Draft Comprehensive Conservation Plan and Environmental Assessment

Bowdoin National Wildlife Refuge Complex

Montana

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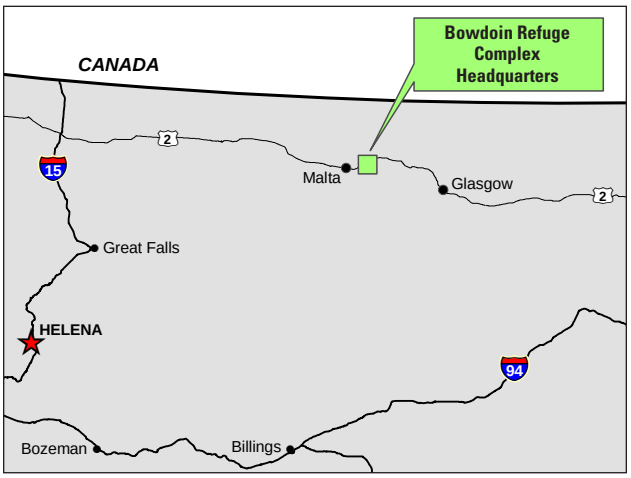
Summary

The U.S. Fish and Wildlife Service manages the Bowdoin National Wildlife Refuge Complex, which covers 84,724 acres in north-central Montana. The refuge complex is spread across Blaine, Hill, Phillips, and Valley Counties. With its headquarters near the town of Malta, the refuge complex comprises the following units:

- Bowdoin National Wildlife Refuge
- Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges (unstaffed satellite refuges)
- Bowdoin Wetland Management District—nine waterfowl production areas, refuge and flowage easements, wetland conservation easements, and grassland conservation easements

This is a summary of the draft comprehensive conservation plan and environmental assessment that the Service has prepared for the Bowdoin National Wildlife Refuge Complex. The full document contains background information and the Service's analyses of alternatives for managing the refuge complex.



The Refuge Complex

The Bowdoin National Wildlife Refuge Complex is located within the Prairie Pothole Region of the Great Plains. While the five national wildlife refuges and the wetland management district were established under different authorities, they all have the overriding purpose of providing migration, nesting, resting, and feeding habitat for migratory birds.

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Chokecherry is a native shrub in the Bowdoin National Wildlife Refuge Complex.

The refuge complex provides opportunities for the public to enjoy compatible wildlife-dependent public use activities including hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

The Planning Process

The National Wildlife Refuge System Improvement Act of 1997 requires the U.S. Fish and Wildlife Service to develop a comprehensive conservation plan by 2012 for each national wildlife refuge. The final plan for the Bowdoin Refuge Complex is scheduled for completion in 2011 and will guide the management of the refuge complex for the next 15 years.

The planning process for a comprehensive conservation plan is a series of steps including environmental analysis. The Service encourages and values the involvement of the public and partners throughout the process. The Service's planning team compiled a list of issues to consider and analyzed management alternatives for the comprehensive conservation plan that would not only address these issues but also meet the purposes, vision, and goals of the refuge complex.

There are three separate alternatives' analyses within the draft comprehensive conservation plan and environmental assessment for the refuge complex that are summarized under the "Alternatives" section of this summary:

- Divestiture (the selling or release of Service interests) of Lake Thibadeau National Wildlife Refuge
- Salinity and blowing salts at Lake Bowdoin
- Management of the remaining programs throughout the Bowdoin National Wildlife Refuge Complex

Chapter 7 contains the draft plan for the refuge complex. After the public reviews and provides comments on the draft plan and environmental assessment, the Regional Director will consider the environmental effects of each alternative including information gathered during public review. The Service's Regional Director of the Mountain–Prairie Region will select a preferred alternative for each of the three analyses.

After the planning team prepares the final CCP for publication, a notice of availability will be published in the Federal Register, and copies of the final CCP or accompanying summary will be sent to individuals on the mailing list. Subsequently, the Service will implement the CCP with help from partner agencies, organizations, and the public.

Issues

Substantive issues were identified following an internal review of refuge information and through public scoping, which was begun in 2007. The following are summaries of the issues detailed in chapter 2.

Lake Bowdoin Salinity Levels

The principle sources of water for the Bowdoin National Wildlife Refuge are precipitation, floodwater from Beaver Creek, ground water seepage, water deliveries from the Milk River Project, and irrigation return flows. The last three sources of water add dissolved solids (salinity) to the refuge. In addition, the refuge and adjoining lands are underlain by glacial till and shale containing high concentrations of soluble salts. The Milk River Project water supply on Bowdoin Refuge is limited and insufficient to improve wetland water quality. As water evaporates from Lake Bowdoin's closed system, salts have become concentrated and water salinity has increased. Historically, two methods have been used to improve Lake Bowdoin's water quality and reduce salinity levels: (1) discharges of saline water into Beaver Creek; and (2) managing Dry Lake as an evaporation basin for Lake Bowdoin's water. Neither of these methods is an environmentally feasible option for removing salts. If no action is taken to improve water quality on the refuge, the progressively increasing salinity levels in Lake Bowdoin and the blowing salts out of Dry Lake will continue to threaten migratory birds, other wildlife, wetland habitats, and, potentially, neighboring landowners and downstream irrigators.

Water Quantity, Delivery, and Cost for Bowdoin National Wildlife Refuge

The current water delivery of 3,500 acre-feet and natural sources of water have been insufficient to supply the necessary water for wildlife habitat management and for improving water quality. If the refuge is to survive as a viable migratory bird refuge, it will require additional supplies of water and the means to reduce and dispose of saline water, primarily from Lake Bowdoin.

Water Resources within Bowdoin Wetland Management District

In the wetland management district, the Korsbeck and Holm WPAs and the satellite refuges have

reservoirs that rely on the runoff from precipitation events to fill them. Since the satellite refuges were established, there has been extensive water development in the watersheds, in particular, Lake Thibadeau. Runoff is being captured or diverted upstream of these wetlands. This has decreased waterbird habitat on some of these refuges, changing some from semipermanent to seasonal wetland habitat.

Upland Habitat and Associated Wildlife

Historically, the northern Great Plains was a grassland-dominated system where fire, relatively low precipitation, and native grazers restricted natural tree growth to riparian floodplains, wooded draws, islands within lakes, and small patches downwind of wetland edges (Higgins 1986). These large expanses of treeless prairies have been fragmented by cropland, shelterbelts, and human settlement, as well as from the uncontrolled spread of nonnative Russian olive trees.

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Marbled godwit and long-billed curlew are shorebirds that nest in native prairie at the refuge complex.

Grassland bird populations are declining faster and more consistently than any other group of North American birds (Samson and Knopf 1994) due to habitat fragmentation and loss of native grasslands.

Piping Plover

Approximately 3,325 acres of Bowdoin National Wildlife Refuge has been designated as critical habitat for the threatened Great Plains population of piping plover. However, there have been no known piping plover nests on the refuge since 1999, primarily due to insufficient water supplies necessary to create attractive nesting habitat.

Invasive Plants, Nonnative Plants, and Noxious Weeds

The refuge complex is constantly challenged to maintain its native grassland habitat—critical to migratory birds—unfragmented by nonnative trees and shrubs. One of the most damaging nonnative plant species throughout the refuge complex is Russian olive. Although this tree is not designated as an invasive species in Montana, its ability to outcompete native species and fragment habitat is well documented. Russian olive trees can take over native vegetation, interfere with natural plant succession and nutrient cycling, damage water management facilities and fences, and tax water reserves. The largest infestations are on the Bowdoin Refuge and the Pearce WPA.

Crested wheatgrass is the primary invasive grass species and leafy spurge, perennial pepperweed, and Canada thistle are the primary invasive forb species. Left unmanaged these invasive plant species can have a detrimental effect on the diversity of native plants, wildlife species, and habitat quality.

Habitat Protection and Acquisition

Native prairie areas and wetlands are the most productive habitat types in Montana, particularly in the Prairie Pothole Region. Although there are laws that protect these areas, particularly wetlands, these vital habitats continue to be lost. Most of these habitat types occur on private lands. The Service has committed to work with willing landowners in Montana to compensate them for protecting these habitats, primarily through perpetual wetland or grassland conservation easements. Habitat protection needs to be evaluated through a priority system so that critical areas are identified and the most effective means of protection, through either fee title or easement, can be determined.

Visitor Services

An estimated 25,000 visitors come to explore the refuge complex annually. The refuge complex is located in north-central Montana, an area with one of the smallest population densities in the State. A major attraction for wildlife observers and hunters, the refuge complex is also popular with local school groups. For self-guided visitors, the Bowdoin National Wildlife Refuge's auto tour route offers the excellent opportunities for viewing and photographing wildlife.

There are few programs and no staff assigned to work with these visitors and students, many of whom do not know they are on a national wildlife refuge. This often results in a general lack of understanding about the mission and purposes the National Wildlife Refuge System and the refuge complex.

Operations

The Bowdoin National Wildlife Refuge Complex manages or protects 84,724 acres within a four-county area. Due to the large size of the management area, limited staff and funding, and long travel times, some lands can only be inspected once a year for maintenance and management needs. In addition, the lack of a full maintenance and biological staff limits opportunities to develop an effective habitat management program that could address some of the more challenging management issues including native grassland restoration.

Oil and Gas Development

Extraction of oil and natural gas within the Bowdoin Wetland Management District has occurred since the 1940s. When the Service acquired most refuge complex lands, the mineral rights were reserved or excepted by the landowner or the Bureau of Land Management. Hewitt Lake's establishing purposes permit oil and gas extraction.

There are currently 104 natural gas wells in production status on Service-interest lands. Annual activities on these lands include mineral exploration, well drilling and maintenance, pipeline construction and maintenance, road building, and hauling off-site of produced water. Many of these activities can fragment habitats and disturb wildlife. Production companies operating within the Bowdoin natural gas dome estimate that drilling is expected to last about 10–15 years, with a project life of 30–50 years.

Research, Inventory, and Monitoring

Research throughout the Bowdoin National Wildlife Refuge Complex has been minimal and sporadic, and some past projects have not adequately addressed management issues. As a result, some current management actions are based on outside research, not necessarily designed to address critical refuge issues, and may not follow an established management plan.

Lake Thibadeau National Wildlife Refuge

Lake Thibadeau National Wildlife Refuge was established in 1937 as what the Service now calls a limited-interest refuge. Except for the 19.4 acres reserved from public domain, the remaining refuge is private lands that are encumbered by refuge and flowage easements. These easements give the Service the right to control hunting and trapping and

USFWS

Spring water conditions in the glaciated pothole region of Phillips County, Montana (1986).

the uses of the main bodies of water including the impoundment, lakes, and streams. The Service did not buy the right to control uses of the upland areas including farming, grazing, and development.

Habitat loss has been significant over the decades. The refuge currently offers little value to wildlife, and the purposes for which this area was first established are no longer attainable. Native prairie areas that once existed are now farmed intensively. Due to upstream development, Lake Thibadeau, Grassy Lake, and Mud Lake are often dry and farmed in most years, offering no value for migratory birds.

The Future of the Refuge Complex

The vision for Bowdoin National Wildlife Refuge Complex is based on the establishing purposes of the refuge complex, resource conditions and potential, and the issues identified during the planning process. The goals were developed to meet the vision for the refuge complex.

Vision for the Refuge Complex

Under seemingly limitless skies, Bowdoin National Wildlife Refuge Complex provides vast expanses of gently rolling native mixed-grass prairie, dotted with an array of diverse wetlands.

Recognized as one of the most important migratory bird refuges in the State of Montana, these habitats are managed to ensure that grassland- and wetland-dependent waterfowl, shorebirds, songbirds, and native wildlife species thrive.

Visitors recognize these unique and wondrous qualities and experience a sense of solitude and a connection to the land that fosters a desire to conserve this and other remnants of the northern Great Plains.

Goal for Upland Habitat and Associated Wildlife

Protect, enhance, and restore grassland habitat for breeding and migratory birds and other wildlife while maintaining the biological diversity and integrity of native prairie grasslands.

Goal for Wetland Habitat and Associated Wildlife

Provide, protect, and manage wetland habitat for breeding and migratory birds and other wildlife that maintains the biological diversity and integrity of prairie pothole wetlands.

Goal for Visitor Services

Provide visitors of all abilities with wildlife-dependent recreation, interpretation, and environmental education opportunities that foster an appreciation and understanding of the unique wildlife, plant communities, and cultural resources of the Montana Prairie Pothole Region.

Goal for Partnerships

Maintain and expand partnerships that preserve, restore, and enhance healthy and productive prairie-wetland complexes on Bowdoin National Wildlife Refuge and within Bowdoin Wetland Management District.

Goal for Operations

Prioritize for wildlife first and emphasize the protection of trust resources in the use of staff, funding, partnerships, and volunteer programs.

Alternatives

This section summarizes the three analyses within the draft comprehensive conservation plan and environmental assessment.

Mike Artmann / USFWS

Salt residue covers the shoreline on the southeastern edge of Lake Bowdoin in late summer.

Salinity and Blowing Salts at Lake Bowdoin

The following goal is what the Service hopes to achieve by addressing the salinity and blowing salts issue, so it can manage the refuge to meet its establishment purposes and the overall vision for the Bowdoin National Wildlife Refuge Complex.

> **Goal:** *Develop a water management system on Bowdoin National Wildlife Refuge that would protect the environment and mitigate current and future salt-dust-blowing concerns for neighboring properties while providing quality water and wildlife habitat for migratory birds.*

A major aspect of achieving this goal would be to meet the Service's salinity objective of sustaining a brackish water quality level of approximately 7,000 mg/L of total dissolved solids (salts) in Lake Bowdoin.

The Service developed and analyzed five alternatives to address the salinity and blowing salts issue for Lake Bowdoin in the Bowdoin National Wildlife Refuge:

- Salinity alternative 1—current management (no action)
- Salinity alternative 2—evaporation ponds and removal of salt residue
- Salinity alternative 3—flushing by Beaver Creek
- Salinity alternative 4—underground injection and flushing by Beaver Creek (proposed action)
- Salinity alternative 5—pumping to Milk River

The Service is proposing alternative 4 as the best option for meeting the salinity objective for Lake Bowdoin and for achieving the salinity goal for the Bowdoin Refuge. The Service expects this proposed treatment would be highly effective in meeting the salinity goal, which would result in beneficial environmental and social consequences at a reasonable cost for addressing this persistent problem.

Lake Thibadeau National Wildlife Refuge

The Service completed an environmental analysis of two alternatives to address the situation at the Lake Thibadeau Refuge (section 3.1 in chapter 3):

- Lake Thibadeau Refuge alternative 1–current management (no action)
- Lake Thibadeau Refuge alternative 2–divestiture (proposed action)

Using the divestiture model for the Mountain–Prairie Region, the Service evaluated the habitat quality and ability of Lake Thibadeau National Wildlife Refuge to meet its purposes and support the goals of the National Wildlife Refuge System. The Service owns less than 1 percent of the lands within the 3,868-acre approved acquisition boundary; the remaining area

is private land encumbered by refuge and flowage easements.

