

needlegrasses, blue grama, little bluestem, and upland sedges. Interspersed within the grasses are numerous species of forbs such as coneflowers, asters, and goldenrods; and patches of shrubs comprised of western snowberry, Woods' rose, silverberry, or mixtures of these species. The plant community is the transition zone between the wetter tall-grass prairie to the east and the drier short-grass prairie to the west.

The 660 acres of riparian floodplain and wooded draws are primarily associated with the James River valley and with lakeshores within the refuge. Tree species present include green ash, cottonwood, elm, chokecherry, and cedar. Shrubs and small woody species are present in the native and “go-back” areas and wooded ravines. Common species are western snowberry, prairie rose, and silver buffaloberry.

### ***Tame Grassland***

Approximately 3,540 acres of the upland habitats are tame grasslands. About 400 acres have been recently seeded with DNC (a mixture of introduced wheatgrass species with alfalfa and sweetclover) and retain the seeded composition. The remaining 3,140 acres are old crop fields that were generally seeded to a mixture of introduced grasses and legumes in the 1970s and 1980s. These old crop fields are predominantly comprised of smooth brome, Kentucky bluegrass and in many cases, invasive plants, with little to no forb component remaining. DNC fields have proven very attractive to nesting waterfowl and have shown increased nest success within their confines.

DNC is very important to upland-nesting birds, especially ducks. DNC makes a major contribution toward achieving the waterfowl production objectives of the Arrowwood NWR Complex (Duebbert 1969, Duebbert and Lokemoen 1976, Higgins and Barker 1982). Some of these stands provide excellent nesting and winter cover. Many have declined in productivity due to the tendency of smooth brome to invade and dominate the stand and then to become sod-bound. DNC fields tend to become heavily infested with leafy spurge, Canada thistle, and other exotic and invasive plant species. An integrated approach to invasive plant control has been carried out to combat this problem.

Grazing, prescribed burning, haying, and cultivation have been the primary management tools used to achieve habitat objectives. Other than prescribed fire treatments, most management actions have been conducted under a special use permit with permittees selected through a bid process.

### ***Woodland and Shelterbelts***

Arrowwood NWR contains more than 125 acres in shelterbelts (planted tree rows) and old farmstead



*Prescribed fire was used to remove litter, increase native vegetation, and improve habitat for ground-nesting birds in unit G21 at west Jim Lake.*

tree groves. The CCC and WPA planted most of these from 1937 through 1942 to control wind erosion and provide wildlife habitat. Species planted were chokecherry, caragana, Russian olive, cottonwood, boxelder, ponderosa pine, red cedar, American elm, and plum. Firebreaks have protected the shelterbelts. However, the shelterbelts have deteriorated with no other management such as pruning or replacement of dead trees. More than 30 of these plantings remain scattered throughout the refuge.

Tree plantings have significantly altered grassland habitats. The loss and degradation of native grasslands and habitat fragmentation have been implicated in the consistent decline of grassland bird populations (Samson and Knopf 1994, Herkert 1995, Bakker et al. 2002). In addition, the removal of trees may reduce avian predation on grassland-nesting species (Johnson and Temple 1990). Avian predators such as American crows and black-billed magpies prey on waterfowl eggs and use shelterbelts for nesting and food (Sargeant et al. 1993). Raptor species such as red-tailed hawk, Swainson's hawk, and great horned owl prey on adult ducks and ducklings (Murphy 1997). The removal of woody vegetation within grasslands likely reduces the cover and travel corridors for mammalian predators (Sovada et al. [in press]).

### ***Wetland Vegetation***

Wetland or aquatic vegetation consists of plants associated with wetlands or soil saturated for the majority of the growing season. The impoundments and pools contain sedges, smartweed, cordgrass, duckweed, reedgrass, cattails, and submergent plants such as sago pondweed. One of the most important aquatic food resources occurring at the refuge is the extensive beds of sago pondweed. Diving ducks, especially the canvasback, heavily use these beds. Good sago pondweed production occurs approximately 5 out of every 10 years.

Wetland plants affected by upland management are emergent vegetation along the upland-wetland edge. These include cattail, bulrush, and several species of moist soil plants such as smartweed. Substantial natural variation in submergent vegetation quantity and spatial distribution has occurred at the refuge since 1983. Emergent vegetation has remained relatively constant.

Impoundments and pools have been managed using the bypass channel system and water control structures. This manipulation of water levels has encouraged desirable plant growth and discouraged less desirable species.

**Threatened and Endangered Plants**

The refuge has no documented threatened or endangered plant species; however, no formal surveys have been conducted.

**Invasive Plants**

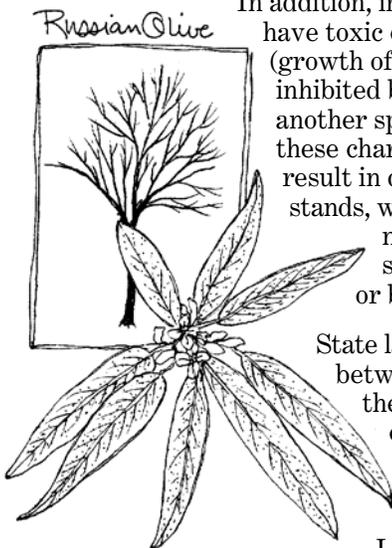
“Noxious weeds” is a legal designation. In the North Dakota Noxious Weed Law and Regulations Guide, the North Dakota Department of Agriculture has identified noxious weeds as plants that are difficult to control, easily spread, and injurious to public health, crops, livestock, land, or other property. Many of the state-listed noxious weeds are also invasive species.

Invasive plants are introduced organisms that colonize and rapidly spread in native systems due to the absence of natural controls. Invasive plants often share characteristics including effective seed dispersal, rapid colonization, and expansion capacities.

In addition, invasive plants can have toxic or allelopathic (growth of one species inhibited by chemicals of another species) effects. All these characteristics can result in dense single-species stands, which rapidly exclude native species or suppress crop yields or both.

State laws, and agreements between the Service and the state, mandate the control of state-listed noxious weeds on Service-owned lands.

Limited resources restrict the ability to control effectively all invasive plants at the refuge; therefore, priorities have been established to determine which species would be controlled first. These priorities are based the weeds’ potential



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adverse effects to refuge grasslands, wildlife, and economic capital. The adverse effects are derived from the life history, species biology, and control techniques of the species. Those species selected as the highest priority for control are those known to be invasive in their characteristics and currently found in refuge habitats. The four priority invasive plant species are Canada thistle, absinth wormwood, leafy spurge, and Russian olive. Infestations of other invasive plant species are targeted for treatment immediately upon identification. Invasive plants are managed as described in the Integrated Pest Management Plan for the Arrowwood NWR Complex (IPM Plan) (USFWS 2005).

Smooth brome, Kentucky bluegrass, crested wheatgrass, and quackgrass are species of tame grasses that have been seeded on or adjacent to refuge lands. These grasses have been seeded by neighboring landowners for forage or in plantings through the Conservation Reserve Program (a U.S. Department of Agriculture [USDA] program that “idles” highly erodible land), or by the USDA for bank stabilization. In some cases, the Service has seeded some of these species on refuge lands for wildlife habitat. Although these grass species are invasive in their characteristics and can damage native prairie grasslands when they invade, they are not considered invasive plants or noxious weeds in the IPM Plan (USFWS 2005).

Significant infestations of invasive plants have resulted in more than a loss of habitat for wildlife and a decline in species diversity in prairie grasslands. For many years, invasive plant issues have been sources of contention between the Service, neighboring landowners, the state of North Dakota, and county officials. Invasive plants have not always been effectively managed at the refuge. Invasive plant control efforts were often cosmetic, shortsighted, and reactive; many times, control efforts used only one technique instead of an integrated approach designed to meet a habitat objective.

The refuge employs an integrated approach to more effectively control noxious weeds and invasive plants, to achieve management goals and refuge purposes. The “Upper James River Weed Management Area” partnership was developed to work cooperatively and apply for grants.

**Cropland**

Although the refuge has a long history of agricultural crop production, there is currently no cropland at the refuge. The process of reducing cropland acres began in 1995 and the last field was seeded to native grass in 2005. Old crop fields have been seeded to mixtures of native grasses and DNC.



*Tundra Swan*

John and Karen Hollingsworth/USFWS

## Wildlife

An important stopping place for migratory birds, the refuge also hosts threatened and endangered species and other wildlife described in this section. Lists of refuge wildlife species are in appendixes G–J.

### *Invertebrates*

Invertebrate production in refuge waters is excellent especially in low-water years. Production of chironomids (midges), corixids (water boatmen), notonectids, and many other aquatic species normally peak at the same time the majority of the waterfowl broods are hatching. These aquatic insects provide an important source of protein to waterfowl and other wildlife. Terrestrial invertebrates are also an important food source to wildlife at the refuge. There are no known endangered invertebrates at the refuge.

### *Amphibians and Reptiles*

Tiger salamander, Great Plains toad, Dakota toad, leopard frog, snapping turtle, painted turtle, plains garter snake, and prairie skink are some of the common reptiles and amphibians that inhabit the James River watershed.

Several species of reptiles and amphibians have been documented at the refuge, but no formal surveys have been conducted. Tiger salamander, leopard frog, chorus frog, and two species of turtles are known to be present. There are only three species of snakes known to occur at the refuge—garter snake, red-bellied snake, and smooth green snake. Appendix H contains a list of potentially occurring amphibian and reptile species at the refuge.

### *Fish*

The shallow nature of impoundments usually results in a winterkill of fish. However, in high-water years fish can move upstream from the Jamestown Reservoir. This can result in good populations of northern pike, walleye, yellow perch, crappie, smallmouth bass, and black bullhead, but also brings

undesirable species such as bigmouth buffalo and carp. Fathead minnows and sticklebacks are also present. The fish provide a valuable food source for herons, grebes, mergansers, pelicans, and other fish-eating birds. Management efforts directed at sago production normally results in winterkill in all impoundments.

Common carp and bigmouth buffalo are always present in the James River and will enter refuge subimpoundments at every opportunity. Management of water levels on the refuge will minimize these undesirable species. Low water levels in the fall will cause winterkill of fish in most years. In addition, the electric fish barrier constructed as part of the Arrowwood NWR mitigation project (located between the refuge and Jamestown Reservoir) prevents fish from migrating from the reservoir into the refuge. The barrier is effective in normal and low water years but in high-flow years when the reservoir elevation exceeds 1,442 feet, water will overtop the barrier and fish will move into the refuge.

### *Birds*

There are 266 species of birds that have been observed at the refuge (appendix I). Of these, 124 species are known to nest at the refuge. Spring and fall migrations find spectacular numbers of waterfowl passing through the area and the refuge is an important stop for many on the journey north or south. The James River serves as a major migration route and breeding ground for thousands of geese and ducks.



*Gadwall*

Dave Menke/USFWS

Canada goose, snow goose, white-fronted goose, mallard, gadwall, blue-winged teal, American wigeon, lesser scaup, hooded merganser, redhead, and canvasback are common in the James River watershed.

Arrowwood NWR provides production habitat as well as resting and feeding areas for thousands of waterfowl and other migratory birds. The refuge is particularly important as a major diving duck staging area in North Dakota, with specific

importance to fall populations of canvasbacks. The refuge is a major waterfowl production area and provides wetland habitat for migratory waterfowl.

In addition to the waterfowl use of the refuge, other migratory and resident species inhabit the wetlands. Game and nongame species observed in the watershed include ring-necked pheasant, sharp-tailed grouse, gray partridge, mourning dove, upland sandpiper, bobolink, Baird's sparrow, western meadowlark, and chestnut-collared longspur. Other bird species associated with riverine and wetland habitat found at the refuge include great blue heron, American bittern, American white pelican, red-winged blackbird, sora rail, American coot, yellow rail, Le Conte's sparrow, and sharp-tailed sparrow. Numbers of upland birds are cyclic, but good populations are normally present.

**Mammals**

Upland habitats are important to mammals at the refuge in many ways. White-tailed deer is the major big game species found in the James River watershed. Populations have increased statewide over the past 30 years and reached near record levels in the late 1990s.



James R. Williams/USFWS

*The eastern cottontail is common where sufficient woody vegetation provides adequate habitat.*



Dave Menke/USFWS

*Muskrat*

Major furbearers in the James River watershed include mink, muskrat, beaver, raccoon, red fox, and coyote. In addition, weasels, badgers, striped and

spotted skunks, and jackrabbits inhabit the area. Appendix J contains a list of mammal species at the refuge.

**Threatened and Endangered Wildlife**

There are three federally listed threatened and endangered species known to occur at the refuge. The whooping crane is listed as endangered. The bald eagle and piping plover are threatened species.



Steve Hillebrand/USFWS

*Bald Eagle*

Whooping cranes migrate through the area but there have been only two confirmed sightings in recent years on or near the refuge. A lone whooping crane with a flock of sandhill cranes was recorded during the 2001 fall migration. A single whooping crane was sighted just west of Pingree, North Dakota, during spring 1997.

Bald eagles are observed regularly during spring and fall migrations. Spring concentrations are normally higher during years with winterkilled fish in impoundments and when there is a large influx of rough fish from the Jamestown Reservoir.

The piping plover has been recorded nesting at the refuge during years of low water; the bird prefers exposed gravel islands and shoreline habitat for nesting. Piping plovers have not been observed at the refuge since 1991. Because of its history of piping plover use, the refuge has designated critical habitat for piping plovers. The refuge participates in the "International Piping plover Breeding Census" conducted every 5 years.

The following species of special concern may be present at the refuge during certain times of the year:

- black tern
- ferruginous hawk
- Baird's sparrow
- loggerhead shrike
- northern goshawk
- Dakota skipper butterflies (periodic surveys of butterflies have been conducted since 1997; no Dakota skippers have been recorded)
- *Pyroctomena sinuate* Green, a rare firefly (documented in 1991 by a professor from the University of Florida, Gainesville)

## CULTURAL RESOURCES

The built environment and archaeological remains on and near refuge lands represent the rich 10,000-year cultural heritage of the Arrowwood NWR. The varied habitats and resources of the refuge have attracted human settlement for more than 10,000 years. Until the last 150 years, the region was occupied by numerous groups of Native Americans who used a wide variety of adaptations to local resources, which included economies based on hunting, gathering, and horticulture (an early form of agriculture). The fur trade initiated contact between native peoples and Anglo visitors in the seventeenth century. By the mid-eighteenth century, the influx of nonnative peoples significantly altered the traditional culture of the native people and reshaped the landscape of the region. Evidence of both the prehistory (pre-native contact) and the history (postnative contact) is found in the numerous archaeological sites and historic buildings on the refuge.

The refuge lies within the James River study unit of the “Archeological Components of the North Dakota Comprehensive Plan for Historic Preservation.” Based on information provided in that document, the prehistoric occupation of the region began with the Paleo-Indian period (9500–5500 B.C.); and extended through the Archaic (5500–400 B.C.), Woodland (400 B.C.–A.D. 1000), and Plains Village (A.D. 1000–1780) periods. Archaeological evidence suggests that bison were a major component of the economies of the prehistoric residents, with dependence on this resource decreasing through time. The Paleo-Indian period was based on an economy that relied heavily on migratory, large-game animals; this required settlements to be highly mobile. The Archaic and Woodland periods were marked with increased specialization in a broader spectrum of local resources, which resulted in less need for mobile settlements. During the Plains Village period, people became more sedentary because plant husbandry required that crops be tended. The Plains Village lifestyle maintained bison hunting due to the lack of development of crops that would consistently produce in the short growing seasons of the area. A variety of archaeological sites and surface finds provide evidence for prehistoric occupation including stone tool and ceramic scatters, stone circles, burial mounds, villages, and bison kills.

Although there has been very limited cultural resource survey done at the refuge, evidence from the surrounding areas suggests that a common location for prehistoric sites is along the bluff edge overlooking the river valley. Many of these sites probably exist at the refuge; however, future archaeological knowledge should be used to identify and protect these resources. No doubt, prehistoric

archaeological sites that were below the bluffs in the river valley were covered with the deposition of sediments when water was dammed for the reservoirs in historic times.

Locations and items of traditional religious and cultural importance to Native Americans deserve special mention. The presence of several historic Native American tribes in the area at various times is well documented, predominantly various bands of the Lakota, Dakota, and Yanktonai Sioux. The name of the refuge, Arrowwood, comes from the fact that the Sioux gathered materials for bow and arrow manufacturing in this area from stands of oak and hackberry, which were not abundant outside the river valley. Sioux speakers named the area “Itazi paha koksji” meaning “the place for cutting bows” and they called the James River “san san san,” meaning “white wooded river.” There was a close relationship between native people and refuge lands in the past. Currently, the Spirit Lake Nation Indian Reservation and the Sisseton-Wahpeton Sioux Tribe of the Lake Traverse Reservation are near the refuge. Therefore, refuge lands likely support areas and resources that hold special meaning for these groups to preserve traditional religious or resource procurement activities.

The historic period began with the appearance of the Euro-American explorers and fur traders in the area about A.D. 1750, although extensive settlement did not occur for until nearly 100 years later. In 1872, the Fort Totten Trail was constructed as a military route connecting Fort Seward in Jamestown to Fort Totten near Devil’s Lake. The remains of the trail are still visible in the form of wagon ruts east of Jim Lake and in the Grasshopper Hills area. A fortified camp associated with the trail, complete with trenches and sod berms, lies near the north refuge boundary. Once the military was well established, the area became ripe for Anglo homesteading and agriculture. Many of these earlier settlers were of eastern European descent. Common site types associated with the establishment of farming communities are farmsteads, homesteads, dugouts, small rural communities, bridges, schools, and railroads.

The establishment of the refuge is directly tied to the Civilian Conservation Corps (CCC) and Works Progress Administration (WPA) programs of the mid-1930s. President Franklin D. Roosevelt created these programs during the Great Depression as a means to employ young men of ages 18–25 to work providing useful projects for society and income for the workers to send to their families. The men planted thousands of trees and shrubs at the refuge. The CCC and WPA built many low-level dikes and water control structures on the refuge between 1935 and 1942. Arrowwood, Mud, and Jim lakes were natural lakes enhanced by these projects, while Depuy Marsh is a constructed feature. In addition,

infrastructure was constructed in the form of a residence, an equipment building, a barn, a root cellar (also referred to as an aquatic cellar), and a bunkhouse.

## SPECIAL MANAGEMENT AREAS

Arrowwood NWR meets the size, scientific, scenic, and ecological value criteria for wilderness. However, the refuge is impacted by roads, fences, and extensive human effects from grazing, agriculture, and wetland modifications that restrict it from being designated a wilderness area.

To be designated a wilderness area, lands must meet certain criteria (below) as outlined in the Wilderness Act of 1964:

- generally appears to have been affected primarily by the forces of nature, with the imprint of human work substantially unnoticeable
- has outstanding opportunities for solitude or a primitive and unconfined type of recreation
- has at least 5,000 acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition
- may contain ecological, geological, or other features of scientific, educational, scenic, or historical value

## VISITOR SERVICES

The refuge offers a wide variety of year-round accessible recreational opportunities that are wildlife dependent. Hunting, fishing, wildlife observation, wildlife photography, and environmental education are popular activities.

The report, “Banking on Nature 2004: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation” (Caudill and Henderson 2005), stated that Arrowwood NWR recorded 6,796 visitors in 2004. Residents accounted for 5,526 visits and nonresidents 1,270 visits. Visitors engaged in nonconsumptive activities 76% of the time, with hunting and fishing 19% and 5% of the time. In addition to the wildlife-dependent activities it provides, the refuge offers a scenic contrast to the agriculturally dominated landscape that surrounds it.

### Hunting

Unlike most refuges in North Dakota, Arrowwood NWR has never been open to waterfowl hunting. Hunters are able to harvest waterfowl that leave the refuge to feed in surrounding crop fields; resident and nonresident hunters alike take advantage of this fact.



John Stehm/USFWS

*The refuge is well known for white-tailed deer hunting.*

In 2004, there were approximately 1,125 deer-hunting visits. Hunters pursue deer with bows, muzzleloaders, and modern firearms. To maintain a safe, high-quality hunt, access is walk-in only unless a hunter has a documented disability and obtains a refuge permit that allows the use of a vehicle for hunting. Specified times have been established to allow hunters to retrieve harvested deer using vehicles. The entire refuge is open to hunting, except the closed zone around the headquarters and the Warbler Woodland Watchable Wildlife Area (figure 7).

The refuge is open to upland game hunting after the firearm deer season closes. Hunters can take ring-necked pheasant, sharp-tailed grouse, gray partridge, cottontail, and red fox.

The hunting program is described in the draft compatibility determination in appendix K.

### Fishing

The Service does not actively manage sport fisheries at refuges, including Arrowwood NWR, in the James River watershed. Managing for sport fisheries would conflict with the wildlife objectives for which the refuge was established. Sport fisheries would also create ideal habitat conditions for the survival of carp, which degrade wetland habitat for migrating and nesting waterfowl.

Fishing opportunities at the refuge are limited to extremely high-water years when the refuge is flooded. When water from the Jamestown Reservoir overtops the levees, fish can move upstream and populate the refuge. Fish species are typical of northern reservoirs with sport fish such as northern pike, walleye, yellow perch, crappie, and smallmouth bass. Abundant nonsport species include black bullhead, white sucker, carp, and bigmouth buffalo.

Public access is allowed to the sport fish resource when it is present. The spring and summer fishing season runs from May 1 through September 30. During that time, the following is allowed:

- motorized boats, 25 horsepower and under, on Arrowwood and Jim lakes

- nonmotorized boats on all refuge waters
- bank fishing

Primitive boat launch facilities are located in the Warbler Woodland Watchable Wildlife Area and at the southwest corner of Jim Lake (figure 7).

Bow fishing for rough fish is permitted from May 1 through September 30 of each fishing year, in accordance with state regulations. Spear fishing is not permitted.

Arrowwood, Mud, and Jim lakes are open to winter fishing. Fish houses are allowed. Vehicles (no ATVs or snowmobiles) are allowed on the ice, but only on Jim Lake and only via the primitive boat launch. Fish houses must be removed no later than March 15. Portable fish houses can be removed daily and are allowed after March 15.

The fishing program is described in the draft compatibility determination in appendix L.

When needed to address the problem of carp and bigmouth buffalo, the refuge has issued a special use permit for commercial fishing to net these undesirable fish species. More information is in the draft compatibility determination in appendix M.

## Wildlife Observation and Wildlife Photography

Three county roads and one state highway cross the refuge and offer opportunities for wildlife viewing. The refuge is included in two of the birding routes described in the “Birding Drives Dakota” brochure and the number of nonresident birders has increased in recent years. The first half of the 5.5-mile auto tour route (figure 7) follows the river channel and provides access to a wildlife observation deck on the riverbank overlooking two managed wetlands. The second half of the tour route climbs to the top of the river bluffs and offers panoramic views of the valley and surrounding lands.

The Warbler Woodland Watchable Wildlife Area (figure 7) includes an interpretive nature trail, natural spring drinking water, a vault toilet, tables, and grills. The Centennial Overlook provides a panoramic view of Arrowwood Lake; in the spring and fall months, thousands of migrating waterfowl, shorebirds, and other waterbirds can be seen. The public can reserve two blinds set up each spring on sharp-tailed grouse leks, offering excellent viewing and photo opportunities.

Walk-in access is allowed everywhere except the closed area near the headquarters, which includes the shop, equipment storage areas, and residents’ quarters. Nonmotorized biking is allowed on roads and service trails, but not allowed off-road.

During the boating season, from May 1 through September 20, nonmotorized boats and canoes are allowed on all waters. Boats with less than 25 horsepower motors are allowed on Arrowwood and Jim lakes.

The program for wildlife observation and wildlife photography is described in the draft compatibility determination in appendix N.

## Interpretation

There is interpretive information for the auto tour route and nature trail. In addition, there are information kiosks at the entrance to the tour route, in the Warbler Woodland Watchable Wildlife Area, at the entrance to the grouse blind, and at refuge headquarters (figure 7). The refuge headquarters has a very small visitor contact area. The refuge staff is interested in increasing the size of the visitor contact area to provide interpretive information and brochures.

The interpretive program is described in the draft compatibility determination in appendix O.

## Environmental Education

The refuge has both on- and off-site environmental education programs. Special events include participation with other refuges and conservation agencies in several water and river festivals, “JAKES (Juniors Acquiring Knowledge, Ethics & Skills) Day,” “Refuge Night at the Redhawks,” “Go Wild at the Mall,” and “Refuge Day at the Zoo.”

The refuge hosts numerous elementary, secondary, and college groups; and scout groups for environmental education activities and tours. Additionally, local third graders join the refuge for educational games and demonstrations during National Wildlife Refuge Week. The refuge is also a partner with the Kensal Public School and supports programs at the 1.5-acre Outdoor Wildlife Learning Site (OWLS).

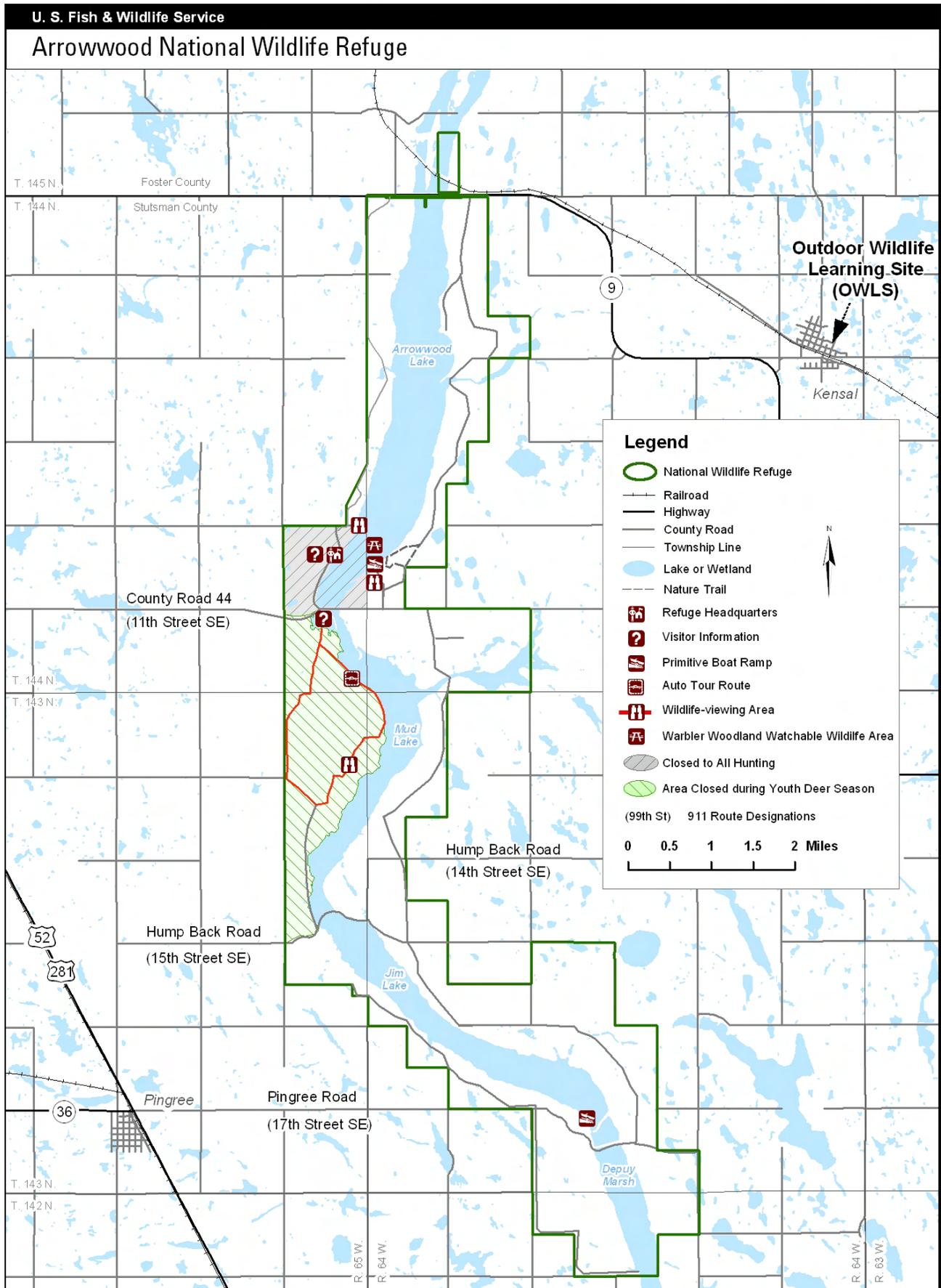


Figure 7. Public use areas at Arrowwood NWR, North Dakota

The environmental education program is described in the draft compatibility determination in appendix O.



*Refuge staff demonstrate the benefits of wetland and riparian habitats.*

## Other Recreational Uses

Refuge users are allowed to collect aboveground portions of commonly used edible plants such as berries, mushrooms, and asparagus for their personal use (see appendix P). Trapping for recreational purposes is also allowed, under special use permit, on most areas of the refuge (see appendix Q). The visiting public, under special use permit, can enjoy horseback riding on designated areas (see appendix R).

## Compatibility Determinations

Compatibility determinations were approved for several uses in 1998. New compatibility determinations (below) have been drafted to update the 1998 determinations and to address public use at Arrowwood NWR:

- hunting (appendix K)
- fishing (appendix L)
- commercial fishing (appendix M)
- wildlife observation and wildlife photography (appendix N)
- interpretation and environmental education (appendix O)
- wild food gathering (appendix P)
- recreational trapping (appendix Q)
- horseback riding (appendix R)

## AESTHETICS

The NEPA requires agencies to consider aesthetic impacts to scenery, noise, and odor from proposed

federal actions. The Service preserves and enhances aesthetic resources to the extent that refuge objectives can still be fulfilled. A natural undisturbed appearance is the visual standard that applies to refuge habitat rehabilitation and management projects. If this standard cannot be met, the Service takes actions to mitigate or diminish any negative impacts.

Service policy is to use the most natural means available to meet wildlife objectives. In situations where objectives cannot be met using natural processes, more intensive and artificial methods such as cropland management may be employed. The acreage cropped would be the minimum required to meet approved objectives. Service policy also states that the long-term productivity of the soil would not be jeopardized to meet wildlife objectives.

The following are examples of how the refuge carries out these policies:

- Borrow sites are reclaimed using pre-existing species.
- Old crop fields are being converted to various mixtures of grasses.
- Firebreaks are kept to the minimum necessary for safety and to meet prescribed fire management objectives; most firebreaks are being eliminated,
- Existing gravel pits are being reclaimed and no new gravel pits are being opened.

## SOCIOECONOMIC ENVIRONMENT

This is a summary of the socioeconomic setting. The complete economic analysis is in appendix S.

Jamestown (Stutsman County) and Carrington (Foster County) are the primary communities near the refuge. According to “Tour North Dakota” (Central Dakota Tourism Partnership 2004), one of the greatest assets of the area is the quality of life enjoyed by its residents. In 2000, the population of North Dakota was 642,200 with an average density of 9.3 persons per square mile (U.S. Census Bureau 2002).

Stutsman County accounted for 3.4% of North Dakota’s total population in the year 2000, with a population of 21,908 residents averaging 9.9 persons per square mile (U.S. Census Bureau 2002). Jamestown, the county seat, is located in the south end of Stutsman County with a population of 15,571 people. Located in the valley where the James and Pipestem rivers meet, Jamestown offers a variety of recreational opportunities from summer activities such as fishing, hunting, and golfing to winter activities such as ice fishing, snowmobiling, and cross-country skiing (Jamestown, ND 2004).

Foster County, located just north of Stutsman County, is one of the smallest of the state's 53 counties, 18 miles by 36 miles in size. Foster County accounted for 0.5% of North Dakota's total population in the year 2000, with a population of 3,759 residents averaging 5.9 persons per square mile (U.S. Census Bureau 2002). Carrington, the largest town in Foster County, is commonly referred to as the "Central City" for its location central to the four major North Dakota cities of Bismarck, Fargo, Minot, and Grand Forks. With its outstanding leadership, community commitment, location, and updated infrastructure, Carrington has been recognized as the most dynamic community in North Dakota with a population under 2,500 (Carrington, ND 2004).

While the state of North Dakota experienced a relatively low 0.5 % population increase from 1990 to 2000, Stutsman County's population increased by 3.0%, while Foster County's population decreased 6.0% over the same time frame. Approximately 78% of the Foster County population and 81% of the Stutsman County population 25 years and older have high school diplomas, while 20% were college graduates (U.S. Census Bureau 2002).

Based on population origin estimates from the 2000 census, 91.7% of the state's population was white persons not of Hispanic/Latino origin, 5.0% were American Indian and Alaska Native, 1.2% were Hispanic or Latino origin, 0.6% were Black or African American persons, and 0.6% of Asian decent. Population origins in Foster and Stutsman counties were similar to the state population (U.S. Census Bureau 2002). The predominant immigrant cultures in the region include Scandinavian, German, Ukrainian, and Icelandic (Central Dakota Tourism Partnership 2004).

The majority of Stutsman and Foster counties are rural with agriculture as the main industry (U.S. Department of Commerce 2002). Like most North Dakota communities, Jamestown and Carrington can trace their development to the arrival of the railroad (Central Dakota Tourism Partnership 2004). Agriculture formed the basis for the region's early economy and still is an important component today. According to the U.S. Department of Commerce (2002), total farm self-employment accounted for 8.3% of total employment in North Dakota (8.3% in Stutsman County and 13.8% in Foster County) in 2000. Besides agriculture, the other major local and state employers are service-related business, government, and retail trade.

Major employers in Jamestown include health providers, education, potato processing, and aerospace products manufacturing (U.S. Census Bureau 2002). Carrington's business community is diversified, including agriculture, manufacturing, financial, retail, and technology-based endeavors (Carrington, ND 2004). Carrington serves as the

center of an important corridor of agribusiness (Dietz 2003). Carrington is home to state-of-the-art Dakota Growers Pasta Company, which markets premium quality pasta worldwide (Carrington, ND 2004).

Foster County per capita personal income was \$25,138 in 2000, which very close to the state average of \$25,109. Meanwhile, Stutsman County per capita personal income was \$23,686, which was \$1,423 lower than the state average (U.S. Department of Commerce 2002). Total personal income was \$94 million in Foster County and \$517 million for Stutsman County in 2000 (U.S. Department of Commerce 2002).

The communities and local governments near the refuge benefit economically from the presence of the refuge and the activities that occur there. In September 2005, the Service released the results of a report entitled "Banking on Nature 2004: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation" (Caudill and Henderson 2005). Arrowwood NWR served as a sample refuge for this study, which resulted in the creation of economic models used to estimate the economic impact of refuge visitation nationwide. The report estimates that in fiscal year 2004, Arrowwood NWR recreational visitors spend \$68,300, with the majority of that related to big game hunting (\$46,200). When the total monetary value of this economic activity to the local area economy is considered, recreational visitation to the refuge generates \$87,500 per year, which is enough to create two jobs (both part time and full time) with a combined income of \$30,400.

## STAFFING

Staff located at the refuge headquarters has responsibility for the entire Arrowwood NWR Complex; however, for this document, the payroll expenditures are attributed entirely to Arrowwood NWR. Currently there are nine permanent employees and six temporary employees located at the refuge headquarters. Funding for employee salaries and benefits totaled \$752,993 in fiscal year 2006. Table 2 shows the current refuge staff.

## PARTNERSHIPS AND OTHER PUBLIC OUTREACH

The refuge has a long history of fostering partnerships that help the refuge accomplish its mission and goals. These partners include city, county, state, and federal agencies; nongovernmental organizations; conservation groups; and private citizens.

**Table 2. Current staff at Arrowwood NWR, North Dakota.**

<i>Staff Group</i>	<i>Position</i>
Management	Project leader, GS <sup>1</sup> -14*   Deputy project leader, GS-13* Refuge operations specialist, GS-7/9/11*
Biology	Wildlife biologist, GS-9/11*
Administration	Administrative officer, GS-9* Clerk (office assistant), GS-5*
Maintenance	Engineering equipment operator, WG <sup>2</sup> -10
Fire	Fire management officer, GS-11* Fire technician, GS-6/7*
Term <sup>3</sup> , Temporary	Tractor operator (term), WG-6 Biological technicians (5), GS-3/4/5/6
<i>Total Salaries and Benefits = \$752,993</i>	

<sup>1</sup>GS=General pay schedule<sup>2</sup>WG=Wage grade pay schedule<sup>3</sup>term=temporary time-limited position

\*Staff with responsibilities for the entire Arrowwood NWR Complex

The refuge's partners have assisted in wildlife and habitat management, visitor services and recreational opportunities, and community outreach. Many of these relationships have developed into formalized partnerships with written agreements or understandings, while others remain more informal.