The easements give the Service the right to manage the impoundments and the uses that occur on that water and to control hunting and trapping, but these easements do not prohibit development, grazing, or agricultural uses. Due to upstream development in the watershed, the impoundments do not receive adequate water supplies and are often dry enough to be farmed. The surrounding uplands are also farmed or heavily grazed. This loss or lack of habitat is the basis for the Service's proposed action to divest this refuge.

Alternatives for the Remaining Refuge Complex Programs

The Service developed and analyzed three alternatives as options for managing habitats and public use at Bowdoin National Wildlife Refuge Complex (chapters 3 and 5):

- Alternative A–current management (no action)
- Alternative B (proposed action)
- Alternative C

Alternative B would likely have the most effective management for providing wetland and upland habitat for migratory birds. While meeting this overriding purpose of the refuge complex by mimicking natural conditions, there would be benefits to many other wildlife species. In addition, there would be increased opportunities for visitors to learn about the migratory shorebirds and waterfowl, along with other wildlife species, that rely on so many aspects of the native prairie.

Alternative A–Current Management (No Action)

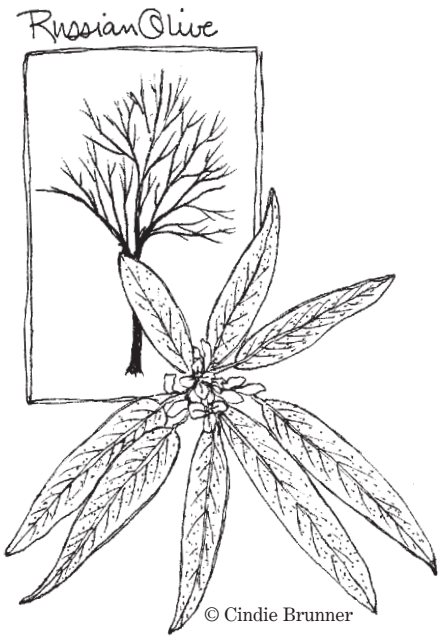
The current staff of five Service employees would continue to manage Bowdoin National Wildlife Refuge Complex primarily for migratory birds. The Service would continue to manipulate native grasslands using various management techniques including prescribed fire and grazing. Approximately 10 percent of the uplands would be grazed annually, and there would be minimal monitoring of response. As resources become available, cropland on waterfowl production areas would be restored to native grasses and forbs; however, dense nesting cover would continue to be seeded on highly erodible lands in the wetland management district. The Service would continue to use mechanical and chemical methods to control existing and new infestations of Russian olive. Larger infestations of invasive species such as crested wheatgrass would continue to be given little to no attention due to the extent of infestation and the lack of resources and staff.

The Service would continue to attempt to mimic natural conditions on managed wetlands to meet the needs of migratory water birds. The 19 ground water wells on and around Bowdoin Refuge would be monitored to collect water quality data for the refuge and the Beaver Creek Waterfowl Production Area. Lake Bowdoin and Dry Lake would continue to be managed as closed basins.

Visitor services programs including hunting, fishing, wildlife observation, photography, environmental education, and interpretation would remain at current levels.

Alternative B (Proposed Action)

The Service would conserve natural resources by restoring, protecting, and enhancing native mixed-grass prairie and maintaining quality wetland habitat for target migratory and resident birds within the Bowdoin National Wildlife Refuge Complex. Invasive and nonnative plants that are causing habitat losses and fragmentation would be controlled or eradicated. Research would be conducted to control crested wheatgrass and restore treated areas. Enhanced wetlands would be managed to mimic natural conditions for wetland-dependent migratory birds during spring and fall migrations and during the breeding and nesting season.



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Visitor services programs would be enhanced, providing additional opportunities for staff- and volunteer-led programs to provide a greater understanding of the purposes of the refuge complex, importance of conserving migratory birds and the unique mixed-grass prairie and wetlands, and an awareness of the mission of the U.S. Fish and Wildlife Service and the National Wildlife Refuge System. A sanctuary area would be created for waterfowl on the east half of the Bowdoin National Wildlife Refuge during the hunting season,

closing this to all foot traffic. A new wildlife observation site would be added on the auto tour route. The Service would work with the State to investigate the potential for offering a safe, compatible, and quality big-game hunt at Bowdoin Refuge.

The success of these additional efforts and programs would depend on added staff, research, and monitoring programs, including additional operations funding, infrastructure, and new and expanded partnerships.

Alternative C

This alternative includes most of the elements in alternative B. In addition, the Service would improve the water management infrastructure (for example, water delivery systems, dikes, and levees to manipulate individual wetland) to create a more diverse and productive wetland complex. Biological staff would monitor the level of sedimentation occurring in natural wetlands and plan for its removal to restore the biological integrity of these wetlands.

Through partnerships, the Service would increase the acres of invasive species treated annually with an emphasis on preventing further encroachment of crested wheatgrass and Russian olive trees into native grassland. The refuge complex would serve as a conservation-learning center for the area. Public access would be improved to Creedman Coulee Refuge.

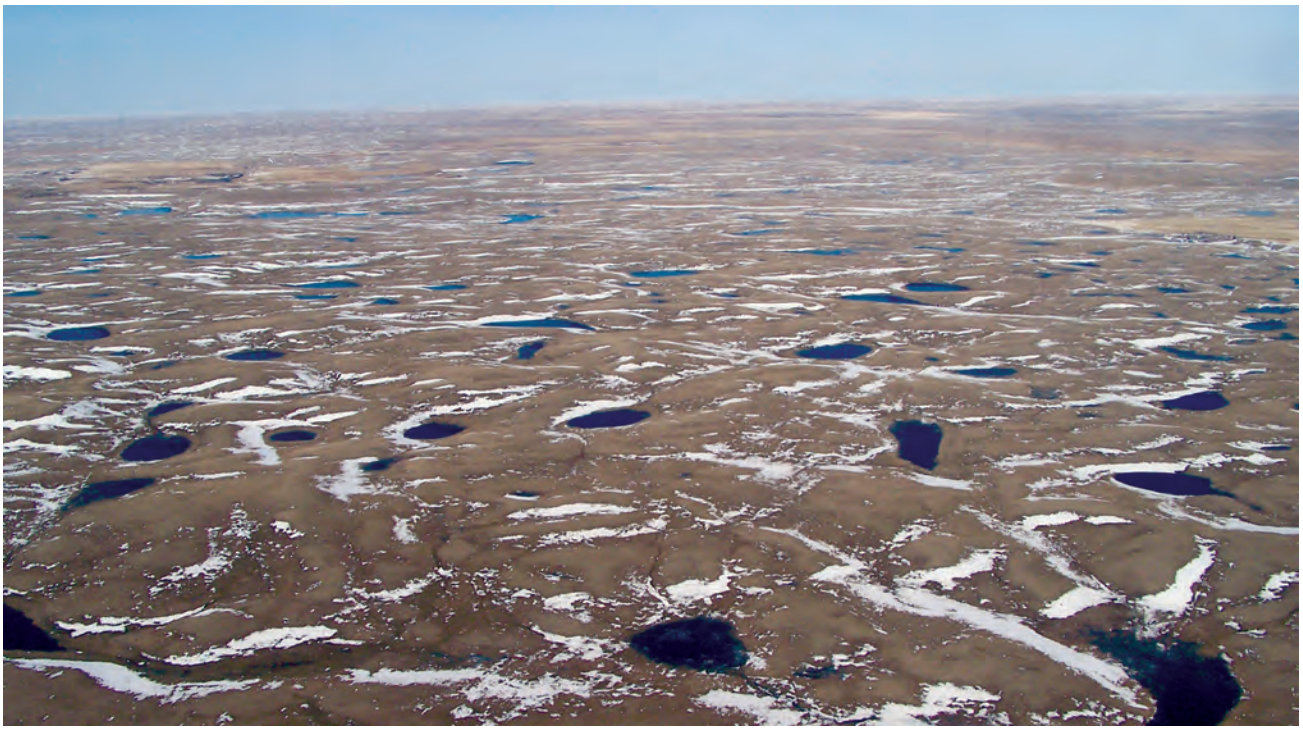
Abbreviations

ac	Acre
A.D.	Anno Domini or "in the year of the Lord"
BAER	Burned Area Emergency Response
BAR	Burned Area Rehabilitation
CCP	Comprehensive conservation plan
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cm	Centimeter
CO_2	Carbon dioxide
Compact	Montana House Bill Number 717–Bill to Ratify Water Rights Compact
Compact Commission	Montana Reserved Water Rights Compact Commission
district	Wetland management district
DEQ	Montana Department of Environmental Quality
DNC	Dense nesting cover
DNRC	Montana Department of Natural Resources and Conservation
EA	Environmental assessment
EC	Electrical conductivity
EPA	U.S. Environmental Protection Agency
°F	Degrees Fahrenheit
FmHA	Farmers Home Administration
ft	Feet, foot
FWS	U.S. Fish and Wildlife Service
GIS	Geographic Information System
GLO	General Land Office
gpm	Gallons per minute
GPS	Global Positioning System
GS	General Schedule (pay)
HAPET	Habitat Assessment and Population Evaluation Team
Improvement Act	National Wildlife Refuge System Improvement Act of 1997
MBOGC	Montana Board of Oil and Gas Conservation
mg/L	Milligrams per liter
mmhos/cm	Millimhos per centimeter
MOA	Memorandum of agreement
MOU	Memorandum of understanding
mS	MilliSiemens
MSGWG	Montana Sage Grouse Working Group
NEPA	National Environmental Policy Act
NWR	National wildlife refuge
ppt	Parts per thousand
Reclamation	Bureau of Reclamation
refuge	Refuge within the Bowdoin National Wildlife Refuge Complex

refuge complex	Bowdoin National Wildlife Refuge Complex
Refuge System	National Wildlife Refuge System
RLGIS	Refuge Lands Geographic Information System
Service	U.S. Fish and Wildlife Service
TDS	Total dissolved solids
µmhos/cm	Micromhos per centimeter
µS/cm	MicroSiemens per centimeter
U.S.	United States
U.S.C.	United States Code
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USRS	U.S. Reclamation Service
WG	Wage Grade (pay schedule)
WPA	Waterfowl production area

Definitions of these and other terms are in the glossary, located after chapter 7.

CHAPTER 1—Introduction



USFWS

The Bowdoin National Wildlife Refuge Complex is in north-central Montana within the Prairie Pothole Region.

The Service (United States Fish and Wildlife Service) manages the 84,724-acre Bowdoin National Wildlife Refuge Complex. The refuge complex is in the mixed-grass prairie region of north-central Montana (Kuchler 1964), within an area known as the Prairie Pothole Region (figure 1).

The refuge complex oversees management of 14 units and numerous refuge, flowage, wetland, and grassland easements located in Blaine, Phillips, and Valley Counties and in the eastern half of Hill County. These counties are bordered by Canada to the north and the Missouri River to the south. The refuge complex's units and easements are part of the Refuge System (National Wildlife Refuge System):

- Five national wildlife refuges: Bowdoin National Wildlife Refuge and four unstaffed satellite refuges—Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges.

- Nine waterfowl production areas within the four-county Bowdoin Wetland Management District (Blaine, Hill, Phillips, and Valley Counties). These nine areas, along with conservation easements, protect approximately 67,712 acres of wetland and grassland (figure 2). The protection of habitat in the district continues to grow with the acquisition of additional easements annually.

To address the long-term management of the refuge complex, the Service has developed a draft CCP (comprehensive conservation plan) and EA (environmental assessment). This document presents the EA, which evaluates alternatives for, and expected consequences of, managing the Bowdoin National Wildlife Refuge Complex. There are three separate alternatives' analyses in this document: (1) whether to divest Lake Thibadeau National Wildlife Refuge; (2) addressing the salinity and blowing salts issue at Bowdoin Refuge; and (3) an analysis of management alternatives for the remaining refuge complex programs. The Service has identified the following alternatives as its proposed actions:

Figure 1. Map of refuges in Bowdoin National Wildlife Refuge Complex within the Prairie Pothole Region of North America.

- Lake Thibadeau Refuge alternative 2 (divestiture); described in chapter 3 and appendix E
- Salinity and blowing salts alternative 4 (underground injection and flushing by Beaver Creek); described in chapter 6
- Alternative B for the remaining refuge programs; described in chapter 7

Chapter 1 introduces the process for development of the Bowdoin Refuge Complex's CCP, including descriptions of the involvement of the Service, the State of Montana, the public, and others. This chapter also describes the conservation issues and plans that affect the refuge complex.

The remaining chapters contain information the Service used and results of the Service's analysis that is the foundation of the draft plan:

- Chapter 2 describes the refuge complex and planning issues.
- Chapter 3 sets out the alternatives for management of the refuge complex.
- Chapter 4 describes the physical, biological, and social environment that the alternatives would affect.
- Chapter 5 explains the expected consequences of carrying out each of the alternatives.

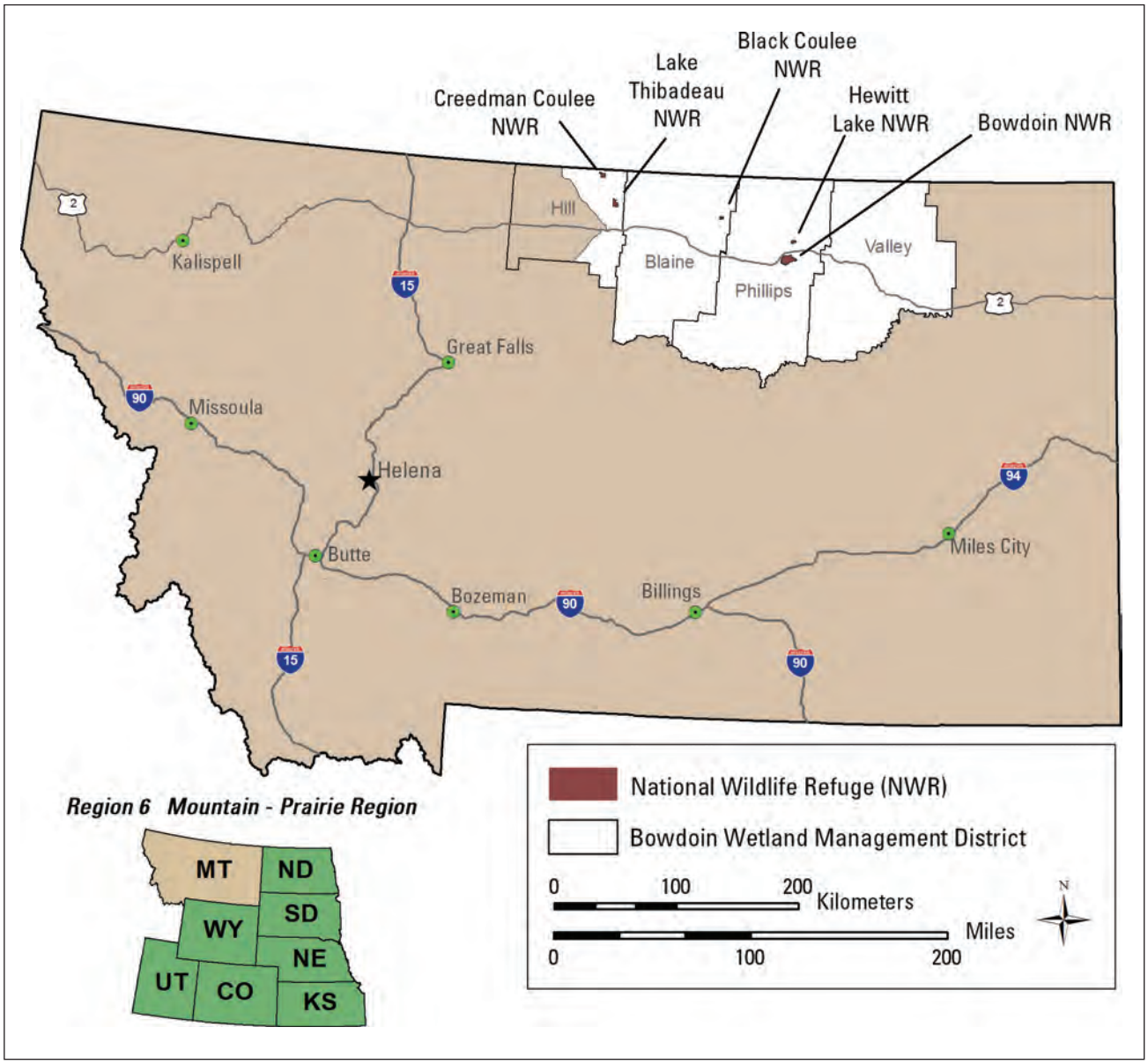


Figure 2. Vicinity map of the five refuges and one wetland management district in the Bowdoin National Wildlife Refuge Complex, Montana.