## Existing Partnerships

The most significant partnership is with the Bureau of Reclamation for construction of the mitigation features authorized under the Garrison Diversion Unit Reformulation Act of 1986. Once completed, this project will allow independent management of water levels in each of the refuge impoundments. A memorandum of understanding that stipulates Reclamation would purchase necessary equipment and supplies, and fund a position to operate and maintain the mitigation project features, is currently being renegotiated.

The refuge has worked closely with the Stutsman County Weed Board to combine resources, apply for grants, and cooperate on control actions. This arrangement has allowed both parties to purchase chemicals and insects for biological control at lower prices. In addition, this partnership has allowed county employees to assist with chemical application and map infestations on refuge lands. This partnership has expanded to three other county weed boards and extension offices, and several other partners. This partnership has received funding from the National Fish and Wildlife

Foundation's "Pulling Together Initiative," for additional invasive species work within the Arrowwood NWR Complex.

"Birding Drives Dakota," a coalition of communities and agencies dedicated to the promotion of birding in North Dakota, is a new organization with which the refuge is collaborating. Some of the primary sponsors are Carrington Chamber of Commerce, Carrington Community Development Corporation, Carrington Convention & Visitors Bureau, Garrison Diversion Conservancy District, Jamestown Area Chamber of Commerce, Jamestown Promotion & Tourism, Jamestown Sun, and Northern Plains Electric Cooperative. Arrowwood NWR was a major contributor to the development of the "Birding Drives Dakota" pamphlet, which details six routes in and around Stutsman County where birders can expect to view North Dakota's abundant bird life. Additionally, the refuge was a major sponsor and organizer of the first "Potholes and Prairie Birding Festival," which has become an annual event to promote birding, other nature-based activities, and preservation of native grassland and wetland habitats.

The Northern Prairie Wildlife Research Center of the USGS is a valuable partner, providing the latest research information on wildlife issues. A current project includes long-term monitoring following completion of the study, "Role of nutrient manipulation and biological control insects on leafy spurge population regulation at Arrowwood and Tewaukon national wildlife refuges," in 2003.

The development of the OWLS at Kensal (figure 7) is the result of another partnership with the Kensal Public School and NDGF.

The refuge actively sought and fostered partnerships with organizations and individuals with whom a common goal is shared. Many individuals, groups, and organizations have contributed in important ways to the refuge, including the following groups:

- U.S. Army Corps of Engineers–Pipestem Dam
- NDGF
- Stutsman County Weed Board
- Foster County Weed Board
- North Dakota State University Extension Service
- Stutsman County Park Board
- Stutsman County Wildlife Club
- United Sportsman–Jamestown Chapter
- Dakota Anglers
- Tri-County Trap Club
- Ducks Unlimited
- Boy Scouts
- Girl Scouts
- 4-H

## Potential Partnerships

Only with public support can the Service succeed in its mission. That support comes through outreach—fostering education and understanding, and communicating the importance of the Service commitment to protecting habitat on which wildlife depends. Outreach includes a broad array of activities and services focused on building relationships and communication. The Service is committed to getting its message to both traditional and nontraditional groups.

Existing Service private lands programs and the refuge’s proposed watershed management (alternative 3 in chapter 4) correspond very well with programs offered by the Natural Resources Conservation Service (NRCS), NDGF, EPA, North Dakota State Health, and county water boards. A partnership to improve watershed health in the upper James River could include all these entities as well as others. The refuge is open to any partnership that would further the purposes, goals, and objectives of the Service, the refuge, or the Refuge System.

Additional partnerships can be forged with various universities to assist with research needs. Researchers from University of North Dakota and North Dakota State University have inquired into potential sites to initiate or expand current research.

# 4 Alternatives



*Rolling grasslands overlook Mud Lake.*

A challenge for natural resource managers is to find ways to address the sometimes-conflicting goals for various aspects and levels of resource management and protection. For Arrowwood NWR, it is of paramount importance to provide diverse grassland types that emulate the natural variation of the Prairie Pothole Region. This will ultimately benefit trust resources including waterfowl, grassland birds, and songbirds.

Each alternative in this EA has been designed to meet the purposes and goals of the refuge through a unique set of objectives, levels of management, and timeframes. Three alternatives for management of the refuge form options for addressing the ecosystem and resource needs and the public use.

The no-action alternative (alternative 1) portrays current management. Alternative 2 would provide enhanced management with an emphasis on grasslands. The Service's proposed action (alternative 3) describes the draft CCP for the refuge. The proposed action includes not only enhanced management, but also a plan to improve water quality entering the refuge and reduce peak flows in the upper James River watershed during spring runoff and summer rainfall events.

This chapter includes the following sections:

- alternatives considered but eliminated from detailed study
- summary of alternatives
- description of alternatives
- staff and funding to carry out alternatives
- monitoring

## ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

The planning team considered other alternatives for management of the refuge, but eliminated them from detailed study. One such alternative was to focus all management efforts on water levels and the wetland units and to minimize or eliminate management activities on the uplands. This alternative would not meet refuge goals for migratory birds, other wildlife, recreation, or interpretation. Without active management on the uplands, invasive plant species would spread unchecked and continue to degrade the remaining tracts of native prairie. Seeded, native plant and DNC tracts would also degrade and not provide optimal habitat for waterfowl or other grassland-nesting birds. There would be no interpretative efforts for the public. The auto tour route, nature trail, Warbler Woodland Watchable Wildlife Area, and observation decks would not be maintained and would be closed to the public. Deer hunting and wildlife viewing from the state highway and county roads would be the only recreation available.

The removal of the Jamestown Dam and Jamestown Reservoir was another alternative that was considered. This alternative was dropped from further consideration (1) due to the social, political, and economical ramifications, and (2) because Reclamation has constructed a bypass channel at the refuge and has lowered the operating level of Jamestown Reservoir by 1.8 feet. The bypass channel along with the lower reservoir levels allow the refuge to manage water levels in each pool independent of each other and independent of the river flow. The increased capability to manage water levels mitigates the past, present, and future impacts of the reservoir at the refuge.

## SUMMARY OF THE ALTERNATIVES

Table 3 provides descriptions of management actions by resource and use topics for each of the three alternatives.

**Table 3. Summary of the management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b><i>Water Resources</i></b>		
Manage water as outlined in the long-range water management plan, with the capability to independently manage water levels in each impoundment.	<i>Same as alternative 1.</i>	<i>Same as alternative 1, plus:</i>  Improve water quality entering the refuge, and reduce peak flows in the upper James River watershed during spring runoff and summer rainfall events.
<b><i>Habitat—Native Grassland</i></b>		
Protect native prairie. Manage with fire and grazing to increase the species diversity of the flora and fauna.	<i>Same as alternative 1.</i>	<i>Same as alternative 1.</i>
<b><i>Habitat—Tame Grassland</i></b>		
Apply management that encourages nesting by waterfowl and upland-nesting birds.	Manage uplands to maximize the production of waterfowl and other grassland-nesting species.	<i>Same as alternative 2.</i>
<b><i>Habitat—Woodland and Shelterbelts</i></b>		
Passively manage the woodlands.	Remove selected shelterbelts and tree stands. Reduce protection from fire.	<i>Same as alternative 2.</i>
<b><i>Habitat—Wetland</i></b>		
Manage to provide abundant aquatic foods for migrating waterfowl.	Manage to provide habitat conditions for migrating waterfowl, migrating shorebirds, and nesting waterbirds.	<i>Same as alternative 2.</i>
<b><i>Habitat—Invasive Plants</i></b>		
Apply management practices that follow the IPM Plan (USFWS 2005).	<i>Same as alternative 1.</i>	<i>Same as alternative 1.</i>
<b><i>Habitat—Cropland</i></b>		
Phase out croplands unless needed to rehabilitate DNC or other grass plantings.	<i>Same as alternative 1.</i>	<i>Same as alternative 1.</i>

**Table 3. Summary of the management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b>Wildlife—Threatened and Endangered Wildlife</b>		
Monitor. Consult Ecological Services. Manage Jim Lake for piping plovers during drought years.	<i>Same as alternative 1.</i>	<i>Same as alternative 1.</i>
<b>Wildlife—Predator Management</b>		
Apply management activities through local cooperators in accordance with the predator management plan.	<i>Same as alternative 1.</i>	<i>Same as alternative 1.</i>
<b>Cultural Resources</b>		
Protect known and newly discovered cultural resources.	Expand cultural resource interpretation where compatible and as funding opportunities allow.	<i>Same as alternative 2.</i>
<b>Visitor Services—Hunting</b>		
Manage the hunting program to manage wildlife and provide compatible, priority, wildlife-dependent public use.	Expand upland hunting where compatible and as opportunities allow. Modify refuge-specific regulations where appropriate to enhance the quality of the refuge hunting experience.	<i>Same as alternative 2.</i>
<b>Visitor Services—Fishing</b>		
Manage the fishing program to provide compatible, priority, wildlife-dependent public use. Allow no expansion.	<i>Same as alternative 1, plus:</i> Clarify and modify the regulations about access to fishing opportunities to minimize or eliminate the potential for conflict with other refuge users. Produce new refuge “tear sheets” and informational brochures.	<i>Same as alternative 2.</i>
<b>Visitor Services—Wildlife Observation, Wildlife Photography, Interpretation, and Environmental Education</b>		
Carry out and support the OWLS program. Allow use of the auto tour route to support priority wildlife-dependent use.	<i>Same as alternative 1, plus:</i> Expand wildlife observation and wildlife photography opportunities, and environmental education where compatible and as funding and staffing allow. Actions may include enhancement of the OWLS with interpretive signs or a brochure, development of field study kits for visitors, and construction of an environmental education pavilion in the Warbler Woodland Watchable Wildlife Area.	<i>Same as alternative 2.</i>

**Table 3. Summary of the management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<i>Visitor Services—Public Access</i>		
Provide limited public use opportunities when compatible.	Enhance compatible public access when staffing, funding, and volunteer opportunities occur. Clarify public access opportunities with modified refuge “tear sheets” and informational brochures.	<i>Same as alternative 2.</i>
<i>Partnerships and Other Public Outreach</i>		
Foster existing partnerships.	<i>Same as alternative 1, plus:</i> Develop new partnerships.	<i>Same as alternative 1, plus:</i> Seek new and innovative partnerships to improve the upper James River watershed.

## DESCRIPTION OF THE ALTERNATIVES

This section further describes the three management alternatives. Management actions for each alternative are described for water resources, habitat and wildlife, visitor services, and operations. Alternative 3 is the Service’s proposed action and is the basis for the draft CCP (chapter 6).

The following actions relating to the bypass channel apply to all alternatives. The bypass channel and other infrastructure constructed by Reclamation to mitigate the impacts of the Jamestown Reservoir would allow management of refuge water levels in all but the most extreme high water years. Refuge managers would be able to use the bypass channel to move large volumes of water downstream, bypassing all refuge wetlands except Arrowwood Lake. Since water passing through the refuge in the bypass channel would not be filtered through the remaining shallow refuge wetlands, sediment and contaminants gained in the upper watershed would have a greater chance of entering Jamestown Reservoir.

### Alternative 1—Current Management (*No Action*)

The no-action alternative would continue the management of habitat, wildlife, programs, and facilities at current levels. Active management would continue as time, staff, and funds allow; in some cases, management would be reactionary to conditions as they present themselves. Interpretation, education, administration, and

facilities would be maintained as is, with minor increases or decreases based on time, funding, and staffing.

### Water Resources

Wetland management includes water level manipulations and mechanical treatments of dry pools. Water management would continue as outlined in the wetland management component of the step-down HMP, which would incorporate the improved water control features of the Arrowwood NWR mitigation project. Water elevations would be adjusted to provide quality habitat for migrating and resting waterfowl. The focus on waterfowl would also benefit shorebirds and other waterbirds. Pools would be filled per the water management plan, based on the amount of annual runoff (low, medium, high, and flood). Pools would be drawn down as allowed by downstream conditions to provide pair, brood, and resting habitat. This would also encourage seed-producing vegetation that provides a food source during migration and a substrate for spring production of invertebrates.

Management of the water impoundments would be aimed at providing abundant aquatic foods (mostly sago pondweed), exposed shoreline, and feathered marsh edge for tundra swan, geese, mallard, scaup, and northern pintail. The aquatic foods that have the potential to grow in abundance are sago pondweed, arrowhead plant, smartweed, and wild millet. Production of these aquatic plants generates production of aquatic invertebrates (an important food source for waterfowl).

The attractiveness of these habitats would be further enhanced through timely management of exposed shorelines and by seasonally flooding the

shoreline to produce a vegetated marsh edge. Timely water level manipulation can change the proportion of each of these habitats during different seasons.

Another key to management of refuge impoundments is timing of food production based on the biological need of the birds. There are two critical periods at the refuge when waterfowl energy demands are high—the brood-rearing period (June–August) and the fall migration period (October–November).

Wetland management on the larger pools would be mostly reactionary and has been essentially nonexistent for the past 10 years (1993–2003) due to flooding and construction. The Arrowwood NWR mitigation project would allow independent management of each impoundment. Water management would follow the guidelines in the wetland management component of the step-down HMP, which is currently being developed. No management would occur on naturally occurring wetlands located in upland areas except for protection. These wetlands are expected to maintain their natural productivity as they fluctuate in normal wet and dry cycles.

### *Habitat and Wildlife*

Management of upland habitats would continue at current levels to encourage nesting by waterfowl and upland-nesting birds. Tools include mechanical manipulations, grazing, chemical applications, rest, and fire. Invasive plant control would continue at current or lower levels, but would not be expanded. Prescribed fire would be used on established burn units, with minimal monitoring to gauge success or failure. Grazing would probably be reduced as local animals and cooperators become scarce; however, grazing would be the “tool of choice” when good opportunities arose.

The Service has a longstanding policy prohibiting the conversion of native grasslands or unbroken sod to other upland types or conditions such as cropland or “improved” DNC. Native grasslands disturbed as a result of construction or other management actions would be restored using native species. Tools currently used are fire, grazing, mowing, haying, and rest. Monitoring would be limited to current systems to assess the effects of fire, grazing, and rest. Restoration efforts would occur for invasive plant control on currently identified conversion areas.

The estimated 785 acres of woodlands consist of naturally occurring wooded draws along lakeshores, wooded ravines, and shelterbelts. Select woodland tracts would be protected from prescribed fire. No management, surveys, or monitoring would be conducted.

The purpose of cropland management would be to reestablish quality nesting cover and provide

additional winter food and cover. Purposes and objectives of cropland management are listed below:

- Reestablish cover while maintaining refuge soils.
- Break the invasive plant cycle and prepare fields for planting of DNC or native grasses.
- Demonstrate that profitable farming can be accomplished using environmentally sound practices.
- Provide a source of winter feed for wildlife to reduce private landowner depredation complaints.

Invasive plant control efforts would continue as time and funding allow. Herbicides would be judiciously applied to invasive plant infestations and used as field preparation for grass or DNC plantings. Biological control is the preferred method of control; this program continues to expand as insectaries (places for breeding insects) become more productive and insects are moved to more sites within the refuge boundary.

Threatened and endangered species that occur at the refuge include the whooping crane (endangered species) and the bald eagle and piping plover, both listed as threatened species. The eagle and the crane are present during migration periods. Sightings of these species would be noted but no special efforts would be dedicated to inventory or monitoring. However, no actions would be undertaken that would negatively affect these species.

The piping plover has been recorded as nesting at the refuge during years of low water, which exposed the gravel islands and shoreline habitat the bird prefers for nesting. Because of a history of piping plover use, the refuge has designated critical habitat for piping plovers. Piping plovers are not expected to nest regularly at the refuge. However, in years of severe drought when habitat is limited across the state, Jim Lake would be managed to provide access to the gravel islands, shoreline, and gravel side slopes of the dike along the eastern edge of the lake. The refuge would continue to participate in the “International Piping plover Breeding Census” conducted every 5 years.



*A marsh drawdown on Jim Lake encourages the growth of wetland plants.*

The primary nest predator species targeted under the predator management plan are striped skunk, raccoon, and red fox. Local cooperators in accordance with the plan would conduct predator management activities. Additional control would be conducted within the predator enclosure by refuge staff. The refuge hosts a small, stable population of coyotes. No coyote control would be anticipated or conducted by refuge personnel or trappers. However, the North Dakota Department of Agriculture's Wildlife Services Program responds to landowner complaints in the area. The presence of coyotes appears to preclude the colonization of the refuge by the red fox, a much more effective predator of ground-nesting birds. In addition, nuisance animals such as beaver and muskrat would be removed to prevent damage to dikes and water control structures. This action is normally completed by recreational trappers or opportunistically by staff.



*Red Fox*

Vernon Burns/USFWS



*Raccoon*

Dave Menke/USFWS

### ***Visitor Services***

Public use and recreation programs would continue to be conducted essentially on a request basis.

Hunting programs would be provided for deer, upland game (late season), fox, and rabbit. Refuge managers would accommodate hunters with special access needs through special use permits.

The fishing program would be allowed under current regulations. Anglers would have access when the fishery was available. The fishing access is primarily at road crossings, where people can fish from the bank. Most fishing has been directed at northern pike. Fishing use has increased in flood years as the upstream movement of game fish from the reservoir has increased.

Refuge fisheries would be temporary and sporadic in nature as winterkill of fish would be common during severe winters with low water levels. Fish confined in refuge impoundments under the ice would die due to lack of sufficient oxygen. Another major factor limiting the fisheries would be the electric fish barrier located between the Jamestown Reservoir and the refuge. The electric barrier installed as part of the Arrowwood mitigation project would prevent carp from moving into the refuge and degrading water quality and habitat for migratory birds. However, in flood years when the Jamestown Reservoir elevation surpasses 1,442 feet mean sea level, water would overtop the electric barrier and both sport and rough fish could move into the refuge. The refuge would issue a special use permit to commercial fishing contractors to net carp and remove them from the river. This would also benefit the fishery in Jamestown Reservoir. The refuge would work closely with NDGF to coordinate the removal.

Boats could be used for fishing. The boating season is from May 1 through September 30. All refuge waters would be open to nonmotorized boating and canoeing. Nonmotorized boats and canoes are estimated at up to 100 visits per season. Boats with motors less than 25 horsepower could be used on Arrowwood and Jim lakes. The current level of boating is low and the use of motorized boats is rare.

Wildlife observation and wildlife photography would be permitted. The nature trail would receive minimal maintenance, as would the OWLS at the Kensal Public School. The auto tour route would remain open and receive maintenance as time and funding allow. No new interpretive signs, exhibits, or viewing opportunities would be developed.

Environmental education and outreach would continue on an as-requested basis with no new efforts initiated. Every effort would be made to maintain existing partnerships; however, new partnerships would only be undertaken if they resulted in a net gain of staff time or funding.

The following additional activities would continue at the present low levels: ice fishing (appendix L); biking (appendix N); gathering of wild foods such as berries, mushrooms, and asparagus (appendix P); recreational trapping (appendix Q); and horseback riding (appendix R).



Great Egret

Lee Karney/USFWS

## Alternative 2—Enhanced Management

This alternative would maximize the biological potential of wetland and upland habitats at the refuge, to support a well-balanced and diverse flora and fauna representative of the Prairie Pothole Region. A scientific-based monitoring program would be developed and incorporated in the HMP. Monitoring would measure the habitat and wildlife population response to management activities. Public use opportunities would be expanded with the construction of additional facilities and development of educational programs. Public use regulations would be clarified and modified where appropriate to enhance the quality and quantity of wildlife-dependent recreational opportunities.

### Water Resources

Wetland habitats would be managed to provide habitat conditions for migrating waterfowl, migrating shorebirds, and nesting waterbirds. Properly timed water level manipulations would result in the development of various wetland habitats: (1) deepwater, emergent vegetation habitat for black terns, Franklin's gulls, and heron and egret nesting habitat; (2) shallow water with emergent vegetation for pied-billed grebes and rails; (3) open water and submergent vegetation for eared grebes; and (4) annual plants for feeding waterfowl. Acres and location would vary from year to year. A monitoring plan would be developed and carried out to monitor the water manipulations, timing, habitat characteristics and response from the birds. The current long-range water management plan would be rewritten to reflect the habitat benefits to the colonial or overwater-nesting species.

### Habitat and Wildlife

Upland habitats would be managed to maximize production of waterfowl and other grassland-nesting species. Areas of tame grass or DNC close to water would be managed primarily for tall DNC for waterfowl. Sharp-tailed grouse, other grassland birds, and small mammals would also benefit from

this habitat type. Areas of native prairie would primarily be managed for ecological integrity, but would also provide important habitat conditions for upland-nesting birds, especially the grassland-endemic songbirds. The Grasshopper Hills area, which is probably the largest contiguous tract of native prairie, would be a priority tract for management.

Upland habitats would be managed with grazing, prescribed fire, mechanical manipulations, chemical applications, biological control, and rest. The treatment applications would vary from year to year and would be applied as habitat objectives dictate. A monitoring plan would be developed and carried out to monitor the habitat characteristics and wildlife population response to management activities.

To reduce the impacts of woody vegetation on grassland-dependent birds, selected sites would be targeted for tree removal; grasslands invaded by trees in areas with populations of priority species would be targeted. Priority would be given to sites with planted tree rows (shelterbelts) within 164 feet of grassland patches greater than 247 acres, and to plantings of single rows and dilapidated stands of trees.



Early morning fog rolls over Arrowwood's uplands.

© Jennifer Jewett

Cropping would be used to prepare fields for planting of DNC or native grasses.

Invasive plant control would be carried out as outlined in the IPM Plan (USFWS 2005).

Predator management would remain at the current level unless population monitoring results dictate otherwise.

### Visitor Services

Public use would be enhanced with the improvement and expansion of wildlife-dependent recreation. The draft compatibility determinations in appendixes K–R detail the public use programs.

Opportunities to increase hunting and fishing would be reviewed and facilities constructed as funding became available. Due to recent changes made by the state regarding the early Canada goose season and resident-only waterfowl season, the periods for which the refuge is accessible to boats and canoes would be shortened to minimize disturbance and allow waterfowl to use the refuge as a rest area.

Refuge-specific regulations regarding access into the refuge for wildlife observation, wildlife photography, and other wildlife-dependent recreational activities would be clarified and, where appropriate, modified to eliminate or minimize potential conflicts between refuge user groups. For example, biking on vehicle trails would cease when archery deer season begins, and walk-in access for wildlife observation and wildlife photography would not be recommended during the deer gun and muzzleloader seasons.



*Eastern Bluebird*

Dave Menke/USFWS

Environmental education programs would be developed for presentation on and off the refuge. Additional staff would seek out opportunities to share the story of the Refuge System and educate the public about the refuge's natural resources.

Additional wildlife-viewing opportunities

would be explored with the possible development of additional trails, overlooks, and improved interpretive and directional signs. The office entrance would be remodeled to accommodate a small visitor contact area. Outdated and extraneous signs would be removed to enhance the aesthetic beauty of the refuge. The access road to the Warbler Woodland Watchable Wildlife Area would be upgraded, along with the directional signs to the trailhead and interpretive signs on the trail. A covered pavilion at the Warbler Woodland Watchable Wildlife Area is planned to accommodate workshops, group presentations, and environmental education. The refuge would maintain at least one portable observation blind on an active sharp-tailed grouse lek and seek a suitable site for a permanent blind.

### **Alternative 3**—Enhanced Refuge and Watershed Management (*Proposed Action*)

The management of habitat and wildlife, visitor services, and operations would be the same as described for alternative 2. The draft compatibility determinations in appendixes K–R detail the public use programs. Alternative 3's water resource actions are described below.



USFWS

*Sunrise at the Refuge*

### **Water Resources**

In addition to the water resource actions described in alternative 2, this alternative includes a plan to improve water quality entering the refuge and reduce peak flows in the upper James River watershed during spring runoff and summer rainfall events.

In addition to wildlife benefits, the water quality and flood prevention benefits of protecting small streams and wetlands are well documented. Small streams and wetlands provide natural flood control, maintain surface water and groundwater supplies, trap sediment, filter and process natural nutrients and pollutants, and sustain natural biological diversity. Agricultural and other land use changes near small streams and wetlands can impair the natural functions on headwater systems. Removal of natural vegetation, hardening of soil surfaces, removal or straightening of stream channels, and draining of small wetlands greatly reduces the amount of rainfall and snowmelt the watershed can absorb before it floods. This increase in water volume scours stream channels, which promotes additional flooding. The altered channels and lack of wetlands significantly reduce groundwater recharge, sediment retention, and recycling of nutrients. Downstream lakes and rivers have poorer water quality, greater fluctuations in flow, and less diverse aquatic life. Algal blooms and fish kills become more common and recreational uses are adversely affected.

As stated in the UWA (described in chapter 3 under "Water Quality"), the upper James River watershed (including portions of Stutsman, Foster, and Eddy counties) encompasses 1,773 square miles with 70% in cropland. Targeting cropland in key areas and converting it to permanent cover would reduce sedimentation and improve water quality. Restoring wetlands in these key areas would trap sediment, slow runoff, and reduce peak flows entering the refuge, resulting in increased groundwater recharge. Based on interpretation of the National Wetland Inventory maps, more than 7,000 acres of wetlands have been drained in Eddy and Foster counties.

The water quality and water retention capabilities of the upper James River watershed could be improved and the refuge's wetland objectives could be achieved through cooperative efforts. This would include working through existing programs, as well as with the Service's Private Lands Program, the NRCS, county soil conservation districts, water boards, the EPA, Reclamation, and private landowners.

**Habitat and Wildlife**

Same as alternative 2.

**Visitor Services**

Same as alternative 2.

**STAFFING AND FUNDING TO CARRY OUT THE ALTERNATIVES**

Current staffing consists of 10 permanent, full-time employees (table 4). This current staff, plus any additional staff, as shown in table 4 would be required to carry out all aspects of each alternative.

**Table 4. Current and additional staff required to carry out the management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b>Management Staff</b>		
Project leader GS <sup>1</sup> -14*	Project leader GS-14*	Project leader GS-14*
Deputy project leader GS-13*	Deputy project leader GS-13*	Deputy project leader GS-13*
Refuge operations specialist GS-7/9/11*	Refuge operations specialist GS-7/9/11*	Refuge operations specialist GS-7/9/11*
	Refuge operations specialist GS-9	Refuge operations specialist GS-9
<b>Biology Staff</b>		
Wildlife biologist GS-9/11*	Wildlife biologist GS-9/11*	Wildlife biologist GS-9/11*
	Biological technician GS-7	Biological technician GS-7
	Biological technician GS-5/6/7	Fish and wildlife biologist GS-5/7/9/11
		Biological technician GS-5/6/7
<b>Visitor Services Staff</b>		
Outdoor recreation planner (assigned to Long Lake NWR) GS-9	Outdoor recreation planner GS-9	Outdoor recreation planner GS-9
	Park ranger GS-7/9	Park ranger GS-7/9
<b>Administrative Staff</b>		
Administrative officer GS-9*	Administrative officer GS-9*	Administrative officer GS-9*
Clerk (office assistant) GS-5*	Clerk (office assistant) GS-5*	Clerk (office assistant) GS-5*

**Table 4. Current and additional staff required to carry out the management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b><i>Maintenance Staff</i></b>		
Engineering equipment operator WG <sup>2</sup> -10	Engineering equipment operator WG-10	Engineering equipment operator WG-10
Tractor operator (term <sup>3</sup> ) WG-6	Tractor operator (term) WG-6	Tractor operator (term) WG-6
	Maintenance worker WG-7/8	Maintenance worker WG-7/8
	Maintenance worker WG-6	Maintenance worker WG-6
<b><i>Fire Staff</i></b>		
Fire management officer GS-11*	Fire management officer GS-11*	Fire management officer GS-11*
Fire technician GS-6/7*	Fire technician GS-6/7*	Fire technician GS-6/7*
	Range technician (career- seasonal <sup>4</sup> ) GS-5/6	Range technician (career-seasonal) GS-5/6
<b><i>Total Cost of Staff Salaries and Benefits</i></b>		
\$752,993	\$1,029,800	\$1,099,400

<sup>1</sup>GS=General pay schedule

<sup>2</sup>WG=Wage grade pay schedule

<sup>3</sup>term=temporary time-limited position

<sup>4</sup>career-seasonal=permanent seasonal position

\*Staff with responsibilities for the entire Arrowwood NWR Complex

Base operational funding for fiscal year 2004 is \$1,079,900. With additional funds for annual maintenance, deferred maintenance, small equipment, and the fire program, the total is \$1,527,200. This base budget represents the minimum required to maintain existing programs (alternative 1). However, this budget level would not adequately support proposed (alternative 3) habitat management, biological monitoring, public use and education programs, and maintenance of all facilities and structures.

Additional funding to carry out the CCP may be made available through Refuge System funding and the Service Asset Maintenance Management System (SAMMS). The SAMMS is a database that records maintenance and replacement needs for real property. Cost estimates will be developed for projects needed to carry out the final CCP, and then entered into the SAMMS.

## MONITORING

Monitoring is essential not only to ensure that approved CCP goals and objectives have been met, but also to assess whether those goals and objectives have achieved the desired effects.

### Plan Monitoring

Implementation of the CCP would be monitored throughout its 15-year effective period (2007 through 2022). The supervisor of the project leader for Arrowwood NWR would annually monitor accomplishment of objectives in the CCP. Monitoring of accomplishments would be critical to carrying out the CCP.

It is reasonable to believe that substantial changes could occur within the Service during the next 15

years. The CCP objectives would be examined at least every 5 years to determine if revisions are necessary and to allow the addition or deletion of objectives.

## Habitat and Wildlife Monitoring

Habitat management on refuges is an ongoing process, and the Service recommends that planning be conducted within the context of adaptive resource management (USFWS 1995, 1996).

Monitoring is essential to successful implementation of the CCP. Periodic review of the CCP would be required to ensure that established goals and objectives are being met and strategies are being carried out. Many of the objectives have associated monitoring strategies; others remain to be developed. A HMP and wildlife-monitoring plan would be developed with the specific details on monitoring techniques, frequency, and locations.



*Big Bluestem*

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Donna Dewhurst/USFWS

*Redhead*

An adaptive resource management approach to monitoring would be used. Adaptive resource management is a flexible management framework in which the success of management strategies can be evaluated. Management techniques for habitat, wildlife, and public use would be periodically evaluated; results would be used to modify or adapt the techniques or objectives to better achieve refuge goals.

Effects of management strategies on habitats and wildlife populations would be evaluated to assess whether the desired effects have been achieved. Baseline surveys would be conducted for wildlife species for which existing data is lacking or not well documented. Monitoring protocols would be developed—cooperatively with the wildlife researchers within the USGS and universities, and with other professionals—to ensure proper data collections and analysis. A habitat-monitoring plan would be written; a wildlife inventory plan would be updated following completion of the CCP.

Habitat and wildlife-related research would be encouraged. Refuge staff would pursue research opportunities related to the refuge's habitat management goals, species of concern, monitoring techniques, and data analysis. All studies would be applicable and compatible with refuge objectives.

Monitoring for wildlife diseases would be limited primarily to the detection of avian botulism outbreaks in waterfowl in the wetlands. New diseases that are causing some concern and that may affect refuge wildlife include the West Nile virus, avian chlamydiosis, avian influenza, and chronic wasting disease.



# 5 Environmental Consequences

The environmental consequences discussed in this chapter are the potential effects on a resource as a result of carrying out the actions of an alternative. For a better understanding of why these effects may occur, refer to the descriptions of resource conditions and interactions in chapter 3 (affected environment).

This chapter includes the following sections:

- effects common to all alternatives
- description of consequences by alternative
- cumulative impacts
- summary of the effects

## EFFECTS COMMON TO ALL ALTERNATIVES

The U.S. Department of the Interior and its representatives are charged with managing archeological and historic sites found on federal land. Prior to all habitat and facility maintenance activities, appropriate efforts would be made to identify known and unknown cultural resources within the area of potential impact. Avoidance of cultural resources would be the preferred treatment. Mitigation of any impacts would be undertaken if impacts could not be avoided. The Service's regional cultural resources manager would be consulted during the planning phase of any proposed activity. The regional cultural resources manager would take the necessary steps to coordinate with the North Dakota State Historic Preservation Officer if needed.

## DESCRIPTION OF CONSEQUENCES BY ALTERNATIVE

This section describes the potential consequences of each alternative's actions on water resources, habitat and wildlife, and visitor services.

### **Alternative 1**—Current Management (*No Action*)

The anticipated effects of carrying out alternative 1 are described below.

#### ***Water Resources***

Water management would continue as outlined in the wetland management component of the step-



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*The blanketflower is a native prairie plant.*

down HMP to be developed. The focus would be to provide quality habitat for migrating and nesting waterfowl, migrating shorebirds, and nesting waterbirds. Migratory birds would benefit through water level controls that encourage (1) seed-producing vegetation during migration and (2) mud flats for invertebrates. In addition, moist soil management would provide nesting habitats for other wetland species.

#### ***Habitat and Wildlife***

Alternative 1 would maintain the current habitat management program at approximately the same intensity. Management practices would remain the same for uplands—management to encourage nesting by waterfowl and upland-nesting birds. Priority on waterfowl production would benefit waterfowl, but would not provide optimal habitat for migrating shorebirds and other grassland-nesting species. Grassland-dependent bird species would remain at current levels or decline since habitat blocks of contiguous grassland without trees would remain on the landscape.

Woodland-dependent species would remain at current levels because there would not be an expanded program to reduce trees and shrubs.

Through implementation of the IPM Plan (USFWS 2005), control of invasive plants would continue to reduce the acres affected and decrease the rate of expansion.

Native plant species would recover and habitat conditions for upland-nesting migratory birds would improve.

### *Visitor Services*

Public use would continue at the present level, with current management strategies. The refuge would provide quality, universally accessible, recreational opportunities for visitors of all ages and abilities. The draft compatibility determinations in appendixes K–R provide details about these public use programs.

#### *Hunting*

Hunting deer, upland game birds, fox, and cottontail would be permitted. Other species could not be hunted. The majority of current and potential hunters would find sufficient opportunities for quality hunts. Hunters seeking opportunities to hunt waterfowl would not be able to hunt on the refuge, but this hunting demand would be met on state and private lands in the area.

#### *Fishing*

The refuge fishery is temporary and sporadic in nature and there would be no expansion. Most anglers seeking fishing opportunities are aware of the cyclic nature of the refuge fishery. There are abundant fishing opportunities available on other federal, state, and private waters in the area to satisfy local demands.

#### *Wildlife Observation, Wildlife Photography, Interpretation, and Environmental Education*

Current on- and off-refuge opportunities for wildlife viewing, interpretation, and education would be retained. Most current and potential refuge visitors would find satisfactory opportunities for quality wildlife viewing and wildlife photography. Interpretative and environmental education facilities and programs would meet most visitors' expectations.

#### *Other Recreational Opportunities*

Refuge visitors would be allowed to collect berries, mushrooms, and asparagus for their own personal use. Recreational trapping would be allowed under special use permit, as would horseback riding.

## **Alternative 2—Enhanced Management**

The anticipated effects of carrying out alternative 2 are described below.

### *Water Resources*

Same as alternative 1.

### *Habitat and Wildlife*

Alternative 2 would be similar to the current habitat management program, but at an increased intensity. Management treatments would increase on upland nesting habitat and would benefit many more upland-nesting species including some of the

nationally declining, grassland-dependent species. Wetlands would be managed to encourage nesting by waterfowl and other wetland-nesting birds. Management of wetlands would focus on waterfowl production, migrating waterfowl, migrating shorebirds, and overwater-nesting species. Nonnative trees and select, planted tree rows (shelterbelts) would be removed, improving nesting success of grassland-nesting birds because of the increased contiguous habitat blocks, less fragmentation, and reduced predator perches.



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*Arrowwood Lake*

Woodland-dependent species would decrease because there would be an expanded program to reduce trees and shrubs.

Control of invasive plants would decrease the rate of expansion due to enhanced management on greater acreages and monitoring of management actions. Upland habitats would slowly recover to a more native plant species composition as invasive species were controlled. Habitat conditions would improve for many upland-nesting wildlife species, which would increase nesting success.

### *Visitor Services*

Alternative 2 calls for increased management strategies for public use. The refuge would provide quality, universally accessible, wildlife-dependent recreational opportunities for visitor of all ages and abilities. The draft compatibility determinations in appendixes K–R provide details about these public use programs.

#### *Hunting*

Hunting deer, upland game birds, fox, and cottontail would continue to be allowed. Other species could not be hunted. Most current and potential hunters would find sufficient opportunities for quality hunts. Clarified regulations, along with limiting other recreational uses during the deer season, would improve the hunting experience for most refuge hunters. Hunters seeking opportunities to hunt waterfowl would not be able to hunt on the refuge,

but this hunting demand would continue to be met on state and private lands in the area.

The quality of the hunting experience would be enhanced through clarified and modified refuge-specific regulations. The risk of injury would be reduced and conflicts between user groups minimized by restricting other refuge uses during the archery, deer gun, and muzzleloader seasons.

#### *Fishing*

The refuge fishery is temporary and sporadic in nature; however, opportunities to expand the program would be reviewed. The visitor experience for fishing would be benefited if funding became available for facilities to accommodate users at different locations.

Angling experiences would be enhanced through clarified information about fishing access, as provided in revised “tear sheets” and brochures.

Hunted species would have a safe haven for resting when boating or canoeing ceases prior to the September waterfowl seasons, per revised refuge-specific regulations. Anglers would have a shorter season (than currently) for using boats.

#### *Wildlife Observation, Wildlife Photography, Interpretation, and Environmental Education*

Potential conflicts between refuge user groups would be minimized or eliminated based on increased user understanding of access for wildlife observation, wildlife photography, and other wildlife-dependent recreational activities, due to clarified refuge-specific regulations.

Environmental education programs would be developed for presentation on and off refuge. Additional workshops, presentations, and classroom opportunities would be available due to construction of suitable facilities. Wildlife-viewing opportunities would be increased with the development of additional trails and overlooks, and improved signs. The aesthetic beauty of the refuge’s natural areas would be enhanced through removal of unnecessary signs.



*Carrington third graders participate in the dedication of the Mud Lake observation deck.*

#### *Other Recreational Opportunities*

Same as alternative 1.

### **Alternative 3—Enhanced Refuge and Watershed Management (*Proposed Action*)**

The anticipated effects of carrying out alternative 3 are described below.

#### *Water Resources*

Same as alternative 1 with the addition of improving the upper James River watershed. Improving the health of the upper James River watershed would improve water quality and reduce peak flows during high-water events. This would improve wetland habitat on the refuge and benefit Jamestown Reservoir and all downstream users.

#### *Habitat and Wildlife*

In addition to the benefits described for alternative 2, there would be an increase in wildlife habitat and habitat values due to the watershed management component of alternative 3. Working with private landowners the Service would strive to protect and restore wetlands and grasslands in the watershed. In addition, improved water quality and reduced flood flows would improve habitat for aquatic species and waterbirds throughout the James River watershed.

#### *Visitor Services*

Same as alternative 2. The draft compatibility determinations in appendixes K–R provide details about the public use programs.

## **CUMULATIVE IMPACTS**

Cumulative impacts include the incremental effects of the actions for an alternative, when these are added to foreseeable actions of the past, present, and future. These cumulative impacts can be the result of individually minor impacts, which can become significant when added over time.

The NEPA requires mitigation measures when the environmental analysis process detects possible significant impacts to habitat, wildlife, or the human environment.

None of the activities proposed are expected nor intended to produce significant levels of environmental impacts that would require mitigation measures. Nevertheless, the final CCP would contain the following measures to preclude significant environmental impacts from occurring:

- Federally listed species would be protected from intentional or unintended impacts by having activities banned where these species occur.

- Hunting safety regulations would be closely coordinated with and enforced by personnel from the refuge and the NDGF.
- All proposed activities would be regulated to lessen potential impacts to wildlife and plant species, especially during the sensitive reproductive cycles.
- Monitoring protocols would be established to determine goal achievement levels and possible unforeseen impacts to resources, for application of adaptive resource management to ensure wildlife and habitat resources, as well as the human environment, are preserved.
- The CCP could be revised and amended after 5 years of implementation, for application of adaptive resource management to correct unforeseen impacts that occur during the first years of the plan.

## SUMMARY OF THE EFFECTS

Table 5 summarizes the estimated effects—impacts and benefits—associated with carrying out each alternative.

**Table 5. Comparison of impacts and benefits of management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b>Water Resources</b>		
Water quality and quantity entering the refuge would remain at current levels.  Target elevations would be achieved 70% of the time.	<i>Same as alternative 1.</i>	Water quality would be improved and peak flows during high-water events would be reduced.  Wetland habitats would be improved and target elevations should be met more often.  Water quality leaving the refuge should be improved and benefit Jamestown Reservoir and all downstream users.
<b>Habitat and Wildlife—Upland</b>		
There would be nesting habitat for waterfowl, but there would not be optimal habitat for migrating shorebirds and other grassland-nesting species.	Waterfowl nesting habitat would improve as habitat conditions improve.  Nesting success for grassland-nesting birds would improve because of the increased quality habitat and less fragmentation.	<i>Same as alternative 2, plus:</i>  Grassland-dependent species would benefit from increased protection and restoration of off-refuge habitat.
<b>Habitat and Wildlife—Woodland and Shelterbelts</b>		
The gradual decrease in shelterbelts and other planted trees would slowly increase the block size of grassland habitats for grassland-nesting birds, reduce predators, and decrease the woodland species diversity in selected units.	Removal of nonnative trees and shelterbelts would immediately increase the block size of grassland habitats for grassland-nesting birds and reduce predators.  Abundance of woodland species would decrease in selected units as the trees were removed.	<i>Same as alternative 2.</i>

**Table 5. Comparison of impacts and benefits of management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b><i>Habitat and Wildlife—Wetland</i></b>		
<p>There would be nesting habitat for waterfowl.</p> <p>There would be limited habitat for migrating shorebirds and limited nesting habitat for other waterbirds.</p>	<p>There would be nesting and migration habitat for waterfowl, shorebirds, and other waterbirds.</p>	<p><i>Same as alternative 2, plus:</i></p> <p>Water quality would be improved. Peak flows entering the refuge would be reduced.</p> <p>The wetlands and riparian habitat in the watershed would be restored and protected.</p>
<b><i>Habitat and Wildlife—Invasive Plants</i></b>		
<p>Invasive species should decrease. New infestations would be contained.</p> <p>Upland habitat conditions would slowly improve, which should result in increased nesting of grassland-dependent species.</p>	<p>Invasive species would be significantly reduced. Upland habitats would improve to a more native plant species composition as invasive species were controlled.</p> <p>Habitat conditions would improve for many upland-nesting wildlife species, which would increase the nesting success.</p>	<p><i>Same as alternative 2.</i></p>
<b><i>Habitat and Wildlife—Waterfowl</i></b>		
<p>Waterfowl breeding and migration numbers would remain constant.</p>	<p>Waterfowl breeding numbers would increase. Waterfowl migration numbers would increase in the fall due to additional undisturbed and “safe haven” habitat in September due to restricted boating.</p>	<p><i>Same as alternative 2.</i></p>
<b><i>Habitat and Wildlife—Predator Management</i></b>		
<p>Predator populations would fluctuate.</p>	<p>Predator populations would remain at acceptable levels.</p>	<p><i>Same as alternative 2.</i></p>
<b><i>Habitat and Wildlife—Threatened and Endangered Wildlife</i></b>		
<p>Management of Jim Lake for piping plovers during drought years would maintain or increase the piping plover numbers.</p>	<p><i>Same as alternative 1.</i></p>	<p><i>Same as alternative 1.</i></p>
<b><i>Visitor Services—Hunting</i></b>		
<p>Hunter numbers and satisfaction would remain relatively unchanged.</p>	<p>The quality of the hunting experience would be enhanced through clarification and revision of regulations. Hunters would find it easier to understand the regulations, and potential conflicts with other users would be reduced.</p>	<p><i>Same as alternative 2.</i></p>

**Table 5. Comparison of impacts and benefits of management alternatives for Arrowwood NWR, North Dakota.**

<b>ALTERNATIVE 1</b> Current Management ( <i>No Action</i> )	<b>ALTERNATIVE 2</b> Enhanced Management	<b>ALTERNATIVE 3</b> Enhanced Refuge and Watershed Management ( <i>Proposed Action</i> )
<b>Visitor Services—Fishing</b>		
Fishing opportunities would continue to be sporadic and anglers would find it difficult to understand the fishing regulations.	Fishing opportunities would be reduced in most years due to the electric fish barrier and lower target water elevations. In high-water years, the quality of the fishing experience would be enhanced through clarification or revision of the fishing access information.	<i>Same as alternative 2.</i>
<b>Visitor Services—Wildlife Observation and Wildlife Photography</b>		
Wildlife observation and wildlife photography opportunities would minimally meet the needs of the public.	Enhanced and expanded wildlife-viewing opportunities may cause additional disturbance to wildlife, especially waterfowl and shorebirds. Uses would be monitored and evaluated to minimize and mitigate any adverse effects.  Conflicts with other refuge users would be minimized, as well as safety increased, due to the revised access regulations.	<i>Same as alternative 2.</i>
<b>Visitor Services—Interpretation, Outreach, and Environmental Education</b>		
Interpretation, outreach, and environmental education would minimally meet the public demand.	There would be greater public understanding and appreciation of the refuge resources and issues due to expanded interpretive, outreach, and educational programs.	<i>Same as alternative 2.</i>
<b>Staffing</b>		
With stable staffing levels, the habitat quality and wildlife response would remain constant.  Habitat and wildlife populations would be minimally monitored to determine if the goals and objectives were being met.  Public use would be provided through adequately staffed programs.  Maintenance of facilities would remain constant, with improvements as funding allowed.	Maximum benefits to wildlife would be achieved through full staffing to carry out all management strategies.  Habitat and wildlife populations would be effectively monitored to determine if the goals and objectives were being met.  Increased public use and visitor satisfaction would be provided through adequately staffed programs.  Maintenance of facilities would be enhanced, with improvements as funding allowed.	<i>Same as alternative 2.</i>

## 6 Implementation of the Proposed Action



Tim McCabe/USFWS

*Mallards at Rest*

The Service's proposed action (alternative 3) was identified after a determination that it does the following:

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

The draft CCP described in this chapter presents the details of how the Service would carry out its proposed action (alternative 3) for management of Arrowwood NWR.

The implementation of the final CCP begins once the preferred management alternative has been selected and finalized, the CCP has been approved, and the Service has notified the public of its decision.

If alternative 3 were selected, the objectives and strategies presented in this chapter would be carried out over the next 15 years. The CCP would serve as the primary management document for the refuge until it is formally revised. The Service would carry out the final CCP with assistance from partner agencies, organizations, and the public.

The management direction in this chapter meets the purposes, vision, and goals of the refuge. 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; who is responsible to achieve it.
- Rationale for each objective includes background information, assumptions, and technical details used to formulate the objective. The rationale

provides context to enhance comprehension and facilitate future evaluations.

- Strategies are way to achieve an objective.

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

## UPLAND GOAL

Provide a diversity of grassland types that emulate the range of natural variation characteristic of the Prairie Pothole Region to benefit trust resources including waterfowl, grassland birds, and songbirds.



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*Sharp-tailed Grouse*

NOTE: Arrowwood NWR contains about 11,340 acres of grassland, of which approximately 6,000 acres are native prairie. The potential natural vegetation of the area is cool-season, needlegrass-wheatgrass, mixed-grass prairie. Vegetation of the mixed-grass prairie is predominantly a mixture of western wheatgrass, needlegrasses, blue grama, little bluestem, and upland sedges. Interspersed within the grasses are numerous species of forbs and patches of shrubs comprised of western snowberry, Woods' rose, silverberry, or mixtures of these species (Kuchler 1964). Long-term management would be to provide pre-1870s vegetation composition and habitat characteristics of the grassland-dependent species currently exhibiting significant population declines. The remaining 5,340 acres are comprised of seeded natives, DNC, or other cool-season introduced grasses.

### Upland Objective 1

Provide 4,000 acres of grasslands, on a 5-year average, in blocks of a minimum of 100 acres in size with less than 30% shrub cover and greater than 80% grass cover, located within 300 feet of brood water. Structural characteristics of these grasslands include

variable visual obstruction readings (VORs) greater than 4 inches and variable vegetation heights greater than 6 inches. This would primarily benefit nesting waterfowl such as mallard, gadwall, and blue-winged teal. In addition, these vegetation characteristics would provide the habitat needs for sharp-tailed grouse, dickcissel, sedge wren, and common yellowthroat.

### Rationale

The location where this objective is met would change over time as burning, grazing, and mowing are used to manipulate the habitat. Structural characteristics such as litter, grass height, and density would be lowest the first one or two growing seasons following treatment and would increase each year after that. Since treatments would not be applied consistently over the entire landscape, this would result in a mosaic of vegetation structures.

Emphasis would be placed on DNC and other tame grass fields located within 300 feet of permanent and semipermanent water for nesting waterfowl. In addition to providing tall dense cover for nesting waterfowl, tame grass fields generally contain less than 10% shrub canopy. This is necessary for sedge wren habitat. Tracts of native prairie located within 300 feet of permanent water would also be managed to provide tall, dense cover. This tall dense cover also provides optimal habitat for nesting sharp-tailed grouse and common yellowthroat, as well as nesting waterfowl.

### Strategies

a. DNC and other tame grass fields would periodically be treated using grazing, prescribed fire, haying, and mowing. Approximately 30% of the 4,000 acres would have periods of 3–5 years rest between treatments for undisturbed nesting habitat. Prescribed fire and grazing would be used to remove excessive litter that is suppressing growth of favorable species such as wheatgrasses and forbs in DNC and native grasses and forbs in native prairie. Burning and grazing would improve nutrient cycling and encourage new vegetation growth and seed production. Haying and mowing would be used primarily for invasive plant control and litter reduction. In native prairie, haying and mowing would be used to reduce or maintain shrub canopy.



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*Unit G21, west Jim Lake, is treated with prescribed fire for brush reduction, litter removal, and grassland rejuvenation for ground-nesting wildlife.*

b. Croplands would be eliminated except as a means of rejuvenating DNC and for invasive plant control. Existing cropland within areas designated primarily for waterfowl production management would be planted to a DNC mixture. Currently, approximately 130 acres of cropland are designated to be seeded to DNC. Reduction of cropland would provide larger contiguous grassland tracts. Some existing grassland tracts may need to be cultivated and reseeded or “interseeded” with various grass and forb species to increase the height and density of the cover and provide the necessary structural characteristics for the species of interest. Approximately 2,200 acres of tame grasses would need to be rejuvenated in the next 15 years.

c. Some fields of native prairie would require an aggressive, systematic use of prescribed fire, grazing, haying, and mowing to reduce the brush canopy cover under 30% for sedge wren, Savannah sparrow, grasshopper sparrow, Baird’s sparrow, bobolink and chestnut-collared longspur (Arnold and Higgins 1986, Bakker 2003). The common yellowthroat prefers tall dense cover, but with a higher brush composition of 30–60%. These thicker patches of brush are scattered throughout the fields and would continue to provide the habitat conditions necessary for breeding common yellowthroats.

d. Maintain the 38-acre predator exclosure to provide safe nesting habitat for waterfowl and other grassland-nesting species. The habitat within the fence would be maintained as DNC and periodically treated using prescribed fire or haying following the nesting season to maintain tall dense cover. The fence would be electrified from late March through July each year and the area trapped to ensure a predator-free nesting environment. The surrounding vegetation would be managed to minimize competing vegetation outside the fence and encourage nesting within the boundary of the fence. The fenced area would be monitored annually to determine the nesting success.

e. Invasive plant species such as leafy spurge, wormwood, and especially Canada thistle would continue to be controlled using an integrated approach. Control methods would include mechanical and chemical treatments, but priority would be given to current and emerging biological control methods. Research would be encouraged to investigate improved methods to control invasive plants and analyze the effect of grassland management treatments on invasive plants.

f. Selected planted tree rows (shelterbelts) would no longer be protected from prescribed fire. Decreasing the number of trees would reduce perching sights for predators such as red-tailed hawk and great horned owl. Tree removal would increase field size and eliminate the “hostile” habitat within select grassland tracts. The abandoned firebreaks around

the trees would be seeded to a vegetation mixture similar to the surrounding habitat.

g. Purchase of private inholdings to complete the legislated refuge boundary could provide an additional 3,200 acres of upland and wetland habitat that could be managed to provide the habitat required by many of the grassland-dependent species. The additional upland habitat could increase the field sizes and reduce the habitat fragmentation. In turn, this could increase the nesting success. Also, the addition of 260 acres of wetlands could increase the pair habitat to attract additional waterfowl pairs and other waterbirds.

## Upland Objective 2

Provide 5,000 acres of grasslands, on a 5-year average, with less than 30% shrub cover and greater than 25% grass cover, in blocks of a minimum of 75 acres, but preferably greater than 150 acres. Structural characteristics include a variable VOR greater than 4 inches and a variable vegetation height from less than 6 inches to greater than 20 inches. This would benefit nesting grassland Neotropical migrants including Le Conte’s sparrow, clay-colored sparrow, Savannah sparrow, grasshopper sparrow, western meadowlark, and bobolink, in addition to other nesting species such as common snipe, willet, northern pintail, short-eared owl, and northern harrier. This grassland habitat would also support abundant small mammal populations that provide prey for numerous raptor species.



*Bobolink*

S. Maslowski/USFWS

### *Rationale*

This objective would increase diversity of both flora and fauna and would be mainly applied to the native prairie areas, but also would apply to tame grass fields located away from permanent water. The emphasis would be to return the native prairie areas to conditions that existed prior to European settlement (pre-1870s), which provided the necessary habitat characteristics for many grassland-dependent species that are showing significant breeding

population declines today. This would include reducing brush and exotic, cool-season grasses such as smooth brome and Kentucky bluegrass; and increasing the composition of the native grasses and forbs.

### Strategies

a. Brush would be reduced. Currently, approximately 40% of the native prairie acreage has a brush canopy cover greater than 50%. Woody vegetation within or bordering prairie fragments would be reduced because it attracts nest predators and consequently reduces nesting success (Johnson and Winter 1999). These fields would require an aggressive, systematic use of prescribed fire during mid-July to late August to reduce western snowberry stems and increase the composition of native grasses and forbs. Haying and mowing would be used on those areas not conducive to prescribed fire. An integrated approach would be carried out using fire; grazing; and mechanical, chemical, and biological control methods to maintain the brush canopy cover under 30% and encourage native species.

b. Native vegetation composition would be increased. Native prairie areas would be rejuvenated and enhanced using grazing, prescribed fire, haying, and mowing when the native grasses and forbs have less than 50% canopy cover. Prescribed burning and grazing would be carried out during different periods of vegetative growth or, in combination, to attain specific objectives: (1) to remove excessive litter suppressing favorable species such as native grasses and forbs; (2) to reduce the competition between the native and nonnative species; (3) to reduce exotic cool-season grasses when at the 3–5 leaf stage; (4) to increase the native forb composition; (5) to provide nutrient cycling; and (6) to encourage new vegetation growth and seed production. The presence of various native grasses and forbs would provide the structural characteristics required by most grassland nesting species and foraging habitat and habitat needs for various invertebrates such as butterflies and moths. Native prairie areas would be aggressively treated with multiple treatments to reduce brush and increase the native species composition of grasses and forbs.

c. Decrepit DNC stands would be rejuvenated and enhanced using grazing, prescribed fire, haying and mowing when the VORs and vegetation heights fall below 50% of the maximum values. Prescribed fire and grazing would be used to (1) remove excessive litter that is suppressing favorable species growth such as that of wheatgrasses and forbs in DNC, (2) to increase nutrient cycling, and (3) to encourage new vegetation growth and seed production. Haying and mowing would be used primarily in the tame grass fields for invasive plant control and litter reduction and in native prairie fields to reduce or maintain shrub canopy. Tame grass fields with very low

habitat value would require cropping for 2 or 3 years and reseeding with native grasses and forbs. As an alternative to farming, fields may be treated with a nonselective herbicide and then “no-till” seeded with native species.

d. The use of croplands would be eliminated except as a means of rejuvenating old DNC fields and for invasive plant control.



*Leafy spurge, a noxious weed, infested this area of the refuge prior to release of flea beetles for biological control in 1995.*

e. Invasive plant species such as leafy spurge, wormwood, and especially Canada thistle would continue to be controlled using an integrated approach. Control methods would include mechanical and chemical treatments, but priority would be given to current and emerging biological control methods. Research would be encouraged to investigate improved methods to control invasive plants and analyze the effect of grassland management treatments on invasive plants.

f. Selected planted tree rows (shelterbelts) would no longer be protected from prescribed fire. Decreasing the number of trees would reduce perching sights for predators such as red-tailed hawk and great horned owl. Tree removal would reduce habitat fragmentation and eliminate the “hostile” habitat within select grassland tracts. The abandoned firebreaks would be seeded to a vegetation mixture similar to the surrounding habitat.

g. Purchase of private inholdings to complete the legislated refuge boundary would increase the size of several fields to meet the minimum required habitat size of 25–100 acres for most species.

### Upland Objective 3

Provide a minimum of 1,600 acres of grasslands in blocks of at least 75 acres with less than 30% shrub cover and 15–70% grass cover. Structural characteristics include less than 4 inches VOR and variable vegetation heights ranging from 6 to 20 inches to benefit Vesper sparrow, chestnut-collared

longspur, horned lark, upland sandpiper, and marbled godwit (Kantrud and Higgins 1992).

### **Rationale**

This set of grassland habitat characteristics exists off the refuge and in abundance on private lands. Smaller areas are available on refuge hilltops and within the thin upland soil types. In addition, this habitat would be provided at the refuge for one or two growing seasons following management treatments applied to achieve upland objectives 1 and 2.

### **Strategies**

- a. The development of mini-joint-venture grazing systems that encourage rest on adjacent private lands would continue.
- b. The potential for reintroduction of prairie dogs would be evaluated.
- c. Purchase of private inholdings to complete the legislated refuge boundary would increase the size of several fields to meet the minimum required habitat size of 25–100 acres for most species.

## **Upland Objective 4**

Maintain existing wooded ravines and trees in riparian zones that historically supported woody vegetation.

### **Rationale**

The 660 acres of riparian floodplain and wooded ravines are primarily associated with the James River valley and lakeshores within the refuge. These native woodlands provide habitat for many woodland-dependent species. Although these habitats cover less than 1% of the northern Great Plains, wooded ravines can attract a disproportionately rich number of bird species compared to other plains habitats (Dobkin 1992.) These woody habitats increase species diversity by providing the migration and breeding habitats for many migratory land birds. Some of the bird species that use these habitats include Cooper's hawk, black-billed cuckoo, least flycatcher, willow flycatcher, great-crested flycatcher, red-eyed vireo, yellow warbler, and northern oriole.

### **Strategies**

- a. The woody ravines would not be intentionally burned; however, they would not be protected from prescribed fire treatments. Fires historically kept the ravines in early successional plant species, which benefited many birds.
- b. Management treatments to increase bur oak germination in the riparian zones would be investigated.

## **WETLAND GOAL**

Provide a diversity of wetland types that emulate the range of natural variation characteristic of the Prairie Pothole Region to benefit threatened and endangered species, waterfowl, shorebirds, wading birds, and other wetland birds.

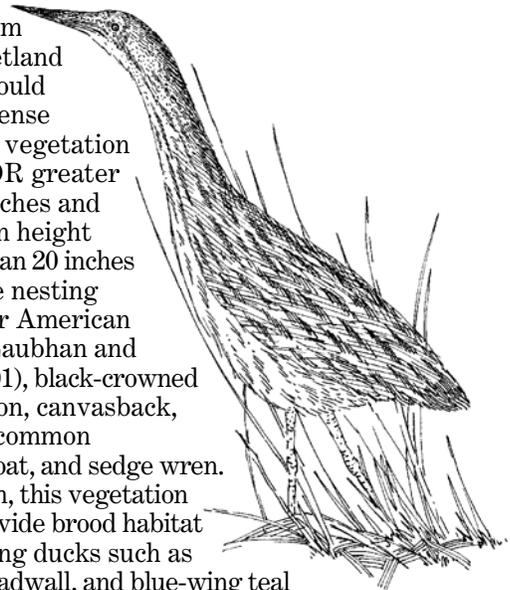
### **Wetland Objective 1**

Provide 1,250 acres (50%) consisting of 30–60% emergent vegetation, primarily bulrushes and cattail, interspersed with 40–70% open water that supports beds of aquatic vegetation, preferably sago pondweed, with water depths of 8–20 inches (stable or slightly declining) between May 1 and August 1.

### **Rationale**

The beds of aquatic vegetation provide foraging habitat for breeding dabbling ducks, herons, egrets, grebes, canvasback, and tundra swan (Earnst 1994, Kantrud 1990) in the fall. This objective would be applied to Arrowwood and Jim lakes.

A minimum of 25% wetland habitat would support dense emergent vegetation with a VOR greater than 12 inches and vegetation height greater than 20 inches to provide nesting habitat for American bittern (Laubhan and Roelle 2001), black-crowned night-heron, canvasback, redhead, common yellowthroat, and sedge wren. In addition, this vegetation would provide brood habitat for dabbling ducks such as mallard, gadwall, and blue-wing teal and foraging habitat for migrating diving ducks and tundra swan.



*American Bittern*  
© Cindie Brunner

A minimum of 25% wetland habitat would support sparse emergent vegetation with a VOR ranging from 4 to 12 inches and vegetation height ranging from 6 to 20 inches to provide nesting habitat for black tern (Bergman 1970, Naugle et al. 2000), Franklin's gull (Du Mont 1940), and pied-billed grebe (Naugle et al. 1999).

### **Strategies**

- a. After ice out, maintain or raise water depths to 3–5 feet, with clear water for adequate light penetration during the critical sago pondweed-germination period, March through April.

Slowly raise the water level from mid-June through September, and then slowly draw down the water level through October, to develop 3- to 5-foot bands of seasonally flooded emergent vegetation. Emergent vegetation establishment may take several years of low water levels. A fringe of emergent vegetation around the shoreline would reduce wind erosion and re-suspension of sediments. Reflood the emergent vegetation the following spring to provide nesting and brood cover.

b. Reduce sedimentation rates by working with other federal and state programs to improve the upper James River watershed. Conserve, restore, enhance, and create habitat resources in watersheds to influence the quality and quantity of water flowing into rivers and streams.

c. Control rough fish by reducing water levels enough to result in fish kills during winter months, as conditions dictate.

d. Use Arrowwood Lake to store water for management of other pools as long as sago production is unimpeded.

## Wetland Objective 2

Provide 300 acres consisting of greater than 80% emergent vegetation (such as bulrushes and cattail) and 0–20% open water with depths ranging from moist to 8 inches, between May 1 and August 1, in patches greater than 25 acres.



Western Grebe

Tim McCabe/USFWS

## Rationale

Thick stands of bulrushes and cattails provide nesting habitat for black tern, eared grebe, western grebe, Franklin's gull, sora, and Virginia rail. This objective would target Arrowwood and Jim lakes.

## Strategies

a. Control rough fish by reducing the water level enough to result in fish kills during winter months.

b. Raise water levels slowly until late summer, to depths of 1–4 feet, then maintained at stable or slightly declining levels between May 1 and August 1 to favor emergent vegetation growth along edges. Emergent vegetation establishment may take several years of low water levels. A fringe of emergent vegetation around the shoreline would reduce wind fetch and re-suspension of sediments. Reflood the emergent vegetation the following spring to provide nesting and brood cover.

c. Reduce sedimentation rates by working with other federal and state programs to improve the upper James River watershed. Conserve, restore, enhance, and create habitat resources in watersheds to influence the quality and quantity of water flowing into rivers and streams.

d. Use Arrowwood Lake to store water for management of other pools as long as sago production is unimpeded.

e. When expanses of emergent vegetation exceed 150 acres, draw down the lake and disturb with prescribed fire or disking to set back plant succession.

## Wetland Objective 3

Provide 500 acres of open-water habitats consisting of 20–100% submergent aquatic vegetation (such as pondweed, bladderwort, and coon's tail) in patches greater than 8 acres, with depths ranging from moist to 8 inches, between May 1 and August 1.

## Rationale

Patches of submergent aquatic vegetation provide habitat conditions for nesting black tern, eared grebe, western grebe, Franklin's gull, sora, and Virginia rail. In addition, this vegetation provides foraging habitat for breeding dabbling ducks, herons, egrets, grebes, canvasback, and tundra swan in the fall. This objective would target Arrowwood and Jim lakes.

## Strategies

a. After ice out, maintain or raise water depths to 3–5 feet, with clear water for adequate light penetration during the critical submergent vegetation germination period, March through April.

b. Beginning in July, slowly draw down water levels in selected pools to 8 inches, through July.

### Wetland Objective 4

Provide 300–600 acres of less than 12 inches tall emergent vegetation (such as rushes, sedges, and spikerush) that is flooded with less than 8 inches between April 1 through June 1, and between July 15 through November 30 with a VOR of less than 4 inches (or approximately less than 1.4 stems per square foot).

#### *Rationale*

This objective would provide nesting habitat to benefit foraging waterfowl and migrating shorebirds. This objective would target the Mud Lake and Depuy Marsh subimpoundments and Stony Brook. Approximately one-third of the units would be managed to achieve this objective on an annual basis.

#### *Strategies*

- a. In the early spring, draw down selected ponds to initiate new growth of spikerushes and expose old clumps of rushes, bulrushes, grasses, and sedges for rail habitat (Fredrickson and Taylor 1982).
- b. In the fall, slowly draw down selected ponds to concentrate foods for migrating waterfowl and other waterbirds.

### Wetland Objective 5

Provide annually approximately 300–600 acres of greater than 80% cover of seed-producing vegetation (such as smartweeds, millet, beggarticks, and sedges) flooded to depths less than 8 inches, between April 1 and November 30.

#### *Rationale*

Annual seed-producing vegetation would provide habitat for foraging waterfowl and shorebirds. This objective would target the subimpoundments; approximately one-third of the units would be managed to achieve this objective on an annual basis.

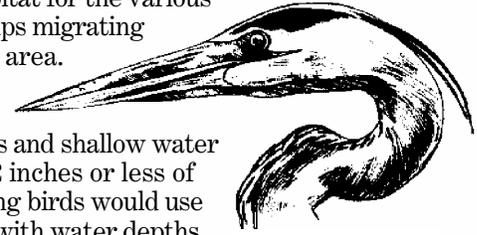
#### *Strategies*

- a. Periodically flood nine moist soil units to depths less than 12 inches. Every third year or as conditions dictate, completely draw down the units in the spring and early summer, then dry, and disturb and reflow the soil surface to increase the sprouting of seeds within the soil.

Use early drawdowns to stimulate germination of smartweeds. Mid-season drawdowns would result in millets and late-season drawdowns would produce beggarticks. Once plants reach 6–8 inches in height,

shallowly (1–2 inches) flood them. As the perennials increase, so do the invertebrates that provide foraging habitat for waterfowl, rails, and herons. The uneven topography of pools would provide foraging habitat for the various wildlife groups migrating through the area.

Shorebirds would use the mud flats and shallow water areas with 2 inches or less of water, wading birds would use those areas with water depths from 3 to 5 inches deep, and waterfowl would have areas available with water depths ranging from 5 to 10 inches deep.



*Great Blue Heron*

Time to shorebird migration the early spring drawdowns with shallow water zones interspersed with mud flats. The new growth of spikerushes and old clumps of rushes, bulrushes, grasses, and sedges provide concealment for rails (Fredrickson and Taylor 1982).

### Wetland Objective 6

During years of severe drought in the region, maintain low water levels in Jim Lake to provide exposed gravel islands and shoreline habitat during piping plover nesting season.

#### *Rationale*

The piping plover has been recorded nesting at the refuge during years of low water that exposed the gravel islands and shoreline habitat the bird prefers for nesting. Because the refuge has a history of piping plover use, it has designated critical habitat for piping plovers. Piping plovers are not expected to nest regularly at the refuge. However, in years of severe drought when habitat is limited across the state, Jim Lake would be managed to provide access to the gravel islands and gravel side slopes of the dike along the eastern edge of the lake.

#### *Strategies*

- a. Draw down Jim Lake to maintain exposed gravel islands and shorelines from mid-May through mid-July.
- b. Participate in the International Piping Plover Breeding Census at the refuge every 5 years.

### Wetland Objective 7

Improve water quality in the watershed upstream of the refuge and also water leaving the refuge. Reduce peak flows entering the refuge during spring snowmelt and summer rainfall events to reduce flooding and improve water management capability.

### *Rationale*

During high-water events, most water entering the refuge would be diverted into the bypass channel at the southern end of Arrowwood Lake. This practice would limit opportunities to improve the quality of water leaving the refuge. However, managing water levels in Arrowwood Lake to promote emergent vegetation growth along the shoreline and other shallow areas would improve water quality by increasing plant uptake of nitrogen and phosphorous.

Another water quality problem that has existed for many years is lack of dissolved oxygen during periods of low flow and under ice (Reclamation 1992). To help alleviate this problem, water released from Arrowwood Lake into other impoundments and the bypass channel would be from the top of the water column, which usually has higher dissolved oxygen levels. Furthermore, as water drops over the water control structure and mixes with air, dissolved oxygen levels would be increased.

When water is diverted from Arrowwood Lake or the bypass channel into other wetland units, there would be additional opportunities for improving water quality. Sedimentation rates would increase as water levels are maintained to provide migratory bird habitat. Water levels would be managed to promote growth of desirable aquatic vegetation, which would greatly increase plant uptake of organic nutrients. Wetland units would be periodically drawn down and burned or disked to recycle nutrients and set back succession. As part of the Arrowwood NWR mitigation project, fish barriers were installed to prevent carp from entering the bypass channel and the wetland units. Excluding carp would also benefit water quality by reducing turbidity. As with Arrowwood Lake, water released from these units would be from the top of the water column and dissolved oxygen levels would be increased when the water drops over the structure.

### *Strategies*

- a. Use stream-gauging data in conjunction with water quality models to calculate a mass nutrient balance for the refuge. The Water Resources Division of the USGS maintains stream gauging stations on the James River, both upstream and downstream of the refuge. Data collected at these gauging stations include streamflow and water chemistry. This data, when combined with water quality models, can be used to calculate a mass nutrient balance for the refuge. A mass nutrient balance assesses nutrient load entering and leaving the refuge, providing insight into the refuge's role as a nutrient source or nutrient "sink" for downstream water users.
- b. Work with the watershed managers from county soil conservation districts to use the agricultural nonpoint source (AGNPS) model. The AGNPS

model predicts soil erosion and nutrient transport and loadings from agricultural watersheds for real or hypothetical storms. It can be used in evaluating the effect of management decisions impacting a watershed. It can also be used to target areas in the upper watershed for "best management practices" such as minimum tillage, grass waterways, filter strips, green belts, and grazing systems that would provide the greatest water quality benefit to the refuge.

- c. Achieve the goals of the Federal Water Pollution Control Act by developing partnerships with county, state, and federal agencies. In cooperation with the state health department and the EPA, identify potential projects in the upper watershed that qualify for Clean Water Act funding.

- d. Use "thunderstorm maps" to determine priority areas within 1 mile of the James River and significant tributaries to protect and restore wetlands and to prevent further loss of native or naturalized cover. In these same priority areas, the proportion of perennial cover would be increased; where permanent cover restoration was not possible, annual cover such as winter cereals for nesting waterfowl would be increased.

- e. Calculate a mass nutrient balance to determine if the refuge is functioning as a nutrient source or nutrient "sink."

## **VISITOR SERVICES GOAL**

Visitors of all abilities would enjoy a refuge visit and increase their knowledge and appreciation of the prairie ecosystem and the refuge's history by participating in compatible wildlife-dependent activities.

NOTE: Appendixes K–R contain draft compatibility determinations for the public uses at Arrowwood NWR.

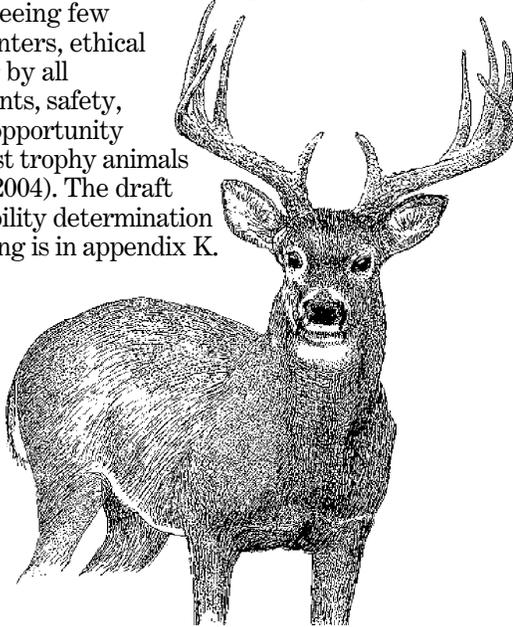
### **Visitor Services Objective 1—Hunting**

Continue to provide and increase opportunities as compatible and appropriate for accessible hunting of big game, upland birds, small game, and fox.