- Chapter 6 documents the analysis of salinity and blowing salts.
- Chapter 7 describes objectives and strategies for the proposed action (alternative B), which comprises the draft CCP.

The Service has developed this draft CCP to provide a foundation for the management and use of the Bowdoin National Wildlife Refuge Complex. The CCP specifies the necessary actions to achieve the vision and purposes of the refuge complex. Wildlife is the first priority in refuge and district management, and public use (including wildlife-dependent recreation) is allowed and encouraged as long as it is compatible with the purposes of each management unit. When finalized, the CCP will serve as a working guide for management programs and activities throughout the refuge complex over the next 15 years. Although this document contains management direction for the refuge complex, greater detail would be provided in stepdown management plans as part of implementing the final CCP (refer to section 7.10 in chapter 7).

1.1 Purpose and Need for the Plan

The purpose of this draft CCP is to identify the role that the Bowdoin National Wildlife Refuge Complex would play in support of the mission of the National Wildlife Refuge System and to provide long-term guidance for managing programs and activities. The CCP is needed to help the Service achieve the following:

- Communication with the public and other partners in efforts to carry out the mission of the Refuge System
- A clear statement of direction for managing the refuge complex
- Providing neighbors, visitors, and government officials with an understanding of the Service's management actions on and around the refuge complex
- Management actions by the Service that are consistent with the mandates of the Improvement Act (National Wildlife Refuge System Improvement Act of 1997)
- Management of the refuge complex that is consistent with Federal, State, and county plans
- A basis for development of budget requests for the refuge complex's operation, maintenance, and capital improvement needs

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

1.2 Early History of Conservation

Wildlife conservation in North America evolved to take on a form unique to the world. In recent years, it has come to be known as the North American Model of Wildlife Conservation (Geist et al. 2001). The wildlife conservation movement arose out of the conflict between market hunters and sport hunters in the mid- to late 19th century. Market hunting increased in response to the growth in urban population fueled by the Industrial Revolution. Between 1820 and 1860, the percentage of Americans who lived in cities increased from 5 percent to 20 percent; this four-fold increase is the greatest proportional increase in urban population that ever occurred in America (Reiss 1995). The demand for meat and hides—along with feathers for the millinery trade—led to exploitation of game animals by market hunters. Along with the increase in the urban population came a new breed of hunter—one who hunted for the chase and the challenge it provided. These sport hunters valued game animals more when they were alive, as opposed to market hunters who placed value on dead animals they could bring to market. The growing legion of sport hunters started a national movement that resulted in Federal and State governments taking responsibility for regulating the take of wildlife.

The keystone concept of the North American Model of Wildlife Conservation and the bedrock that allowed the Government to exercise control is the Public Trust Doctrine (Geist and Organ 2004). Originating in an 1842 United States (U.S.) Supreme Court decision in the *Martin* v. *Waddell* case, its origins derive from Greek and Roman law and the Magna Carta. Simply stated, wildlife belongs to no one; it is held in trust for all by the Government.

The seven pillars of the North American Model of Wildlife Conservation follow:

- Wildlife as a public trust resource
- Elimination of markets for game
- Allocation of wildlife by law
- Wildlife only killed for a legitimate purpose
- Wildlife considered an international resource
- Science as the proper tool to discharge wildlife policy
- Democracy of hunting

These pillars have stood the test of time and have seen significant changes in approaches to wildlife conservation for more than 100 years. The original conservation movement championed by Theodore Roosevelt, George Bird Grinnell, and others placed emphasis on stemming the decline, and programs restricting take and protecting lands were put in place. During the 1920s, conservationists realized that more was needed, and a committee comprised of Aldo Leopold, A. Willis Robertson, and other leading conservationists of the time authored the 1930 American Game Policy. This policy called for a restoration program for habitats and populations based on scientific research with stable, equitable funding to achieve this. Within a decade, landmark legislation fulfilled many of the needs identified including the Duck Stamp Act to fund land acquisition for national wildlife refuges. In addition, the Pittman–Robertson Wildlife Restoration Act shifted excise taxes imposed on firearms and ammunition to fund wildlife restoration through cooperation between the Service and State fish and wildlife agencies. For States to use this money, they were required to pass laws that prevented diversion of hunting license revenues to any purpose other than administration of the State fish and wildlife agency.

In recent decades, the importance of overall wildlife diversity has gained more emphasis in wildlife management. All wildlife have benefited from the North American Model of Wildlife Conservation pillars, not just game animals. However, the vast majority of funding for wildlife conservation at Federal and State levels comes from Pittman–Robertson excise taxes, Duck Stamp revenues, and hunting license sales. We owe the origins of the National Wildlife Refuge System to the hunters who articulated the need and provided the money (Grinnell 1913). The National Wildlife Refuge System has evolved along with the North American Model of Wildlife Conservation—it today provides refuge for virtually all species found in America and recreation for all Americans. It is a realization of the North American Model of Wildlife Conservation to provide for science-based management of international wildlife resources held in trust for all. The importance of this system to American society can best be appreciated if we were to contemplate its loss. Wildlife connects us to the heritage of this country and our ancestors who built our society. It connects us as well to the natural world of which we are a part, but from which we have become so disconnected. To lose this connection is to lose the basis of our humanity.

1.3 The U.S. Fish and Wildlife Service and the Refuge System

The U.S. Fish and Wildlife Service is the principal Federal agency responsible for fish, wildlife, and plant conservation. The Refuge System is one of the Service's major programs.

U.S. Fish and Wildlife Service

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

In the late 19th and early 20th centuries, America's fish and wildlife resources were declining at an alarming rate, largely due to unrestricted market hunting. Concerned citizens, scientists, and hunting and angling groups joined together and generated the political will for the first significant conservation measures taken by the Federal Government. These actions included the establishment of the Bureau of Fisheries in the 1870s and, in 1900, passage of the first Federal wildlife law—the Lacey Act—which prohibited interstate transportation of wildlife taken in violation of State laws. Beginning in 1903, President Theodore Roosevelt created more than 50 wildlife refuges across the Nation.

Over the next three decades, the United States ratified the Migratory Bird Treaty with Great Britain, and Congress passed laws to protect migratory birds, establish new refuges, and create a funding source for refuge land acquisition. In 1940, the U. S. Fish and Wildlife Service was created within the Department of the Interior, and existing Federal wildlife functions including law enforcement, fish management, animal damage control, and wildlife refuge management were combined into a single organization for the first time.

Today, the Service enforces Federal wildlife laws, manages migratory bird populations, restores nationally significant fisheries, conserves and re-

stores vital wildlife habitat, protects and recovers endangered species, and helps other governments with conservation efforts. In addition, the Service administers a Federal aid program that distributes hundreds of millions of dollars to States for fish and wildlife restoration, boating access, hunter education, and related programs across the United States.

Service Activities in Montana

Service activities in Montana (2009) contribute to the State's economy, ecosystems, and education programs. The following list highlights the Service's presence and activities:

- Employed 220 people in Montana
- 446 volunteers donated more than 21,780 hours to Service projects on refuge and district lands
- Managed two national fish hatcheries, one fish and wildlife management assistance office, six coordination areas, one fish health center, four ecological services offices, and one fish technology center
- Managed 23 national wildlife refuges encompassing 1,217,617 acres (1.29 percent of the State)
- Managed five wetland management districts
  - Managed 48,026 acres of fee-title waterfowl production areas
  - Managed 146,816 acres under leases or easements
- Hosted more than 690,173 annual visitors to Service-managed lands
  - 96,866 hunting visits
  - 80,370 fishing visits
  - 506,632 wildlife observation, photography, and interpretation visits
  - 6,305 students participated in environmental education programs
- Provided $9.6 million to Montana Fish, Wildlife & Parks for sport fish restoration and $17.4 million for wildlife restoration and hunter education
- Since 1988, the Service's Partners for Fish and Wildlife Program has helped private landowners (1) restore more than 31,759 wetland acres; 360,826 upland acres; and 1,263 miles of river habitat; and (2) install 45 structures to open 502 river miles for fish passage.
- Paid Montana counties $394,799 under the Refuge Revenue Sharing Act (money used for schools and roads)

National Wildlife Refuge System

In 1903, President Theodore Roosevelt designated the 5.5-acre Pelican Island in Florida as the Nation's first wildlife refuge for the protection of native nesting birds. This was the first time the Federal Government set aside land for wildlife. This small but significant designation was the beginning of the National Wildlife Refuge System.

One hundred years later, the Refuge System has become the largest collection of lands in the world specifically managed for wildlife, encompassing more than 150 million acres within 553 refuges and more than 3,000 waterfowl production areas that provide breeding and nesting habitat for migratory birds and other wildlife. Today, there is at least one refuge in every State including Puerto Rico and the U.S. Virgin Islands.

The Improvement Act established a clear mission for the Refuge System.

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

The Improvement Act states that each national wildlife refuge (meaning every unit of the Refuge System, which includes wetland management districts) shall be managed to do the following:

- Fulfill the mission of the Refuge System
- Fulfill the individual purposes of each refuge and district
- Consider the needs of fish and wildlife first
- Fulfill the requirement of developing a CCP for each unit of the Refuge System and fully involve the public in preparation of these plans

- Maintain the biological integrity, diversity, and environmental health of the Refuge System
- Recognize that wildlife-dependent recreational activities including hunting, fishing, wildlife observation, photography, environmental education, and interpretation are legitimate and priority public uses
- Retain the authority of refuge managers to determine compatible public uses

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

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

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

People and the Refuge System

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

Whether through birdwatching, fishing, hunting, photography, or other wildlife pursuits, wildlife recreation contributes millions of dollars to local economies. In particular, money generated from the taxing of sporting arms and ammunition and of fishing equipment that is authorized by the Pittman–Robertson and Dingell–Johnson Acts, respectively, has generated tens of millions of dollars. Distributed by the Service, this money has been used by States to increase wildlife and fish populations, expand habitat, and train hunters across the Nation. Approximately 35 million people visited the Refuge System in 2006, mostly to observe wildlife in their natural habitats (Caudill and Henderson 2005). Visitors are most often accommodated through nature trails, auto tours, interpretive programs, and hunting and fishing opportunities. Significant economic benefits are being generated to the local communities that surround refuges and wetland management districts. Economists report that Refuge System visitors contribute more than $1.7 billion annually to local economies.

1.4 National and Regional Mandates

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

The Improvement Act amends the Refuge System Administration Act by providing (1) a unifying mission for the Refuge System, (2) a new process for determining compatible public uses on refuges and districts, and (3) a requirement that each refuge and district be managed under a CCP. The Improvement Act states that wildlife conservation is the priority of Refuge System lands and that the Secretary of the Interior will ensure that the biological integrity, diversity, and environmental health of refuge lands are maintained. Each refuge and district must be managed to fulfill the Refuge System's mission and the specific purposes for which the unit was established. The Improvement Act requires the Service to monitor the status and trends of fish, wildlife, and plants in each national wildlife refuge and wetland management district.

A detailed description of these and other laws and Executive orders that may affect the CCP or the Service's implementation of the CCP is in "Appendix A–Key Legislation and Policy." Service policies for planning and day-to-day management of refuges and districts are in the "Refuge System Manual" and the "Fish and Wildlife Service Manual."

1.5 Contributions to National and Regional Plans

Bowdoin National Wildlife Refuge Complex contributes to the conservation efforts outlined in the various State and national plans described here.

Fulfilling the Promise

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

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

Partners in Flight

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

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

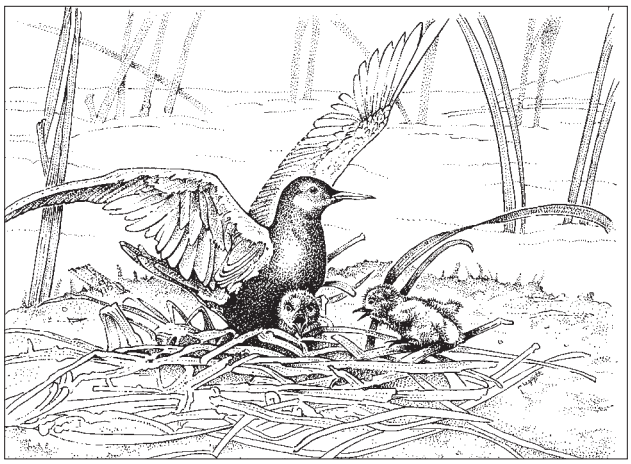
Montana Partners in Flight considered 141 species for priority status. It identified 14 high-priority species in need of immediate conservation action (priority 1), 43 moderate-priority species with lesser threats but in need of better monitoring and conservation consideration (priority 2), and 51 species of local interest whose habitat needs may play a role in the design and selection of conservation strategies (priority 3). The highest priority species are common loon, trumpeter swan, harlequin duck, greater sage-grouse, piping plover, mountain plover, interior least tern, flammulated owl, burrowing owl, black-backed woodpecker, olive-sided flycatcher, brown creeper, Sprague's pipit, and Baird's sparrow (Casey 2000).

The highest priority habitats in Montana are mixed grassland, sagebrush steppe, dry forest (ponderosa pine and Douglas-fir), riparian deciduous forest, and prairie pothole wetlands. The primary objectives in each priority habitat are to restore ecological processes necessary to provide suitable habitat for priority (target) species, identify and protect those remaining blocks of habitats that have undergone drastic declines, and develop management prescriptions that can be applied at all geographic scales. The Partners in Flight plan identified 58 of these areas.

Northern Shortgrass Prairie Physiographic Region

The conservation unit chosen by Partners in Flight for planning purposes has been the physiographic area. These areas, which are not limited by state borders, are based on the Breeding Bird Survey system, which was the first planning effort to reflect actual bird distributions.

There are 58 physiographic areas defined by similar physical geographic features that are wholly or partially contained within the contiguous United States, and several others are wholly or partially in Alaska. The Bowdoin National Wildlife Refuge Complex lies within physiographic area unit 39, known as the northern shortgrass prairie. It is a huge physiographic area, extending from northeastern Wyoming over all of eastern Montana and into southern Alberta. The area within the refuge complex is more of a mixed-grass prairie, which does include native shortgrasses. This physiographic region includes all of the area in Montana officially



Black Tern

designated as the Prairie Pothole Region, one of the highest priority habitats identified in the Montana's bird conservation plan (Casey 2000). The region also contains some of the last remnants of native grasslands including those found on the refuge complex. Although a plan has not yet been completed for this physiographic region, the Partners in Flight plan for Montana identifies this area as critical habitat to some of the priority I bird species, most of which reside on or visit the refuge complex, including piping plover, burrowing owl, Sprague's pipit, Baird's sparrow, and greater sage-grouse. There are also numerous priority II species that nest on and use the refuge complex including chestnut-collared longspur, long-billed curlew, marbled godwit, white-faced ibis, black tern, and Franklin's gull. The proposed actions in this plan would focus on continuing and expanding efforts to support these and other imperiled bird species.

North American Waterbird Conservation Plan

The North American Waterbird Conservation Plan provides a contiguous framework for conserving and managing colonial-nesting waterbirds including 209 species of seabirds, coastal waterbirds (gulls, terns, and pelicans), wading birds (herons and ibises), and marsh birds (certain grebes and bitterns). The overall goal of the plan is to ensure that the following are sustained or restored throughout the waterbirds' ranges in North America: (1) the distribution, diversity, and abundance of waterbird populations; (2) waterbird habitats (breeding, migratory, and nonbreeding); and (3) important sites for waterbirds. The geographic scope of the plan covers 28 countries, from Canada to Panama, as well as islands and near-shore areas of the Atlantic and Pacific oceans, the Gulf of Mexico, and the Caribbean Sea. This waterbird partnership includes Federal, State, and provincial wildlife agencies, individuals, and nonprofit conservation organizations. The plan also calls for establishment of "practical units for planning" for terrestrial habitats. Bowdoin National Wildlife Refuge Complex is located within the Northern Prairie and Parklands Region.

The challenge for the Northern Prairie and Parklands Regional Plan is operating in a landscape significantly affected by agriculture, oil, gas, and other human development activities that factor immensely in the region's conservation issues. Wetland loss and deterioration tops the list, which is further influenced by the region's natural cycles of drought and inundation. The widespread and uncertain ramifications of global warming will affect the regional plan's strategies to combat wetland loss and properly manage associated upland habitats for the benefit of waterbirds and other bird species (Kushlan et al. 2002).

USFWS

International Border contrast in 1994—Blaine County, Montana, United States (left); Saskatchewan, Canada (right).

North American Waterfowl Management Plan

Written in 1986, the North American Waterfowl Management Plan envisioned a 15-year effort to achieve landscape conditions that could sustain waterfowl populations. Specific plan objectives are to increase and restore duck populations to the average levels of the 1970s—62 million breeding ducks and a fall flight of 100 million birds (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1986).

The plan is innovative because of its international partnerships and implementation at the regional level. Its success depends on the strength of the joint ventures, which involve Federal, State, provincial, tribal, and local governments; businesses; conservation organizations; and individual citizens.

Joint ventures develop implementation plans that focus on areas of concern identified in the plan. Bowdoin National Wildlife Refuge Complex lies within the Prairie Pothole Joint Venture. It encompasses prairie wetlands from Montana, North Dakota, and South Dakota into Minnesota and Iowa. These prairie wetlands support more than 300 species of migratory birds, many of which are found within the refuge complex and are the primary breeding areas for the continent's waterfowl. The most important activity of this joint venture is the protection, restoration, and enhancement of prairie wetlands and grasslands on private and public lands (USFWS 2008b).

Northern Plains/Prairie Potholes Regional Shorebird Conservation Plan

The Northern Plains/Prairie Pothole Region encompasses two bird conservation regions—the Prairie Potholes and the Badlands and Prairies—and all or parts of seven States (eastern Montana, northeastern Wyoming, North Dakota, South Dakota, western Minnesota, north-central Iowa, and northeastern Nebraska). The landscape is characterized by rolling hills of prairie grasses, millions of depressional wetlands ranging in size from shallow temporary or seasonal wetlands to deeper semipermanent wetlands, and agricultural land.

Thirteen species of shorebirds breed within the Northern Plains/Prairie Pothole Region and require a landscape of grassland and wetland habitats for nesting and brood rearing. One of the major migration routes for Western Hemisphere shorebirds, especially that of long-distance migrants, traverses this area. Because long-distance migrations are energetically expensive, the availability of abundant habitat and food resources at migration stopovers within this region is critical. Shorebirds use a wide range of habitat types within the region including dry grasslands, sand and gravel beaches, natural freshwater and alkaline wetlands, lake margins, and shallowly flooded agricultural fields. During migration, the unvegetated shallow waters and moist mudflats of freshwater or alkaline wetlands are especially important. Due to the dynamic nature of wetlands in this region, many shorebirds are opportunistic and dispersed across the changing landscape (Helmers 1992).

Three major shorebird issues have been identified for the Northern Plains/Prairie Pothole Region:

1. Conservation of threatened and endangered species, declining species, and species of special concern

2. Habitat loss including fragmentation and degradation

3. The need for additional information to evaluate potential threats—such as contaminants, predation, and invasion of exotic plants—to migrating and breeding shorebirds

Bowdoin National Wildlife Refuge Complex has been identified as part of the Western Hemisphere Shorebird Reserve Network. Enrollment in this network requires that a site meet biological criteria and that site stakeholders agree to participate (Helmers 1992).

Montana Piping Plover Management Plan

Federal agencies are mandated by the Endangered Species Act of 1973 to conserve federally listed threatened and endangered species under section 7(a)(1) of the act. In response to Federal listing of the Great Plains population of the piping plover as a threatened species in 1985, the Montana Piping Plover Recovery Committee was formed. Beginning in 1986, members of several Federal and State agencies along with volunteers made an effort to monitor all historical and potential piping plover habitat within the State. The Montana Piping Plover Management Plan evolved from these efforts and was most recently updated in 2006.

The Service, along with the other agencies involved, consulted to determine the status of the population and habitat as well as the potential for increase. The committee set a goal within the management plan to "manage for and maintain approximately 60 breeding pairs of piping plovers, on a running 10-year average, distributed in appropriate habitats in Montana" (Atkinson and Dood 2006).

Bowdoin National Wildlife Refuge is an integral part of this joint effort because of its historical use by piping plovers. A portion of the refuge was designated as critical habitat for the species in 2002.

Management Plan and Conservation Strategies for Sage Grouse in Montana

Loss of sagebrush grasslands in some western States has approached or exceeded 50 percent. Such habitat loss in Montana, in terms of quality or quantity, may not have been as high as in other States although significant enough (at least in part of the State) to influence greater sage-grouse numbers and population trends. Growing concern about the status of sagebrush on western rangelands and declines in sage-grouse numbers have led to petitioning the Service to protect populations in some western States under provisions of the Endangered Species Act. After a thorough analysis of the best available scientific information, the Service has concluded that the greater sage-grouse warrants protection under the Endangered Species Act. However, the Service has determined that proposing the species

Mike Morel / USFWS

Piping Plover

Gary Kramer / USFWS

Greater Sage-Grouse

for protection is precluded by the need to take action on other species facing immediate and severe extinction threats. As a result, the greater sage-grouse has been placed on the list of species that are candidates for Endangered Species Act protection. The Service will review the status of the species annually, as it does with all candidate species, and will propose the species for protection when funding and workload priorities for other listing actions allow.

The "Management Plan and Conservation Strategies for Sage Grouse in Montana" is the product of the Montana Sage Grouse Working Group. Participants in the group include representatives of Federal and State agencies, tribal representatives, and private organizations, along with several individuals from the public, all of whom have a stake in the issue. The overall goal of the plan is to "provide for the long-term conservation and enhancement of the sagebrush steppe/mixed-grass prairie complex within Montana in a manner that supports sage grouse and a healthy diversity and abundance of wildlife species and human uses" (MSGWG 2005). The plan establishes a process to achieve sage-grouse management objectives and provides a framework to guide local management efforts.

The greater sage-grouse is a documented local breeder on the Bowdoin National Wildlife Refuge Complex and is a target species for upland management.

State Comprehensive Fish and Wildlife Conservation Strategy

Montana's Comprehensive Fish and Wildlife Conservation Strategy (Montana Fish, Wildlife & Parks 2005) is for all vertebrate species known to exist in Montana including both game and nongame species, as well as some invertebrate species such as freshwater mussels and crayfish.

Although game species are included in Montana's conservation strategy, the priority is species and their related habitats "in greatest conservation need." This means focus areas, community types, and species that are significantly degraded or declining, federally listed, or where important distribution and occurrence information used to assess the status of individuals and groups of species are lacking. The conservation strategy uses five ecotypes to describe the broad areas of Montana's landscape that have similar characteristics. Bowdoin National Wildlife Refuge Complex is in the plains grassland and plains forest ecotype. Montana's high eastern plains, which are part of America's Great Plains, are generally found on high, rolling land and on some scattered hills and in wide river valleys.

Within each of the ecotypes, tier 1 geographic focus areas (greatest need of conservation) were identified for all terrestrial and aquatic areas of the State. Bowdoin National Wildlife Refuge Complex is located within the Montana glaciated plains focus area, which is dominated by level to rolling till plains covered by sagebrush grasslands and short,

mixed-grass prairie and croplands. This area consists of plains, terraces, fans, and floodplains that formed in glacial till, gravel deposits, and alluvium over clay shale, sandstone, and siltstone. Land use is predominantly livestock grazing and dryland farming. The tier 1 priority (target) species for this area are the northern leopard frog, snapping turtle, spiny softshell, western hog-nosed snake, milksnake, common loon, bald eagle, greater sage-grouse, yellow rail, whooping crane, piping plover, mountain plover, long-billed curlew, interior least tern, black tern, burrowing owl, spotted bat, Townsend's big-eared bat, black-tailed prairie dog, black-footed ferret, and American bison.

The Montana Comprehensive Fish and Wildlife Conservation Strategy (Montana Fish, Wildlife & Parks 2005) outlines five conservation concerns and strategies for the Montana glaciated plains focus area. The key concerns are:

- Conversion of native prairie to small grain production
- Petroleum exploration and development impacts
- Invasive or exotic plant species
- Disruption of natural fire disturbance processes and hydrologic regimes
- Range management or forest management practices
- Loss of natural wetlands

1.6 Strategic Habitat Conservation

In the face of escalating challenges such as land use conversion, invasive species, water scarcity, and refuge complex issues that have been amplified by accelerating climate change, the Service has evolved from its ecosystem approach of thinking about conservation to developing a broader vision.

A cooperative effort by the Service and U.S. Geological Survey culminated in a report by the National Ecological Assessment Team (U.S. Geological Survey 2006). The report outlines a unifying adaptive resource management approach for conservation at a landscape scale, the entire range of a target species or suite, or guild, of species. This is strategic habitat conservation: a way of thinking and doing business—by incorporating biological goals for target species populations—by making strategic decisions about the work needed—and by constantly reassessing.

Since 2006, the Service has taken significant steps to turn this vision into reality and has defined a framework of 21 geographic areas. Experts from the Service and U.S. Geological Survey developed this framework through an aggregation of bird conservation regions. The Bowdoin National Wildlife Refuge Complex lands and waters lie in Geographic Area 13–Plains and Prairie Potholes (figure 3). Key issues in this geographic area are conservation of paddlefish, pallid sturgeon, waterfowl, shorebirds, grassland birds, and black-footed ferret.

The Service is using the framework as the basis to locate the first generation of landscape conservation cooperatives. These cooperatives are conservation-science partnerships between the Service and other Federal agencies, States, tribes, nongovernmental organizations, universities, and others. Designed as fundamental units for planning and science, the cooperatives have the capacity to help the Service carry out the elements of strategic habitat conservation—biological planning, conservation design and delivery, and monitoring and research. Coordinated planning and scientific information will strengthen the Service's strategic response to accelerating climate change.

Climate Change

The Service expects that accelerating climate change will affect the Nation's fish, wildlife, and plant resources in profound ways. While many species will continue to thrive, some may decline and in some instances go extinct. Others will survive in the wild only through direct and continuous intervention by managers. In 2010, the Service drafted a strategic plan to address climate change for the next 50 years titled, "Rising to the Challenge—Strategic Plan for Responding to Accelerating Climate Change" (USFWS 2010). The strategic plan employs three key strategies: adaptation, mitigation, and engagement. In addition, the plan acknowledges that no single organization or agency can address climate change without allying itself with others in partnership across the Nation and around the world (USFWS 2010). This plan is an integral part of the Department of the Interior's strategy for addressing climate change as expressed in Secretarial Order 3289 (September 14, 2009).