#### *Rationale*

Current refuge-specific regulations are designed to provide opportunities for a quality hunt within the laws imposed by the state. The definition of a quality hunt is completely determined by the individual participating in the activity. In a survey of 10,000 hunters conducted by the Wisconsin Department of Natural Resources in 2000, hunters were asked to rate the factors having the most influence on their perception of a quality hunt. The most important factor indicated by the respondents was seeing game. The second most frequent answer

was spending time with friends and family, and the least important factor in determining a quality hunt was the weather. Successful hunters (harvest of game pursued) rated their hunt quality as very high or fairly high 22% of the time, while unsuccessful hunters (no game harvested) rated their hunt quality as very high or fairly high only 7% of the time. Other factors determined to be integral to a quality hunt include seeing few other hunters, ethical behavior by all participants, safety, and the opportunity to harvest trophy animals (Dhuey 2004). The draft compatibility determination for hunting is in appendix K.



*White-tailed Deer*

### **Strategies**

- a. Revise the current hunting brochures and “tear sheets” that provide information on refuge hunting regulations, and access.
- b. Continue to work cooperatively with the NDGF to conduct law enforcement patrols to ensure compliance with regulations.
- c. Increase opportunities accessible hunting on the refuge.
- d. Continue to limit hunting to walk-in-only access.

### **Visitor Services Objective 2—Fishing**

Continue to provide public opportunity for accessible fishing, including bow fishing for rough fish during high-water years and ice fishing when conditions permit.

#### **Rationale**

Fishing is a compatible priority public use and would continue to be supported. See the draft compatibility determination in appendix L.

#### **Strategies**

- a. Update and revise brochures that provide information on refuge fishing opportunities, regulations, and access.

- b. Use local media to promote fishing opportunities during high-water years when the fishery is active.
- c. Permit fishing, in accordance with state regulations, year-round except during the deer gun and muzzleloader seasons.
- d. Allow boats from May 1 through August 31.
- e. Allow, on Arrowwood and Jim lakes, boats with less than 25 horsepower motors.

### **Visitor Services Objective 3—Wildlife Observation and Wildlife Photography**

Provide the public opportunities for accessible wildlife/wildland observation and photography for at least 10,000 visitors per year.

#### **Rationale**

The refuge’s auto tour route and locations around Jim Lake and the Depuy pools provide excellent opportunities for viewing and photographing wildlife. These are compatible priority public uses (see the draft compatibility determination in appendix N).

#### **Strategies**

- a. Continue to maintain the refuge’s 5.5-mile auto tour route to provide a safe and enjoyable experience for visitors.
- b. Update and revise the interpretive brochure. Clarify and revise regulations regarding access into the refuge for walk-in access, biking on refuge trails, and horseback riding.
- c. Upgrade the access road to the Warbler Woodland Watchable Wildlife Area.
- d. Improve and maintain the nature trail in the Warbler Woodland Watchable Wildlife Area by adding directional signs to the trailhead and replacing the interpretive signs.
- e. Maintain at least one observation blind located near an active sharp-tailed grouse lek. Locate a suitable site for installation of a permanent, accessible blind.
- f. Investigate new opportunities for compatible wildlife viewing, with the possible development of additional trails and overlooks.
- g. Develop and upgrade wildlife and bird lists as new information becomes available.
- h. Allow boats from May 1 through August 31.
- i. Allow, on Arrowwood and Jim lakes, boats with less than 25 horsepower motors.

## Visitor Services Objective 4—Interpretation

Increase public awareness and advocacy by reaching 10,000 people annually using accessible programs, exhibits, signs, and pamphlets that interpret refuge management activities, and the natural, cultural, and historic resources.

### *Rationale*

By expanding the interpretive and public outreach activities at the refuge, the public would be made aware of the Refuge System and Arrowwood NWR and the benefits it provides to wildlife and the local community. This is a compatible priority public use (see the draft compatibility determination in appendix O).

### *Strategies*

- a. Remodel the office entrance to include a visitor contact station containing interpretive exhibits and a cooperative association store.
- b. Develop permanent exhibits at local community locations to increase awareness of national wildlife refuges in North Dakota.
- c. Widely disseminate informational leaflets to libraries, local businesses, chambers of commerce, recreational groups, local lodging, and designated rest areas along interstates.
- d. Develop a portable travel exhibit interpreting the refuge and its key resources.
- e. Develop a professional-quality presentation on Arrowwood NWR and the Refuge System.
- f. Create a native grass and forb demonstration plot, complete with interpretive signs and identification markers for each species.
- g. Work with tourism division of the North Dakota Commerce Department, and North Dakota



*Prairie Lily*

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Department of Transportation to install directional signs off Interstate 94 and state highways.

- h. Maintain existing interpretive panels.
- i. Develop and place new entrance signs at each main refuge access road.
- j. Interpret the cultural history including the Fort Totten Trail, the story of Limpy Jack, and the legend of Grasshopper Hills.
- k. Interpret the geology of the refuge and surrounding area.

## Visitor Services Objective 5—Partnerships and Other Public Outreach

Foster advocacy and develop public awareness of refuge resource issues and management practices through accessible public outreach.

### *Rationale*

Fostering relationships within the community would help the refuge open the lines of communication, build support for the refuge, and provide an avenue for discussion. The Service recognizes that communication is vital to the Service mission. Refuge staff would continue to seek out new opportunities and foster existing relationships to help with achieving mutually beneficial goals and objectives.

### *Strategies*

- a. Pursue development of a “friends group.”
- b. Develop partnerships to increase volunteer opportunities at the refuge.
- c. Annually update the refuge website.
- d. Send out monthly news releases to communities regarding refuge events and management activities. Conduct radio and television spots on request.
- e. Attend local wildlife and community group meetings on a regular basis to provide information on refuge activities, management, and other issues.
- f. Continue to work with the nonprofit organization, Birding Drives Dakota, on the annual “Potholes & Prairie Birding Festival” and visits to the refuge.
- g. Annually participate in at least five outreach programs such as holding events for National Wildlife Refuge Week and International Migratory Bird Day, or staffing a booth at a local event.
- h. Work with congressional offices and external affairs to keep them informed of refuge activities and management issues. Build and maintain relationships with county officials.

## Visitor Services Objective 6— Environmental Education

Promote the Refuge System and Arrowwood NWR by conducting or hosting at least 10 environmental education programs per year to local schools and groups on the wetlands and grasslands within the Prairie Pothole Region.

### *Rationale*

By expanding the environmental education activities at the refuge, the public would be made aware of the Refuge System and Arrowwood NWR and the benefits it provides to wildlife and the local community. This is a compatible priority public use (see the draft compatibility determination in appendix O).

### *Strategies*

- a. Enhance the OWLS, located at the Kensal Public School, with interpretive signs or a brochure describing the native vegetation.
- b. Develop environmental education trunks complete with hands-on items such as mammal skins and skulls, to be used during presentations and tours with various school groups and organizations.
- c. Develop field study equipment kits to be checked out by visitors or organized groups. Include a

backpack with binoculars, field guides, hand lenses, dip nets, tweezers, ruler, pen, vials, and other supplies.

d. Construct an environmental education “learning pavilion” in the Warbler Woodland Watchable Wildlife Area.

e. Involve local schools to develop an education program that can be used to explain the refuge management practices, and the wildlife and habitats found at the refuge.



*Prairie Smoke in Winter*

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# Glossary

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

**adaptive resource management**—The 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 implemented within a framework of scientifically driven experiments to test predictions and assumptions inherent in 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.

**AGNPS**—Agricultural nonpoint source (model).

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

**amphibian**—A class of cold-blooded vertebrates including frogs, toads, or salamanders.

**annual**—A plant that flowers and dies within 1 year of germination.

**ATV**—All-terrain vehicle.

**baseline**—A set of critical observations, data, or information used for comparison or a control.

**biological control**—The use of organisms or viruses to control invasive plants or other pests.

**biological diversity**, *also* **biodiversity**—The 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.

**canopy**—A 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.

**CCC**—*See* Civilian Conservation Corps.

**CCP**—*See* comprehensive conservation plan.

**CFR**—*See* Code of Federal Regulations.

**cfs**—Cubic feet per second.

**Civilian Conservation Corps (CCC)**—Peacetime civilian “army” established by President Franklin D. Roosevelt to perform conservation activities from 1933–42. Activities included erosion control; firefighting; tree planting; habitat protection; stream improvement; and building of fire towers, roads, recreation facilities, and drainage systems.

**Code of Federal Regulations (CFR)**—The 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.

**compatibility determination**—*See* compatible use.

**compatible use**—A wildlife-dependent recreational use or any other use of a refuge 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 (*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)**—A document that describes the desired future conditions of the refuge and provides long-range guidance and management direction for the refuge manager to accomplish the purposes of the refuge, 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.

**conspecific**—An individual belonging to the same species as another.

**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. Examples of cool-season grasses at the refuge are western wheatgrass, needle and thread, and green needlegrass.

**coteau**—A 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.

**cultural resources**—The remains of sites, structures, or objects used by people in the past.

**dense nesting cover (DNC)**—A 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.

**depredation**—Destruction or consumption of eggs, broods, or individual wildlife due to a predatory animal; damage inflicted on agricultural crops or ornamental plants by wildlife.

**DNC**—*See* dense nesting cover.

**drawdown**—The act of manipulating water levels in an impoundment to allow for the natural drying-out cycle of a wetland.

**EA**—*See* environmental assessment.

**ecosystem**—A 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.

**EIS**—Environmental impact statement.

**emergent**—A plant rooted in shallow water and having most of the vegetative growth above water such as cattail and hardstem bulrush.

**endangered species, federal**—A 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**—A 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.

**endemic species**—Plants or animals that occur naturally in a certain region and whose distribution is relatively limited to a particular locality.

**environmental assessment (EA)**—A 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).

**EPA**—Environmental Protection Agency.

**extinction**—The complete disappearance of a species from the earth; no longer existing.

**extirpation**—The 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 resource**—A trust is something managed by one entity for another who holds the ownership. The Service holds in trust many natural resources for the people of the United States as a result of federal acts and treaties. Examples are species listed under the Endangered Species Act, migratory birds protected by international treaties, and native plant or wildlife species found on a national wildlife refuge.

**federal trust species**—All species where the federal government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.

**flora**—All the plant species of an area.

**FMP**—Fire management plan.

**forb**—A 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**—The 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.

**“friends group”**—Any formal organization whose mission is to support the goals and purposes of its associated refuge and the National Wildlife Refuge Association overall; “friends” organizations and cooperative and interpretive associations.

**FWS**—*See* U.S. Fish and Wildlife Service.

**geographic information system (GIS)**—A 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).

**grassland tract**—A contiguous area of grassland without fragmentation.

**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 disturbance**—Significant alteration of habitat structure or composition; may be natural (for example, wildland fire) or human-caused events (for example, timber harvest and disking).

**habitat type, also vegetation type, cover type**—A land classification system based on the concept of distinct plant associations.

**hemi-marsh**—A wetland with a 50–50 interspersion of open-water and emergent vegetation.

**HMP**—Habitat management plan.

**HUA**—Hydrologic unit area.

**impoundment**—A 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.

**introduced species**—A 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**—A 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.

**inviolate sanctuary**—A place of refuge or protection where animals and birds may not be hunted.

**IPM**—*See* integrated pest management.

**issue**—Any 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).

**JAKES**—“Juniors Acquiring Knowledge, Ethics & Skills.”

**management alternative**—*See* alternative.

**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 which follow a seasonal movement from their breeding grounds to their wintering grounds. Waterfowl, shorebirds, raptors, and songbirds are all migratory birds.

**mission**—Succinct statement of purpose and/or reason for being.

**mitigation**—Measure designed to counteract an environmental impact or to make an impact less severe.

**mixed-grass prairie**—A 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**—The process of collecting information to track changes of selected parameters over time.

**national wildlife refuge**—A 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 refuges in 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, wildlife 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 refuge by the year 2012. This Act amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

**native species**—A species that, other than as a result of an introduction, historically occurred or currently occurs in that ecosystem.

**Neotropical migrant**—A bird species that breeds north of the United States and Mexican border and winters primarily south of this border.

**NEPA**—National Environmental Policy Act.

**NDGF**—North Dakota Department of Game and Fish.

**nest success**—The percentage of nests that successfully hatch one or more eggs of the total number of nests initiated in an area.

**NOA**—Notice of availability.

**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 United States) 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 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.

**NRCS**—Natural Resources Conservation Service of the U.S. Department of Agriculture.

**NWR**—National wildlife refuge.

**objective**—An objective is a 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).

**overwater species**—Nesting species such as diving ducks and many colonial-nesting birds that build nests within dense stands of water-dependent plants, primarily cattail, or that build floating nests of vegetation that rest on the water.

**OWLS**—Outdoor wildlife learning site.

**patch**—An area distinct from that around it; an area distinguished from its surroundings by environmental conditions.

**perennial**—Lasting or active through the year or through many years; a plant species that has a life span of more than 2 years.

**plant community**—An 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.

**prescribed fire**—The 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 a refuge's purposes. This includes hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation.

**proposed action**—The alternative proposed to best achieve the purpose, vision, and goals of a refuge (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**—A 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 management.

**purpose of the refuge**—The purpose of a refuge 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 refuge, a refuge unit, or a refuge subunit (*The Fish and Wildlife Service Manual*, 602 FW 1.5).

**raptor**—A 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).

**Reclamation**—Bureau of Reclamation of the U.S. Department of the Interior.

**refuge purpose**—*See* purpose of the refuge.

**Refuge System**—*See* National Wildlife Refuge System.

**refuge use**—Any activity on a refuge, except administrative or law enforcement activity, carried out by or under the direction of an authorized Service employee.

**resident species**—A species inhabiting a given locality throughout the year; nonmigratory species.

**rest**—Free from biological, mechanical, or chemical manipulation, in reference to refuge 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**—An 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.

**rough fish**—A fish that is neither a sport fish nor an important food fish.

**SAMMS**—*See* Service Asset Maintenance Management System.

**scoping**—The process of obtaining information from the public for input into the planning process.

**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.

**Service**—*See* U.S. Fish and Wildlife Service.

**Service Asset Maintenance Management System (SAMMS)**—A national database which contains the unfunded maintenance needs of each refuge; 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 a plover or a snipe that frequent the seashore or mud flat areas.

**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**—A permit for special authorization from the refuge manager required for any refuge service, facility, privilege, or product of the soil provided at refuge 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**—Those 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 populations declines, small or restricted populations, or dependence on restricted or vulnerable habitats.

**step-down management plan**—A plan that provides the details necessary to implement management strategies identified in the comprehensive conservation plan (*The Fish and Wildlife Service Manual*, 602 FW 1.5).

**strategy**—A 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**—A vascular or nonvascular hydrophyte, either rooted or nonrooted, that lies entirely beneath the water surface, except for flowering parts in some species.

**tame grass**—*See* dense nesting cover.

**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**—A 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.

**travel corridor**—A landscape feature that facilitates the biologically effective transport of animals between larger patches of habitat dedicated to conservation functions. Such corridors may facilitate several kinds of traffic including frequent foraging movement, seasonal migration, or the once in a lifetime dispersal of juvenile animals. These are transition habitats and need not contain all the habitat elements required for long-term survival or reproduction of its migrants.

**trust resource**—*See* federal trust resource.

**trust species**—*See* federal trust species.

**USDA**—U.S. Department of Agriculture.

**U.S. Fish and Wildlife Service (Service, USFWS, FWS)**—The principal federal agency 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 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)**—A federal agency 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.

**UWA**—Unified watershed assessment.

**vision statement**—A concise statement of the desired future condition of the planning unit, based primarily on the Refuge System mission, specific refuge purposes, and other relevant mandates (*The Fish and Wildlife Service Manual*, 602 FW 1.5).

**visual obstruction**—Pertaining to the density of a plant community; the height of vegetation that blocks the view of predators and conspecifics to a nest.

**visual obstruction reading (VOR)**—A method of visually quantifying vegetative structure and composition.

**VOR**—*See* visual obstruction reading.

**wading birds**—Birds having long legs that enable them to wade in shallow water including egrets, great blue herons, black-crowned night-herons, and bitterns.

**waterfowl**—A category of birds that includes ducks, geese, and swans.

**watershed**—The region draining into a river, a river system, or a body of water.

**wetland management 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.

**WG**—Wage grade schedule (pay rate schedule for certain federal positions).

**wildland fire**—A 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 involving hunting, fishing, wildlife observation, wildlife 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.

**WMD**—*See* wetland management district.

**woodland**—Open stands of trees with crowns not usually touching, generally forming 25–60 percent cover.

**WPA**—Works Progress Administration.

**WUI**—Wildland–urban interface.



# Appendixes



# Appendix A

## Key Legislation and Policies

This appendix briefly describes the guidance for the National Wildlife Refuge System and other policies and key legislation that guide the management of Arrowwood National Wildlife Refuge.

### NATIONAL WILDLIFE REFUGE SYSTEM

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

—National Wildlife Refuge System Improvement Act of 1997

#### Goals

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

#### Guiding Principles

There are four guiding principles for management and general public use of the Refuge System

established by Executive Order 12996 (1996):

*Public Use*—The Refuge System provides important opportunities for compatible wildlife-dependent recreational activities involving hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

*Habitat*—Fish and wildlife will not prosper without high quality habitat, and without fish and wildlife, traditional uses of refuges cannot be sustained. The Refuge System will continue to conserve and enhance the quality and diversity of fish and wildlife habitat within refuges.

*Partnerships*—America’s sportsmen and women were the first partners who insisted on protecting valuable wildlife habitat within wildlife refuges. Conservation partnerships with other federal agencies, state agencies, tribes, organizations, industry, and the general public can make significant contributions to the growth and management of the Refuge System.

*Public Involvement*—The public should be given a full and open opportunity to participate in decisions regarding acquisition and management of our national wildlife refuges.

### LEGAL AND POLICY GUIDANCE

Management actions on national wildlife refuges are circumscribed by many mandates including laws and executive orders, the latest of which is the Volunteer and Community Partnership Enhancement Act of 1998. Regulations that affect refuge management the most are listed below.

**American Indian Religious Freedom Act (1978)**—Directs agencies to consult with native traditional religious leaders to determine appropriate policy changes necessary to protect and preserve Native American religious cultural rights and practices.

**Americans with Disabilities Act (1992)**—Prohibits discrimination in public accommodations and services.

**Antiquities Act (1906)**—Authorizes the scientific investigation of antiquities on federal land and provides penalties for unauthorized removal of objects taken or collected without a permit.

**Archaeological and Historic Preservation Act (1974)**—Directs the preservation of historic and archaeological data in federal construction projects.

**Archaeological Resources Protection Act (1979), as amended**—Protects materials of archaeological interest from unauthorized removal or destruction and requires federal managers to develop plans and schedules to locate archaeological resources.

**Architectural Barriers Act (1968)**—Requires federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

**Clean Water Act (1977)**—Requires consultation with the U.S. Army Corps of Engineers (404 permits) for major wetland modifications.

**Endangered Species Act (1973)**—Requires all federal agencies to carry out programs for the conservation of endangered and threatened species.

**Executive Order No. 7168 (1935)**—Establishes Arrowwood Migratory Waterfowl Refuge “as a refuge and breeding ground for migratory birds and other wild life ... to effectuate further the purposes of the Migratory Bird Conservation Act.”

**Executive Order 11988 (1977)**—Requires federal agencies to provide leadership and take action to reduce the risk of flood loss, minimize the impact of floods on human safety, and preserve the natural and beneficial values served by the floodplains.

**Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System (1996)**—Defines the mission, purpose, and priority public uses of the National Wildlife Refuge System. It also presents four principles to guide management of the Refuge System.

**Executive Order 13007, Indian Sacred Sites (1996)**—Directs federal land management agencies to accommodate access to and ceremonial uses 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.

**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.

**Migratory Bird Conservation Act (1929)**—Establishes procedures for acquisition by purchase, rental, or gifts of areas approved by the Migratory Bird Conservation Commission.

**Migratory Bird Hunting and Conservation Stamp Act (1934)**—Authorizes the opening of part of a refuge to waterfowl hunting.

**Migratory Bird Treaty Act (1918)**—Designates the protection of migratory birds as a federal responsibility; and enables the setting of seasons and other regulations, including the closing of areas, federal or nonfederal, to the hunting of migratory birds.

**National Environmental Policy Act (1969)**—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 implementation of all actions. Federal agencies must integrate this Act with other planning requirements, and prepare appropriate documents to facilitate better environmental decision making. [From the Code of Federal Regulations (CFR), 40 CFR 1500.]

**National Historic Preservation Act (1966), as amended**—Establishes as policy that the federal government is to provide leadership in the preservation of the nation’s prehistoric and historical resources.

**National Wildlife Refuge System Administration Act (1966)**—Defines the National Wildlife Refuge System and authorizes the Secretary of the Interior to permit any use of a refuge, provided such use is compatible with the major purposes for which the refuge was established.

**National Wildlife Refuge System Improvement Act of 1997**—Sets the mission and administrative policy for all refuges in the National Wildlife Refuge System; mandates comprehensive conservation planning for all units of the Refuge System.

**Native American Graves Protection and Repatriation Act (1990)**—Requires federal agencies and museums to inventory, determine ownership of, and repatriate cultural items under their control or possession.

**Refuge Recreation Act (1962)**—Allows the use of refuges for recreation when such uses are compatible with the refuge’s primary purposes and when sufficient funds are available to manage the uses.

**Rehabilitation Act (1973)**—Requires programmatic accessibility in addition to physical accessibility for all facilities and programs funded by the federal government to ensure that any person can participate in any program.

**Rivers and Harbors Act (1899)**—Section 10 of this Act requires the authorization of U.S. Army Corps of Engineers prior to any work in, on, over, or under navigable waters of the United States.

**Volunteer and Community Partnership Enhancement Act (1998)**—Encourages the use of volunteers to assist 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 the resources; and encourages donations and other contributions.



# Appendix B

## *Ecosystem Goals and Objectives*

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The Service has adopted an ecosystem approach to conservation to enable it to fulfill its trust responsibility with greater efficiency and effectiveness. Through this holistic approach to resource conservation, the Service can accomplish its mission to “conserve, protect, and enhance the Nation’s fish and wildlife and their habitats for the continuing benefit of the American people.”

An ecosystem approach to fish and wildlife conservation means protecting or restoring functions, structure, and species composition of an ecosystem while providing for its sustainable socioeconomic use. Key to carrying out this approach is recognizing that partnerships are an essential part of a diverse management to accomplish ecosystem health.

The Service has adopted watersheds as the basic building blocks for carrying out ecosystem conservation. Arrowwood NWR is located in the “main stem Missouri River ecosystem,” which includes North Dakota, South Dakota, and northeastern Montana. This ecosystem has been categorized into nine, prioritized focus areas. The refuge contains three of these focus areas: wetland habitat (priority 1), riparian habitat (priority 3), and grassland habitat (priority 5).

### **WETLAND HABITAT—PRIORITY 1**

The glaciated prairies of North Dakota, South Dakota, and northeastern Montana cover approximately 60 million acres. Once a myriad of prairie pothole wetlands in a sea of native prairie, the area is now intensively farmed and is considered the breadbasket of the country. Drainage, largely for agricultural purposes, has reduced 7.2 million acres of wetlands by more than 54%, to 3.9 million acres. Native prairie, mostly mid-grass, has been reduced by 75% to 14.9 million acres. Livestock overgraze much of the remainder.

The area is rich in wildlife. Prairie potholes are essential for waterfowl and other migratory waterbirds. As an example of the importance of the prairie, ducks banded in North Dakota have been recovered in 46 states and 23 other countries. Grassland-nesting, Neotropical birds have been declining faster than woodland Neotropical birds or prairie-nesting ducks. Several endangered, threatened, and candidate species including the

ferruginous hawk, black tern, and Baird’s sparrow breed in the prairie and wetland habitats of this focus area.

Agriculture is the dominant economic activity and force on prairie wetlands and grasslands. No other activity in the focus area affects habitats and wildlife populations to the extent that agriculture does. The USDA and various federal farm programs have more influence on natural resources and wildlife than the Service, all the state wildlife agencies, and all the conservation organizations combined.

The Service has been involved in prairie and wetland resources since the early 1900s. The Service has 68 national wildlife refuges (340,000 acres) and 16 wetland management districts in the focus area. Since 1961, the Service’s Small Wetland Acquisition Program has acquired 380,000 acres in fee title and 1.3 million acres in perpetual easement.

### **Vision, Goals, and Objectives— Wetlands and Watersheds Focus Area**

**Vision**—Diverse wetland habitats and watersheds that provide an abundance and diversity of native flora and fauna in the ecosystem for the benefit of the American public.

**Goal 1:** Increase recognition of wetland values by the various publics (community, conservation, communication, congressional, and corporate entities) and develop a wetland advocacy.

**Objective A:** Over the next 3 years, develop and implement an information and outreach plan in North and South Dakota and northeastern Montana. (Work with the division of education and visitor services).

**Goal 2:** Conserve, restore, and enhance wetland habitats’ qualities and functions for trust species and species of concern.

**Objective A:** At a minimum, annually protect 10,000 acres of wetlands through fee and easement over the next 10 years in the ecosystem.

**Objective B:** Assist partners and other agencies in protecting, creating, restoring, managing, and enhancing 5,000 acres of wetlands and associated uplands annually.

*Goal 3:* Protect the water supply and property interests of wetlands on Service lands and easements. (This goal would be further defined with the water rights division.)

Objective A: File for water rights on eligible Service properties and easements over the next 10 years.

*Goal 4:* Maintain and restore values and functions of watersheds in the ecosystem.

## **RIPARIAN HABITAT—PRIORITY 3**

Riparian areas make up a very small portion of the habitat in the ecosystem. However, riparian and riverine wetland habitats are very important to fish and wildlife resources including migratory birds, threatened and endangered species, native fish, rare and declining fish, amphibians, and many mammals. Many vertebrates, including species of nongame and Neotropical migratory birds, are dependent on riparian and adjacent aquatic zones for reproduction or for foraging during reproduction. Riparian habitats provide for much of the biodiversity in the ecosystem. Many of the species occurring in the ecosystem would be eliminated without healthy riparian habitats.

Riparian habitats are important even to the species that mainly occur in the adjacent upland areas. Many of the rare and declining Neotropical prairie grassland species need to nest a short distance from water and use riparian areas during juvenile dispersal and as critical sites during migratory stopovers. Many wildlife species use these zones as migratory corridors. Riparian habitats are also important for stabilizing riverbanks, reducing sedimentation, and providing woody debris and organic material for invertebrates, therefore, enhancing fish habitat. Many resident wildlife species use riparian areas for winter survival. These species leave the upland areas to use the riparian areas for food and cover during the winter.

National wildlife refuges have been established along the Souris, James, and Des Lacs rivers and tributaries of the Red River. These refuges include sites of internationally significant Prairie Pothole Joint Venture projects that are critical to success of the North American Waterfowl Management Plan.

### **Vision, Goals, and Objectives—Riparian Habitat Focus Area**

*Vision*—Healthy riparian floodplain and watershed ecosystems that provide an abundance and diversity of indigenous flora and fauna.

*Goal 1:* Reduce the conversion of riparian habitats and maintain, restore, or enhance riparian habitat quality and function.

Objective A: Inventory and determine the quality of riparian habitats within the ecosystem by 2004 to provide baseline information.

Objective B: Implement an informational program in the ecosystem by 2004 to promote a public appreciation and understanding of the benefits and the threats to riparian habitats.

Objective C: Use existing programs and opportunities in the ecosystem by 2009 to improve critical riparian habitats.

Objective D: Facilitate the location and control of invasive species in the ecosystem by 2007 to maintain or improve the quality of the riparian habitat.

*Goal 2:* Conserve and recover threatened and endangered species of special concern.

Objective A: Inventory threatened and endangered species of special concern along riparian corridors in the ecosystem by 2004 to provide baseline information.

Objective B: Develop and implement strategies for conserving and recovering threatened and endangered species of special concern along riparian habitat in the ecosystem by 2004, and prevent any species from becoming listed.

*Goal 3:* Conserve, restore, enhance, and create habitat resources in watersheds to influence the quality and quantity of water flowing into rivers and streams.

Objective A: Use existing oversight, coordination, and technical assistance by 2007 to promote sound management on critical watersheds in the ecosystem.

Objective B: Use existing programs and opportunities in the ecosystem by 2007 to conserve, enhance, or restore grasslands and to provide quality water runoff.

## **GRASSLAND HABITAT—PRIORITY 4**

Prairie habitats in the MMRE consist of tall-grass, mid-grass, and short-grass prairies from eastern North Dakota and South Dakota to the west. Although the plant and wildlife species differ across the gradation from tall to short grass, the threats and issues remain the same—conversion of prairie to other uses. Habitat losses have been the most severe in the tall grass, and least in the western reaches of the Dakotas and northeastern Montana.

The tall-grass prairie once spanned millions of acres along the eastern borders of North Dakota and South Dakota. Vegetation representative of tall-grass prairie including big bluestem, switchgrass, Indiangrass, and prairie dropseed characterizes the focus area. In North Dakota, this is found mainly in the Agassiz Lake plain, but transitionally can be found along the state's eastern border in a strip two to three counties wide. Similarly, in South Dakota, the zone follows the eastern border in a comparable width broadening to the Missouri River at the southern end of the state and extending into northeastern Nebraska. Vast acreages of the habitat have been converted to agriculture. The remaining prairie sites are found in small fragmented parcels scattered throughout and are crucial to maintaining and restoring the ecosystem. These sites are threatened by conversion to cropland; invasion of exotics, invasive plants, and woody plants; pesticides; and heavy grazing pressure.

The remaining prairie sites support a wide diversity of plant and animal species including many federally and state-listed rare species. Sites in North Dakota have the largest population of the western prairie fringed orchid, a federally listed threatened plant found in wet meadows and low prairie within the tall-grass community. Other species of concern include (1) the regal fritillary and Dakota skipper butterflies, which are federally classified as candidates for endangered or threatened status, and (2) the powesheik skipper, a species of high concern. Eighteen state-classified rare plants occur in the tall-grass prairies of North Dakota. These prairies also provides primary and secondary breeding habitat for Neotropical migrants in decline such as the upland plover, bobolink, common yellowthroat, grasshopper sparrow, and clay-colored sparrow. Candidate bird species include the Baird's sparrow and loggerhead shrike. Long-term survival of these small, isolated prairies depends on establishing prairie networks and connecting these prairies and nearby habitats to ward off extinctions, and integrating prairies with their surroundings to reduce harm from improper management on surrounding lands.

## **Vision, Goals, and Objectives— Grassland Habitat Focus Area**

**Vision**—Protect, restore, and maintain native prairie and other grasslands to ensure diversity and abundance of indigenous flora and fauna.

**Goal 1:** Prevent degradation and conversion of native prairie grassland.

Objective A: Locate, categorize, evaluate, and map native prairie within the ecosystem for baseline information by 2003.

Objective B: Protect native prairie by FWS easement on a minimum of 50,000 acres per year for the next 10 years.

Objective C: By the year 2003, develop and implement informational programs to promote awareness and advocacy for native prairie.

Objective D: Develop partnerships to protect 500,000 acres of native prairie by 2010.

Objective E: Develop partnerships to minimize the extent and reduce impacts of invasive species in native prairie by 2010.

Objective F: Strive to work with partners to reduce fragmentation effects to flora and fauna in native prairie communities.

Objective G: Identify contaminants entering native prairie and what adverse impact each contaminant may have on native prairie.

Objective H: Develop a plan, including informational programs, on how to prevent and/or reduce further contaminants from entering native prairie.

**Goal 2:** Maintain and establish networks of native prairie and planted grasslands on public and private lands.

Objective A: Promote and implement prescribed burning and rotational grazing on a minimum of 20% of private lands per year to enhance and maintain healthy native prairie.

Objective B: By the year 2003, develop informational programs on types and importance of proper defoliation of native prairie.

Objective C: By the year 2002, identify the key areas in the ecosystem to restore perennial grasslands, or maintain and/or increase planted grassland, with an emphasis on native species restoration.

Objective D: Strive to treat a minimum of 20% of agency-administered grasslands annually.

**Goal 3:** Protect and enhance habitat for trust species and species of special concern.

Objective A: Identify grassland species that are in decline, by the year 2003.

Objective B: Develop informational programs on why grassland species in decline are important, approaches to be taken to reverse decline, and the public role in remedies.

Objective C: Develop statewide partnerships to get private landowners and the public involved in species management.

Objective D: Develop criteria and use to identify the most biologically significant landscapes by 2003.

Objective E: Over the next 10 years, develop partnerships to enhance and manage native prairie including invasion by nonnative species.

# Appendix C

## *List of Preparers, Consultation, and Coordination*

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This document is the result of the extensive, collaborative, and enthusiastic efforts by the members of the planning team shown below.

<i>Team Member</i>	<i>Position</i>	<i>Current Work Unit</i>
Dave Azure	Refuge manager	Arrowwood NWR; Pingree, ND
Mark Ely	Geographic information system (GIS) specialist	USFWS, region 6; Lakewood, CO
Sean Fields	<i>Former</i> GIS Specialist	USFWS, region 6; MT
Kim Hanson	Project leader	Arrowwood NWR; Pingree, ND
Linda Kelly	<i>Former</i> planning team leader	Bureau of Land Management; NV
Kathleen Linder	<i>Former</i> planning team leader	USFWS, region 6; CO
Adam Misztal	<i>Former</i> planning team leader	USFWS, region 6; Lakewood, CO
Deb Parker	Writer-editor	USFWS, region 6; Lakewood, CO
Paulette Scherr	Wildlife biologist	Arrowwood NWR; Pingree, ND
Mike Spratt	Planning team leader; chief of the division of refuge planning	USFWS, region 6; Lakewood, CO
Mark Vaniman	<i>Former</i> refuge manager	Arrowwood NWR; Pingree, ND
Stacy Whipp	WMD manager	Arrowwood WMD; Pingree, ND

Many organizations, agencies, and individuals provided invaluable assistance with the preparation of this draft CCP and EA. The Service acknowledges the efforts of the following individuals. The diversity, talent, and knowledge contributed dramatically improved the vision and completeness of this document.

- Bob Barrett (deputy refuge supervisor for ND and SD; USFWS, region 6)
- Rick Coleman (assistant regional director for the Refuge System; USFWS, region 6)
- Sheri Fetherman (chief of the division of education and visitor services; USFWS, region 6)
- Galen Green (fire ecologist, *retired*; USFWS, region 6)
- Wayne King (biologist; USFWS, region 6)
- Lynne Koontz (economist; USGS science center, Fort Collins, CO)
- Rod Krey (refuge supervisor for ND and SD; USFWS, region 6)
- Murray Laubhan (special assistant to the director; USGS Northern Prairie Wildlife Research Center, Jamestown, ND)
- Rachel Laubhan (wildlife biologist; USFWS, region 6)
- Rhoda Lewis (regional archaeologist, *retired*; USFWS, region 6)
- Cindy Souders (outdoor recreation planner; USFWS, region 6)
- Cheryl Williss (chief hydrologist, *retired*; USFWS, region 6)
- Harvey Wittmier (chief of the division of realty, *retired*; USFWS, region 6)



# Appendix D

## *Public Involvement*

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Public scoping was initiated for Arrowwood NWR in a NOI dated August 1, 2001. The NOI announced the availability of an issues workbook and dates for open houses to be held for public input on management of the refuge and development of the CCP.

Public meetings were held in Kensal, Pingree, and Jamestown, North Dakota. Approximately 40 people attended these meetings. Numerous written comments were received during the open comment period. Comments received identified biological, social, and economic concerns regarding refuge management. The mailing list follows.

### **Federal Officials**

U.S. Representative Earl Pomeroy, Washington DC  
Rep. Pomeroy's Area Director, Bismarck, ND

U.S. Senator Kent Conrad, Washington DC  
Sen. Conrad's Area Director, Bismarck, ND

U.S. Senator Byron Dorgan, Washington DC  
Sen. Dorgan's Area Director, Bismarck, ND

### **Federal Agencies**

Bureau of Reclamation, Bismarck, ND

U.S. Army Corps of Engineers, Omaha District  
Office, NE

USFWS Ecological Services, Bismarck, ND

USFWS Habitat and Population Evaluation Team,  
Bismarck, ND

USGS-Northern Prairie Wildlife Research Center,  
Jamestown, ND

### **Tribal Officials**

Spirit Lake Tribal Council, Fort Totten, ND

Three Affiliated Tribes, New Town, ND

Turtle Mountain Band of Chippewa, Belcourt, ND

### **State Officials**

Governor John Hoeven, Bismarck, ND

Representative William Devlin, Finley, ND

Representative Lyle Hanson, Jamestown, ND

Representative Craig Headland, Montpelier, ND

Representative Joe Kroeber, Jamestown, ND

Representative Chet Pollert, Carrington, ND

Representative Don Vigesaa, Cooperstown, ND

Senator Michael Every, Minnewaukan, ND

Senator April Fairfield, Eldridge, ND

### **State Agencies**

NDGF, Bismarck, ND

North Dakota State Water Commission, Bismarck, ND

Southeast Fisheries District, Jamestown, ND

### **Local Government**

Kensal Fire Protection District, Kensal, ND

Mayor, Carrington, ND

Mayor, Jamestown, ND

Pingree Fire Protection District Chief Bill Riebe,  
Pingree, ND

Stutsman County Commission Chair Steve Cichos,  
Jamestown, ND

### **Organizations**

American Bird Conservancy, Washington DC

American Rivers, Washington DC

Audubon Dakota, Fargo, ND

Dakota Anglers, Jamestown, ND

Defenders of Wildlife, Washington DC

Ducks Unlimited, Memphis, TN

Izaak Walton League, Gaithersburg, MD

National Audubon Society; Washington DC; New  
York, NY

National Wildlife Federation, Reston, VA

National Wildlife Refuge Association, Washington DC

The Nature Conservancy, Boulder, CO

North Dakota Chapter of The Wildlife Society,  
Bismarck, ND

North Dakota Wildlife Federation, Bismarck, ND

Sierra Club, San Francisco, CA

Stutsman County Wildlife Federation, Jamestown, ND

United Sportsmen-Jamestown Chapter,  
Jamestown, ND

The Wilderness Society, Washington DC  
Wildlife Management Institute; Fort Collins, CO;  
Bend, OR; Washington DC

### **Universities, Colleges, and Schools**

Jamestown College, Jamestown, ND  
Kensal Public School, Kensal, ND  
North Dakota State University, Fargo, ND  
Pingree–Buchanan School District, Buchanan, ND  
The University of North Dakota, Grand Forks, ND

### **Media**

Foster County Independent, Carrington, ND  
The Jamestown Sun, Jamestown, ND

### **Individuals**

1 individual

# Appendix E

## *Fire Management Program*

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The Service has management and administrative responsibility, including fire management, on approximately 21,684 acres of national wildlife refuge lands and approximately 62,671 acres of lands in wetland management districts in eastern North Dakota.

### **FIRE: A CRITICAL NATURAL PROCESS**

In prairie ecosystems of the Great Plains, vegetation has evolved under periodic disturbance and defoliation from grazing animals and fire, with minor weather events. This periodic disturbance is what kept the ecosystem diverse and healthy while maintaining significant biodiversity for thousands of years. Historically, natural fire including Native American ignitions has played an important disturbance role in many ecosystems: removing fuel accumulations, decreasing the impacts of insects and diseases, stimulating regeneration, cycling critical nutrients, and providing a diversity of habitats for plant species and wildlife.

When fire is excluded on a broad scale (such as 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 fire regime characteristics, and have created a potential in many areas across the country for uncharacteristically severe wildland fires. These catastrophic wildland fires often pose risks to public and firefighter safety. In addition, they 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 most ecosystems including grasslands, wetlands, woodlands, and forests. When integrated back into an ecosystem, fire can help restore and maintain healthy systems and reduce the risk of wildland fires. To facilitate fire's natural role in the environment, fire must first be integrated into land and resource management plans and activities on a broad scale.

#### Reintroduced fire

can improve waterfowl habitat, wetlands, and riparian areas by reducing the density or modifying the species in the vegetation;

can improve deer and elk habitat, especially in areas with shortages such as winter habitat and on spring and fall transitional ranges;

can sustain biological diversity;

can improve access in woodlands and shrublands;

can improve soil fertility;

can improve the quality and amount of livestock forage;

can improve growth in immature woodlands by reducing density;

can remove excessive buildup of fuels;

can reduce susceptibility of plants to insects and disease caused by moisture and nutrient stress;

can improve water yield for off-site activities and communities dependent on wildlands for their water supply.

### **WILDLAND FIRE MANAGEMENT POLICY AND GUIDANCE**

In 2001, the Secretaries of the Interior and Agriculture approved an update of the 1995 Federal Fire Policy. The 2001 Federal Wildland Fire Management Policy directs federal agencies to achieve a balance between fire suppression to protect life, property, and resources and 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 fire as an essential ecological process and natural change agent would 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 public health and environmental quality consideration; federal, state, tribal, local, interagency, and international coordination and cooperation are essential.
- Standardization of policies and procedures among federal agencies is an ongoing objective.

The fire management considerations, guidance, and direction should be addressed in the land use resources management plans, for example, the 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 Arrowwood NWR would protect life, property, and other resources by safely suppressing all wildfires. Prescribed fire and manual and mechanical fuel treatments would be used in an ecosystem management context for habitat management, and to protect federal and private property. Fuel reduction activities would be applied where needed, especially in areas with a higher proportion of residences that may be considered “wildland–urban interface” (WUI) areas.

All aspects of the fire management program would be conducted consistent with applicable laws, policies, and regulations. The refuge would maintain a FMP and carry it out to accomplish resource management objectives. Prescribed fire and manual and mechanical fuel treatments would be applied in a scientific way under selected weather and environmental conditions to accomplish habitat management objectives.

### Fire Management Goals

1. Protect life, property, and other resources from wildland fire.
2. Use prescribed fire as a tool to accomplish habitat management objectives.
3. Maintain a wildland-fire management program that is professional in nature and uses available resources both economically and efficiently.

### Fire Management Objectives

1. Safely suppress all wildland fires using appropriate management responses based on safety

considerations, refuge complex objectives, and values at risk.

2. Minimize the impact and cost of fire suppression activities through the professional use of preparedness processes.
3. Use prescribed fire for hazardous fuel reduction to the fullest extent possible within or near the refuge complex’s development zones, wildfire sensitive resources, and boundary areas to reduce the risk from wildland fire damage. Treat 3,000 acres yearly.
4. Restore fire to the refuge complex on a landscape scale with prudent use of prescribed fire to restore and perpetuate native species and communities.
5. Maintain a diversity of healthy plant communities at various successional stages to provide suitable habitat for all grassland species with prescribed fire.
6. Use prescribed fire to suppress and control exotic invader species such as leafy spurge, smooth brome, and Kentucky bluegrass. Treat 2,000 acres yearly.
7. Use prescribed fire to control woody plant invasion within the refuge complex. Treat 1,000 acres yearly.
8. Educate the public regarding the role of prescribed fire within the refuge complex.
9. Work with adjacent landowners and cooperators to increase the use of prescribed fire in the public and private sectors within the refuge complex’s sphere of influence and to foster increased understanding and cooperation between all entities involved in wildland fire activities.
10. Provide wildland-fire management support to other agencies to the extent possible within the interagency fire management support network.

### Strategies

Strategies and tactics that consider public and firefighter safety as well as resource values at risk have been used. Wildland fire suppression, wildland fire use and prescribed fire methods, manual and mechanical means, timing, and monitoring are found in a more detailed list in the step-down FMP for Arrowwood NWR.

All management actions would use prescribed fire and manual and/or mechanical means to (1) restore and maintain desired habitat conditions, and (2) control nonnative vegetation and the spread of woody vegetation within the diverse ecosystem habitats. The prescribed fire program is outlined in the FMP for the refuge.

Additionally, detailed prescribed burn plans have been developed that describe the following:

- burn units and their predominant vegetation
- primary objectives for the units

- 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

## **FIRE MANAGEMENT ORGANIZATION, CONTACTS, AND COOPERATION**

The region has established qualified fire management, technical oversight, and support for the Arrowwood NWR Complex using the fire management district approach. Using this approach, an appropriate fire management staffing organization has been determined and is listed in more detail in the Arrowwood NWR Complex FMP.



# Appendix F

## List of Plant Species

The following plant species that occur at Arrowwood NWR are listed in alphabetic order of their scientific names (The Great Plains Flora Association 1991, NRCS 2006).

Genus	Species	Common Name
<i>Acer</i>	<i>negundo</i>	boxelder
<i>Acer</i>	<i>negundo</i>	boxelder shrub
<i>Achillea</i>	<i>lanulosa</i>	yarrow
<i>Achnatherum</i>	<i>hymenoides</i>	Indian ricegrass
<i>Acroptilon</i>	<i>repens</i>	Russian knapweed
<i>Actaea</i>	<i>rubra</i>	baneberry
<i>Agalinis</i>	<i>aspera</i>	rough gerardia
<i>Agalinis</i>	<i>tenuifolia</i>	slender gerardia
<i>Agastache</i>	<i>foeniculum</i>	lavender hyssop
<i>Agoseris</i>	<i>glauca</i>	false dandelion
<i>Agrimonia</i>	<i>striata</i>	agrimony
<i>Agropyron</i>	<i>desertorum</i>	crested wheatgrass
<i>Agrostis</i>	<i>hyemalis</i>	ticklegrass
<i>Agrostis</i>	<i>perennans</i>	autumn bent
<i>Agrostis</i>	<i>stolonifera</i>	redtop
<i>Allium</i>	<i>cernuum</i>	nodding onion
<i>Allium</i>	<i>stellatum</i>	pink wild onion
<i>Allium</i>	<i>textile</i>	white wild onion
<i>Almutaster</i>	<i>pauciflorus</i>	few-flowered aster
<i>Alopecurus</i>	<i>aequalis</i>	shortawn foxtail
<i>Alopecurus</i>	<i>carolinianus</i>	Carolina foxtail
<i>Alopecurus</i>	<i>geniculatus</i>	marsh foxtail
<i>Amaranthus</i>	<i>albus</i>	tumbleweed
<i>Amaranthus</i>	<i>graecizans</i>	tumbleweed
<i>Amaranthus</i>	<i>retroflexus</i>	rough pigweed
<i>Ambrosia</i>	<i>artemisiifolia</i>	common ragweed
<i>Ambrosia</i>	<i>psilostachya</i>	western ragweed
<i>Ambrosia</i>	<i>trifida</i>	giant ragweed
<i>Amelanchier</i>	<i>alnifolia</i>	Juneberry
<i>Amorpha</i>	<i>canescens</i>	leadplant
<i>Amorpha</i>	<i>nana</i>	dwarf wild indigo
<i>Andropogon</i>	<i>gerardi</i>	big bluestem
<i>Androsace</i>	<i>occidentalis</i>	western rock jasmine
<i>Androsace</i>	<i>septentrionalis</i>	pygmy flower
<i>Anemone</i>	<i>canadensis</i>	meadow anemone
<i>Anemone</i>	<i>cylindrica</i>	candle anemone
<i>Anemone</i>	<i>multifida</i>	anemone multi
<i>Anemone</i>	<i>patens</i>	pasqueflower
<i>Anemone</i>	<i>quinquefolia</i>	wood anemone
<i>Anemone</i>	<i>virginiana</i>	tall anemone
<i>Anethum</i>	<i>graveolens</i>	dill

Genus	Species	Common Name
<i>Antennaria</i>	<i>neglecta</i>	field pussytoes
<i>Antennaria</i>	<i>parvifolia</i>	pussytoes
<i>Antennaria</i>	<i>plantaginifolia</i>	plainleaf pussytoes
<i>Antennaria</i>	<i>rosea</i>	rose pussytoes
<i>Apocynum</i>	<i>androsaemifolium</i>	spreading dogbane
<i>Apocynum</i>	<i>cannabinum</i>	hemp dogbane
<i>Apocynum</i>	<i>sibiricum</i>	prairie dogbane
<i>Arabis</i>	<i>divaricarpa</i>	rockcress
<i>Arabis</i>	<i>glabra</i>	tower mustard
<i>Arabis</i>	<i>hirsuta</i>	rockcress
<i>Arabis</i>	<i>holboellii</i>	rockcress
<i>Aralia</i>	<i>nudicaulis</i>	wild sarsaparilla
<i>Arctium</i>	<i>minus</i>	common burdock
<i>Arctostaphylos</i>	<i>uva-ursi</i>	bearberry
<i>Argentina</i>	<i>anserina</i>	silverweed
<i>Aristida</i>	<i>purpurea</i>	red threeawn
<i>Arnica</i>	<i>fulgens</i>	arnica
<i>Artemisia</i>	<i>absinthium</i>	wormwood
<i>Artemisia</i>	<i>biennis</i>	biennial wormwood
<i>Artemisia</i>	<i>cana</i>	dwarf sagebrush
<i>Artemisia</i>	<i>caudata</i>	western sagebrush
<i>Artemisia</i>	<i>dracunculus</i>	silky wormwood
<i>Artemisia</i>	<i>filifolia</i>	silver wormwood
<i>Artemisia</i>	<i>frigida</i>	fringed sagewort
<i>Artemisia</i>	<i>longifolia</i>	longleaf wormwood
<i>Artemisia</i>	<i>ludoviciana</i>	white sage
<i>Asclepias</i>	<i>hirtella</i>	green milkweed
<i>Asclepias</i>	<i>ovalifolia</i>	oval-leaf milkweed
<i>Asclepias</i>	<i>speciosa</i>	showy milkweed
<i>Asclepias</i>	<i>syriaca</i>	common milkweed
<i>Asclepias</i>	<i>verticillata</i>	whorled milkweed
<i>Asparagus</i>	<i>officinalis</i>	asparagus
<i>Aster</i>	<i>ericoides</i>	white aster
<i>Aster</i>	<i>falcatus</i>	smallflower aster
<i>Aster</i>	<i>laevis</i>	smooth blue aster
<i>Aster</i>	<i>oblongifolius</i>	aromatic aster
<i>Aster</i>	<i>simplex</i>	simple aster
<i>Astragalus</i>	<i>agrestis</i>	purple milkvetch
<i>Astragalus</i>	<i>bisulcatus</i>	two-grooved milkvetch
<i>Astragalus</i>	<i>canadensis</i>	Canada milkvetch
<i>Astragalus</i>	<i>crassicaarpus</i>	ground plum milkvetch
<i>Astragalus</i>	<i>flexuosus</i>	slender milkvetch
<i>Astragalus</i>	<i>gilviflorus</i>	tufted milkvetch
<i>Astragalus</i>	<i>laxmannii</i>	vetch adsug
<i>Astragalus</i>	<i>missouriensis</i>	Missouri milkvetch
<i>Astragalus</i>	<i>pectinatus</i>	narrowleaf poisonvetch
<i>Astragalus</i>	<i>racemosus</i>	creamy poisonvetch
<i>Astragalus</i>	<i>tenellus</i>	looseflower milkvetch
<i>Atriplex</i>	<i>argentea</i>	silverscale saltbush
<i>Atriplex</i>	<i>dioica</i>	rillscale

Genus	Species	Common Name
<i>Atriplex</i>	<i>hortensis</i>	garden orach
<i>Atriplex</i>	<i>nuttallii</i>	salt sage
<i>Atriplex</i>	<i>patula</i>	spearscale
<i>Atriplex</i>	<i>rosea</i>	redscale
<i>Axyris</i>	<i>amaranthoides</i>	Russian pigweed
<i>Bassia</i>	<i>scoparia</i>	kochia
<i>Beckmannia</i>	<i>syzigachne</i>	American sloughgrass
<i>Berteroa</i>	<i>incana</i>	hoary false alyssum
<i>Betula</i>	<i>papyrifera</i>	paper birch
<i>Bidens</i>	<i>cernua</i>	nodding beggarticks
<i>Bidens</i>	<i>frondosa</i>	beggarticks
<i>Bidens</i>	<i>vulgata</i>	beggarticks
<i>Boltonia</i>	<i>asteroides</i>	violet boltonia
<i>Bouteloua</i>	<i>curtipendula</i>	sideoats grama
<i>Bouteloua</i>	<i>gracilis</i>	blue grama
<i>Brickellia</i>	<i>eupatorioides</i>	false boneset
<i>Bromus</i>	<i>ciliatus</i>	fringed brome
<i>Bromus</i>	<i>inermis</i>	smooth brome
<i>Bromus</i>	<i>japonicus</i>	Japanese brome
<i>Bromus</i>	<i>latiglumis</i>	brome lati
<i>Bromus</i>	<i>porteri</i>	nodding brome
<i>Bromus</i>	<i>tectorum</i>	downy brome
<i>Buchloe</i>	<i>dactyloides</i>	buffalograss
<i>Calamagrostis</i>	<i>canadensis</i>	blue joint
<i>Calamagrostis</i>	<i>montanensis</i>	plains reedgrass
<i>Calamagrostis</i>	<i>stricta</i>	slimstem reedgrass
<i>Calamovilfa</i>	<i>longifolia</i>	prairie sandreed
<i>Calylophus</i>	<i>serrulatus</i>	yellow evening primrose
<i>Calystegia</i>	<i>sepium</i>	hedge bindweed
<i>Camelina</i>	<i>microcarpa</i>	littlepod false flax
<i>Camelina</i>	<i>sativa</i>	gold-of-pleasure
<i>Campanula</i>	<i>rapunculoides</i>	creeping bellflower
<i>Campanula</i>	<i>rotundifolia</i>	harebell
<i>Capsella</i>	<i>bursa-pastoris</i>	shepherd's purse
<i>Cardaria</i>	<i>draba</i>	hoary cress
<i>Carduus</i>	<i>nutans</i>	musk thistle
<i>Carex</i>	<i>aenea</i>	sedge
<i>Carex</i>	<i>assiniboinensis</i>	Assiniboia sedge
<i>Carex</i>	<i>atherodes</i>	wheat sedge
<i>Carex</i>	<i>aurea</i>	golden sedge
<i>Carex</i>	<i>bebbii</i>	Bebb's sedge
<i>Carex</i>	<i>bicknellii</i>	Bicknell's sedge
<i>Carex</i>	<i>brevior</i>	shortbeak sedge
<i>Carex</i>	<i>douglasii</i>	Douglas' sedge
<i>Carex</i>	<i>duriuscula</i>	needleleaf sedge
<i>Carex</i>	<i>filifolia</i>	threadleaf sedge
<i>Carex</i>	<i>gravida</i>	heavy sedge
<i>Carex</i>	<i>hallii</i>	deer sedge
<i>Carex</i>	<i>inops</i>	sun sedge
<i>Carex</i>	<i>interior</i>	inland sedge

Genus	Species	Common Name
<i>Carex</i>	<i>laeviconica</i>	smoothcone sedge
<i>Carex</i>	<i>lanuginosa</i>	woolly sedge
<i>Carex</i>	<i>meadii</i>	Mead's sedge
<i>Carex</i>	<i>molesta</i>	troublesome sedge
<i>Carex</i>	<i>peckii</i>	Peck's sedge
<i>Carex</i>	<i>pensylvanica</i>	Pennsylvania sedge
<i>Carex</i>	<i>praegracilis</i>	clustered field sedge
<i>Carex</i>	<i>retrorsa</i>	knotsheath
<i>Carex</i>	<i>rostrata</i>	beaked sedge
<i>Carex</i>	<i>saximontana</i>	Rocky Mountain sedge
<i>Carex</i>	<i>sprengelii</i>	Sprengel's sedge
<i>Carex</i>	<i>sychnocephala</i>	manyhead sedge
<i>Carex</i>	<i>tetanica</i>	rigid sedge
<i>Carex</i>	<i>vulpinoidea</i>	fox sedge
<i>Carum</i>	<i>carvi</i>	caraway
<i>Castilleja</i>	<i>sessiliflora</i>	downy paintbrush
<i>Catabrosa</i>	<i>aquatica</i>	brookgrass
<i>Celastrus</i>	<i>scandens</i>	climbing bittersweet
<i>Celtis</i>	<i>occidentalis</i>	hackberry
<i>Centunculus</i>	<i>minimus</i>	common pimpernel
<i>Cerastium</i>	<i>arvense</i>	prairie chickweed
<i>Cerastium</i>	<i>brachypodium</i>	nodding chickweed
<i>Cerastium</i>	<i>nutans</i>	powderhorn cerastium
<i>Ceratoides</i>	<i>lanata</i>	winterfat
<i>Ceratophyllum</i>	<i>demersum</i>	hornwort
<i>Chamaerhodos</i>	<i>erecta</i>	little rose
<i>Chamaesyce</i>	<i>glyptosperma</i>	ridge-seeded spurge
<i>Chamaesyce</i>	<i>serpyllifolia</i>	thyme-leaved spurge
<i>Chenopodium</i>	<i>album</i>	lambsquarters
<i>Chenopodium</i>	<i>berlandieri</i>	pitseed goosefoot
<i>Chenopodium</i>	<i>disiccatum</i>	aridland goosefoot
<i>Chenopodium</i>	<i>fremontii</i>	Fremont's goosefoot
<i>Chenopodium</i>	<i>glaucum</i>	oakleaf goosefoot
<i>Chenopodium</i>	<i>rubrum</i>	akali blite
<i>Chenopodium</i>	<i>simplex</i>	maple-leaved goosefoot
<i>Chenopodium</i>	<i>strictum</i>	chenopodium
<i>Cinna</i>	<i>arundinacea</i>	woodreed
<i>Cinna</i>	<i>latifolia</i>	drooping woodreed
<i>Cirsium</i>	<i>arvense</i>	Canada thistle
<i>Cirsium</i>	<i>canescens</i>	prairie thistle
<i>Cirsium</i>	<i>undulatum</i>	wavyleaf thistle
<i>Cirsium</i>	<i>vulgare</i>	bull thistle
<i>Cleome</i>	<i>serrulata</i>	Rocky Mountain beeplant
<i>Collomia</i>	<i>linearis</i>	collomia
<i>Comandra</i>	<i>umbellata</i>	bastard toadflax
<i>Commelina</i>	<i>communis</i>	dayflower
<i>Conringia</i>	<i>orientalis</i>	hare's ear mustard
<i>Convolvulus</i>	<i>arvensis</i>	field bindweed
<i>Conyza</i>	<i>canadensis</i>	horseweed
<i>Cornus</i>	<i>sericea</i>	redosier dogwood

Genus	Species	Common Name
<i>Corydalis</i>	<i>aurea</i>	golden corydalis
<i>Corylus</i>	<i>americana</i>	American hazelnut
<i>Crataegus</i>	<i>chrysocarpa</i>	roundleaf hawthorn
<i>Crataegus</i>	<i>rotundifolia</i>	northern hawthorn
<i>Crataegus</i>	<i>succulenta</i>	fleshy hawthorn
<i>Crepis</i>	<i>occidentalis</i>	hawksbeard
<i>Crepis</i>	<i>runcinata</i>	hawksbeard
<i>Cryptantha</i>	<i>celosioides</i>	buttecandle
<i>Cuscuta</i>	<i>cephalanthi</i>	buttonbush dodder
<i>Cuscuta</i>	<i>gronovii</i>	scaldweed
<i>Cuscuta</i>	<i>indecora</i>	bigseed alfalfa dodder
<i>Cymopterus</i>	<i>acaulis</i>	wild parsley
<i>Cyperus</i>	<i>bipartitus</i>	brook flatsedge
<i>Cyperus</i>	<i>erythrorhizos</i>	redroot cyperus
<i>Cyperus</i>	<i>odoratus</i>	slender flatsedge
<i>Cyperus</i>	<i>squarrosus</i>	bearded flatsedge
<i>Cystopteris</i>	<i>fragilis</i>	common bladder fern
<i>Dactylorhiza</i>	<i>viridis</i>	longbract frog orchid
<i>Dalea</i>	<i>candida</i>	western prairie clover
<i>Dalea</i>	<i>purpurea</i>	purple prairie clover
<i>Danthonia</i>	<i>spicata</i>	poverty oatgrass
<i>Delphinium</i>	<i>bicolor</i>	little larkspur
<i>Deschampsia</i>	<i>caespitosa</i>	tufted hairgrass
<i>Descurainia</i>	<i>pinnata</i>	tansy mustard
<i>Descurainia</i>	<i>sophia</i>	flixweed
<i>Desmodium</i>	<i>canadense</i>	Canada tickclover
<i>Dichanthelium</i>	<i>leibergii</i>	Leiberg's panicum
<i>Dichanthelium</i>	<i>wilcoxianum</i>	Wilcox's panicum
<i>Distichlis</i>	<i>stricta</i>	saltgrass
<i>Dodecatheon</i>	<i>pulchellum</i>	shooting star
<i>Draba</i>	<i>nemorosa</i>	woodland draba
<i>Dracocephalum</i>	<i>parviflorum</i>	dragonhead
<i>Echinacea</i>	<i>angustifolia</i>	purple coneflower
<i>Echinochloa</i>	<i>crusgalli</i>	barnyard grass
<i>Echinocystis</i>	<i>lobata</i>	wild cucumber
<i>Elaeagnus</i>	<i>angustifolia</i>	Russian olive
<i>Elaeagnus</i>	<i>commutata</i>	silverberry
<i>Eleocharis</i>	<i>acicularis</i>	needle spikesedge
<i>Eleocharis</i>	<i>compressa</i>	flatstem spikesedge
<i>Eleocharis</i>	<i>erythropoda</i>	spikerush
<i>Eleocharis</i>	<i>macrostachya</i>	spikerush
<i>Eleocharis</i>	<i>obtusa</i>	blunt spikesedge
<i>Ellisia</i>	<i>nyctelea</i>	waterpod
<i>Elymus</i>	<i>canadensis</i>	Canada wildrye
<i>Elymus</i>	<i>lanceolatus</i>	thickspike wheatgrass
<i>Elymus</i>	<i>repens</i>	quackgrass
<i>Elymus</i>	<i>trachycaulus</i>	slender wheatgrass
<i>Elymus</i>	<i>virginicus</i>	Virginia wildrye
<i>Epilobium</i>	<i>angustifolium</i>	fireweed
<i>Epilobium</i>	<i>brachycarpum</i>	tall annual willowherb

Genus	Species	Common Name
<i>Epilobium</i>	<i>ciliatum</i>	willowherb
<i>Epilobium</i>	<i>leptophyllum</i>	bog willowherb
<i>Equisetum</i>	<i>arvense</i>	field horsetail
<i>Equisetum</i>	<i>fluviatile</i>	water horsetail
<i>Equisetum</i>	<i>laevigatum</i>	smooth horsetail
<i>Eragrostis</i>	<i>hypnoides</i>	teal lovegrass
<i>Ericameria</i>	<i>nauseosa</i>	rubber rabbitbrush
<i>Erigeron</i>	<i>caespitosus</i>	tufted fleabane
<i>Erigeron</i>	<i>compositus</i>	fernleaf fleabane
<i>Erigeron</i>	<i>glabellus</i>	smooth fleabane
<i>Erigeron</i>	<i>lonchophyllus</i>	spearleaf fleabane
<i>Erigeron</i>	<i>philadelphicus</i>	Philadelphia fleabane
<i>Erigeron</i>	<i>pumilus</i>	low fleabane
<i>Erigeron</i>	<i>strigosus</i>	daisy fleabane
<i>Eriogonum</i>	<i>flavum</i>	yellow buckwheat
<i>Eriogonum</i>	<i>pauciflorum</i>	erigonum
<i>Eriophorum</i>	<i>viridicarinatum</i>	cottongrass
<i>Erucastrum</i>	<i>gallicum</i>	dog mustard
<i>Erysimum</i>	<i>asperum</i>	western wallflower
<i>Erysimum</i>	<i>cheiranthoides</i>	wormseed wallflower
<i>Erysimum</i>	<i>inconspicuum</i>	smallflower wallflower
<i>Escobaria</i>	<i>vivipara</i>	pincushion cactus
<i>Eupatorium</i>	<i>maculatum</i>	spotted joeypyeweed
<i>Euphorbia</i>	<i>esula</i>	leafy spurge
<i>Euthamia</i>	<i>graminifolia</i>	narrowleaf goldenrod
<i>Festuca</i>	<i>campestris</i>	rough fescue
<i>Festuca</i>	<i>idahoensis</i>	bluebunch fescue
<i>Festuca</i>	<i>ovina</i>	sheep's fescue
<i>Fragaria</i>	<i>virginiana</i>	wild strawberry
<i>Fraxinus</i>	<i>pennsylvanica</i>	green ash
<i>Fritillaria</i>	<i>atropurpurea</i>	spotted fritillary
<i>Gaillardia</i>	<i>aristata</i>	blanketflower
<i>Galium</i>	<i>aparine</i>	catchweed bedstraw
<i>Galium</i>	<i>boreale</i>	northern bedstraw
<i>Galium</i>	<i>trifidum</i>	small bedstraw
<i>Galium</i>	<i>triflorum</i>	sweet-scented bedstraw
<i>Gaura</i>	<i>coccinea</i>	scarlet gaura
<i>Gentiana</i>	<i>affinis</i>	northern gentian
<i>Gentianella</i>	<i>amarella</i>	annual gentian
<i>Gentianopsis</i>	<i>crinita</i>	gentian
<i>Geum</i>	<i>aleppicum</i>	yellow avens
<i>Geum</i>	<i>triflorum</i>	purple avens
<i>Glaux</i>	<i>maritima</i>	sea milkwort
<i>Glyceria</i>	<i>borealis</i>	northern mannagrass
<i>Glyceria</i>	<i>grandis</i>	tall mannagrass
<i>Glyceria</i>	<i>striata</i>	fowl mannagrass
<i>Glycyrrhiza</i>	<i>lepidota</i>	wild licorice
<i>Gnaphalium</i>	<i>palustre</i>	everlasting
<i>Gratiola</i>	<i>neglecta</i>	hedge hyssop
<i>Grindelia</i>	<i>squarrosa</i>	curlycup gumweed

Genus	Species	Common Name
<i>Gutierrezia</i>	<i>sarathrae</i>	broom snakeweed
<i>Gypsophila</i>	<i>paniculata</i>	perennial baby's breath
<i>Hackelia</i>	<i>deflexa</i>	wood stickseed
<i>Hackelia</i>	<i>floribunda</i>	stickseed
<i>Haplopappus</i>	<i>lanceolatus</i>	lanceleaf goldenweed
<i>Haplopappus</i>	<i>spinulosus</i>	spring ironplant
<i>Hedeoma</i>	<i>hispida</i>	rough pennyroyal
<i>Hedysarum</i>	<i>boreale</i>	sweet vetch
<i>Helenium</i>	<i>autumnale</i>	sneezeweed
<i>Helianthus</i>	<i>annuus</i>	common sunflower
<i>Helianthus</i>	<i>maximiliani</i>	Maximilian sunflower
<i>Helianthus</i>	<i>nuttallii</i>	Nuttall's sunflower
<i>Helianthus</i>	<i>petiolaris</i>	plains sunflower
<i>Helianthus</i>	<i>rigidus</i>	stiff sunflower
<i>Helianthus</i>	<i>tuberosus</i>	Jerusalem artichoke
<i>Helictotrichon</i>	<i>hookeri</i>	spikeoat
<i>Heliotropium</i>	<i>curassavicum</i>	seaside heliotrope
<i>Heracleum</i>	<i>sphondylium</i>	cowparsnip
<i>Hesperis</i>	<i>matronalis</i>	dames rocket
<i>Hesperostipa</i>	<i>comata</i>	intermediate needle and thread
<i>Hesperostipa</i>	<i>spartea</i>	shortbristle needle and thread
<i>Heterotheca</i>	<i>villosa</i>	golden aster
<i>Heuchera</i>	<i>richardsonii</i>	alum root
<i>Hibiscus</i>	<i>trionum</i>	flower of an hour
<i>Hieracium</i>	<i>umbellatum</i>	hawkweed
<i>Hierochloa</i>	<i>odorata</i>	sweetgrass
<i>Hippuris</i>	<i>vulgaris</i>	mare's-tail
<i>Hordeum</i>	<i>jubatum</i>	foxtail barley
<i>Humulus</i>	<i>lupulus</i>	common hop
<i>Hymenopappus</i>	<i>filifolius</i>	fineleaf hymenopappus
<i>Hymenopappus</i>	<i>tenuifolius</i>	slimleaf hymenopappus
<i>Hyoscyamus</i>	<i>niger</i>	henbane
<i>Hypoxis</i>	<i>hirsuta</i>	yellow stargrass
<i>Iva</i>	<i>axillaris</i>	povertyweed
<i>Iva</i>	<i>xanthifolia</i>	marsh elder
<i>Juncus</i>	<i>alpinoarticulatus</i>	alpine rush
<i>Juncus</i>	<i>arcticus</i>	Baltic rush
<i>Juncus</i>	<i>bufonius</i>	toad rush
<i>Juncus</i>	<i>dudleyi</i>	Dudley's rush
<i>Juncus</i>	<i>interior</i>	inland rush
<i>Juncus</i>	<i>longistylis</i>	longstyle rush
<i>Juncus</i>	<i>nodosus</i>	knotted rush
<i>Juncus</i>	<i>torreyi</i>	Torrey's rush
<i>Juniperus</i>	<i>communis</i>	dwarf juniper
<i>Juniperus</i>	<i>horizontalis</i>	creeping juniper
<i>Juniperus</i>	<i>scopulorum</i>	Rocky Mountain red cedar
<i>Koeleria</i>	<i>macrantha</i>	Junegrass
<i>Lactuca</i>	<i>ludoviciana</i>	western wild lettuce
<i>Lactuca</i>	<i>tatarica</i>	blue lettuce
<i>Lactuca</i>	<i>serriola</i>	prickly lettuce

Genus	Species	Common Name
<i>Lappula</i>	<i>squarrosa</i>	blue stickseed
<i>Lappula</i>	<i>occidentalis</i>	low stickseed
<i>Lathyrus</i>	<i>ochroleucus</i>	yellow vetchling
<i>Lathyrus</i>	<i>palustris</i>	marsh vetchling
<i>Leonurus</i>	<i>cardiaca</i>	common motherwort
<i>Lepidium</i>	<i>densiflorum</i>	peppergrass
<i>Lepidium</i>	<i>ramosissimum</i>	bushy peppergrass
<i>Leptochloa</i>	<i>fusca</i>	bearded sprangletop
<i>Lesquerella</i>	<i>alpina</i>	alpine bladderpod
<i>Lesquerella</i>	<i>ludoviciana</i>	silver bladderpod
<i>Liatris</i>	<i>ligulistylis</i>	Rocky Mountain blazing star
<i>Liatris</i>	<i>punctata</i>	dotted blazing star
<i>Lilium</i>	<i>philadelphicum</i>	wood lily
<i>Limosella</i>	<i>aquatica</i>	mudwort
<i>Linaria</i>	<i>vulgaris</i>	butter and eggs
<i>Linum</i>	<i>perenne</i>	blue flax
<i>Linum</i>	<i>rigidum</i>	stiffstem flax
<i>Linum</i>	<i>sulcatum</i>	grooved flax
<i>Linum</i>	<i>usitatissimum</i>	common flax
<i>Lipocarpa</i>	<i>drummondii</i>	Drummond's halfchaff sedge
<i>Lithospermum</i>	<i>canescens</i>	hoary puccoon
<i>Lithospermum</i>	<i>incisum</i>	narrowleaf stoneseed
<i>Lobelia</i>	<i>kalmii</i>	Kalm's lobelia
<i>Lobelia</i>	<i>spicata</i>	palespike lobelia
<i>Lolium</i>	<i>perenne</i>	perennial ryegrass
<i>Lolium</i>	<i>persicum</i>	Persian ryegrass
<i>Lomatium</i>	<i>foeniculaceum</i>	desert biscuitroot
<i>Lomatium</i>	<i>macrocarpum</i>	bigseed biscuitroot
<i>Lomatium</i>	<i>orientale</i>	northern Idaho biscuitroot
<i>Lonicera</i>	<i>dioica</i>	wild honeysuckle
<i>Lonicera</i>	<i>tatarica</i>	Tatarian honeysuckle
<i>Lotus</i>	<i>unifoliolatus</i>	prairie bird's-foot trefoil
<i>Lycium</i>	<i>barbarum</i>	matrimony vine
<i>Lycopus</i>	<i>americanus</i>	American bugleweed
<i>Lycopus</i>	<i>asper</i>	rough bugleweed
<i>Lygodesmia</i>	<i>juncea</i>	rush skeletonplant
<i>Lysimachia</i>	<i>ciliata</i>	fringed loosestrife
<i>Lysimachia</i>	<i>hybrida</i>	loosestrife
<i>Lysimachia</i>	<i>thrysiflora</i>	tufted loosestrife
<i>Machaeranthera</i>	<i>canascens</i>	canescent aster
<i>Machaeranthera</i>	<i>grindeliode</i>	goldenweed
<i>Maianthemum</i>	<i>stellatum</i>	starry false lily of the valley
<i>Malva</i>	<i>neglecta</i>	common mallow
<i>Marsilea</i>	<i>vestita</i>	pepperwort
<i>Matricaria</i>	<i>maritima</i>	wild chamomile
<i>Matricaria</i>	<i>discoides</i>	mayweed
<i>Medicago</i>	<i>lupulina</i>	black medick
<i>Medicago</i>	<i>sativa</i>	alfalfa
<i>Melilotus</i>	<i>alba</i>	white sweetclover
<i>Melilotus</i>	<i>albus</i>	white sweetclover