The Service will use the following guiding principles from the strategic plan (USFWS 2010) in responding to climate change:

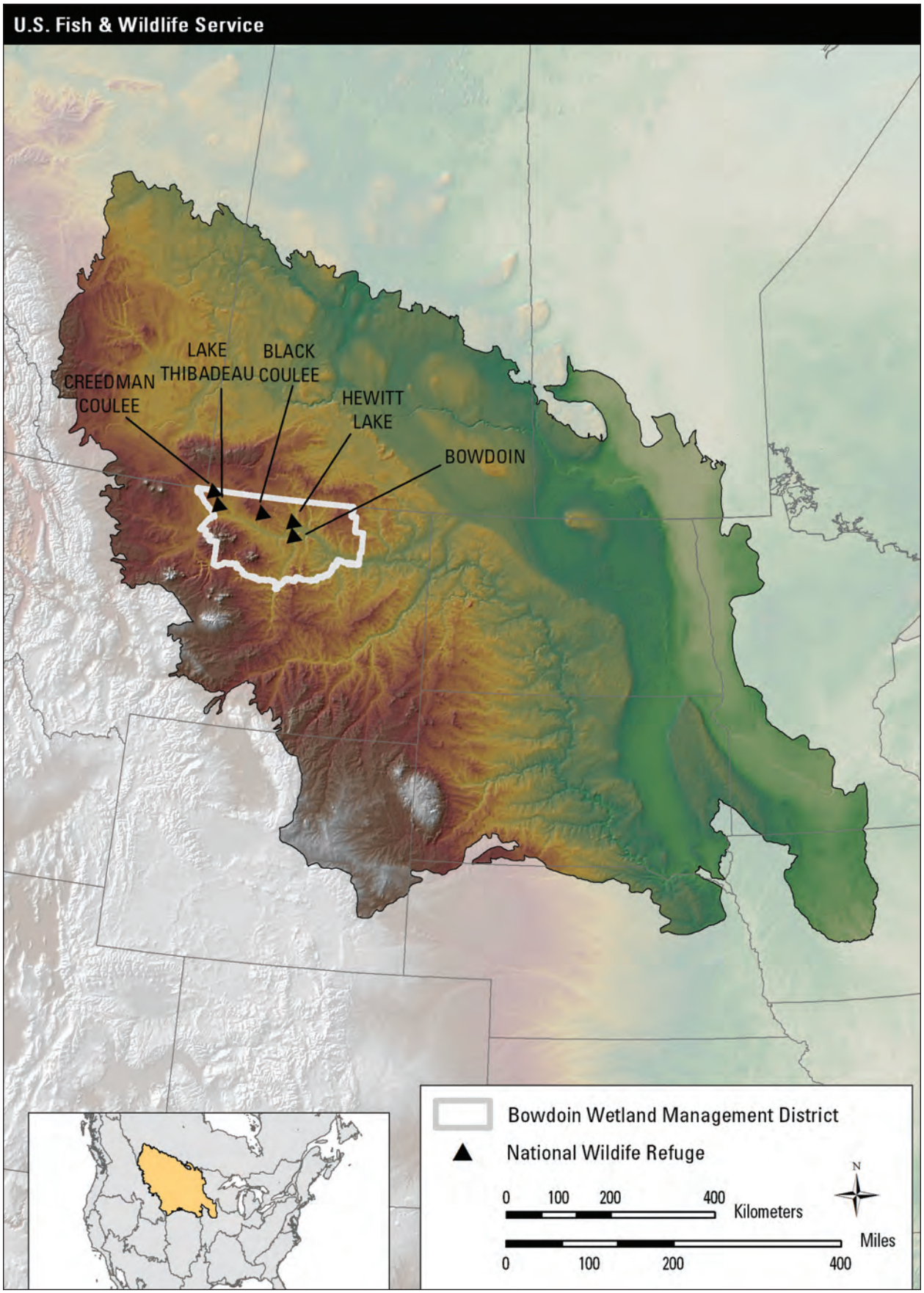


Figure 3. Map of the five refuges and one wetland management district in Bowdoin National Wildlife Refuge Complex within Geographic Area 13–Plains and Prairie Potholes.

- *Priority Setting*—Continually evaluate priorities and approaches, make difficult choices, take calculated risks, and adapt to climate change.
- *Partnership*—Commit to a new spirit of coordination, collaboration, and interdependence with others.
- *Best Science*—Reflect scientific excellence, professionalism, and integrity in all the Service's work.
- *Landscape Conservation*—Emphasize the conservation of habitats within sustainable landscapes, applying the Service's strategic habitat conservation framework.
- *Technical Capacity*—Assemble and use state-of-the-art technical capacity to meet the climate change challenge.
- *Global Approach*—Be a leader in national and international efforts to meet the climate change challenge.

1.7 Planning Process

The Service prepared this draft CCP and EA in compliance with the Improvement Act and part 602 (National Wildlife Refuge System Planning) of the "Fish and Wildlife Service Manual." The actions described in the draft CCP and EA meet the requirements of the Council on Environmental Quality regulations that implement the National Environmental Policy Act of 1969. Additional requirements and guidance are contained in the Refuge System's planning policy, issued in 2000. This policy established requirements and guidance for refuge and district plans—including CCPs and stepdown management plans—to ensure that planning efforts follow the Improvement Act. The planning policy identified several steps of the CCP and environmental analysis process (figure 4).

The Service began the pre-planning process in October 2006 with the establishment of a planning team comprised primarily of Service staff from Bowdoin Refuge and staff from Montana Department

Figure 4. Process steps for comprehensive conservation planning and associated environmental analysis.

of Natural Resources and Conservation, Montana Department of Environmental Quality, and Montana Fish, Wildlife & Parks. Additional contributors included other Service divisions, U.S. Geological Survey, Montana State University, Natural Resource Conservation Service, and several partners (refer to "Appendix B–List of Preparers, Consultation, and Coordination"). During pre-planning, the team developed a mailing list, internal issues, and identified the unique qualities of the refuge complex (refer to section 2.2 in chapter 2). The planning team identified and reviewed current programs, compiled and analyzed relevant data, and determined the purposes of the refuge complex.

Public scoping started with a notice of intent to prepare the draft CCP and EA that was published in the Federal Register on May 15, 2007. Information was distributed through news releases, issuance of the first planning update, and holding a public scoping meeting in Malta on May 22, 2007. Public scoping concluded on June 14, 2007, when the comment period closed. This project complies with public involvement requirements of the National Environmental Policy Act, and the planning team incorporated public input throughout the planning process. Over the course of pre-planning and public scoping, the planning team collected available information about the resources of the refuge complex units and the surrounding areas. This information is summarized in "Chapter 4–Affected Environment."

Table 1 lists the specific steps in the planning process to date for the preparation of this draft CCP and EA.

Table 1. Summary of the CCP planning process for Bowdoin National Wildlife Refuge Complex, Montana.

Date	*Event*	*Outcome or purpose*
October 25–26, 2006	Kickoff meeting	Service staff discussed the CCP overview, reviewed the refuge complex purposes, discussed the initial planning team list, developed the first draft of the internal issues and the qualities list, started the mailing list, discussed the planning schedule, and discussed the biological data needs.
February 15, 2007	Work plan	Service staff prepared the planning work plan.
March 6, 2007 April 26, 2007	Biological review planning meeting	The planning team developed an agenda and objectives for the biological review workshops.
April 29, 2007	Vision and goals workshop	The planning team developed draft vision and goal statements for the refuge complex.
May 7, 2007	Planning update	The first planning update was sent to people and organizations on the mailing list. The update described the planning process and announced the upcoming public scoping meeting.
May 15, 2007	Notice of intent	The notice of intent to prepare a CCP was published in the Federal Register (volume 72, number 93, page 27325–27).
May 22–23, 2007	Water resources workshop	A panel of biologists and researchers gathered to discuss and propose options for managing the Bowdoin Refuge's wetland resources and addressing the salinity issue. A salinity team was established.
May 22, 2007	Public scoping meeting	The public had an opportunity to learn about the CCP process and provide comments.
June 4, 2007	Visitor services review	Staff from the Service's Division of Education and Visitor Services evaluated the refuge complex's visitor services programs and facilities.
June 14, 2007	Public scoping period ends	Public scoping comments that would be considered had to be received or postmarked by this date.
June 17, 2007	Chamber of Commerce presentation	Service staff gave a presentation to the Malta Chamber of Commerce, describing the CCP process and answering questions.
July 10, 2007	Salinity team meeting	The salinity team reviewed water resources at the Bowdoin Refuge and evaluated nine modeling scenarios to address the salinity issue.
August 20, 2007	Salinity team meeting	The salinity team evaluated the revised modeling scenarios and narrowed the options down to four including no action.

Table 1. Summary of the CCP planning process for Bowdoin National Wildlife Refuge Complex, Montana.

Date	*Event*	*Outcome or purpose*
October 3, 2007	Pre-planning for objectives and strategies workshop	The planning team met with Rick Schroeder (U.S. Geological Survey) and staff to discuss developing alternatives and the supporting objectives and strategies for the proposed action.
October 16–17, 2007	Uplands biological workshop	A panel of biologists and researchers gathered to discuss and propose options for future management of upland habitats in the refuge complex.
October 24– 25, 2007	Alternatives workshop	The planning team developed and evaluated three alternatives for refuge complex management, excluding the salinity and blowing salts issue.
November 20, 2007	Followup to alternatives workshop	The planning team reviewed the alternatives table and discussed environmental consequences.
December 4, 2007	Followup to alternatives workshop	The planning team finalized the draft alternatives and environmental consequences table.
January 21–23, 2008	Objectives and strategies workshop	The planning team began writing objectives and strategies for the proposed action alternative.
February 4, 2008	Salinity team meeting	The salinity team discussed other options for addressing the salinity issue and prepared for a salinity workshop.
February 28, 2008	Salinity team meeting	The salinity team finalized plans for the salinity workshop.
March 12, 2008	Salinity team meeting	The salinity team discussed the salinity workshop agenda, meeting objectives, and needed presentations.
April 22–23, 2008	Salinity issue workshop	A panel of hydrologists, managers, and biologists evaluated the products of the salinity team and discussed alternatives. A proposal to hire a contractor to conduct further analysis was presented and accepted.
May 1, 2008	Start of draft plan preparation	The planning team began writing portions of the draft CCP and EA.
July 2008	Start of URS contract	The Denver-based contractor, URS, began analysis of four alternatives proposed for addressing the salinity and blowing salts issue.
March 2, 2009	URS draft report review	Field and regional office staff met with URS to discuss their report and findings and found that additional data collection and analysis by State and Service staff was needed.
July 16, 2009	URS final report and Milk River alternative review	State and Federal agencies discussed the final URS report and the alternative to pump water to the Milk River. A public meeting to present these findings was planned.
October 22, 2009	Public meeting	The Service invited the public to hear a presentation on the alternatives that have been developed and analyzed to address the salinity and blowing salts issue.
November 2009	Draft plan preparation	The planning team continued preparation of the chapters and maps for the draft CCP and EA.
April 14–15, 2010	Salinity chapter	The salinity team finalized the chapter summarizing alternatives to address the salinity and blowing salts issue on Bowdoin National Wildlife Refuge.
April–October 2010	Draft plan preparation	The planning team finished preparation of the draft CCP and EA for internal review, incorporating the results of the salinity and blowing salts analysis.
November–December 2010	Draft plan internal review	The planning team and other Service staff reviewed the draft CCP and EA and provided comments to help clarify the analyses and provide consistency.
January–May 2011	Draft plan preparation	The planning team finalized the draft plan for distribution to the public for review.

Coordination with the Public

A mailing list of more than 170 names was prepared during pre-planning. The mailing list includes private citizens; local, regional, and State government representatives and legislators; other Federal agencies; and interested organizations (refer to "Appendix C–Public Involvement").

The first planning update was sent in May 2007 to everyone on the mailing list. Information was provided on the history of the refuge and the CCP process and included an invitation to a public scoping meeting. The planning update included a comment form to give the public an opportunity to provide written comments. Emails were also accepted at the refuge's email address: bowdoin@fws.gov.

The Service held one public scoping meeting at the Great Northern Motel in Malta, Montana, on May 22, 2007. There were 25 attendees, primarily local citizens, including surrounding ranchers. Following a presentation about the refuge complex and an overview of the CCP and National Environmental Policy Act processes, attendees were encouraged to ask questions and offer comments. Verbal comments were recorded and each attendee was given a comment form to submit additional thoughts or questions in writing.

All written comments were due June 14, 2007. Fifteen written comments, additional to those received orally at the public scoping meeting, were received throughout the scoping process. All comments were shared with the planning team and considered throughout the planning process.

One of the most significant issues identified by both the public and the planning team was the blowing salts and salinity issue on Bowdoin National Wildlife Refuge. The planning team developed a salinity team that worked for more than 2 years to study this issue and develop alternatives (refer to "Chapter 6–Analysis of Salinity"). On October 22, 2009, the planning team held a public meeting to provide information about the results of this effort. The public had the opportunity to ask questions and offer suggestions about the various aspects of the alternatives. This meeting was announced in the local media and more than 170 meeting announcements were mailed out to the planning mailing list. The staff also provided interviews to statewide newspapers about this meeting and the analysis. Many people helped the refuge staff organize and lead this meeting and answer questions—Service staff from the Division of Refuge Planning and Division of Water Resources and the Montana Department of Natural Resources and Conservation and Department of Environmental Quality, including members of the Montana Reserved Water Rights Compact Commission. Thirty people attended this meeting and provided comments, which the Service recorded. These comments were considered by the planning team in preparation of this draft CCP and EA, particularly chapter 6, which addresses this issue in detail.

State Coordination

At the start of the planning process, the Regional Director (of the Service's Mountain–Prairie Region (Region 6)) sent a letter to Montana Fish, Wildlife & Parks, inviting them to participate in the planning process. Numerous State biologists and hydrologists have since served on the planning team or been involved in the planning process including biological reviews of the refuge complex's management program. At the start of the process, the offices of Montana's United States congressional delegation (then-Senator John Tester, Senator Max Baucus, and Representative Dennis Rehburg) were sent letters notifying them of the planning process and inviting them to comment on the plan. Seven other Montana State senators and representatives and Governor Brian Schweitzer were sent similar letters.

The State was particularly concerned about the saline water and blowing salts issue on Bowdoin National Wildlife Refuge. Hydrologists from the Montana Reserved Water Rights Compact Commission, who asked the refuge to address this water quality issue, worked with Service staff to develop models for predicting the effectiveness of actions to resolve this issue. The salinity team also had representatives from the Montana Department of Environmental Quality and Department of Natural Resources and Conservation. The State has been supportive of the planning process to date.

Tribal Coordination

Early in the planning process, the Service's Mountain–Prairie Regional Director sent a letter to tribes identified as possibly having a cultural and historical connection to the area in which the Bowdoin National Wildlife Refuge Complex is located. Those contacted were the Fort Peck Assiniboine and Sioux, the Fort Belknap Assiniboine and Gros Ventre, Crow, Chippewa Cree, and Blackfeet tribal councils. The tribal councils did not submit responses to the letter from the Regional Director; nevertheless, the councils were provided opportunities to comment.

Results of Scoping

Comments collected from scoping meetings and correspondence were used in the development of a final list of issues to be addressed in this draft CCP and EA. The Service determined which alternatives could best address these issues. The planning process ensures that issues with the greatest effect on the refuge complex resources and programs are resolved or given priority over the life of the final CCP. Identified issues, along with a discussion of effects on resources, are summarized in chapter 2. In addition, the Service considered suggested changes to current refuge management presented by the public and other groups.

Selecting an Alternative

After the public reviews and provides comments on the draft CCP and EA, the planning team will present this document along with a summary of all substantive public comments to the Service's Mountain–Prairie Regional Director. The Regional Director will consider the environmental effects of each alternative including information gathered during public review.

The Regional Director will select a preferred alternative for each of the three analyses in the draft CCP and EA: (1) divestiture of Lake Thibadeau National Wildlife Refuge; (2) management of salinity and blowing salts at Lake Bowdoin; and (3) all other management aspects of the refuge complex. The Regional Director's decision will be disclosed in a finding of no significant impact included in the final CCP. Once approved, the actions in the preferred alternatives will compose the final CCP.

After the planning team prepares the final CCP for publication, a notice of availability will be published in the Federal Register, and copies of the final CCP, summary of the CCP, or both will be sent to individuals on the mailing list. Subsequently, the Service will implement the CCP with help from partner agencies, organizations, and the public.

The CCP will provide long-term guidance for management decisions; support achievement of the goals, objectives, and strategies needed to accomplish the purposes of the Bowdoin Refuge and the Bowdoin District; and identify the Service's best estimate of future needs. The CCP will detail program-planning levels that may be substantially above budget allocations and, thus, are primarily for strategic planning purposes. The CCP does not constitute a commitment for staff increases, operation and maintenance increases, or funding for future land acquisitions.

CHAPTER 2—The Refuge Complex

Mike Artmann / USFWS

Numerous waterfowl and shorebirds use the Lakeside unit of Bowdoin National Wildlife Refuge, Montana.