Genus	Species	Common Name
<i>Melilotus</i>	<i>officinalis</i>	yellow sweetclover
<i>Mentha</i>	<i>arvensis</i>	field mint
<i>Mentzelia</i>	<i>decapetala</i>	tenpetal blazingstar
<i>Mertensia</i>	<i>lanceolata</i>	prairie bluebells
<i>Mertensia</i>	<i>oblongifolia</i>	oblongleaf bluebells
<i>Mirabilis</i>	<i>hirsuta</i>	hairy four o'clock
<i>Mirabilis</i>	<i>linearis</i>	narrowleaf four o'clock
<i>Mirabilis</i>	<i>nyctaginea</i>	heartleaf four o'clock
<i>Monarda</i>	<i>fistulosa</i>	wild bergamot
<i>Monolepis</i>	<i>nuttalliana</i>	povertyweed
<i>Muhlenbergia</i>	<i>asperifolia</i>	scratchgrass
<i>Muhlenbergia</i>	<i>cuspidata</i>	plains muhly
<i>Muhlenbergia</i>	<i>racemosa</i>	marsh muhly
<i>Muhlenbergia</i>	<i>richardsonis</i>	mat muhly
<i>Musineon</i>	<i>divaricatum</i>	leafy musineon
<i>Myosurus</i>	<i>minimus</i>	mousetail
<i>Nassella</i>	<i>viridula</i>	green needlegrass
<i>Navarretia</i>	<i>intertexta</i>	woolly gilia
<i>Nepeta</i>	<i>cataria</i>	catnip
<i>Nothocalais</i>	<i>cuspidata</i>	false dandelion
<i>Oenothera</i>	<i>caespitosa</i>	gumbo lily
<i>Oenothera</i>	<i>flava</i>	yellow lavauxia
<i>Oenothera</i>	<i>nuttallii</i>	Nuttall's evening-primrose
<i>Oenothera</i>	<i>villosa</i>	common evening-primrose
<i>Oligoneuron</i>	<i>album</i>	sneezewort aster
<i>Oligoneuron</i>	<i>rigidum</i>	stiff goldenrod
<i>Onosmodium</i>	<i>molle</i>	false gromwell
<i>Opuntia</i>	<i>fragilis</i>	brittle pricklypear
<i>Opuntia</i>	<i>polyacantha</i>	plains pricklypear
<i>Orobanche</i>	<i>fasciculata</i>	clustered broomrape
<i>Orobanche</i>	<i>ludoviciana</i>	broomrape
<i>Orthocarpus</i>	<i>luteus</i>	yellow owl's-clover
<i>Osmorhiza</i>	<i>longistylis</i>	longstyle sweetroot
<i>Oxalis</i>	<i>stricta</i>	common yellow oxalis
<i>Oxytropis</i>	<i>campestris</i>	late yellow locoweed
<i>Oxytropis</i>	<i>lambertii</i>	purple locoweed
<i>Oxytropis</i>	<i>splendens</i>	showy locoweed
<i>Packera</i>	<i>cana</i>	gray ragwort
<i>Panicum</i>	<i>capillare</i>	witchgrass
<i>Panicum</i>	<i>virgatum</i>	witchgrass
<i>Parietaria</i>	<i>pennsylvanica</i>	Pennsylvania pellitory
<i>Parnassia</i>	<i>palustris</i>	northern grass-of-parnassus
<i>Paronychia</i>	<i>sessiliflora</i>	whitlowwort
<i>Pascopyrum</i>	<i>smithii</i>	western wheatgrass
<i>Pastinaca</i>	<i>sativa</i>	wild parsnip
<i>Pedimelum</i>	<i>argophyllum</i>	silver-leaf scurfpea
<i>Pedimelum</i>	<i>esculentum</i>	breadroot
<i>Penstemon</i>	<i>albidus</i>	white beardtongue
<i>Penstemon</i>	<i>angustifolius</i>	narrow beardtongue
<i>Penstemon</i>	<i>eriantherus</i>	crested beardtongue

Genus	Species	Common Name
<i>Penstemon</i>	<i>gracilis</i>	slender beardtongue
<i>Penstemon</i>	<i>nitidus</i>	smooth blue beardtongue
<i>Phalaris</i>	<i>arundinacea</i>	reed canarygrass
<i>Phleum</i>	<i>pratense</i>	timothy
<i>Phlox</i>	<i>hoodii</i>	Hood's phlox
<i>Physalis</i>	<i>heterophylla</i>	clammy groundcherry
<i>Physalis</i>	<i>virginiana</i>	Virginia groundcherry
<i>Physostegia</i>	<i>parviflora</i>	obedient plant
<i>Piptatherum</i>	<i>micranthum</i>	littleseed ricegrass
<i>Plagiobothrys</i>	<i>scouleri</i>	Scouler's popcornflower
<i>Plantago</i>	<i>elongata</i>	prairie plantain
<i>Plantago</i>	<i>eripoda</i>	alkali plantain
<i>Plantago</i>	<i>major</i>	common plantain
<i>Plantago</i>	<i>patagonica</i>	buckhorn
<i>Plantanthera</i>	<i>aquilonis</i>	northern green orchid
<i>Poa</i>	<i>arida</i>	plains bluegrass
<i>Poa</i>	<i>compressa</i>	Canada bluegrass
<i>Poa</i>	<i>cusickii</i>	early bluegrass
<i>Poa</i>	<i>nemoralis</i>	inland bluegrass
<i>Poa</i>	<i>palustris</i>	foul bluegrass
<i>Poa</i>	<i>pratensis</i>	Kentucky bluegrass
<i>Poa</i>	<i>secunda</i>	Canby's bluegrass
<i>Polanisia</i>	<i>dodecandra</i>	clammyweed
<i>Polygala</i>	<i>alba</i>	white milkwort
<i>Polygala</i>	<i>senega</i>	Seneca snakeroot
<i>Polygala</i>	<i>verticillata</i>	whorled milkwort
<i>Polygonatum</i>	<i>biflorum</i>	smooth Solomon's seal
<i>Polygonum</i>	<i>achoreum</i>	erect knotweed
<i>Polygonum</i>	<i>amphibium</i>	swamp smartweed
<i>Polygonum</i>	<i>arenastrum</i>	common knotweed
<i>Polygonum</i>	<i>convolvulus</i>	wild buckwheat
<i>Polygonum</i>	<i>lapathifolium</i>	pale smartweed
<i>Polygonum</i>	<i>pensylvanicum</i>	Pennsylvania smartweed
<i>Polygonum</i>	<i>persicaria</i>	lady's-thumb
<i>Polygonum</i>	<i>ramosissimum</i>	bushy knotweed
<i>Populus</i>	<i>balsamifera</i>	balsam poplar
<i>Populus</i>	<i>deltoides</i>	cottonwood
<i>Populus</i>	<i>tremuloides</i>	quaking aspen
<i>Portulaca</i>	<i>oleracea</i>	common purslane
<i>Potentilla</i>	<i>arguta</i>	tall cinquefoil
<i>Potentilla</i>	<i>concinna</i>	early cinquefoil
<i>Potentilla</i>	<i>gracilis</i>	graceful cinquefoil
<i>Potentilla</i>	<i>hippiana</i>	woolly cinquefoil
<i>Potentilla</i>	<i>norvegica</i>	Norwegian cinquefoil
<i>Potentilla</i>	<i>paradoxa</i>	bushy cinquefoil
<i>Potentilla</i>	<i>pensylvanica</i>	prairie cinquefoil
<i>Potentilla</i>	<i>rivalis</i>	brook cinquefoil
<i>Prenanthes</i>	<i>racemosa</i>	prairie rattlesnakeroot
<i>Prosartes</i>	<i>trachycarpa</i>	fairybells
<i>Prunella</i>	<i>vulgaris</i>	selfheal

Genus	Species	Common Name
<i>Prunus</i>	<i>americana</i>	American plum
<i>Prunus</i>	<i>pensylvanica</i>	pin cherry
<i>Prunus</i>	<i>pumila</i>	sandcherry
<i>Prunus</i>	<i>virginiana</i>	chokecherry
<i>Pseudoroegneria</i>	<i>spicatum</i>	bluebunch wheatgrass
<i>Psoraleidium</i>	<i>lanceolatum</i>	lemon scurfpea
<i>Puccinellia</i>	<i>nuttalliana</i>	alkaligrass
<i>Quercus</i>	<i>macrocarpa</i>	bur oak
<i>Ranunculus</i>	<i>abortivus</i>	early wood buttercup
<i>Ranunculus</i>	<i>glaberrimus</i>	shiny-leaved buttercup
<i>Ranunculus</i>	<i>macounii</i>	Macoun's buttercup
<i>Ranunculus</i>	<i>rhomboideus</i>	Labrador buttercup
<i>Ratibida</i>	<i>columnifera</i>	prairie coneflower
<i>Rhamnus</i>	<i>cathartica</i>	common buckthorn
<i>Rhus</i>	<i>aromatica</i>	aromatic sumac
<i>Ribes</i>	<i>americanum</i>	wild black currant
<i>Ribes</i>	<i>aureum</i>	buffalo currant
<i>Ribes</i>	<i>hirtellum</i>	low wild gooseberry
<i>Ribes</i>	<i>oxyacanthoides</i>	bristly gooseberry
<i>Rorippa</i>	<i>palustris</i>	bog yellow cress
<i>Rosa</i>	<i>arkansana</i>	prairie rose
<i>Rosa</i>	<i>blanda</i>	smooth rose
<i>Rosa</i>	<i>woodsii</i>	Woods' rose
<i>Rubus</i>	<i>idaeus</i>	red raspberry
<i>Rudbeckia</i>	<i>hirta</i>	black-eyed susan
<i>Rumex</i>	<i>aquaticus</i>	western dock
<i>Rumex</i>	<i>crispus</i>	curly dock
<i>Rumex</i>	<i>longifolius</i>	field dock
<i>Rumex</i>	<i>maritimus</i>	golden dock
<i>Rumex</i>	<i>salicifolius</i>	Mexican dock
<i>Rumex</i>	<i>stenophyllus</i>	narrowleaf dock
<i>Ruppia</i>	<i>maritima</i>	ditchgrass
<i>Salicornia</i>	<i>rubra</i>	saltwort
<i>Salix</i>	<i>amygdaloides</i>	peachleaf willow
<i>Salix</i>	<i>bebbiana</i>	Bebb willow
<i>Salix</i>	<i>candida</i>	sageleaf willow
<i>Salix</i>	<i>discolor</i>	pussy willow
<i>Salix</i>	<i>eriocephala</i>	diamond willow
<i>Salix</i>	<i>exigua</i>	narrowleaf willow
<i>Salix</i>	<i>lucida</i>	shining willow
<i>Salix</i>	<i>pentandra</i>	laurel willow
<i>Salix</i>	<i>petiolaris</i>	meadow willow
<i>Salsola</i>	<i>tragus</i>	Russian thistle
<i>Sanicula</i>	<i>marilandica</i>	black snakeroot
<i>Saponaria</i>	<i>officinalis</i>	bouncing bet
<i>Schedonnardus</i>	<i>paniculatus</i>	tumblegrass
<i>Schizachne</i>	<i>purpurascens</i>	false melic
<i>Scolochloa</i>	<i>festucea</i>	sprangletop
<i>Scrophularia</i>	<i>lanceolata</i>	figwort
<i>Scutellaria</i>	<i>lateriflora</i>	blue skullcap

<b>Genus</b>	<b>Species</b>	<b>Common Name</b>
<i>Selaginella</i>	<i>densa</i>	small clubmoss
<i>Senecio</i>	<i>congestus</i>	swamp ragwort
<i>Senecio</i>	<i>integerrimus</i>	lambstongue ragwort
<i>Senecio</i>	<i>plattensis</i>	prairie ragwort
<i>Setaria</i>	<i>glauca</i>	yellow foxtail
<i>Setaria</i>	<i>viridus</i>	green foxtail
<i>Shepherdia</i>	<i>argentea</i>	buffaloberry
<i>Shizachyrium</i>	<i>scoparius</i>	little bluestem
<i>Silene</i>	<i>cserei</i>	smooth catchfly
<i>Silene</i>	<i>drummondii</i>	Drummond's cockle
<i>Silene</i>	<i>antirrhina</i>	sleepy catchfly
<i>Silene</i>	<i>latifolia</i>	white cockle
<i>Silene</i>	<i>vulgaris</i>	bladder campion
<i>Sinapis</i>	<i>arvensis</i>	charlock
<i>Sisymbrium</i>	<i>altissimum</i>	tumbling mustard
<i>Sisyrinchium</i>	<i>angustifolium</i>	narrowleaf blue-eyed grass
<i>Smilax</i>	<i>herbacea</i>	smooth carrionflower
<i>Solanum</i>	<i>dulcamara</i>	bittersweet
<i>Solanum</i>	<i>triflorum</i>	cutleaf nightshade
<i>Solidago</i>	<i>canadensis</i>	Canada goldenrod
<i>Solidago</i>	<i>gigantea</i>	late goldenrod
<i>Solidago</i>	<i>missouriensis</i>	prairie goldenrod
<i>Solidago</i>	<i>mollis</i>	soft goldenrod
<i>Solidago</i>	<i>nemoralis</i>	gray goldenrod
<i>Solidago</i>	<i>speciosa</i>	showy goldenrod
<i>Sonchus</i>	<i>arvensis</i>	field sowthistle
<i>Sonchus</i>	<i>asper</i>	spiny sowthistle
<i>Sonchus</i>	<i>oleraceus</i>	common sowthistle
<i>Sorghastrum</i>	<i>nutans</i>	Indiangrass
<i>Spartina</i>	<i>gracilis</i>	alkali cordgrass
<i>Spartina</i>	<i>pectinata</i>	prairie cordgrass
<i>Sphaeralcea</i>	<i>coccinea</i>	scarlet globemallow
<i>Sphenopholis</i>	<i>obtusata</i>	prairie wedgegrass
<i>Spiraea</i>	<i>alba</i>	meadowsweet
<i>Spiranthes</i>	<i>cernua</i>	nodding lady's tresses
<i>Spiranthes</i>	<i>romanzoffiana</i>	hooded lady's tresses
<i>Sporobolus</i>	<i>compositus</i>	rough dropseed
<i>Sporobolus</i>	<i>cryptandrus</i>	sand dropseed
<i>Sporobolus</i>	<i>heterolepis</i>	prairie dropseed
<i>Stachys</i>	<i>palustris</i>	hedge nettle
<i>Stellaria</i>	<i>longifolia</i>	longleaf starwort
<i>Stellaria</i>	<i>longipes</i>	longstalk starwort
<i>Stellaria</i>	<i>scarassifolia</i>	fleshy stitchwort
<i>Suaeda</i>	<i>calceoliformis</i>	sea blite
<i>Symphoricarpos</i>	<i>albus</i>	snowberry
<i>Symphoricarpos</i>	<i>occidentalis</i>	western snowberry
<i>Symphyotrichum</i>	<i>boreale</i>	rush aster
<i>Symphyotrichum</i>	<i>ciliatum</i>	rayless aster
<i>Symphyotrichum</i>	<i>ericoides</i>	white aster
<i>Symphyotrichum</i>	<i>falcatum</i>	smallflower aster

Genus	Species	Common Name
<i>Symphyotrichum</i>	<i>laeve</i>	smooth blue aster
<i>Symphyotrichum</i>	<i>lanceolatum</i>	panicked aster
<i>Symphyotrichum</i>	<i>oblongifolium</i>	aromatic aster
<i>Tanacetum</i>	<i>vulgare</i>	common tansy
<i>Taraxacum</i>	<i>laevigatum</i>	rock dandelion
<i>Taraxacum</i>	<i>officinale</i>	dandelion
<i>Teucrium</i>	<i>canadense</i>	American germander
<i>Thalictrum</i>	<i>dasycarpum</i>	purple meadowrue
<i>Thalictrum</i>	<i>venulosum</i>	early meadowrue
<i>Thermopsis</i>	<i>rhombifolia</i>	golden pea
<i>Thinopyrum</i>	<i>intermedium</i>	intermediate wheatgrass
<i>Thlaspi</i>	<i>arvense</i>	penny cress
<i>Townsendia</i>	<i>exscapa</i>	stemless Townsend daisy
<i>Toxicodendron</i>	<i>radicans</i>	poinson ivy
<i>Tradescantia</i>	<i>bracteata</i>	spiderwort
<i>Tragopogon</i>	<i>dubius</i>	goatsbeard
<i>Trifolium</i>	<i>hybridum</i>	alsike clover
<i>Trifolium</i>	<i>pratense</i>	red clover
<i>Trifolium</i>	<i>repens</i>	white clover
<i>Ulmus</i>	<i>americana</i>	American elm
<i>Ulmus</i>	<i>pumila</i>	Siberian elm
<i>Urtica</i>	<i>dioica</i>	stinging nettle
<i>Vaccaria</i>	<i>hispanica</i>	cowherb
<i>Verbena</i>	<i>bracteata</i>	bracted vervain
<i>Verbena</i>	<i>hastata</i>	blue vervain
<i>Verbena</i>	<i>stricta</i>	hoary vervain
<i>Verbena</i>	<i>urticifolia</i>	white vervain
<i>Veronica</i>	<i>anagallis-aquatic</i>	water speedwell
<i>Veronica</i>	<i>fasciculata</i>	ironweed
<i>Veronica</i>	<i>peregrina</i>	purslane speedwell
<i>Veronica</i>	<i>scutellata</i>	marsh speedwell
<i>Viburnum</i>	<i>lentago</i>	nannyberry
<i>Vicia</i>	<i>americana</i>	American vetch
<i>Vicia</i>	<i>villosa</i>	hairy vetch
<i>Viola</i>	<i>adunca</i>	small blue violet
<i>Viola</i>	<i>canadensis</i>	Canada violet
<i>Viola</i>	<i>nephrophylla</i>	meadow violet
<i>Viola</i>	<i>nuttallii</i>	Nuttall's violet
<i>Viola</i>	<i>pedatifida</i>	prairie violet
<i>Vitis</i>	<i>vulpina</i>	wild grape
<i>Vulpia</i>	<i>octoflora</i>	sixweeks fescue
<i>Xanthium</i>	<i>strumarium</i>	cocklebur
<i>Zigadenus</i>	<i>elegans</i>	white camas
<i>Zigadenus</i>	<i>venenosus</i>	death camas
<i>Zizia</i>	<i>aptera</i>	meadow parsnip



# Appendix G

## List of Insect Species

The following list of insect species at Arrowwood NWR was developed by Dr. Ronald A. Royer, professor at Minot State University, Minot, North Dakota. A star(\*) indicates a species that has not yet been recorded at the refuge.

Common Name	Scientific Name
<b><i>Hesperiidae (Pyrginae)</i></b>	
silver-spotted skipper	<i>Epargyreus clarus</i>
common checkered skipper	<i>Pyrgus communis</i>
common sooty wing*	<i>Pholisora catullus</i>
<b><i>Hesperiidae (Hesperiinae)</i></b>	
roadside skipper	<i>Amblyscirtes vialis</i>
Delaware skipper*	<i>Anatrytone logan</i>
least skipper*	<i>Ancyloxypha numitor</i>
Arogos skipper*	<i>Atrytone arogos</i>
dusted skipper*	<i>Atrytonopsis hianna</i>
Dunn skipper	<i>Euphyes vestris</i>
common branded skipper	<i>Hesperia comma</i>
Dakota skipper*	<i>Hesperia dacotae</i>
Pawnee skipper	<i>Hesperia leonardus pawnee</i>
Ottoo skipper*	<i>Hesperia ottoe</i>
Uncas skipper*	<i>Hesperia uncas</i>
Garita skipperling	<i>Oarisma garita</i>
Hobomok skipper	<i>Poanes hobomok</i>
long dash	<i>Polites mystic</i>
Peck's skipper	<i>Polites peckius</i>
tawny-edge skipper	<i>Polites themistocles</i>
<b><i>Papilionidae</i></b>	
black swallowtail	<i>Papilio polyxenes</i>
Canadian tiger swallowtail	<i>Papilio (Pterourus) canadensis</i>
eastern tiger swallowtail*	<i>Papilio (Pterourus) glaucus</i>
<b><i>Pieridae</i></b>	
European cabbage butterfly	<i>Artogeia rapae</i>
alfalfa butterfly	<i>Colias eurytheme</i>
clouded sulphur	<i>Colias philodice</i>
Olympia marble*	<i>Euchloe olympia</i>
checkered white	<i>Pontia protodice</i>

Common Name	Scientific Name
<b><i>Lycaenidae (Lycaeninae)</i></b>	
great copper*	<i>Lycaena (Gaeides) xanthoides</i>
bronze copper	<i>Lycaena (Hyllolycaena) hyllus</i>
purplish copper	<i>Lycaena (Epidemia) helloides</i>
<b><i>Lycaenidae (Theclinae)</i></b>	
coral hairstreak	<i>Satyrrium (Harkenclenus) titus</i>
Acadian hairstreak*	<i>Satyrrium acadicum</i>
striped hairstreak	<i>Satyrrium liparops</i>
gray hairstreak	<i>Strymon melinus</i>
<b><i>Lycaenidae (Polyommatainae)</i></b>	
spring azure	<i>Celastrina ladon</i>
summer azure*	<i>Celastrina neglecta</i>
eastern tailed blue*	<i>Everes comyntas</i>
silvery blue	<i>Glaucopsyche lygdamus</i>
Melissa blue	<i>Lycaeides melissa</i>
<b><i>Nymphalidae (Heliconiinae)</i></b>	
meadow fritillary	<i>Clossiana bellona</i>
silver-bordered fritillary	<i>Clossiana selene</i>
variegated fritillary	<i>Euptoieta claudia</i>
Aphrodite fritillary	<i>Speyeria aphrodite</i>
Callippe fritillary	<i>Speyeria callippe</i>
great spangled fritillary	<i>Speyeria cybele</i>
regal fritillary*	<i>Speyeria idalia</i>
<b><i>Nymphalidae (Nymphalinae)</i></b>	
Milbert's tortoise shell	<i>Aglais milberti</i>
Gorgone checkerspot	<i>Charidryas gorgone</i>
silvery checkerspot*	<i>Charidryas nycteis</i>
mourning cloak	<i>Nymphalis antiopa</i>
northern pearl crescent	<i>Phyciodes cocyta</i>
pearl crescent	<i>Phyciodes tharos</i>
hop merchant	<i>Polygonia comma</i>
question mark	<i>Polygonia interrogationis</i>
gray comma	<i>Polygonia progne</i>
red admiral	<i>Vanessa atalanta</i>
painted lady	<i>Vanessa cardui</i>
American painted lady*	<i>Vanessa virginiensis</i>
<b><i>Nymphalidae (Limenitidinae)</i></b>	
white admiral	<i>Basilarchia a. arthemis</i>
red-spotted purple	<i>Basilarchia a. astyanax</i>
viceroys	<i>Basilarchia archippus</i>
<b><i>Nymphalidae (Apaturinae)</i></b>	
hackberry butterfly	<i>Asterocampa celtis</i>

Common Name	Scientific Name
<i>Nymphalidae (Satyrinae)</i>	
common wood nymph	<i>Cercyonis pegala</i>
inornate ringlet	<i>Coenonympha inornata</i>
northern pearly eye	<i>Enodia anthedon</i>
little wood satyr*	<i>Megisto cymela</i>
Varuna Arctic*	<i>Oeneis uhleri varuna</i>
eyed brown	<i>Satyroides eurydice</i>
<i>Danaidae</i>	
monarch	<i>Danaus plexippus</i>



# Appendix H

## *List of Potentially Occurring Amphibian and Reptile Species*

The following amphibian and reptile species potentially occur at the Arrowwood NWR, as determined by information in the USGS's GAP (geographic analysis program) database for North Dakota.

<b>Common Name</b>	<b>Scientific Name</b>
<b><i>Amphibians</i></b>	
plains spadefoot toad	<i>Scaphiopus bombifrons</i>
Woodhouse's toad	<i>Bufo woodhousei woodhousei</i>
Great Plains toad	<i>Bufo cognatus</i>
American toad	<i>Bufo americanus</i>
Canadian toad	<i>Bufo hemiophrys</i>
gray tree frog	<i>Hyla versicolor</i>
northern leopard frog	<i>Rana pipiens</i>
wood frog	<i>Rana sylvatica</i>
boreal chorus frog	<i>Pseudacris triseriata maculata</i>
tiger salamander	<i>Ambystoma tigrinum</i>
mudpuppy	<i>Necturus maculosus</i>
<b><i>Reptiles</i></b>	
northern prairie skink	<i>Eumeces septentrionalis</i>
western painted turtle	<i>Chrysemys picata bellii (gray)</i>
common snapping turtle	<i>Chelydra serpentina serpentina</i>
red-sided garter snake	<i>Thamnophis sirtalis parietalis</i>
plains garter snake	<i>Thamnophis radix</i>
northern redbelly snake	<i>Storeria occipitomaculata occipitomaculata</i>
smooth green snake	<i>Opheodrys vernalis</i>
western hognose snake	<i>Heterodon nasicus</i>



# Appendix I

## List of Bird Species

This list of resident and breeding bird species at Arrowwood NWR is based on “Birds of Arrowwood National Wildlife Refuge” (USFWS 1999).

### Legend

- c = common (certain to be seen or heard in suitable habitat)
- u = uncommon (present, but not certain to be seen)
- r = rare (may be present, but not in most years)
- = no occurrence (during specified season)
- \* = nests (species that nests at the refuge)
- # = threatened or endangered species in the United States

Common Name	Spring	Summer	Fall	Winter
<b>Loons</b>				
common loon	r	r	–	–
<b>Grebes</b>				
pied-billed grebe *	c	c	c	–
horned grebe *	u	u	u	–
red-necked grebe *	r	r	r	–
eared grebe *	c	c	c	–
western grebe *	c	c	c	–
Clark's grebe	r	r	r	–
<b>Pelicans</b>				
American white pelican	c	c	c	–
<b>Cormorants</b>				
double-crested cormorant *	c	c	c	–
<b>Herons, Egrets, and Bitterns</b>				
American bittern *	c	c	c	–
least bittern	r	r	r	–
great blue heron	c	c	c	–
great egret	u	c	c	–
snowy egret	r	r	r	–
little blue heron	r	r	r	–
cattle egret	r	r	u	–
green heron *	r	r	r	–
black-crowned night-heron *	c	c	c	–
<b>Ibises</b>				
white-faced ibis	r	–	–	–
<b>Vultures</b>				
turkey vulture	r	–	r	–
<b>Swans, Geese, and Ducks</b>				
tundra swan	c	–	c	–
greater white-fronted goose	u	r	u	–
snow goose *	c	r	c	–
Ross's goose	r	–	r	–
brant	–	–	r	–
Canada goose *	c	c	c	u
wood duck *	c	c	c	–
gadwall *	c	c	c	–

Common Name	Spring	Summer	Fall	Winter
American wigeon *	c	u	c	–
American black duck *	r	r	r	–
mallard *	c	c	r	–
blue-winged teal *	c	c	c	–
cinnamon teal *	r	r	r	–
northern shoveler *	c	c	c	–
northern pintail *	c	c	c	–
green-winged teal *	c	u	c	–
canvasback *	c	u	c	–
redhead *	c	c	c	–
ring-necked duck *	c	r	c	–
greater scaup	r	–	r	–
lesser scaup *	c	u	c	–
white-winged scoter	–	–	r	–
bufflehead	c	r	c	–
common goldeneye	c	–	u	r
hooded merganser *	c	c	c	
common merganser	c	–	c	r
red-breasted merganser	u	–	–	–
ruddy duck *	c	u	c	–
<b><i>Hawks and Eagles</i></b>				
osprey	r	–	r	–
bald eagle #	c	–	c	r
northern harrier *	c	c	c	r
sharp-shinned hawk	u	–	u	r
Cooper's hawk *	u	r	u	r
northern goshawk	r	–	r	r
broad-winged hawk	r	–	r	–
Swainson's hawk *	c	c	c	–
red-tailed hawk *	c	c	c	r
ferruginous hawk *	u	r	u	r
rough-legged hawk	c	–	c	r
golden eagle	u	r	u	u
<b><i>Falcons</i></b>				
American kestrel *	c	u	c	r
merlin	u	–	u	r
peregrine falcon #	r	–	r	r
prairie falcon	u	r	u	r
<b><i>Upland Game Birds</i></b>				
gray partridge *	c	c	c	c
ring-necked pheasant *	c	c	c	c
sharp-tailed grouse *	c	c	c	c
greater prairie chicken *	r	r	r	r
wild turkey *	u	u	u	u
<b><i>Rails and Coots</i></b>				
king rail	r	r	r	–
Virginia rail *	u	u	u	–
sora *	c	c	c	–
American coot *	c	c	c	r
common moorhen	r	–	–	–

Common Name	Spring	Summer	Fall	Winter
<b><i>Cranes</i></b>				
sandhill crane	c	r	c	—
whooping crane #	r	—	r	—
<b><i>Shorebirds</i></b>				
black-bellied plover	r	—	r	—
American golden plover	u	—	u	—
semipalmated plover	u	—	u	—
piping plover *#	r	r	r	—
killdeer *	c	c	c	—
American avocet *	c	c	c	—
greater yellowlegs	u	u	u	—
lesser yellowlegs	c	u	c	—
solitary sandpiper	u	u	u	—
willet *	c	c	c	—
spotted sandpiper *	u	u	c	—
upland sandpiper *	c	c	—	—
Hudsonian godwit	r	—	—	—
marbled godwit *	c	c	r	—
sanderling	r	—	r	—
semipalmated sandpiper	c	—	u	—
western sandpiper	c	r	c	—
least sandpiper	c	r	c	—
white-rumped sandpiper	c	—	r	—
Baird's sandpiper	c	—	u	—
pectoral sandpiper	c	—	u	—
dunlin	r	—	r	—
stilt sandpiper	u	—	u	—
buff-breasted sandpiper	r	—	—	—
short-billed dowitcher	u	u	u	—
long-billed dowitcher	c	u	c	—
common snipe *	c	u	c	—
American woodcock	r	r	r	—
Wilson's phalarope *	u	u	u	—
red-necked phalarope	u	—	u	—
<b><i>Gulls and Terns</i></b>				
Franklin's gull	c	c	c	—
Bonaparte's gull	u	—	u	—
ring-billed gull	c	c	c	—
California gull	c	c	c	—
herring gull	r	—	—	—
Caspian tern	r	—	r	—
common tern	c	c	c	—
Forster's tern *	u	u	—	—
black tern *	c	c	c	—
<b><i>Doves</i></b>				
rock dove *	c	c	c	c
mourning dove *	c	c	c	r
<b><i>Cuckoos and Roadrunners</i></b>				
black-billed cuckoo *	u	c	u	—
yellow-billed cuckoo	r	—	—	—

Common Name	Spring	Summer	Fall	Winter
<b>Owls</b>				
barn owl *	r	r	r	r
eastern screech owl *	r	c	r	u
great horned owl *	c	c	c	c
snowy owl	r	–	u	u
burrowing owl	–	r	–	–
barred owl	–	–	–	r
long-eared owl *	r	r	r	–
short-eared owl *	c	c	c	u
northern saw-whet owl	–	–	–	r
<b>Nighthawks and Nightjars</b>				
common nighthawk *	u	u	u	–
whip-poor-will	r	–	–	–
<b>Swifts</b>				
chimney swift	r	r	r	–
<b>Hummingbirds</b>				
ruby-throated hummingbird	r	u	r	–
<b>Kingfishers</b>				
belted kingfisher *	c	c	c	–
<b>Woodpeckers</b>				
red-headed woodpecker *	r	r	r	–
yellow-bellied sapsucker	u	–	u	–
downy woodpecker *	c	c	c	c
hairy woodpecker *	c	c	c	c
northern flicker *	c	c	c	r
<b>Flycatchers</b>				
olive-sided flycatcher	r	–	r	–
eastern wood pewee *	u	u	u	–
yellow-bellied flycatcher	r	–	–	–
alder flycatcher	r	–	–	–
willow flycatcher *	u	c	r	–
least flycatcher *	u	c	r	–
eastern phoebe	u	r	u	–
Say's phoebe *	u	u	u	–
great crested flycatcher	r	r	r	–
western kingbird *	c	c	c	–
eastern kingbird *	c	c	c	–
<b>Shrikes</b>				
loggerhead shrike *	u	u	r	–
northern shrike	u	–	u	u
<b>Vireos</b>				
blue-headed vireo	r	–	r	–
yellow-throated vireo	r	–	r	–
warbling vireo *	u	c	u	–
Philadelphia vireo	r	–	r	–
red-eyed vireo	u	u	u	–
<b>Jays, Magpies, and Crows</b>				
gray jay	–	–	–	r
blue jay *	c	c	c	c
black-billed magpie *	c	c	c	c
American crow *	c	u	c	u

Common Name	Spring	Summer	Fall	Winter
<b>Larks</b>				
horned lark *	c	c	c	c
<b>Swallows</b>				
purple martin *	u	c	u	—
tree swallow *	c	c	c	—
northern rough-winged swallow *	u	u	—	—
bank swallow *	c	c	u	—
cliff swallow *	c	c	c	—
barn swallow *	c	c	c	—
<b>Chickadees and Titmice</b>				
black-capped chickadee *	c	c	c	c
<b>Nuthatches</b>				
red-breasted nuthatch	u	—	u	c
white-breasted nuthatch *	u	u	c	c
<b>Creepers</b>				
brown creeper	u	—	u	u
<b>Wrens</b>				
house wren *	c	c	c	—
winter wren	r	—	—	—
sedge wren *	u	c	r	—
marsh wren *	u	c	u	—
<b>Kinglets, Bluebirds, and Thrushes</b>				
golden-crowned kinglet	r	—	r	r
ruby-crowned kinglet	u	—	u	—
eastern bluebird *	c	u	u	—
mountain bluebird	u	—	u	—
veery	u	—	u	—
gray-cheeked thrush	u	—	u	—
Swainson's thrush	c	—	u	—
hermit thrush	r	—	r	—
American robin *	c	c	c	r
<b>Mimics</b>				
gray catbird *	c	c	u	—
brown thrasher *	c	c	u	—
<b>Starlings</b>				
European starling *	u	u	u	u
<b>Pipits</b>				
American (water) pipit	u	—	u	—
Sprague's pipit *	u	u	u	—
<b>Waxwings</b>				
Bohemian waxwing	u	—	u	u
cedar waxwing *	u	c	c	u
<b>Warblers</b>				
golden-winged warbler	r	—	—	—
Tennessee warbler	c	—	u	—
orange-crowned warbler	c	—	u	—
Nashville warbler	u	—	r	—
yellow warbler *	c	c	u	—
chestnut-sided warbler	u	—	u	—
magnolia warbler	u	—	u	—
Cape May warbler	r	—	r	—
yellow-rumped warbler	c	c	r	—

Common Name	Spring	Summer	Fall	Winter
black-throated green warbler	r	–	r	–
Blackburnian warbler	r	–	r	–
pine warbler	–	r	–	–
palm warbler	c	–	u	–
bay-breasted warbler	r	–	r	–
blackpoll warbler	c	–	u	–
black-and-white warbler	c	–	u	–
American redstart	u	r	u	–
ovenbird	c	–	u	–
northern waterthrush	c	–	u	–
Connecticut warbler	r	–	–	–
mourning warbler	r	–	r	–
common yellowthroat *	c	c	c	–
Wilson's warbler	u	–	u	–
Canada warbler	r	–	r	–
yellow-breasted chat	r	–	r	–
<b>Tanagers</b>				
scarlet tanager	r	–	r	–
<b>Sparrows, Buntings, and Grosbeaks</b>				
eastern towhee	r	–	r	–
American tree sparrow	c	–	c	r
chipping sparrow *	c	c	u	–
clay-colored sparrow *	c	c	u	–
field sparrow	u	r	u	–
vesper sparrow	u	c	u	–
lark sparrow *	u	r	u	–
lark bunting *	u	u	–	–
Savannah sparrow *	c	c	u	–
grasshopper sparrow *	u	c	r	–
Baird's sparrow *	r	r	r	–
Le Conte's sparrow *	u	c	u	–
Nelson's sharp-tailed sparrow *	u	u	u	–
fox sparrow	r	–	r	–
song sparrow *	c	c	c	r
swamp sparrow	u	r	u	–
Lincoln's sparrow	c	–	u	–
white-throated sparrow	c	–	c	r
Harris' sparrow	c	–	c	r
white-crowned sparrow	c	–	c	–
dark-eyed junco	c	–	c	r
Lapland longspur	c	r	c	c
Smith's longspur	r	–	r	–
chestnut-collared longspur *	u	u	u	–
snow bunting	u	–	u	c
rose-breasted grosbeak *	u	r	u	–
indigo bunting	r	–	r	–
dickcissel *	u	u	u	–
<b>Blackbirds and Orioles</b>				
bobolink *	c	c	u	–
red-winged blackbird *	c	c	c	u
western meadowlark *	c	c	c	r
yellow-headed blackbird *	c	c	u	–

Common Name	Spring	Summer	Fall	Winter
rusty blackbird	u	–	u	r
Brewer's blackbird *	u	u	u	r
common grackle *	c	c	c	r
brown-headed cowbird *	c	c	c	–
orchard oriole *	c	u	r	–
Baltimore oriole *	c	c	u	–
<b><i>Finches</i></b>				
pine grosbeak	r	–	r	r
purple finch	u	–	u	u
house finch	r	r	r	c
red crossbill	r	–	r	u
common redpoll	u	–	u	c
hoary redpoll	–	–	–	r
pine siskin *	u	r	c	c
American goldfinch *	u	c	c	r
evening grosbeak	–	–	r	r
<b><i>Old World Sparrows</i></b>				
house sparrow *	c	c	c	c



# Appendix J

## *List of Potentially Occurring Mammal Species*

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The following mammals potentially occur at Arrowwood NWR.

Common Name	Scientific Name
masked shrew	<i>Sorex cinereus</i>
Arctic shrew	<i>Sorex arcticus</i>
pigmy shrew	<i>Microsorex hoyi</i>
northern short-tailed shrew	<i>Blarina brevicauda</i>
little brown bat	<i>Myotis lucifugus</i>
big brown bat	<i>Eptesicus fuscus</i>
eastern cottontail	<i>Sylvilagus floridanus</i>
snowshoe hare	<i>Lepus americanus</i>
white-tailed jack rabbit	<i>Lepus townsendii</i>
woodchuck	<i>Marmota monax</i>
Richardson's ground squirrel	<i>Spermophilus richardsonii</i>
thirteen-lined ground squirrel	<i>Spermophilus tridecemlineatus</i>
Franklin's ground squirrel	<i>Spermophilus franklinii</i>
eastern fox squirrel	<i>Sciurus niger</i>
northern pocket gopher	<i>Thomomys talpoides</i>
olived-backed pocket mouse	<i>Perognathus fasciatus</i>
plains pocket mouse	<i>Perognathus flavescens</i>
western harvest mouse	<i>Reithrodontomys megalotis</i>
deer mouse	<i>Peromyscus maniculatus</i>
northern grasshopper mouse	<i>Onychomys leucogaster</i>
southern red-backed vole	<i>Clethrionomys gapperi</i>
meadow vole	<i>Microtus pennsylvanicus</i>
muskrat	<i>Ondatra zibethicus</i>
meadow jumping mouse	<i>Zapus hudsonius</i>
American beaver	<i>Castor canadensis</i>
common porcupine	<i>Erethizon dorsatum</i>
coyote	<i>Canis latrans</i>
red fox	<i>Vulpes vulpes</i>
common gray fox	<i>Urocyon cinereoargenteus</i>
common raccoon	<i>Procyon lotor</i>
ermine	<i>Mustela erminea</i>
least weasel	<i>Mustela nivalis</i>
long-tailed weasel	<i>Mustela frenata</i>
mink	<i>Mustela vison</i>
American badger	<i>Taxidea taxus</i>

<b>Common Name</b>	<b>Scientific Name</b>
striped skunk	<i>Mephitis mephitis</i>
bobcat	<i>Felis rufus</i>
white-tailed deer	<i>Odocoileus virginianus</i>
moose	<i>Alces alces</i>

# Appendix K

## *Draft Compatibility Determination for Hunting*

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**Use:** Hunting

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Use**

***What is the use? Is the use a wildlife-dependent public use?***

The use would be continuation of the existing hunting program, which includes youth deer hunting, archery deer hunting, deer gun hunting, deer muzzleloader hunting, late-season upland game bird hunting (pheasant, sharp-tailed grouse, and gray partridge), late-season small game hunting (cottontail rabbit and red fox) in accordance with state and federal regulations.

***Where would the use be conducted?***

The use would be conducted over the entire refuge, with the exception of the “Closed Area,” described as section 25 and a small portion of section 36, T. 144 N., R. 65 W., Stutsman County, North Dakota. The portion of the refuge encompassing the auto tour route—the west side of Mud Lake from County

Road 44 to Humpback Road—would be closed to youth deer hunting.

***When would the use be conducted?***

Big game hunting (youth deer, archery deer, deer gun, and muzzleloader) would be allowed during the seasons established by the state. Late-season, upland game bird hunting and small game hunting would open on the day following the deer gun season. The upland game bird hunting season would close when the state season closes. The small game hunting season would close on March 31.

***How would the use be conducted?***

A state-issued unit permit would be required to hunt deer. Current refuge regulations specify that on opening day of deer gun season, hunters may not enter the refuge before legal shooting hours. Thereafter, hunters may enter the refuge, but not shoot, prior to legal shooting hours. Hunters may not reenter the refuge after harvesting their deer, unless unarmed and wearing blaze orange.

Vehicles would be allowed on trails to retrieve deer during designated retrieval times. These times would be conspicuously posted on all refuge gates where access is allowed. Absolutely no ATVs or snowmobiles would be allowed.

There are an estimated 1,200 deer hunter visits at the refuge per year and an estimated 200 upland and small game hunter visits per year.

***Why is this use being proposed?***

Hunting is one of the six wildlife-dependent, priority public uses specified in the Improvement Act. It can be allowed at the refuge without interfering with the migratory bird resource.

### **Availability of Resources**

***Resources involved in the administration and management of the use:*** None.

***Special equipment, facilities, or improvements necessary to support the use:*** None.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

## Anticipated Impacts of the Use

**Short-term impacts:** There may be temporary disturbance to nontarget wildlife near the activity. Animals surplus to populations would be removed by hunting, which may help ensure populations remain beneath the carrying capacity of available habitats.

**Long-term impacts:** Higher quality habitats capable of supporting healthy populations of wildlife would result if animal populations, especially deer, remain beneath carrying capacity.

**Cumulative impacts:** There would be no direct nor indirect cumulative impacts anticipated with this use.

## Public Review and Comment

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

## Determination

Hunting is a compatible use at Arrowwood NWR.

## Stipulations Necessary to Ensure Compatibility

Stipulations for the hunting program would be made available in the refuge's hunting "tear sheet." These stipulations specify the "Closed Area," times for which vehicle access is permitted for deer retrieval, specific season dates, and other information.

## Justification

Hunting is a traditional and legislated, wildlife-dependent, priority public use. The current staff levels are adequate to ensure the activity takes place with minimum negative impacts to the refuge and its associated wildlife. Hunting at the refuge is a legitimate and necessary wildlife management tool that can be used to keep wild animal populations at healthy levels.

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## Signature

\_\_\_\_\_  
 Kim Hanson Date  
 Project Leader, Arrowwood NWR  
 USFWS, Region 6

## Concurrence

\_\_\_\_\_  
 Richard A. Coleman, Ph.D. Date  
 Assistant Regional Director  
 National Wildlife Refuge System  
 USFWS, Region 6

## Review

\_\_\_\_\_  
 Lloyd Jones Date  
 Regional Compatibility Coordinator  
 USFWS, Region 6

## Mandatory 10- or 15-Year Reevaluation Date: 2022

\_\_\_\_\_  
 Rod Krey Date  
 Refuge Supervisor (ND, SD)  
 USFWS, Region 6

# Appendix L

## *Draft Compatibility Determination for Fishing*

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**Use:** Fishing

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Use**

***What is the use? Is the use a wildlife-dependent public use?***

The use would be a continuation of the existing fishing program. Current fishing opportunities are temporary and sporadic in nature due to the predominately low water levels in managed impoundments. However, good fishing opportunities sometimes exist. Fishing techniques include hook and line, as well as bow fishing for rough fish (carp and bigmouth buffalo). Regulations are set by the NDGF and must be observed while fishing at the refuge.

Fishing is one of the six wildlife-dependent public uses specified in the Improvement Act.

***Where would the use be conducted?***

The use would occur over the entire refuge, including all four major impoundments (Arrowwood, Mud, and Jim Lakes; and Depuy Marsh), the subimpoundments, and the bypass channel. Motorized boats would be restricted to Arrowwood and Jim lakes and motor size would be limited to a maximum of 25 horsepower. Nonmotorized boats would be allowed on all impoundments for fishing.

All areas would be open to ice fishing; however, vehicle access onto the ice would be restricted to Jim Lake as this is the only impoundment with vehicle access (a primitive boat ramp). This access is not maintained in winter months, so access would not be guaranteed.

***When would the use be conducted?***

Fishing would be permitted year-round in accordance with state regulations, with the exception of the deer gun and muzzleloader seasons. For safety reasons, fishing would not be allowed during these hunting seasons. This would be a change from the current regulations that allow (1) bank fishing and bow fishing only from May 1 to September 30, and (2) fishing the bypass channel only from June 1 to September 30.

Motorized boats would be allowed from May 1 through August 31 of each year. This would be a change from current regulations that allow the use of boats through September 30. This change is necessary because the state has, in recent years, opened an early Canada goose season and a resident-only waterfowl season in September.

***How would the use be conducted?***

Most of the access to fishing opportunities would be walk-in only. Primitive boat ramps are available on the southeast side of Arrowwood Lake in the Warbler Woodlands Watchable Wildlife Area, and on the southwest side of Jim Lake.

***Why is this use being proposed?***

Fishing is one of the six wildlife-dependent, priority public uses specified in the Improvement Act. It can be allowed at the refuge without interfering with the migratory bird resource.

### Availability of Resources

*Resources involved in the administration and management of the use:* None.

*Special equipment, facilities, or improvements necessary to support the use:* None.

*Maintenance costs:* None.

*Monitoring costs:* None.

*Offsetting revenues:* None.

### Anticipated Impacts of the Use

*Short-term impacts:* Temporary disturbance may exist to wildlife near the activity.

*Long-term impacts:* None.

*Cumulative impacts:* There would be no direct or indirect cumulative impacts anticipated with this use.

### Public Review and Comment

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

### Determination

Fishing is a compatible use at Arrowwood NWR.

### Stipulations Necessary to Ensure Compatibility

Stipulations for the fishing program would be made available in the refuge’s fishing “tear sheet.” These stipulations specify when the activities would be allowed, describe access restrictions, and outline special regulations.

### Justification

Fishing is a legislated, wildlife-dependent, priority public use. No significant adverse impacts to the wildlife resource is expected from the primary or supporting uses.

Access into the refuge would be restricted during the deer gun and muzzleloader seasons due to safety reasons.

In recent years, the state has held an early Canada goose hunting season beginning on September 1 and an early resident-only waterfowl season during the last week of September. Because of this, and the potential for disturbance of hunted species during these times, boat access would not be allowed after August 31.

### Signature

\_\_\_\_\_  
Kim Hanson Date  
Project Leader, Arrowwood NWR  
USFWS, Region 6

### Concurrence

\_\_\_\_\_  
Richard A. Coleman, Ph.D. Date  
Assistant Regional Director  
National Wildlife Refuge System  
USFWS, Region 6

### Review

\_\_\_\_\_  
Lloyd Jones Date  
Regional Compatibility Coordinator  
USFWS, Region 6

### Mandatory 10- or 15-Year Reevaluation

**Date:** 2022

\_\_\_\_\_  
Rod Krey Date  
Refuge Supervisor (ND, SD)  
USFWS, Region 6

# Appendix M

## *Draft Compatibility Determination for Commercial Fishing*

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**Use:** Commercial Fishing

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Use**

***What is the use? Is the use a wildlife-dependent public use?***

The use would be continuation of removal of rough fish (carp and bigmouth buffalo) from the areas below the Depuy Marsh spillway and downstream of the Depuy structure on the bypass channel by commercial fishermen and fisherwomen contracted and licensed by the state of North Dakota. (Reference 50 CFR 31.13.) A special use permit issued by the refuge manager would be required.

Commercial fishing is not a wildlife-dependent public use.

***Where would the use be conducted?***

This activity would be allowed where rough fish congregate and make it possible for removal.

Specifically, these areas are below the Depuy Marsh spillway and downstream of the Depuy structure on the bypass channel.

***When would the use be conducted?***

Removal of rough fish by commercial-fishing contractors would occur in the spring, usually from April to June.

***How would the use be conducted?***

Seines would be used to corral rough fish into holding pens. Fish would then be scooped into large containers, which would be emptied into holding crates. The fish would be loaded either onto a refrigerated trailer or into holding tanks on trailers for transport. A backhoe would sometimes be used to move fish containers from the boats to shore, and from shore to the trailers.

***Why is this use being proposed?***

Because the Depuy spillway and structure on the bypass channel create barriers that prevent rough fish from moving farther upstream in the spring, rough fish congregate in these areas, making them available for harvest. This situation does not presently exist anywhere else downstream of the refuge, so it is presently not feasible for this activity to occur anywhere else.

### **Availability of Resources**

***Resources involved in the administration and management of the use:*** None.

***Special equipment, facilities, or improvements necessary to support the use:*** None.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

### **Anticipated Impacts of the Use**

***Short-term impacts:*** There may be temporary disturbance to nontarget wildlife near the activity.

***Long-term impacts:*** None.

**Cumulative impacts:** There would be no direct nor indirect cumulative impacts anticipated with this use.

## Public Review and Comment

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

## Determination

Commercial fishing is a compatible use at Arrowwood NWR.

## Stipulations Necessary to Ensure Compatibility

All laws, policies, and regulations in effect must be followed. Contractors would adhere to the provisions of the state-issued harvest permit. Vehicles and equipment would be restricted to existing refuge roads, trails, and other facilities.

## Justification

The exclusion of rough fish from refuge impoundments would result in higher water clarity, which allows for better light penetration, increased aquatic plant production, improved habitat for invertebrates, and higher quality habitat for migratory birds. With proper water level management, lakes at the refuge have historically provided quality staging areas for thousands of waterfowl, especially canvasback and tundra swan.

*If the proposed use is an economic use of refuge natural resources, how would it contribute to the purposes of the refuge or the mission of the Refuge System?*

As described above, commercial fishing would contribute to the achievement of the refuge's purposes by excluding rough fish from impoundments to result in higher quality habitat for migratory birds.

## Signature

\_\_\_\_\_  
Kim Hanson Date  
Project Leader, Arrowwood NWR  
USFWS, Region 6

## Concurrence

\_\_\_\_\_  
Richard A. Coleman, Ph.D. Date  
Assistant Regional Director  
National Wildlife Refuge System  
USFWS, Region 6

## Review

\_\_\_\_\_  
Lloyd Jones Date  
Regional Compatibility Coordinator  
USFWS, Region 6

## Mandatory 10- or 15-Year Reevaluation Date: 2022

\_\_\_\_\_  
Rod Krey Date  
Refuge Supervisor (ND, SD)  
USFWS, Region 6

# Appendix N

## *Draft Compatibility Determination for Wildlife Observation and Wildlife Photography*

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**Uses:** Wildlife Observation and Wildlife Photography

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Uses**

***What are the uses? Are the uses wildlife-dependent public uses?***

The uses would be the continuation and enhancement of existing public use programs and activities of and related to wildlife observation and wildlife photography. Wildlife observation and wildlife photography would be the primary uses. Vehicle access, walk-in access (including the hiking trail), nonmotorized bicycle access, and canoe access would be supporting uses.

Wildlife observation and wildlife photography are two of the six wildlife-dependent public uses specified in the Improvement Act.

***Where would the uses be conducted?***

The uses would occur over the entire refuge, with the exception of the area surrounding the residences, shop, and equipment yard. Vehicle access would be restricted to the headquarters road, the auto tour route, and the Warbler Woodlands Road. Nonmotorized bicycle access would be restricted to existing refuge vehicle trails and not allowed on river dikes. Canoe access would be restricted to river impoundments.

***When would the uses be conducted?***

Wildlife observation and wildlife photography would be allowed year-round. However, access into the refuge would be limited during the deer gun and muzzleloader seasons; only hunters or those accompanying hunters (details are in the “tear sheet”) would be allowed at the refuge during these seasons.

The refuge manager would open and close the auto tour route and the Warbler Woodlands Road as road conditions allow. However, they would remain closed during the deer gun and muzzleloader seasons (including bicycle access). Nonmotorized bicycle access would be allowed on vehicle trails (with the exception of river dikes) as soon as conditions allow in the spring. This access would close at the beginning of deer archery season (September 1).

Canoe access to river impoundments would be allowed as soon as conditions allow in the spring; canoe access would close at the beginning of deer archery season (September 1).

***How would the uses be conducted?***

The refuge would be open for wildlife observation and wildlife photography. Their supporting use (access) would be controlled and regulated through the publication of refuge “tear sheets” and brochures, and through information posted at the kiosks. The auto tour route, the Warbler Woodlands Road, and the hiking trail would be maintained, and maybe enhanced, by refuge staff.

***Why are these uses being proposed?***

Wildlife observation and wildlife photography are two of the six wildlife-dependent, priority public uses specified in the Improvement Act. These uses and their supporting access-related uses can be allowed at the refuge without interfering with the migratory bird resource.

**Availability of Resources**

***Resources involved in the administration and management of the uses:*** None.

***Special equipment, facilities, or improvements necessary to support the uses:*** Pending funding, directional signs would be added to the trailhead. New opportunities for wildlife viewing would be investigated, with the possible development of additional trails and overlooks.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

**Anticipated Impacts of the Uses**

***Short-term impacts:*** Temporary disturbance may exist to wildlife near the activity. Direct, short-term impacts may include minor damage from traffic to refuge roads and trails when wet and muddy. Temporary disturbance may occur due to facility improvements. However, suitable habitats exist nearby and effects to wildlife would be minor and nonpermanent.

***Long-term impacts:*** None.

***Cumulative impacts:*** There would be no direct nor indirect cumulative impacts anticipated with these uses.

**Public Review and Comment**

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

**Determination**

Wildlife observation and wildlife photography, along with their supporting uses, are compatible uses at Arrowwood NWR.

**Stipulations Necessary to Ensure Compatibility**

Stipulations regarding the public use program would be made available in published refuge brochures. Dates, closed areas, and other information would be specified.

Access into the refuge would be restricted during the deer gun and muzzleloader seasons for safety reasons. Access to vehicle trails would not be allowed once archery deer season begins to conflict with other refuge users. Canoe access to river impoundments would be allowed beginning May 1 each year, and would cease to be allowed on September 1.

**Justification**

Wildlife observation and wildlife photography are legislated, wildlife-dependent public uses. No significant adverse impacts to the wildlife resource are expected from the primary or supporting uses.

Access into the refuge would be restricted during the deer gun and muzzleloader seasons for safety reasons. In recent years, the state has held an early Canada goose season beginning on September 1 and an early resident-only waterfowl season during the last week of September. Because of this, and the potential for disturbance of hunted species during these times, canoe access on river impoundments would not be allowed after August 31.

The refuge contains unique habitats and supports wildlife populations—particularly migratory birds, upland game birds, and big game animals—in excess of what can be observed on neighboring private lands. These uses promote an appreciation for the natural resources at the refuge. In addition, these uses support conservation programs at the refuge.

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**Signature**

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Kim Hanson  
Project Leader, Arrowwood NWR  
USFWS, Region 6

Date

**Concurrence**

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Richard A. Coleman, Ph.D.  
Assistant Regional Director  
National Wildlife Refuge System  
USFWS, Region 6

Date

**Review**

---

Lloyd Jones  
Regional Compatibility Coordinator  
USFWS, Region 6

Date

**Mandatory 10- or 15-Year Reevaluation****Date:** 2022

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Rod Krey  
Refuge Supervisor (ND, SD)  
USFWS, Region 6

Date



# Appendix 0

## *Draft Compatibility Determination for Interpretation and Environmental Education*

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**Uses:** Interpretation and Environmental Education

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Uses**

***What are the uses? Are the uses the wildlife-dependent public uses?***

The uses would continue and enhance the interpretation and environmental education programs. The refuge would be used as an outdoor classroom and tour site for visiting school and nonprofit groups.

Interpretation and environmental education are two of the six wildlife-dependent public uses specified in the Improvement Act.

***Where would the uses be conducted?***

Environmental education and interpretation would take place over the entire refuge. However, most activities would be on the auto tour route and at the Warbler Woodlands Watchable Wildlife Area, the

Centennial Observation Overlook, and the refuge headquarters. In addition, a learning pavilion would be constructed at the Warbler Woodland Watchable Wildlife Area for environmental education. Occasionally, small groups would be led to interior portions of the refuge such as the river dikes and impoundments.

***When would the uses be conducted?***

These activities would be held during the daytime, most frequently while school is in session (September–May). Less frequently, nonprofit groups would be hosted during the summer months.

***How would the uses be conducted?***

Refuge staff would provide the instruction and host classroom tours in most cases. When someone other than refuge personnel leads activities, a special use permit may be issued.

***Why are these uses being proposed?***

Interpretation and environmental education are two of the six wildlife-dependent, priority public uses specified in the Improvement Act. These uses can be allowed at the refuge without interfering with the migratory bird resource.

### **Availability of Resources**

***Resources involved in the administration and management of the uses:*** None.

***Special equipment, facilities, or improvements necessary to support the uses:*** Pending funding, the bathhouse located at the Warbler Woodlands Watchable Wildlife Area would be replaced with a learning pavilion that would facilitate hosting outdoor classrooms.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

### **Anticipated Impacts of the Uses**

***Short-term impacts:*** Temporary disturbance may exist to wildlife near the activities. Temporary disturbance would also occur during the remodeling of the bathhouse into the learning pavilion.

However, nearby suitable habitats exist for all wildlife species and the impacts would not be permanent.

**Long-term impacts:** These activities would increase local support of the refuge and increase knowledge of stewardship of natural resources to students young and old.

**Cumulative impacts:** There would be no direct nor indirect cumulative impacts anticipated with the continuation of these uses.

## Public Review and Comment

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

## Determination

Interpretation and environmental education are compatible uses at Arrowwood NWR.

## Stipulations Necessary to Ensure Compatibility

Interpretation and environmental education programs for visiting school and nonprofit groups would be approved by the refuge manager. The refuge manager would ensure that the timing and location of activities would not excessively disturb wildlife, particularly migratory birds that may be using the refuge at the time.

## Justification

Interpretation and environmental education are legislated, wildlife-dependent priority public uses. Other than minor disturbance, they would have no impact to the resource. These uses would contribute to the mission of the Refuge System by increasing knowledge and support of the stewardship of natural resources.

The refuge contains unique habitats and supports wildlife populations—particularly migratory birds, upland game birds, and big game animals—in excess of what can be observed on neighboring private lands. These uses promote an appreciation for natural resources and support for conservation programs at the refuge.

## Signature

\_\_\_\_\_  
 Kim Hanson Date  
 Project Leader, Arrowwood NWR  
 USFWS, Region 6

## Concurrence

\_\_\_\_\_  
 Richard A. Coleman, Ph.D. Date  
 Assistant Regional Director  
 National Wildlife Refuge System  
 USFWS, Region 6

## Review

\_\_\_\_\_  
 Lloyd Jones Date  
 Regional Compatibility Coordinator  
 USFWS, Region 6

## Mandatory 10- or 15-Year Reevaluation Date: 2022

\_\_\_\_\_  
 Rod Krey Date  
 Refuge Supervisor (ND, SD)  
 USFWS, Region 6

# Appendix P

## *Draft Compatibility Determination for Wild Food Gathering*

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**Use:** Wild Food Gathering

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Use**

***What is the use? Is the use a wildlife-dependent public use?***

The use would be the continued gathering of certain wild foods for personal use. This would include wild foods such as Juneberries, chokecherries, raspberries, asparagus, and aboveground fruits and vegetables.

Wild food gathering is not a wildlife-dependent public use.

***Where would the use be conducted?***

The entire refuge, with the exception of the area closed to all access surrounding the residences and shop, would be open to wild food gathering.

***When would the use be conducted?***

Wild food gathering would typically occur in the spring and summer. Due to safety reasons, this activity would not be allowed during the deer gun and muzzleloader seasons. However, because these seasons occur late in the year (November–December) at a time when wild foods are typically not gathered, the chances that the two uses would occur at the same time are extremely unlikely.

***How would the use be conducted?***

Those interested in gathering wild food would be allowed to access the refuge by walking. Vehicles would be allowed on the auto tour route and the road leading to the Warbler Woodlands Watchable Wildlife Area. Nonmotorized bicycles would be allowed on established vehicle trails (not including river dikes) until September 1.

***Why is this use being proposed?***

This is an existing use that could be allowed without damage to the migratory bird resource.

### **Availability of Resources**

***Resources involved in the administration and management of the use:*** None.

***Special equipment, facilities, or improvements necessary to support the use:*** None.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

### **Anticipated Impacts of the Use**

***Short-term impacts:*** Temporary disturbance may exist to wildlife near the activity.

***Long-term impacts:*** None.

***Cumulative impacts:*** There would be no direct nor indirect cumulative impacts anticipated with this use.

### Public Review and Comment

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

### Determination

Wild food gathering is a compatible use at Arrowwood NWR.

### Stipulations Necessary to Ensure Compatibility

Picking, digging, or destroying flowers, shrubs, or other vegetation would be strictly prohibited.

### Justification

Wild food gathering is a traditional use of the native vegetation in the area. Allowing this activity would increase the public's appreciation for the natural resources. It would also provide them an opportunity to enjoy other, wildlife-dependent, priority uses such as wildlife observation.

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### Signature

\_\_\_\_\_  
Kim Hanson Date  
Project Leader, Arrowwood NWR  
USFWS, Region 6

### Concurrence

\_\_\_\_\_  
Richard A. Coleman, Ph.D. Date  
Assistant Regional Director  
National Wildlife Refuge System  
USFWS, Region 6

### Review

\_\_\_\_\_  
Lloyd Jones Date  
Regional Compatibility Coordinator  
USFWS, Region 6

### Mandatory 10- or 15-Year Reevaluation Date: 2022

\_\_\_\_\_  
Rod Krey Date  
Refuge Supervisor (ND, SD)  
USFWS, Region 6

# Appendix Q

## Draft Compatibility Determination for Recreational Trapping

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**Use:** Recreational Trapping

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### Establishing and Acquisition Authorities

Migratory Bird Conservation Act, Executive Order 7168

### Refuge Purposes

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### National Wildlife Refuge System Mission

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

### Description of Use

***What is the use? Is the use a wildlife-dependent public use?***

The use would be continuation of recreational trapping under special use permit. Recreational trappers would be allowed to remove red fox, mink, beaver, muskrat, striped skunk, and other furbearers—considered pests that could potentially cause severe depredation of migratory birds.

***Where would the use be conducted?***

The entire refuge would be open to recreational trapping under special use permit only.

***When would the use be conducted?***

Recreational trapping would be allowed under the seasons and restrictions established by the state.

***How would the use be conducted?***

Recreational trapping would be allowed under special use permit only. Walk-in access and vehicle access (no snowmobiles or ATVs) may be allowed on established trails and dikes.

***Why is this use being proposed?***

Recreational trapping can be an effective method of controlling pest species. In addition, trapping can be used to control local populations of small mammalian predators that have a detrimental effect on ground-nesting migratory birds, which are trust species.

Trapping is one method to achieve management goals at the refuge while offering outdoor recreational opportunities.

### Availability of Resources

***Resources involved in the administration and management of the use:*** None.

***Special equipment, facilities, or improvements necessary to support the use:*** None.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

### Anticipated Impacts of the Use

***Short-term impacts:*** Temporary disturbance may exist to nontarget wildlife near the activity. Short-term benefits may be increased nest success of ground-nesting migratory birds due to decreased local populations of small mammalian predators. In addition, there may be increased muskrat populations due to decreased mink populations. Muskrat can be a “keystone” species, creating open-water areas within cattail-choked impoundments—or “hemi-marsh” habitat—proven to be beneficial to some migratory bird species.

***Long-term impacts:*** None

***Cumulative impacts:*** There would be no direct nor indirect cumulative impacts anticipated with this use.

## Public Review and Comment

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

## Determination

Recreational trapping is a compatible use at Arrowwood NWR.

## Stipulations Necessary to Ensure Compatibility

Recreational trapping would be allowed under special use permit only. Trapping would be conducted in accordance with state laws and regulations, in addition to refuge regulations. Only species specified on the special use permit would be permitted to be taken.

## Justification

Recreational trapping in specific areas would benefit the refuge by removing pest species such as

beaver and muskrat that can cause considerable damage to facilities such as water control structures, dikes, and dams. Such damage would hamper efforts to manage water levels in impoundments to provide maximum benefits to migratory bird species, which are trust resources.

Trapping can have short-term benefits by removing certain mammalian predators (red fox, skunk, and raccoon) that can cause severe depredation of ground-nesting birds and their nests and young.

Trapping would only be allowed under a special use permit, so that refuge personnel can closely control the timing, number of animals removed, manner in which animals are removed, and species of animals removed.

*If the proposed use is an economic use of refuge natural resources, how would it contribute to the purposes of the refuge or the mission of the Refuge System?*

As described above, recreational trapping would contribute to the achievement of the refuge's purposes by removing pest species that hamper efforts to manage for maximum benefits to migratory bird species.

## Signature

\_\_\_\_\_  
 Kim Hanson Date  
 Project Leader, Arrowwood NWR  
 USFWS, Region 6

## Concurrence

\_\_\_\_\_  
 Richard A. Coleman, Ph.D. Date  
 Assistant Regional Director  
 National Wildlife Refuge System  
 USFWS, Region 6

## Review

\_\_\_\_\_  
 Lloyd Jones Date  
 Regional Compatibility Coordinator  
 USFWS, Region 6

## Mandatory 10- or 15-Year Reevaluation Date: 2022

\_\_\_\_\_  
 Rod Krey Date  
 Refuge Supervisor (ND, SD)  
 USFWS, Region 6

# Appendix R

## *Draft Compatibility Determination for Horseback Riding*

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**Use:** Horseback Riding

**Refuge Name:** Arrowwood NWR

**County:** Stutsman and Foster counties, North Dakota

### **Establishing and Acquisition Authorities**

Migratory Bird Conservation Act, Executive Order 7168

### **Refuge Purposes**

“As a refuge and breeding ground for migratory birds and other wild life.”  
(Executive Order 7168, dated September 4, 1935)

“For use as an inviolate sanctuary, or for any other management purpose, for migratory birds.”  
(16 U.S.C. § 715d [Migratory Bird Conservation Act])

### **National Wildlife Refuge System Mission**

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

### **Description of Use**

***What is the use? Is the use a wildlife-dependent public use?***

The use would be continuation of horseback riding on selected vehicle trails under a special use permit, during daylight hours only, and during a time of year when wildlife disturbance and interference with other public use would be minimal (May through August).

This use would support two of the six wildlife-dependent public uses—wildlife observation and wildlife photography—specified in the Improvement Act.

***Where would the use be conducted?***

Horseback riding under special use permit would be restricted to existing vehicle trails, with the exception of the auto tour route, where horseback riding would not be allowed. Trails where horseback

riding would be allowed would be highlighted on a map attached to the special use permit.

***When would the use be conducted?***

Horseback riding on trails would be allowed during daylight hours only, from May through August. This period would result in the least amount of interference with other public use such as hunting in the fall. This period would also prevent wildlife disturbance during winter months when wildlife may become stressed and vulnerable to harsh weather conditions.

***How would the use be conducted?***

Horseback riding would be allowed under a special use permit only. One of the following staff would sign a special use permit: office automation clerk, project leader, deputy project leader, or assistant refuge manager. No additional facilities would be needed to support this use.

***Why is this use being proposed?***

Horseback riding on selected trails would support at least two of the wildlife-dependent priority public uses: wildlife observation and photography. The refuge contains unique habitats and supports wildlife populations—particularly migratory birds, upland game birds, and big game animals—in excess of what can be observed on neighboring private lands.

### **Availability of Resources**

***Resources involved in the administration and management of the use:*** None.

***Special equipment, facilities, or improvements necessary to support the use:*** None.

***Maintenance costs:*** None.

***Monitoring costs:*** None.

***Offsetting revenues:*** None.

### **Anticipated Impacts of the Use**

***Short-term impacts:*** Direct, short-term impacts to the resource may include minor disturbance to some wildlife species during their reproductive life cycle (territory establishment, pairing and breeding, nesting and birth, young rearing and dispersal). Minor damage to trails may result from hoof action.

**Long-term impacts:** The introduction and spread of invasive plants from horse manure may result. Invasive plant infestations would require the refuge to conduct invasive plant control and expend resources for labor, machinery, and chemicals. However, in relation to the 1,000–3,000 acres of invasive plants annually treated, any additional infestations would be minor and easily controlled.

**Cumulative impacts:** There would be no direct or indirect cumulative impacts anticipated with this use.

**Public Review and Comment**

This compatibility determination was prepared concurrently with the draft CCP and EA for the refuge. Public review and comment will be achieved concurrently with the public review and comment period for the draft CCP and EA.

**Determination**

Horseback riding on trails, with stipulations, is a compatible use at Arrowwood NWR.

**Stipulations Necessary to Ensure Compatibility**

Horseback riding would continue to be allowed only from May-August; during daylight hours only; on specific Refuge vehicle trails only; via special use permit only.

**Justification**

Horseback riding would support two of the legislated, wildlife-dependent priority public uses: wildlife observation and photography. No significant adverse impacts to the wildlife resource are expected, while the public's appreciation for and support of natural resource conservation would be enhanced.

**Signature**

\_\_\_\_\_  
 Kim Hanson Date  
 Project Leader, Arrowwood NWR  
 USFWS, Region 6

**Concurrence**

\_\_\_\_\_  
 Richard A. Coleman, Ph.D. Date  
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**Review**

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**Mandatory 10- or 15-Year Reevaluation Date: 2022**

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 Rod Krey Date  
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# Appendix S

## *Economic Analysis*

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### **Regional Economic Effects of Current and Proposed Management —Alternatives for Arrowwood National Wildlife Refuge**

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#### **Introduction**

The National Wildlife Refuge System Improvement Act of 1997 requires all units of the National Wildlife Refuge System to be managed under a Comprehensive Conservation Plan (CCP). The CCP must describe the desired future conditions of a Refuge and provide long range guidance and management direction to achieve Refuge purposes. Arrowwood National Wildlife Refuge (NWR), located along the James River in east central North Dakota, is in the process of developing a range of management goals, objectives, and strategies for the CCP. The CCP for Arrowwood NWR must contain an analysis of expected effects associated with current and proposed Refuge management strategies.

Special interest groups and local residents often criticize a change in Refuge management, especially if there is a perceived negative impact to the local economy. Having objective data on income and employment impacts may show that these economic fears are overstated. Quite often, residents do not realize the extent of economic benefits a Refuge provides to a local community, yet at the same time overestimate the impact of negative changes. Spending associated with Refuge recreational activities such as wildlife viewing and hunting can generate considerable tourism activity for the regional economy. Additionally, Refuge personnel typically spend considerable amounts of money purchasing supplies in the local lumber and hardware stores, repairing equipment and purchasing fuel at the local service stations, as well as reside and spend their salaries in the local community.

The purpose of this study was to provide the economic analysis needed for the Arrowwood NWR CCP by evaluating the regional economic impacts associated with the Arrowwood NWR Draft CCP management strategies. For Refuge CCP planning, an economic impact analysis describes how current (No Action Alternative) and proposed management activities (alternatives) affect the local economy. This type of analysis provides two critical pieces of information: 1) it illustrates a refuge's contribution to the local community; and 2) it can help in determining whether local economic effects are or are not a real concern in choosing among management alternatives. Refuge personnel provided the information needed to analyze the economic impacts of the three alternatives evaluated in the draft CCP.