This chapter explains the establishment, management history, purposes, and special values of Bowdoin National Wildlife Refuge Complex in north-central Montana, along with the proposed vision and goals and a discussion of the planning issues.

The refuge complex consists of 84,724 acres of lands and waters encompassing five refuges—Bowdoin, Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges—and Bowdoin Wetland Management District. The Service is responsible for the protection of 10,635 acres of wetland easements, 7,806 acres of refuge and flowage easements, 39,767 acres of grassland easements, 9,504 acres in fee-title waterfowl production areas, and 17,012 acres of refuge lands.

The Bowdoin Refuge Complex spreads across a four-county area in north-central Montana, totaling 17,183 square miles: Blaine County (4,226 square miles), Hill County (2,896 square miles), Phillips County (5,140 square miles), and Valley County (4,921 square miles) (National Association of Counties 2009). The refuge complex headquarters is near the town of Malta.

2.1 Establishment, Acquisition, and Management History

The following section describes the establishment, acquisition, and management history of the national wildlife refuges and wetland management district within the Bowdoin refuge complex. Tables 2 and 3 at the end of this section summarize the land acquisition history.

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Bowdoin Refuge's first entry sign, 1938.

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Headquarters for the Bowdoin National Wildlife Refuge Complex, 2007.

Bowdoin National Wildlife Refuge

Before becoming a national wildlife refuge, the lands within Bowdoin were managed by Reclamation (Bureau of Reclamation). Initially these 10,648.92 acres were reserved from public domain (public land placed into permanent reserved status, such as a national wildlife refuge, that is not held in private ownership).

When President Franklin D. Roosevelt established Bowdoin Migratory Waterfowl Refuge in 1936, the Bureau of Biological Survey (a precursor to the U.S. Fish and Wildlife Service) and Reclamation shared jurisdiction.

On November 15, 1940, Executive Order 8592 changed the refuge name to Bowdoin National Wildlife Refuge and added an additional 1,398.16 acres of land to the area.

On March 22, 1971, a revocation of reclamation withdrawal was filed to give primary jurisdiction to the Service. This revocation was approved on February 7, 1972, under Public Land Order 5162. While under Reclamation jurisdiction, Lake Bowdoin was managed as a sump for irrigation return flows from the Milk River Project.

Bowdoin National Wildlife Refuge lies approximately 7 miles northeast of Malta in the Milk River Valley of Phillips County and today encompasses 15,551 acres (figure 5). The refuge consists of about 8,675 acres of freshwater and saline wetlands. The remaining upland is typical mixed-grass prairie with a complex of western wheatgrass, needle and thread grass, sagebrush, and forbs. Greasewood and rabbitbrush are common on the heavier clay soils. The marsh areas are dominated by sedges, while excellent

USFWS

Refuge headquarters, 1938.

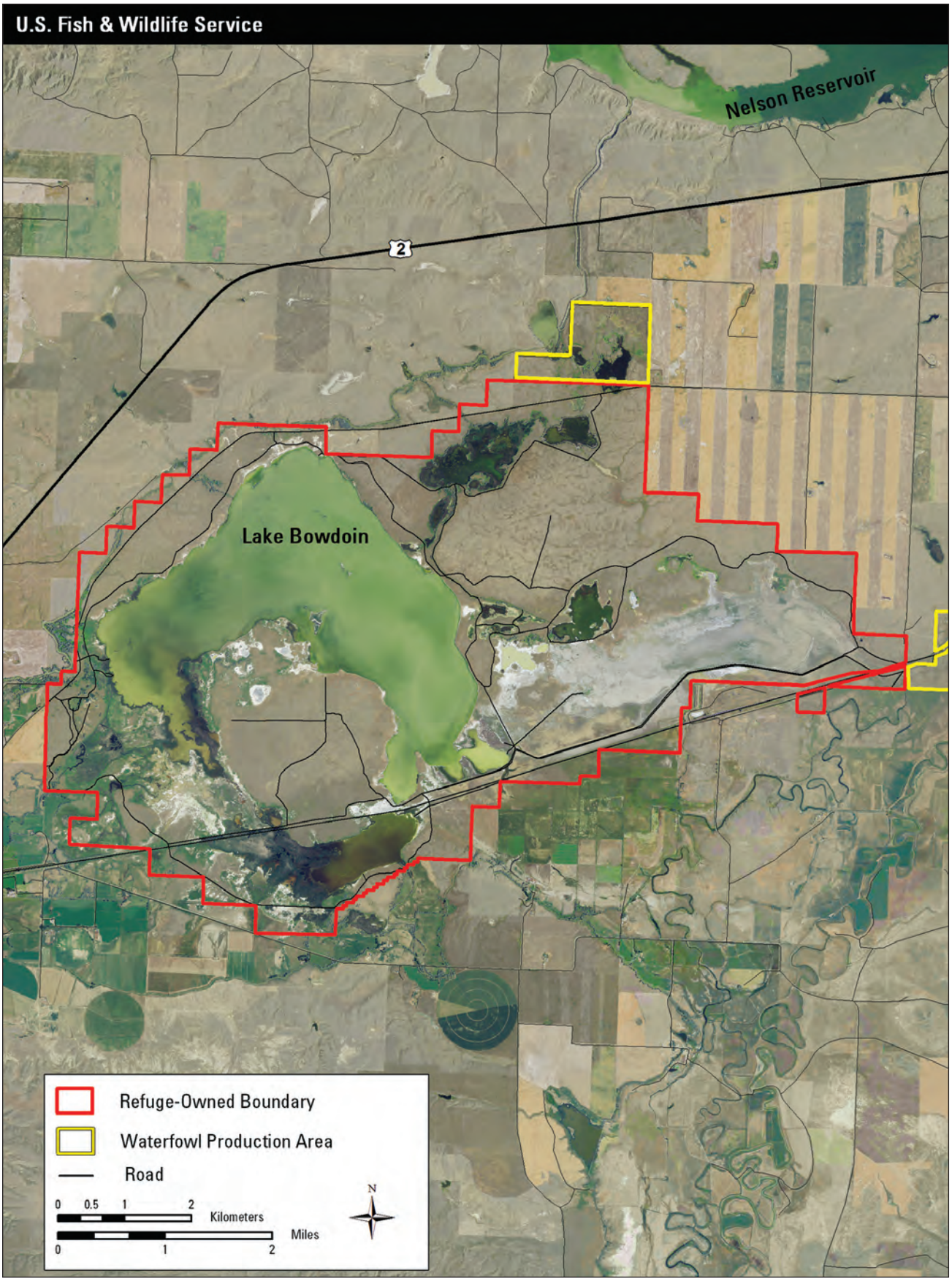
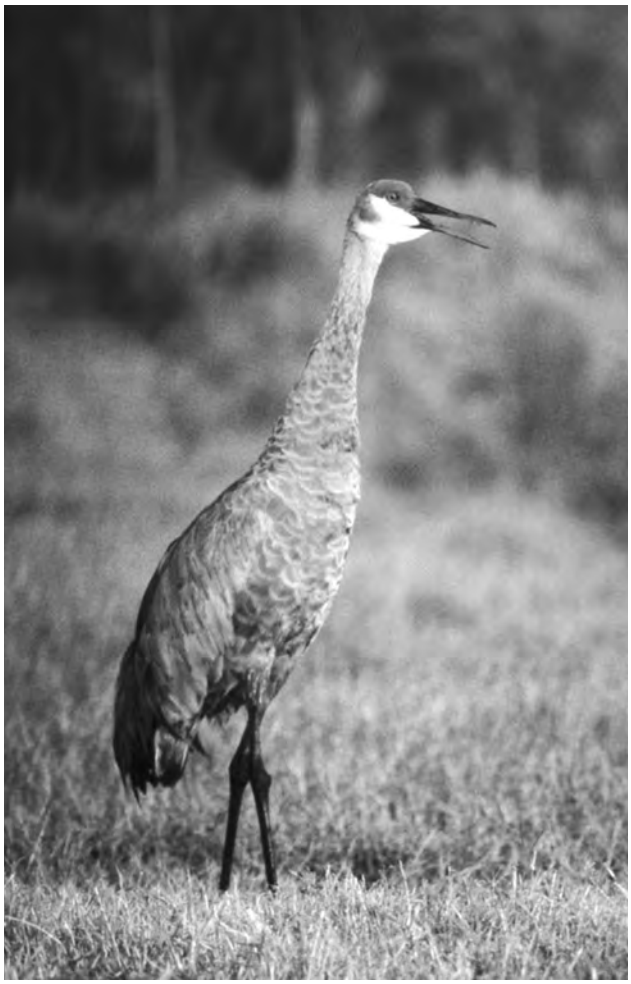


Figure 5. Base map of Bowdoin National Wildlife Refuge, Montana.

stands of emergent and aquatic vegetation are found in the shallow, open-water areas. Plateaus and grassland benches surround the refuge with elevations varying from 2,400 to 2,600 feet (Bureau of Sport Fisheries and Wildlife 1973).

There are three major wetland types on the refuge: (1) 4,187 acres of permanent wetlands; (2) 1,146 acres of semipermanent wetlands; and (3) 3,342 acres of seasonal or temporary wetlands. These wetlands are either freshwater or saline. Upland habitats include more than 5,000 acres of native prairie, 200 acres of DNC (dense nesting cover), 269 acres of planted grasses (primarily crested wheatgrass), and 850 acres of shrubland or woodland. The remaining acreage is in roads, parking lots, and developed areas (figure 6). The refuge serves as an important staging and nesting area for migrating waterfowl, shorebirds, sandhill cranes, and other migratory birds. A variety of refuge habitats are home for resident wildlife such as sharp-tailed grouse, pronghorn, and white-tailed deer.

Geologic history indicates that Lake Bowdoin was once an oxbow of the preglacial Missouri River channel. Today, the Missouri River lies nearly 70 miles south of Bowdoin National Wildlife Refuge. Historically, Lake Bowdoin acted as a large catch basin for precipitation, early spring floods, and runoff events. The lands surrounding the lake were native prairie. Lake levels fluctuated from year to year, depending on runoff conditions and evaporation during the hot, dry summers.



Donna A. Dewhurst / USFWS

Sandhill cranes nest at Bowdoin Refuge.

In the 1800s, Lake Bowdoin was an important watering source for trailing cattle herds. Grasslands around the lake suffered extensive overgrazing from the watering herds, and it was not until the refuge was established in 1936 that the area received protection and development for wildlife purposes (Bureau of Sport Fisheries and Wildlife 1973).

After establishment in 1936, an extensive system of dikes, ditches, and water control structures were constructed to better manage the available water supply. In 1937, the Service negotiated an MOA (memorandum of agreement) with Reclamation to receive part of their water right, 3,500 acre-feet, from the Milk River Project. In return, the Service contributed $40,000 toward construction of the Fresno Reservoir storage facility near Havre, Montana. Water is the lifeline between management and waterfowl survival and is essential to wildlife management at Bowdoin Refuge. During years of normal runoff, Reclamation furnishes up to 3,500 acre-feet of water to the refuge. In years of below-normal runoff, Reclamation agrees to furnish the portion of 3,500 acre-feet that the natural conditions and Federal reclamation laws permit.

Water diverted to Bowdoin National Wildlife Refuge from the Milk River Project is used to manage ponds, lakes, and marshes ranging in size from 1 acre to 5,459 acres. The diverted water provides food and migrating and nesting habitat for migratory birds and wetland-related wildlife, as well as for resident wildlife. In addition, delivered water is used to attract piping plover (a threatened bird species that had used the refuge for nesting in the past) and to manage its habitat.

Black Coulee National Wildlife Refuge

Black Coulee National Wildlife Refuge totals 1,309 acres (figure 7): 639 acres of lands reserved from public domain and 840 acres of privately owned lands encumbered by three perpetual refuge and flowage easements. In 1982, 185 acres were purchased with Duck Stamp money as a waterfowl production area. The new addition included 170 acres of a previous 240-acre flowage easement. This land acquisition reduced the easement area to 670 acres.

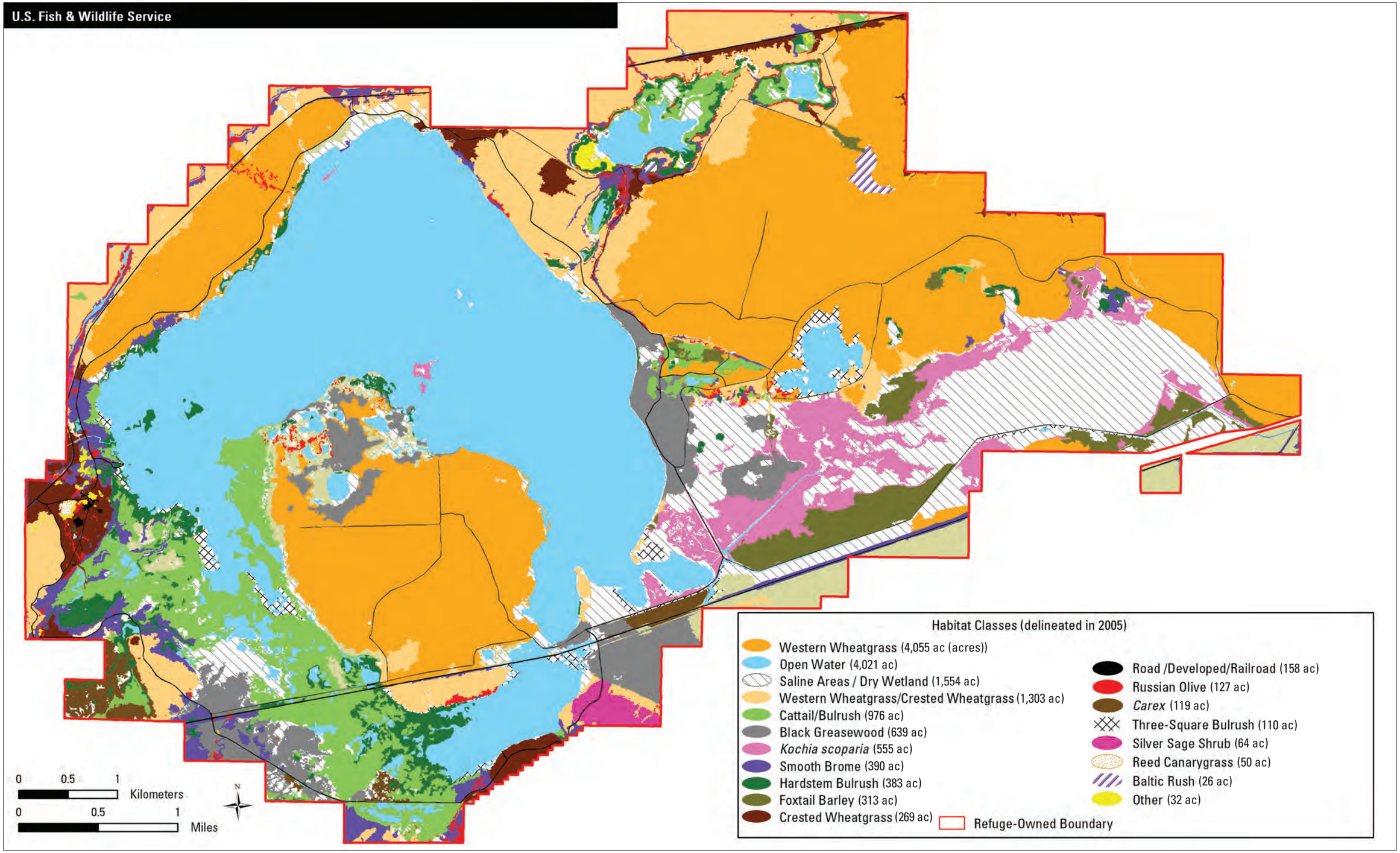


Figure 6. Map of habitat types at Bowdoin National Wildlife Refuge, Montana.