This report first provides a description of the local community and economy near the Refuge. An analysis of current and proposed management strategies that could affect the local economy is then presented. The Refuge management activities of economic concern in this analysis are Refuge personnel staffing and Refuge spending within the local community, and spending in the local community by Refuge visitors.

## Regional Economic Setting

Arrowwood NWR occupies 14 miles of the James River Valley in Foster and Stutsman Counties approximately 30 miles north of Jamestown, North Dakota. Jamestown (Stutsman County) and Carrington (Foster County) are the primary communities near the Refuge. According to Tour North Dakota (2004), one of the greatest assets of the area is the quality of life enjoyed by its residents.

### Population, Employment, and Income

In 2000, the population of North Dakota was 642,200 with an average density of 9.3 persons/square mile (U.S. Census 2002). Stutsman County accounted for 3.4% of North Dakota's total population in the year 2000, with a population of 21,908 residents averaging 9.9 persons per square mile (U.S. Census 2002). Jamestown, the county seat, is located in the south end of Stutsman County with a population of 15,571 people. Located in the valley where the James and Pipestem Rivers meet, Jamestown offers a variety of recreational opportunities: from summer activities such as fishing, hunting, and golfing to winter activities such as ice fishing, snowmobiling, and cross-country skiing (Jamestown, ND 2004).

Foster County located just north of Stutsman County, is one of the smallest of the state's 53 counties, 18 miles by 36 miles in dimension. Foster County accounted for less than one percent (0.5%) of North Dakota's total population in the year 2000, with a population of 3,759 residents averaging 5.9 persons per square mile (U.S. Census 2002). Carrington, the main town in Foster County, is commonly referred to as the 'Central City' for its location central to the four major North Dakota cities of Bismarck, Fargo, Minot and Grand Forks. With its outstanding leadership, community commitment, location and updated infrastructure, Carrington has been recognized as the most dynamic community in North Dakota with a population under 2500 (Carrington North Dakota, 2004).

While the state of North Dakota experienced a relatively low 0.5 % population increase from 1990 to 2000, Stutsman County's population increased by 3.0% while Foster County's population decreased 6.0% over the same time frame. Approximately 78% of Foster County and 81% of Stutsman County population 25 years and older have high school diplomas, while 20% were college graduates (US Census Bureau, 2002).

Based on population origin estimates from the 2000 Census, 1.2% of the state population consists of persons of Hispanic or Latino origin, 91.7% of white persons not of Hispanic/Latino origin, 5.0% of American Indian and Alaska Native Persons, 0.6% of Black or African American persons, and 0.6% of Asian persons. Population origin in Foster and Stutsman Counties were similar to the state population (US Census Bureau, 2002). The predominant immigrant cultures in the region include Scandinavian, German, Ukrainian and Icelandic (Tour North Dakota, 2004).

The majority of Stutsman and Foster counties are rural with agriculture as the main industry (U.S. Department of Commerce, 2002). Like most North Dakota communities, Jamestown and Carrington can trace their development to the arrival of the railroad (Tour North Dakota, 2004). Agriculture formed the basis for the region's early economy and still is an important component today. According to the U.S. Department of Commerce (2002), total farm self employment accounted for 8.3% of total employment in North Dakota (8.3% of Stutsman County and 13.8% in Foster County) in 2000. Besides agriculture, the other major local and state employers are service related businesses, government, and retail trade (Table 1).

**Table 1.** Industry breakdown of full time and part time employment for 2000.

Industry	Foster County (% of County total)	Stutsman County (% of County total)	State of North Dakota (% of State total)
Ag. Services, forestry, & fishing	(D)*	(D)	1.5
Mining	(D)	(D)	1.0
Construction	4.2	3.7	5.2
Manufacturing	(D)	9.6	5.9
Transport/utilities	5.1	5.9	5.3
Wholesale trade	5.1	3.9	5.1
Retail trade	14.7	17.8	16.5
Insurance/real estate	4.4	5.6	6.2
Services	24.2	29.1	28.0
Government	11.4	14.0	17.2

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 2002. \*(L) less than 10 jobs, but the estimates for this item are included in the totals.

Major employers in Jamestown include health providers, education, and aerospace products manufacturing (U.S. Census, 2002). Carrington's business community is diversified, including agriculture, manufacturing, financial, retail, and technology-based endeavors (Carrington North Dakota, 2004). Carrington serves as the center of an important corridor of agribusiness (Dietz, 2003). Carrington is home to state-of-the-art Dakota Growers Pasta Company, which markets premium quality pasta worldwide (Carrington North Dakota, 2004).

Foster County per capita personal income was \$25,138 in 2000, which very close to the state average of \$25,109. Meanwhile, Stutsman County per capita personal income was \$23,686, which was \$1,423 lower than the state average (U.S. Dept. of Commerce, 2002). Total personal income was \$94 million in Foster County and \$517 million for Stutsman County in 2000 (U.S. Dept. of Commerce, 2002).

### **Economic Impacts of Current and Proposed Management Activities**

For the purposes of an economic impact analysis, a region (and its economy) is typically defined as all counties within a 30-60 mile radius of the impact area. Only spending that takes place within this local area is included as stimulating the changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. Based on the relative self-containment in terms of retail trade, Stutsman and Foster Counties were assumed to comprise the economic region for this analysis.

Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on income. Economic input-output models are commonly used to determine how economic sectors would and would not be affected by demographic, economic, and policy changes. The economic impacts of the management alternatives for Arrowwood NWR were estimated using IMPLAN, a regional input-output modeling system developed by the USDA Forest Service (Olson and Lindall, 1996). IMPLAN is a computerized database and modeling system that provides a regional input-output analysis of economic activity in terms of 10 industrial groups involving as many as 528 sectors (Olson and Lindall, 1996). The year 2000

Stustman and Foster County IMPLAN data profiles were used in this study. IMPLAN estimates for employment include both full time and part time workers, which are measured in total jobs.

The IMPLAN model draws upon data collected by the Minnesota IMPLAN Group from multiple federal and state sources including the Bureau of Economic Analysis, Bureau of Labor Statistics, and the U.S. Census Bureau (Olson and Lindall 1999).

Because of the way industries interact in an economy, a change in the activity of one industry affects activity levels in several other industries. For example, if more visitors come to an area, local businesses would purchase extra labor and supplies to meet the increase in demand for additional services. The income and employment resulting from visitor purchases from local businesses represent the *direct* effects of visitor spending within the economy. In order to increase supplies to local businesses, input suppliers must also increase their purchases of inputs from other industries. The income and employment resulting from these secondary purchases by input suppliers are the *indirect* effects of visitor spending within the county. The input supplier's new employees use their incomes to purchase goods and services. The resulting increased economic activity from new employee income is the *induced* effect of visitor spending. The indirect and induced effects are known as the secondary effects of visitor spending. Multipliers capture the size of the secondary effects, usually as a ratio of total effects to direct effects (Stynes 1998). The sums of the direct and secondary effects describe the total economic impact of visitor spending in the local economy.

Regional economic effects from the IMPLAN model are reported in the following categories:

- **Employment** represents the change in number of jobs generated in the region from a change in regional output. IMPLAN estimates for employment include both full time and part time workers, which are measured in total jobs.
- **Personal income** represents the change in employment income in the region that is generated from a change in regional output.

### **Refuge Staffing and Budgeting**

Refuge employees reside and spend their salaries on daily living expenses in communities near the Refuge thereby generating impacts within the local economy. Household consumption expenditures consist of payments by individuals/households to industries for goods and services used for personal consumption. The IMPLAN modeling system contains household consumption spending profiles that account for average household spending patterns by income level. These profiles also capture average annual savings and allow for leakage of household spending to outside the region. Table 2 presents the current and proposed staffing needs for each management alternative. As shown in Table 2, current staffing (Alternative I) at the Refuge consists of ten permanent full time employees and one half time employee. The current staff accounted for an annual payroll (including salaries and benefits) of \$706,000 in 2004. Additional annual funding needed for the proposed personnel/staffing is anticipated to cost \$1,029,800 for Alternative II and \$1,099,400 for Alternative III (Table 2).

**Table 2.** Current and Proposed Staff by Management Alternative

	<b>Alternative I - Current Management</b>	<b>Alternative II - Enhanced Refuge Management</b>	<b>Alternative III - Enhanced Refuge and Watershed Management</b>
Management Staff	Project Leader* Deputy Proj. Leader* Refuge Oper. Spec.*	Project Leader* Deputy Proj. Leader* Refuge Oper. Spec. * Refuge Oper. Spec.	Project Leader* Deputy Proj. Leader* Refuge Oper. Spec. * Refuge Oper. Spec.
Biological Staff	Wildlife Biologist*	Wildlife Biologist* Biological Tech Biological Tech	Wildlife Biologist* Biological Tech F/W Biologist Biological Tech
Public Use Staff	Outdoor Rec. Planner (½ time, shared w/Long Lake)	Outdoor Rec. Planner Park Ranger	Outdoor Rec. Planner Park Ranger
Admin Staff	Admin. Officer* Clerk*	Admin. Officer* Clerk*	Admin. Officer* Clerk*
Maintenance Staff	Engineer. Equip. Op. Tractor Operator	Engineer. Equip. Op. Tractor Operator Maintenance Worker Maintenance Worker	Engineer. Equip. Op. Tractor Operator Maintenance Worker Maintenance Worker
Fire Staff	Fire Manage. Officer* Fire Tech*	Fire Manage. Officer* Fire Tech* Seasonal Range Tech	Fire Manage. Officer* Fire Tech* Seasonal Range Tech
Staff Salary & Benefits	\$706,000	\$1,029,800	\$1,099,400

\*Shared with other stations in Arrowwood Complex Management

Table 3 shows the economic impacts associated with current and proposed management with local staff salary. The current level (Alternative I) spending of salaries by Refuge personnel directly accounts for 5.7 jobs and \$107,600 in personal income. The associated indirect and induced effects generate an additional 1.8 jobs and \$37,400 in personal income throughout the local economy for a total economic impact of 7.5 jobs and \$145,000 associated with the current level of spending of salaries by Refuge personnel (Table 3). Due to the increased staffing levels for Alternatives II and III (Table 2), the associated economic effects generate more jobs and income than Alternative I.

**Table 3.** Local economic impacts of salary spending by refuge personnel (2004\$).

Stutsman and Foster Counties	Alternative I	Alternative II	Alternative III
Salary Spending Impacts			
<b>Direct Effects</b>			
Income (\$/year)	\$107,600	\$156,900	\$167,600
Jobs	5.7	8.4	8.9
<b>Indirect and Induced Effects</b>			
Income (\$/year)	\$37,400	\$54,600	\$58,300
Jobs	1.8	2.6	2.8
<b>Total Effects</b>			
Income (\$/year)	\$145,000	\$211,500	\$225,900
Jobs	7.5	11.0	11.7

In addition to providing salaries and benefits, the Refuge purchased goods and services (non salary expenditures) totaling \$248,100 in 2004, approximately 60% of which was spent locally in Stutsman and Foster Counties. Base operational funding for FY 2004 totaled \$1,079,900 with additional funds for annual maintenance, deferred maintenance, small equipment, and fire program, the total was \$1,527,200. This current budget represents the minimum required to maintain existing programs but does not adequately support planned habitat management, biological monitoring, public use and education programs, and maintenance of all Refuge facilities and structures. Annual non salary expenditures are anticipated to cost \$343,200 for Alternative II and \$366,500 for Alternative III. For Alternatives II and III, it is assumed that approximately 60% of non salary expenditures would still be spent locally in Stutsman and Foster Counties. Table 4 summarizes the anticipated annual expenditures by management alternative.

**Table 4.** Refuge staffing and budgeting expenditures by management alternative (2004\$).

	Annual Expenditures by Alternative		
	I	II	III
Salary	\$706,000	\$1,029,800	\$1,099,400
Non salary	\$248,100	\$343,200	\$366,500
Total	\$954,100	\$1,373,000	\$1,465,900

Table 5 shows the economic impacts associated with current and proposed management non salary spending in Stutsman and Foster Counties. For each alternative, it is assumed that 60% of the non salary expenditures reported in Table 4 are spent locally in Stutsman and Foster Counties. The current level (Alternative I) of Refuge non salary expenditures directly accounts for 5.9 jobs and \$70,500 in personal income. The associated indirect and induced effects generate an additional 1.6 jobs and \$35,700 in personal income throughout the economy of Stutsman and Foster Counties for a total local economic impact of 7.5 jobs and \$106,200 in personal income associated with the current level of Refuge non salary spending in the local economy. Due to the increased non-salary spending levels for Alternatives II and III (Table 4), the associated economic effects generate more jobs and income than Alternative I.

**Table 5.** Local economic impacts of Refuge non salary expenditures (2004\$).

Stutsman and Foster Counties	Alternative I	Alternative II	Alternative III
Non Salary Impacts <i>(60% of total non salary expenditures spent locally)</i>			
<b>Direct Effects</b>			
Income (\$/year)	\$70,500	\$97,600	\$104,200
Jobs	5.9	8.2	8.8
<b>Indirect and Induced Effects</b>			
Income (\$/year)	\$35,700	\$49,400	\$52,800
Jobs	1.6	2.2	2.3
<b>Total Effects</b>			
Income (\$/year)	\$106,200	\$147,000	\$157,000
Jobs	7.5	10.4	11.1

Table 6 presents the combined economic impacts associated with Refuge non salary purchases and spending of salaries by Refuge staff members within the community. Refuge management activities currently generate 15 jobs and \$251,300 in personal income in the local economy. Alternatives II would generate an additional 6.4 jobs and \$107,300 in personal income as compared to Alternative I. Alternative III would generate an additional 7.8 jobs and \$131,700 more in personal income than Alternative I.

**Table 6.** Combined impacts from Refuge management activities (2004\$).

Stutsman and Foster Counties	Alternative I	Alternative II	Alternative III
Total salary spending and budgeting impacts			
<b>Direct Effects</b>			
Income (\$/year)	\$178,100	\$254,500	\$271,800
Jobs	11.6	16.6	17.7
<b>Indirect and Induced Effects</b>			
Income (\$/year)	\$73,100	\$104,000	\$111,100
Jobs	3.4	4.8	5.1
<b>Total Effects</b>			
Income (\$/year)	\$251,200	\$358,500	\$382,900
Jobs	15.0	21.4	22.8

### Recreation Activities

North Dakota is widely considered a top bird-watching destination, with more National Wildlife Refuges than any other state (North Dakota Legendary 2002). Arrowwood NWR offers visitors a variety of recreation opportunities including an auto tour route, nature trails, wildlife observation and photography, upland and big game hunting, fishing, environmental education, and interpretation. A tourist usually buys a wide range of goods and services while visiting an area. Major visitor expenditure categories include lodging, food, and supplies.

To determine the local economic impacts of visitor spending, only spending by persons living outside the local area is included in the analysis. The rationale for excluding local visitor spending is two fold. First, money flowing into Stutsman and Foster Counties from visitors living outside is considered new money injected into the local economy. Second, if residents of Stutsman and Foster Counties visit Arrowwood NWR more or less due to the management changes, they would correspondingly change their spending of money elsewhere in the local area, resulting in no net change to the economy of Stutsman and Foster Counties. These are standard assumptions made in most regional economic analyses at the local level.

Refuge visitors were divided by type of visitor activity and place of residence (local Stutsman and Foster County residents, non local North Dakota residents, and nonresidents). Arrowwood NWR annual visitation was estimated based on the 2003 Refuge annual visitation estimates. The Refuge bases visitation estimates on visitors entering the Visitor Center/Office and general observation. Estimates on the percentage of visitors by place of residence were provided by Refuge personnel. Table 7 summarizes estimated Refuge visitation by type of visitor activity and percentage of visitors by place of residence.

**Table 7.** Estimated annual refuge visitation by visitor activity and place of residence.

	<b>Total # of Visitors</b>	<b>Percentage (%) of Local Stutsman and Foster County Visitors</b>	<b>Percentage (%) of Non Local North Dakota Visitors</b>	<b>Percentage (%) of Nonresident Visitors (live outside of North Dakota)</b>
Total Estimated Visitors	5,157			
Non-Consumptive Users				
Nature Trails	3,087	70	15	15
Observation Platforms	75	70	15	15
Other Wildlife Observation (grouse blind & roadside)	125	75	13	12
Water Use	60	95	3	2
Other (wild food gathering, horseback riding, bicycling, etc)	275	98	1	1
Hunting				
Upland Game	200	90	5	5
Big Game	1,250	80	10	10
Fishing	85	90	5	5

The next step in estimating total visitor spending is the development of visitor spending profiles. Average daily travel related expenditure profiles for various recreation activities derived from the 1996 National Survey of Hunting, Fishing and Wildlife Related Recreation (U.S. Dept. of Interior 1996) by the U.S. Forest Service (Niccolucci and Winter 2002) were used in this analysis. For each type of visitor activity, the Survey reports trip related spending of state residents and non residents for several different recreational activities. State resident and nonresident spending profiles for non-consumptive wildlife recreation (observing, feeding, or photographing fish and wildlife) were used for non consumptive use visitors at Arrowwood NWR. State resident and nonresident spending profiles for big game hunting, upland game hunting, and fresh water fishing were used for Arrowwood NWR hunting and fishing related visitor activities. Because the non resident big game

hunting spending profile was not available for North Dakota, the non resident big game hunting profile for the neighboring state of Minnesota was used instead. For each visitor activity, spending is reported in the categories of lodging, food & drink, transportation, and other expenses. Total spending per day for state residents and nonresidents by visitor activity is reported in Table 8.

**Table 8.** Time spent on the refuge and spending per day for each visitor activity.

	Average state resident spending per day	Average nonresident spending per day
Non Consumptive Users	\$11	\$149
Upland game hunting	\$20	\$129
Big game hunting	\$23	\$112
Fishing	\$22	\$63

Source: Niccolucci and Winter (2002).

Visitor spending is typically estimated on an average per day (eight hours) or average per trip basis. In order to properly account for the amount of spending associated with each type of refuge visitor, it is important to determine the average length of trip. Refuge personnel provided estimates for the number of hours spent at Arrowwood NWR for each visitor activity (shown in Table 9). Because the visitor spending profiles are for an 8 hour visitor day, the number of 8 hour state resident and nonresident visitor days for each visitor activity had to be calculated. The current number of visitor days per activity is shown in Table 9.

**Table 9.** Annual number of non local visitor days per activity for Alternative I.

	Number of non local North Dakota visitors	Number of nonresident visitors	Estimated time spent at Refuge	Number of non local North Dakota resident visitor days <sup>1</sup>	Number of nonresident visitor days <sup>1</sup>
<b>Non-Consumptive</b>					
Nature Trails	463	463	2 hours	116	116
Observation Platforms	11	11	1 hours	1	1
Other Wildlife Observation	16	15	1 hours	2	2
Water Use	2	1	2 hours	0	0
Other	3	3	3 hours	1	1
<b>Hunting</b>					
Upland Game	10	10	4 hours	5	5
Big Game	125	125	6 hours	94	94
<b>Fishing</b>	4	4	4 hours	2	2
Total				222	221

<sup>1</sup>One visitor day = 8 hours.

Table 10 shows the anticipated increase in visitation levels for Alternatives II and III. For Alternatives II and III, non consumptive use visitation is expected to increase substantially. The percentage of non local resident and non resident visitation is also anticipated to increase for Alternatives II and III (Table 10). The expected number of non local resident and nonresident visitor days per activity is shown in Table 11.

**Table 10.** Anticipated annual Refuge visitation for Alternatives II and III.

	<b>Total # of Visitors</b>	<b>Percentage (%) of Local Stutsman and Foster County Visitors</b>	<b>Percentage (%) of Non Local North Dakota Visitors</b>	<b>Percentage (%) of Nonresident Visitors (live outside of North Dakota)</b>
Total Estimated Visitors	17,690			
<b>Non-Consumptive</b>				
Nature Trails	9,500	60	20	20
Observation Platforms	6,000	60	20	20
Other Wildlife Observation	250	65	18	17
Water Use	75	75	13	12
Other	500	85	8	7
<b>Hunting</b>				
Upland Game	250	90	5	5
Big Game	1,300	80	10	10
<b>Fishing</b>	85	90	5	5

**Table 11.** Annual non local visitor days for Alternatives II and III.

	<b>Number of non local North Dakota visitors</b>	<b>Number of nonresident visitors</b>	<b>Estimated time spent at Refuge</b>	<b>Number of non local North Dakota resident visitor days</b>	<b>Number of nonresident visitor days</b>
<b>Non-Consumptive</b>					
Nature Trails	1,900	1,900	2	475	475
Observation Platforms	1,200	1,200	1	150	150
Other Wildlife Observation	45	43	1	6	5
Water Use	10	9	2	2	2
Other	40	35	3	15	13
<b>Hunting</b>					
Upland Game	13	13	4	6	6
Big Game	130	130	6	98	98
<b>Fishing</b>	4	4	4	2	2
Total				754	752

<sup>1</sup>One visitor day = 8 hours.

Total visitor spending is determined by multiplying the total spending per day (Table 8) by the number of non local and non resident visitor days for each visitor activity (Tables 10 and 12). Current Refuge visitors spend about \$32,850 annually in the local economy (Stutsman and Foster Counties). Table 12 shows the economic impacts associated with current visitation and anticipated changes in visitation by management alternative. The current level (Alternative I) of visitor spending directly generates over \$6,400 in personal income and 0.4 of a job for local businesses accommodating visitors (hotels, restaurants, supply stores, and gas stations). The associated indirect and induced effects generate an additional 0.1 of a job and \$3,600 in personal income throughout the

local economy for a total local economic impact of one half of a job and \$10,000 in personal income associated with the current level of Refuge visitation. For Alternatives II and III, the total local economic impact would be 2 jobs and \$38,400 in personal income associated the expected increased level in Refuge visitation (Table 12).

**Table 12.** Economic impacts of Arrowwood NWR visitor spending by alternative (2004\$).

Stutsman and Foster Counties	Alternative I	Alternatives II and III
Visitor spending impacts		
<b>Direct effects</b>		
Income (\$/year)	\$6,400	\$24,500
Jobs	0.4	1.6
<b>Indirect and induced effects</b>		
Income (\$/year)	\$3,600	\$13,900
Jobs	0.1	0.4
<b>Total Effects</b>		
Income (\$/year)	\$10,000	\$38,400
Jobs	0.5	2.0

As shown in Table 12, the economic impacts associated with current Refuge visitation and anticipated changes in visitation for Alternatives II and III are limited in terms of contributing to the overall local income and employment. Any decrease in visitation associated with a change in Refuge management would not have a significant economic effect. An increase in the amount of time current visitors spend on the Refuge would increase the amount of daily spending that can be attributed to visiting the Refuge. An increase in both the length of stay on the Refuge (and in the local economy) and the number of non local residents and nonresidents visiting the Refuge could have a considerable impact on increasing the role Refuge visitors play in the local economy.

#### Economic Significance of Local Visitation

Local visitation accounts for over 75% of the total annual number of refuge visits at Arrowwood NWR. The recent FWS Banking on Nature report (Caudill and Henderson, 2005) estimated the *economic impact* and the *economic significance* associated with Arrowwood NWR. As previously discussed, an economic impact analysis only includes spending by persons living outside the local area because only money flowing into the local economic impact area from outside is considered having an economic impact on the region. An economic significance analysis evaluates the spending of local and non-local visitors to show how large a part of the local economy is connected to refuge activities. The economic significance analysis conducted by Caudill and Henderson (2005) estimated that local visitors generated a total (including direct and secondary effects) of \$14,000 in personal income and 1 job. While this can not be interpreted as income and jobs that would be lost if the refuge were not there since local residents would probably have spent their recreation money in the local economy with or without the refuge, it does show that there is a connection between the local economy and local visitation activities at Arrowwood NWR (Caudill and Henderson, 2005).

## Summary and Conclusions

Table 13 summarizes the direct and total economic impacts for all Refuge management activities by management alternative. Under current Refuge management (Alternative I), economic activity directly related to all Refuge operations generates an estimated 12 jobs and \$184,600 in personal income in Stutsman and Foster Counties. Including direct, indirect, and induced effects, all Refuge activities account for 15.5 jobs and \$261,200 in personal income in Stutsman and Foster Counties. Current Refuge management activities account for less than 1% of total income and employment in Stutsman and Foster Counties. The associated economic effects of Alternatives II and III generate more jobs and income than Alternative I because of the increased levels Refuge staffing, non salary expenditures, and higher visitation levels.

**Table 13.** Summary of all refuge management activities by alternative (2004\$).

Stutsman and Foster Counties	Alternative I	Alternative II	Alternative III
Total Refuge Staffing and Budgeting Impacts			
<b>Direct Effects</b>			
Income (\$/year)	\$178,100	\$254,500	\$271,800
Jobs	11.6	16.6	17.7
<b>Total Effects</b>			
Income (\$/year)	\$251,200	\$358,500	\$382,900
Jobs	15.0	21.4	22.8
Recreation Activities			
<b>Direct Effects</b>			
Income (\$/year)	\$6,400	\$24,500	\$24,500
Jobs	0.4	1.6	1.6
<b>Total Effects</b>			
Income (\$/year)	\$10,000	\$38,400	\$38,400
Jobs	0.5	2.0	2.0
Aggregate Impacts			
<b>Direct Effects</b>			
Income (\$/year)	\$184,500	\$279,000	\$296,300
Jobs	12.0	18.2	19.3
<b>Total Effects</b>			
Income (\$/year)	\$261,200	\$396,900	\$421,300
Jobs	15.5	23.4	24.8
<i>% of Total Local Employment</i>	<i>0.12%</i>	<i>0.18%</i>	<i>0.19%</i>

Table 14 summarizes the economic effects associated with management changes from Alternative I. Both proposed alternatives will increase employment and personal income in Stutsman and Foster Counties primarily because of proposed increases in staffing and non salary expenditures.

**Table 14.** Economic effects associated with changing from Alternative I (2004\$).

Stutsman and Foster Counties	Alternative II	Alternative III
Total salary spending and budgeting impacts		
<b>Direct effects</b>		
Income (\$/year)	+\$76,400	+\$93,700
Jobs	+5.0	+6.1
<b>Total effects</b>		
Income (\$/year)	+\$107,300	+\$131,700
Jobs	+6.4	+7.8
Recreation activities		
<b>Direct effects</b>		
Income (\$/year)	+\$18,100	+\$18,100
Jobs	+1.2	+1.2
<b>Total effects</b>		
Income (\$/year)	+\$28,400	+\$28,400
Jobs	+1.5	+1.5
Aggregate impacts		
<b>Direct Effects</b>		
Income (\$/year)	+\$94,500	+\$111,800
Jobs	+6.2	+7.3
<b>Total effects</b>		
Income (\$/year)	+\$135,700	+\$160,100
Jobs	+7.9	+9.3

## References Cited

- Caudill J., and Henderson, E., 2005, Banking on Nature 2004: The Economic Benefits to Local Communities of National Wildlife Refuge Visitation: U.S. Department of the Interior, Fish and Wildlife Service, Division of Economics, Washington D.C.
- Carrington, North Dakota, 2004, <http://www.carringtonnd.com/website/outdoor.htm>
- Dietz, Laurie, 2003, Prairie Business. March 2003. <http://www.prairiebizmag.com>
- Minnesota IMPLAN Group, Inc., 2002, Year 2000 IMPLAN Data Files. [www.implan.com](http://www.implan.com)
- Niccolucci, M., and Winter, S., 2002, Trip-related expenditures for hunting, fishing, and non-consumptive wildlife recreation activities: U.S. Forest Service, Fort Collins, Colorado.
- North Dakota Legendary, 2002, Department of Commerce, Tourism Division.  
<http://www.ndtourism.com/>
- Olson, D., and Lindall, S., 1996, IMPLAN Professional Software, Analysis, and Data Guide: Minnesota IMPLAN Group, Inc.
- Stynes, D., 1998, Guidelines for measuring visitor spending: Department of Park Recreation and Tourism Resources, Michigan State University.
- Tour North Dakota, 2004, <http://www.tour-nd.com/communities/communities.html>
- U.S. Census Bureau, 2002, [www.census.gov](http://www.census.gov)
- U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economic Information System, 2002, [www.bea.gov](http://www.bea.gov)
- U.S. Department of the Interior, 1996, National Survey of Fishing, Hunting and Wildlife-Associated Recreation, National Report: U.S. Department of the Interior, Fish and Wildlife Service. Washington, D.C.
- Welcome to Jamestown, ND., 2004, <http://www.jamestownnd.com/>

# Bibliography

- Arnold, T.W., and K.F. Higgins. 1986. Effects of shrub coverages on birds of North Dakota mixed-grass prairies. *The Canadian Field-Naturalist* 100:10–14.
- Bakker, K.K. 2003. The effect of woody vegetation on grassland nesting birds: an annotated bibliography. USFWS fact sheet.
- Bakker, K.K., D.E. Naugle, and K.F. Higgins. 2002. Incorporating landscape attributes into models for migratory grassland bird conservation. *Conservation Biology* 16:1638–1646.
- Bergman, R.D., P. Swain, and M.W. Weller. 1970. A comparative study of nesting Forster's and black terns. *Wilson Bulletin*. 82:435–444.
- Bureau of Reclamation (Reclamation). 1992. National wildlife refuges, Garrison Diversion Unit, refuge monitoring annual report. Bismarck, ND: U.S. Department of the Interior, Bureau of Reclamation, Missouri–Souris Projects.
- . 1997. Arrowwood National Wildlife Refuge —final environmental impact statement. Bismarck, ND: U.S. Department of the Interior, Bureau of Reclamation, Dakotas Area Office. [Number of pages unknown].
- Carrington, ND. 2004. <<http://www.carringtonnd.com/website/outdoor.htm>>
- Caudill, J., and E. Henderson. 2005. Banking on nature 2004: the economic benefits to local communities of national wildlife refuge visitation. Washington DC: U.S. Department of the Interior, Fish and Wildlife Service, Division of Economics.
- Central Dakota Tourism Partnership. 2004. Tour North Dakota. 2004. <<http://www.tour-nd.com/communities/communities.html>>
- Dhuey, Brian. 2004. Gun deer hunter questionnaire 2004. <<http://dnr.wi.gov/org/land/wildlife/harvest/Reports/05gundeer.pdf>> Madison, WI: Wisconsin Department of Natural Resources. 15 p.
- Dietz, Laurie, 2003, *Prairie Business*. March 2003. <http://www.prairiebizmag.com>
- Dobkin, D.S. 1992. Neotropical migrant landbirds in the Northern Rockies and Great Plains. Publication No. R1-93-34. Missoula, MT: USDA Forest Service, Northern Region.
- Duebbert, H.F. 1969. High nest density and hatching success of ducks on South Dakota CAP land. In: *Transactions of the North American Wildlife Natural Resource Conference*. 34:218–228.
- Duebbert, H.F., and J.T. Lokemoen. 1976. Duck nesting in fields of undisturbed grass–legume cover. *Journal of Wildlife Management* 40:39–49.
- Du Mont, P.A. 1940. Relation of Franklin's gull colonies to agriculture on the Great Plains. In: *Transactions of the North American Wildlife Conference* 5:183–189.
- Earnst, S.L. 1994. Tundra swan habitat preferences during migration in North Dakota. *Journal of Wildlife Management* 58(3):546–551.
- Fredrickson, L.H., and T.S. Taylor. 1982. Management of seasonally flooded impoundments for wildlife. U.S. Fish and Wildlife Service Resource Publication 148. 29 p.
- The Great Plains Flora Association. 1991. *Flora of the Great Plains*. Lawrence, KS: University Press of Kansas. 1,402 p.
- Herkert, J.R. 1995. An analysis of Midwestern breeding bird population trends: 1966–1993. *American Midland Naturalist* 134:41–50.
- Higgins, K.F., and W.T. Barker. 1982. Changes in vegetation structure in seeded nesting cover in the Prairie Pothole Region. Special Scientific Report—Wildlife No. 242. Washington DC: U.S. Department of the Interior, Fish and Wildlife Service. 27 p.
- Jamestown, ND. 2004. Welcome to Jamestown, ND. <<http://www.jamestownnd.com>>
- Johnson, Douglas H., and Maiken Winter. 1999. Reserve design for grasslands: considerations for bird populations. <<http://www.npwrc.usgs.gov/resource/birds/desgrs/index.htm>> (Version 16MAY2000) In: D. Harmon, ed. *On the frontiers of conservation: proceedings of the tenth conference on research and resource management in parks and on public lands*. The George Wright Society biennial conference, Asheville, NC. Jamestown, ND: USGS Northern Prairie Wildlife Research Center Online. p. 391–396.
- Johnson, R.G., and S.A. Temple. 1990. Nest predation and brood parasitism of tall grass prairie birds. *Journal of Wildlife Management* 54(1):106–111.
- Kantrud, H.A. 1990. Sago pondweed (*Potamogeton pectinatus* L.): a literature review. Resource Publication 176. Washington DC: U.S. Department of the Interior, Fish and Wildlife Service. [Pages unknown].
- Kantrud, H.A. 1981. Grazing intensity effects on the breeding avifauna of North Dakota native grasslands. *Canadian Field-Naturalist* 95(4):404–417.
- Kantrud, H.A., and K.F. Higgins. 1992. Nest and nest site characteristics of some ground-nesting, non-passerine birds of northern grasslands. *Prairie Naturalist* 24(2):67–84.
- Kuchler, A.W. 1964. Potential natural vegetation of the conterminous United States. *American Geographic Society*, New York. [Number of pages unknown].
- Laubhan, M.K., and J.E. Roelle. 2001. Managing wetlands for waterbirds. In: R.B. Rader, D.P. Batzer, and S. Wissinger, eds. *Biomonitoring and management of North American Freshwater*

- wetlands. [Place of publication unknown]. John Wiley and Sons, Inc. P. 387–411.
- Murphy, R.K. 1997. Importance of prairie wetlands and avian prey to breeding great horned owls (*Bubo virginianus*) in northwestern North Dakota. In: J.R. Duncan, D.H. Johnson, and H. Nicholls, eds. Biology and conservation of owls of the Northern Hemisphere. USDA Forest Service General Technical Report ND-190, p. 286–298.
- Natural Resources Conservation Service. 2006. Plants database. <<http://plants.usda.gov>> U.S. Department of Agriculture, Natural Resources Conservation Service.
- Naugle, D.E., K.F. Higgins, and K.K. Bakker. 2000. A synthesis of the effects of upland management practices on waterfowl and other birds in the Northern Great Plains of the U.S. and Canada. College of Natural Resources, University of Wisconsin–Stevens Point, Wildlife Technical Report 1, 28 p.
- Naugle, D.E., K.F. Higgins, M.E. Estey, R.R. Johnson, and S.M. Nusser. 2000. Local and landscape-level factors influencing black tern habitat suitability. *Journal of Wildlife Management* 64(1):253–260.
- Naugle, D.E., K.F. Higgins, S.M. Nusser, and W.C. Johnson. 1999. Scale-dependent habitat use in three species of prairie wetland birds. *Landscape Ecology* 14:267–276.
- Samson, F.B., and F. Knopf. 1994. Prairie conservation in North America. *Bioscience* 44:418–421.
- Sargeant, Alan B., Raymond J. Greenwood, Marsha A. Sovada, and Terry L. Shaffer. 1993. Distribution and abundance of predators that affect duck production in the Prairie Pothole Region. U.S. Fish and Wildlife Service, Resource Publication 194. Jamestown, ND: USGS Northern Prairie Wildlife Research Center. 96 p.
- Sovada, M.A., M.J. Burns, and J.E. Austin. In press. Predation of waterfowl in prairie breeding areas. Jamestown, ND: USGS, Northern Prairie Wildlife Research Center.
- U.S. Census Bureau. 2002. <[www.census.gov](http://www.census.gov)>
- U.S. Department of Commerce 2002. Bureau of Economic Analysis, Regional Economic Information System. <[www.bea.gov](http://www.bea.gov)>
- U.S. Fish and Wildlife Service (USFWS). 1995. An ecosystem approach to fish and wildlife conservation. Unpublished concept document.
- . 1996. Writing refuge management goals and objectives: a handbook. U.S. Department of the Interior, Fish and Wildlife Service, Division of Refuges. 602 FW 1-3.
- . 1999. Birds of Arrowwood National Wildlife Refuge. Pingree, ND: U.S. Department of the Interior, Fish and Wildlife Service. Updated 2004. [Number of pages unknown].
- . 2005. Integrated pest management plan for the Arrowwood NWR Complex. Pingree, ND: U.S. Department of the Interior, Fish and Wildlife Service, Arrowwood NWR. [Number of pages unknown].