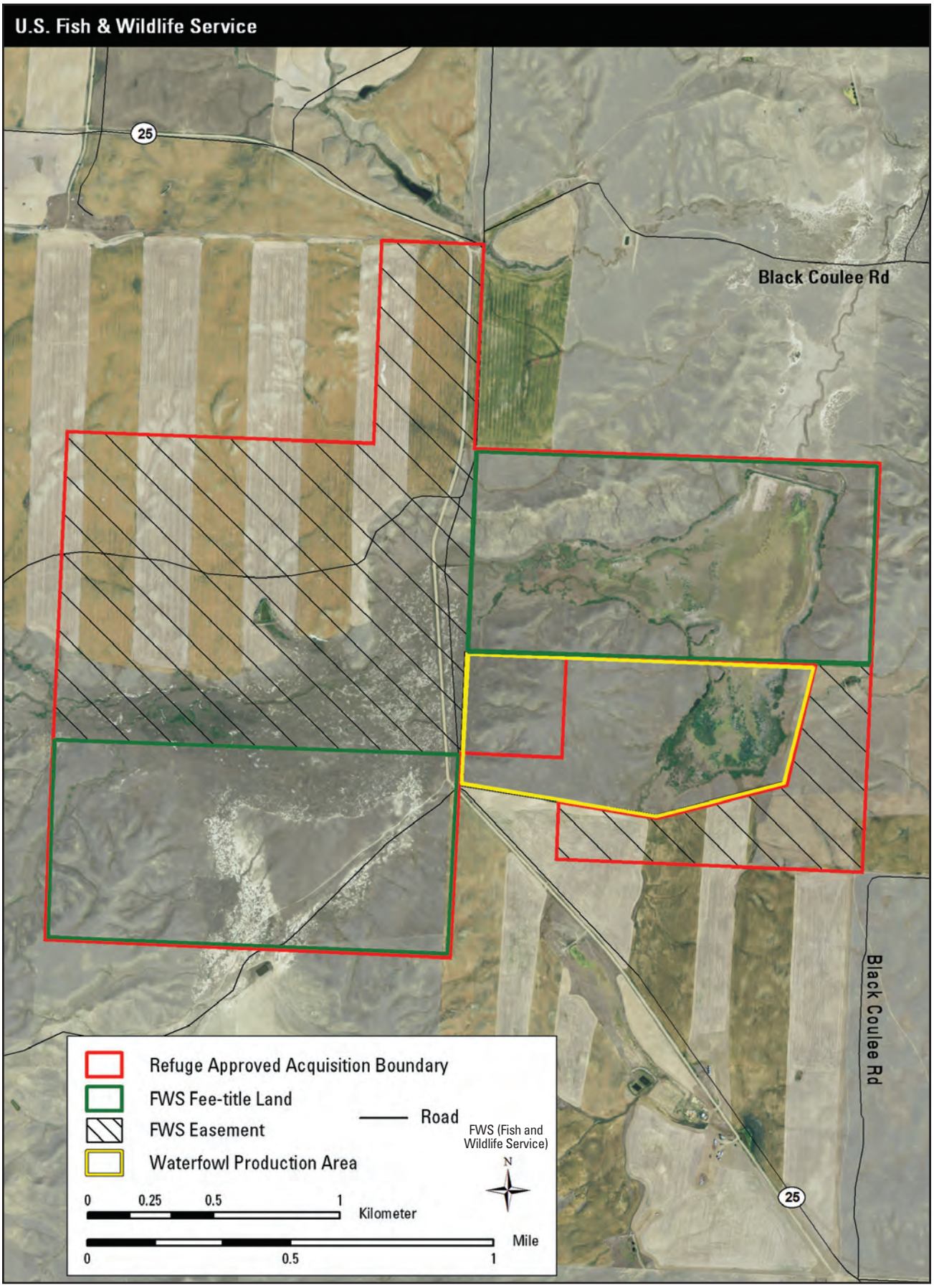


Figure 7. Base map of Black Coulee National Wildlife Refuge, Montana.

The Black Coulee Refuge is located about 10 miles south of the town of Turner in northeastern Blaine County, Montana. The general topography of the land is rolling mixed-grass prairie with major drainages running in a northeasterly direction.

Black Coulee Reservoir provides water for migratory birds as well as nesting and brood-rearing habitat (figure 8). The refuge has a dependable water source from the runoff in the west branch of Black Coulee drainage, which has a large watershed. The area influenced by the dam on the Black Coulee drainage covers about 482 acres. In years when extreme runoff is observed, the upper most areas influenced by the dam are temporarily inundated by water. When average runoff occurs, the reservoir provides about 173 acres of wetland habitat.

The wetland total for the Service-owned land is 211 acres; wetland on the easement-controlled land is about 85 acres. Service-owned uplands protect 428 acres of native prairie. The remaining uplands, which are under easement, consist of both cropland and land enrolled in the Conservation Reserve Program. Due to fluctuations in grain commodity prices, conversion of the Conservation Reserve Program land back to cropland has increased in the past several years.

Creedman Coulee National Wildlife Refuge

The original Executive order designated 3,040 acres, consisting of 80 acres reserved from public domain and 2,960 acres of privately owned land encumbered by eight refuge and flowage easements (figure 9). The 80 acres owned by the Service are located in the southwest corner of the Executive boundary and contain native prairie habitat. Historical records document two other names for this drainage, Greedman Coulee or Greenman Coulee.

Rodney Krey / USFWS

Double-crested cormorants nest in groups in trees, referred to as rookeries.

Creedman Coulee is in Hill County, about 33 miles north of Havre, Montana. One of the primary features of this refuge is the 181-acre Creedman Reservoir. The uplands are a mix of native prairie and agricultural land. The Service easements over these uplands provide no authority over the surface use, except for hunting and trapping. Accurate acreage of the upland habitat on these private lands is difficult to estimate because the landowners convert the prairie to other uses more suitable to their farm and ranch operation needs (figure 10).

When full, Creedman Reservoir attracts migrating waterfowl and provides habitat for hundreds of nesting birds. Established trees near the reservoir serve as a rookery for great blue herons and double-crested cormorants.

Water rights to Creedman Reservoir are owned by one downstream landowner and the Service. Before enlargement of the dam in 1938, Creedman Reservoir was usually dry by late June or early July, providing little to no nesting and brood-rearing habitat for waterfowl. The downstream landowner and the Service reached an agreement that would benefit both parties. The existing dam height was increased, thereby increasing the storage capacity of the reservoir. To ensure that water would be available for nesting waterfowl and broods, a gravity-flow outlet structure was installed in the dam so that water could not be drawn below the elevation of 90 feet. Under this arrangement, the downstream landowner could still use all the water above this elevation for irrigation purposes without the need for pumping.

In recent years, natural gas exploration and extraction has increased within the refuge boundary and surrounding area. No drilling occurs on the 80-acre parcel of Service-owned land, but the presence of this activity contributes to habitat fragmentation and bird disturbance and affecting the aesthetics of the prairie portion of the refuge. The mineral rights were reserved by the landowner when the easement was acquired, and all of this activity is occurring on the privately owned refuge and flowage easement lands. The Service easements do not prohibit such activities.

Hewitt Lake National Wildlife Refuge

The Executive order that established the Hewitt Lake National Wildlife Refuge in 1938 described a 1,200-acre approved acquisition boundary. The early refuge consisted of 400 acres of land reserved from public domain and 800 acres under refuge and flowage easements. An additional 160 acres, not included in the Executive order boundary, was added to the refuge through another easement agreement (tract 2, dated August 30, 1938), bringing the total number of refuge and flowage easements to three.

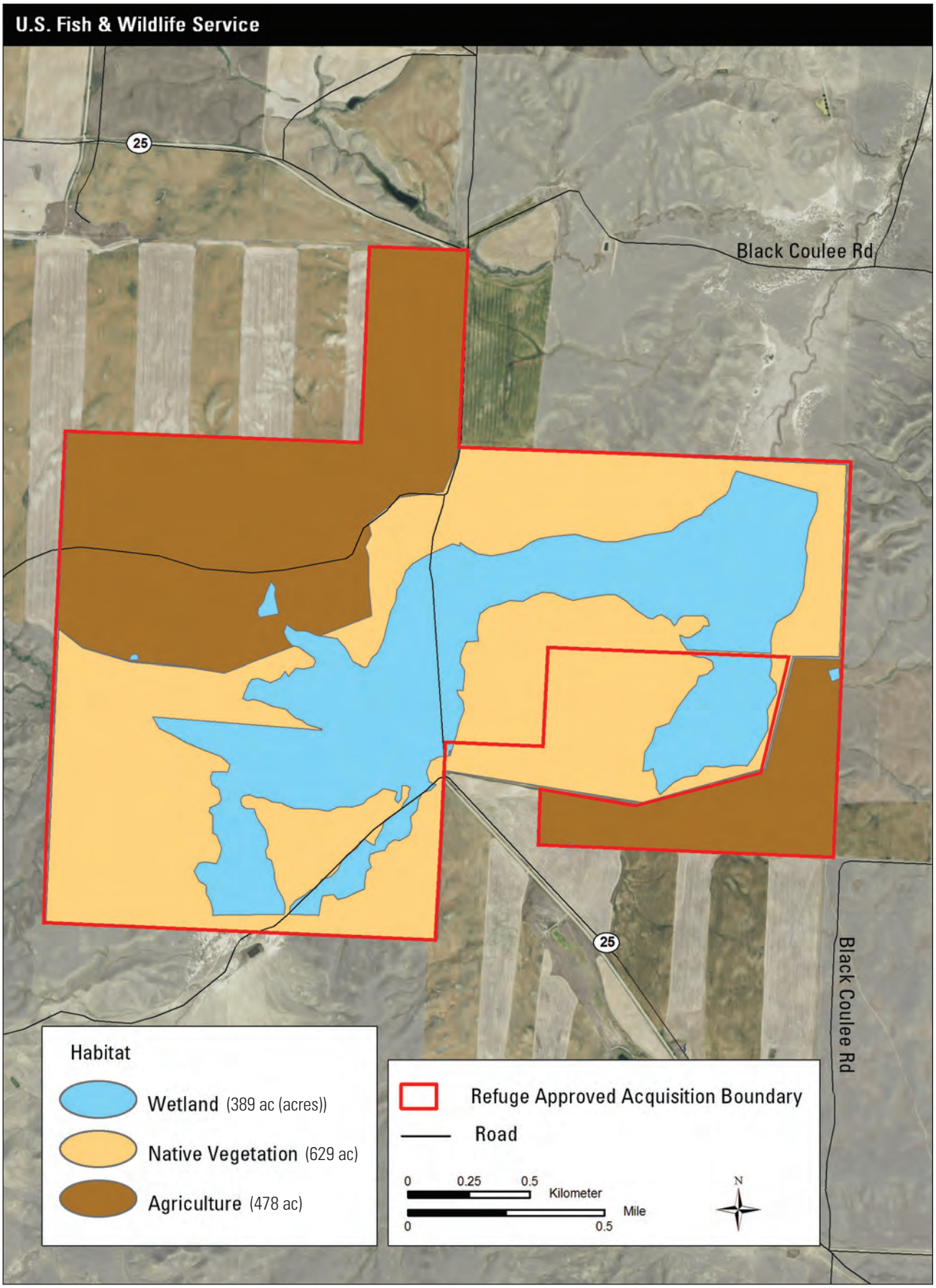


Figure 8. Map of habitat types at Black Coulee National Wildlife Refuge, Montana.

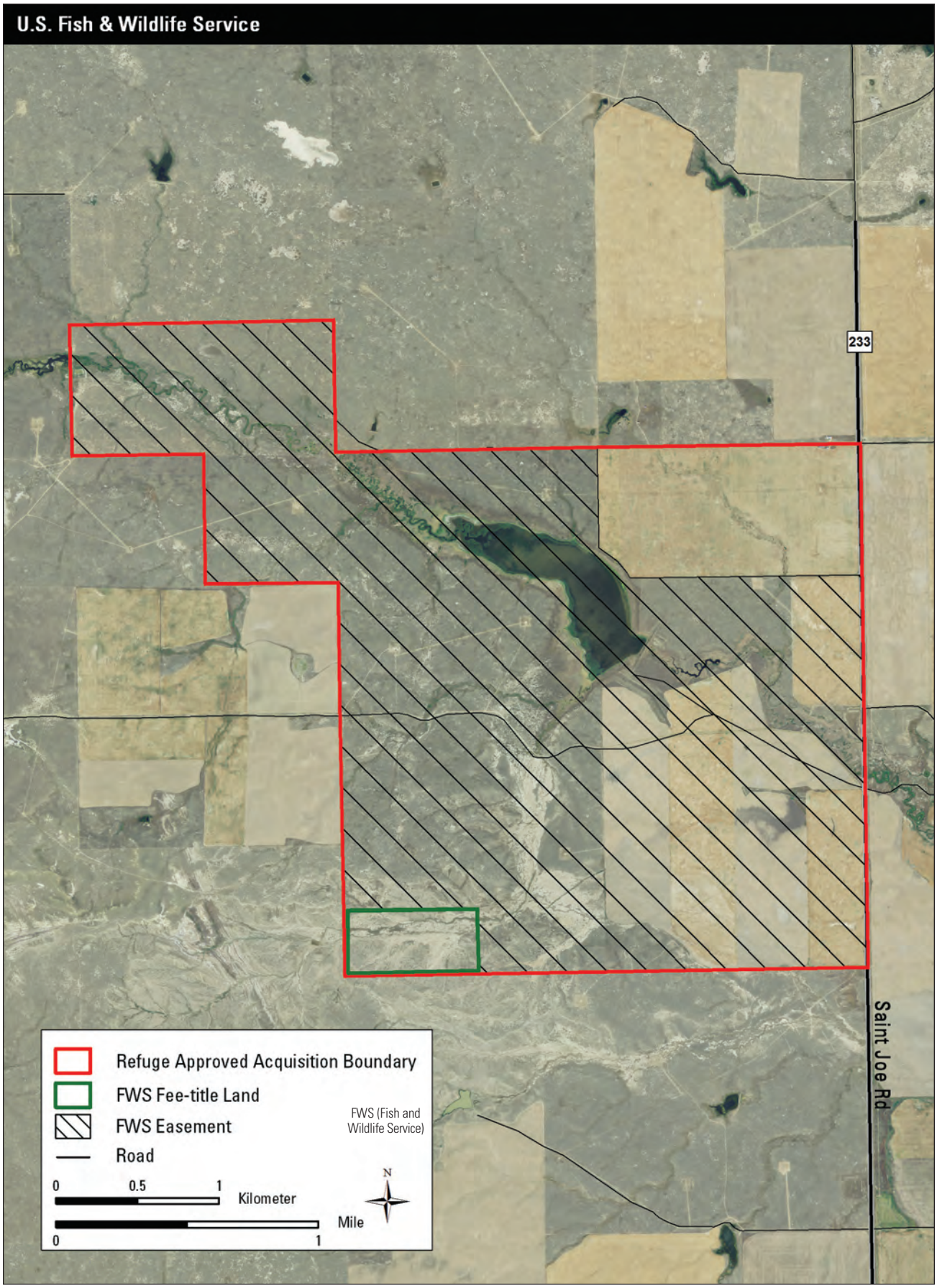


Figure 9. Base map of Creedman Coulee National Wildlife Refuge, Montana.

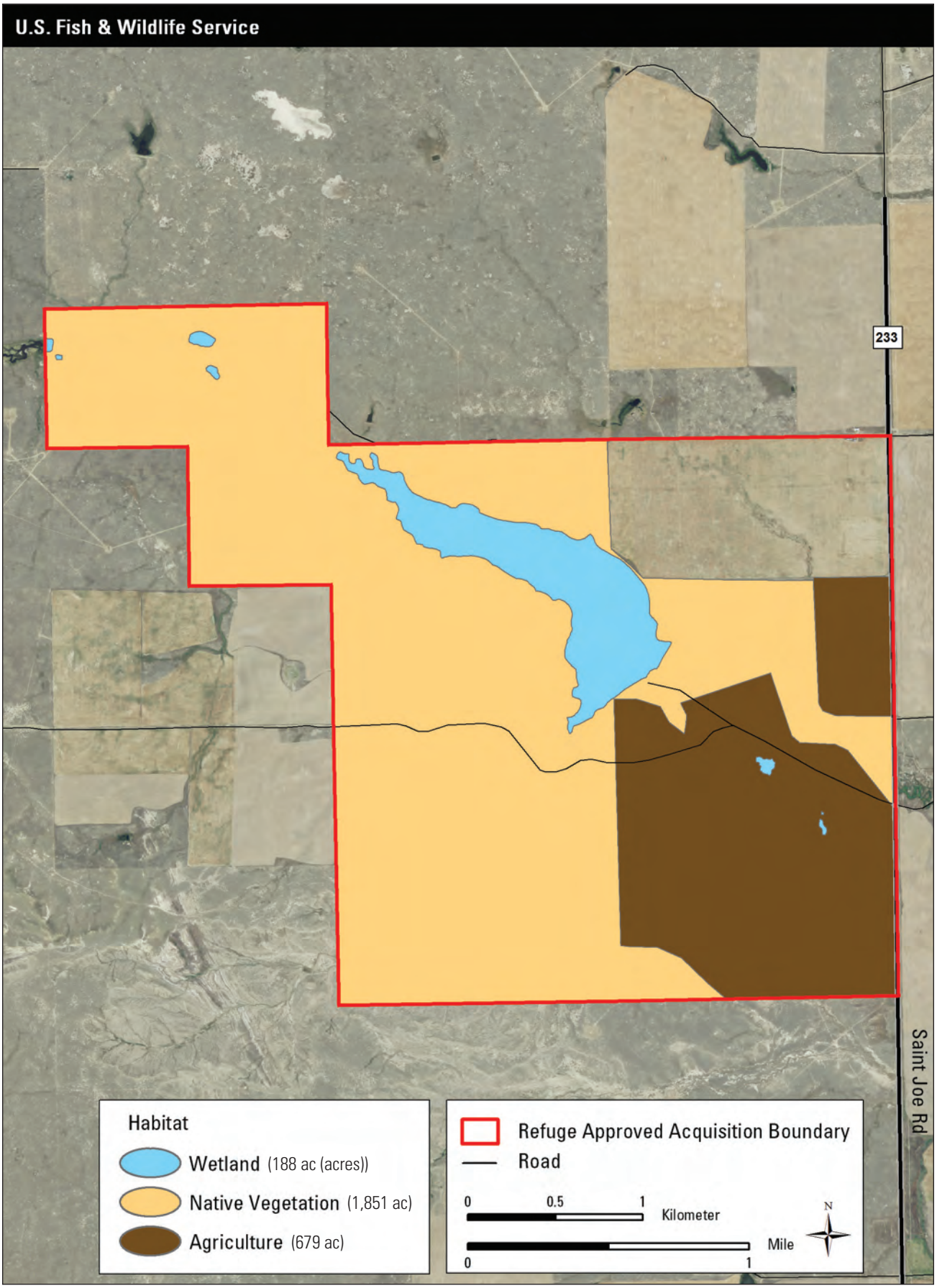


Figure 10. Map of habitat types at Creedman Coulee National Wildlife Refuge, Montana.

In 1959, Secretarial Order 2843 transferred 320 acres of public land for inclusion into Hewitt Lake National Wildlife Refuge, increasing the size to 1,680 acres. In 1992, an existing 320-acre easement tract was purchased with Duck Stamp dollars as a waterfowl production area. The 320-acre Hewitt Lake WPA (waterfowl production area) is described in the below section on Bowdoin Wetland Management District. The current acreage of this limited-interest refuge consists of 1,040 acres of refuge lands (including the 320-acre waterfowl production area) and 640 acres encumbered by easements on private lands (figure 11).

The Hewitt Lake Refuge lies in Phillips County, about 25 miles northeast of Malta via U.S. Highway 2 and about 1.5 miles northwest of Nelson Reservoir (created by Reclamation). The general topography is rolling, mixed-grass prairie with the major drainage running in an easterly direction. Hewitt Lake is located a short distance from the Milk River. The lake, enhanced by an earthen dam, creates a shallow 492-acre seasonal wetland. There are about 234 acres of wetland habitat on the Service-owned lands and another 156 wetland acres on private lands that are protected by Service easements. When the lake is full, it attracts migratory birds in the spring.

The uplands on both Service and private lands are primarily native prairie habitat (figure 12). The Hewitt Lake Refuge has one of two known black-tailed prairie dog towns in the refuge complex. Burrowing owls and mountain plovers have been known to nest within the prairie dog town. The uplands are also used by upland-nesting birds such as long-billed curlew, Sprague's pipit, and waterfowl.

Natural gas exploration and extraction occurs within the refuge boundary and surrounding area, contributing to habitat fragmentation and bird disturbance and affecting the aesthetics of this prairie refuge. The refuge contains a large gas field in which the Federal Government owns much of the mineral rights. The Executive order establishing the refuge permitted oil and gas leasing. Specifically, the Executive order noted that the refuge land was within the known geologic structure of a producing gas field and stated that, "nothing should affect the disposition of its oil and gas deposits under the Mineral Leasing Act of 1920." In addition, at the time it was established, Interior regulations did not prohibit oil and gas leasing on refuge lands (General Accounting Office 2001).

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Hewitt Lake is an important refuge for white-faced ibis (foreground) and many other waterbird species.

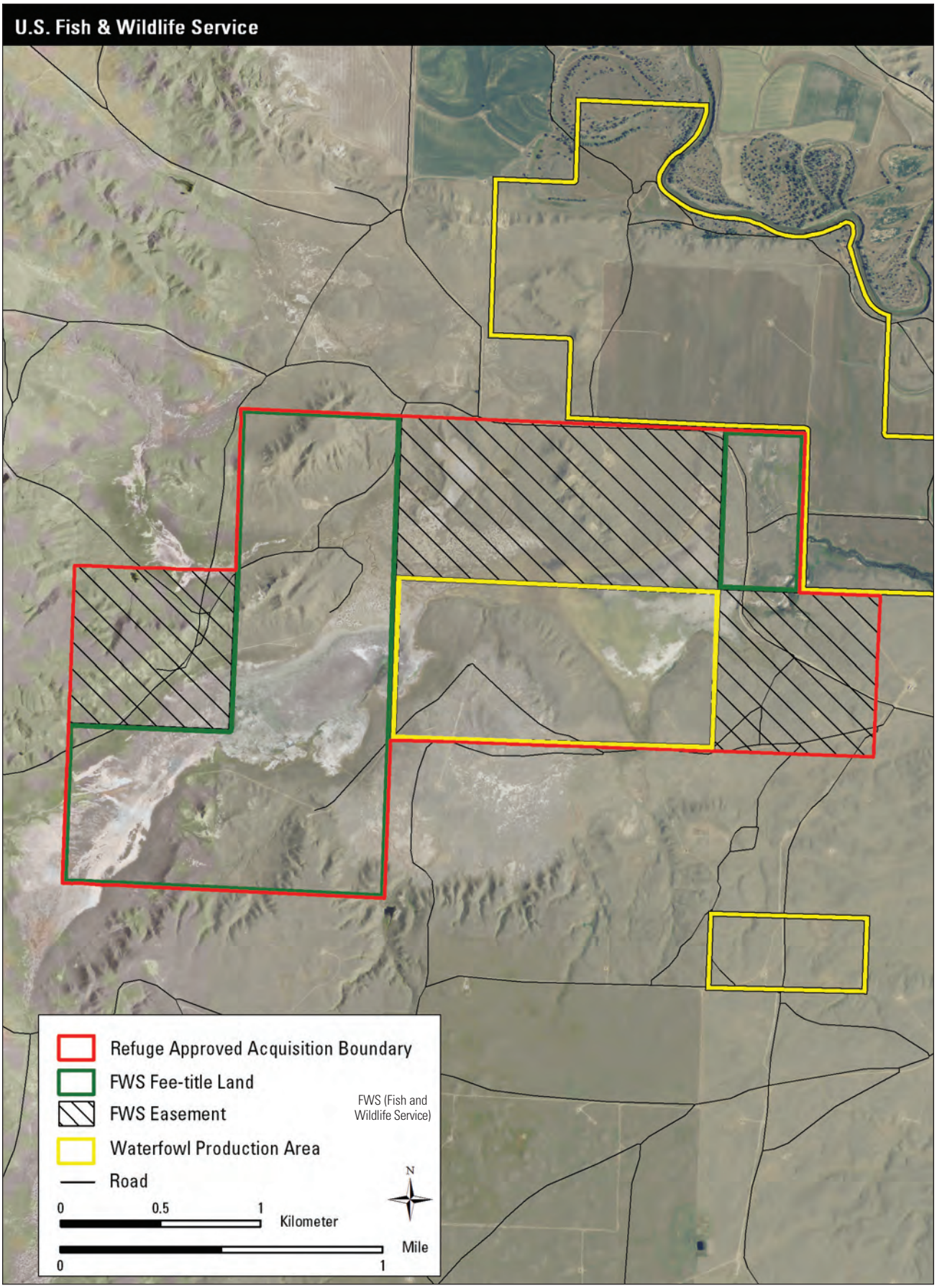


Figure 11. Base map of Hewitt Lake National Wildlife Refuge, Montana.

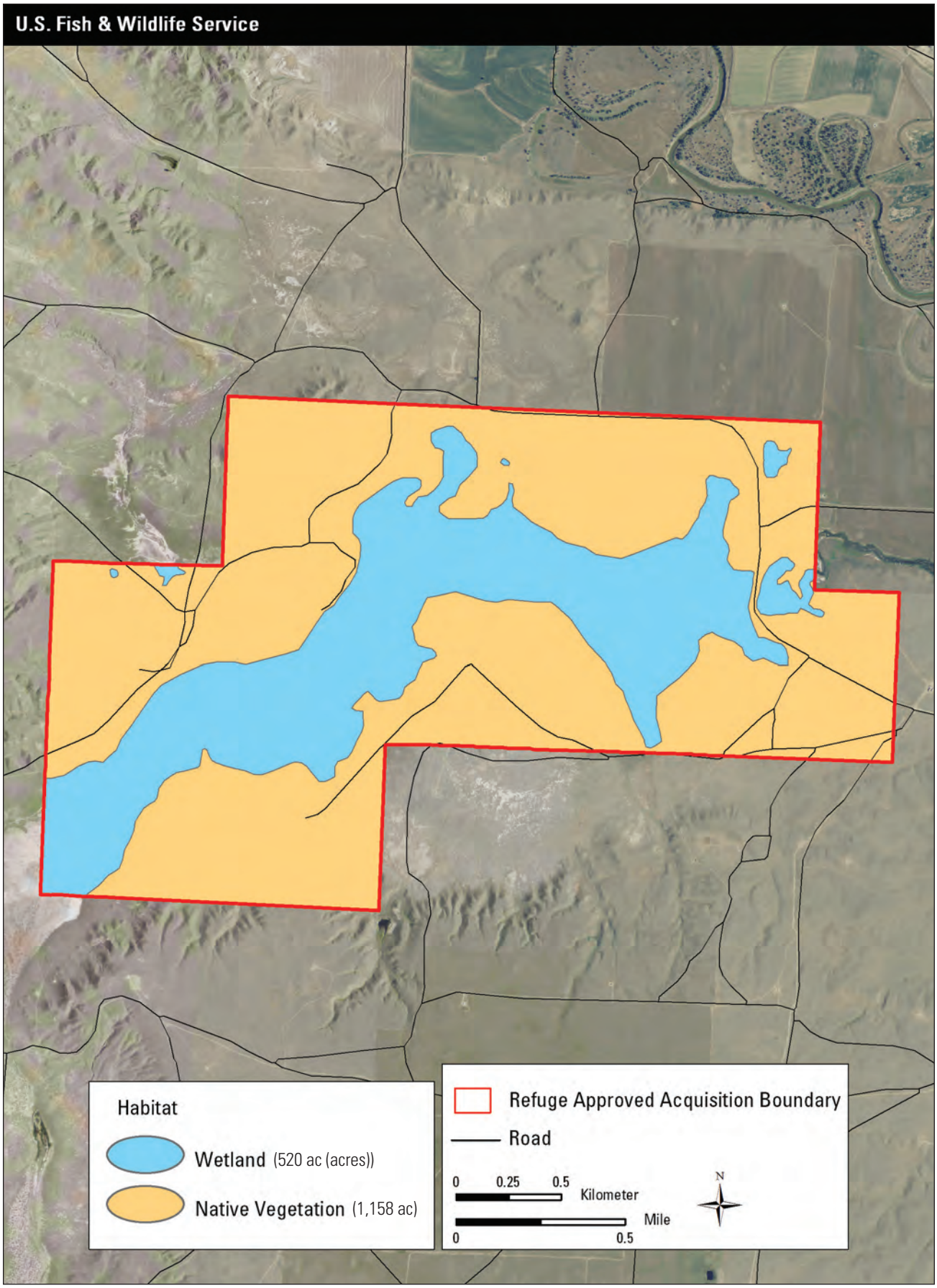


Figure 12. Map of habitat types at Hewitt Lake National Wildlife Refuge, Montana.

Lake Thibadeau National Wildlife Refuge

Lake Thibadeau National Wildlife Refuge, established in 1937, encompasses 3,868.48 acres: 19.42 acres reserved from public domain (originally by the Bureau of Land Management) and 3,849.06 acres encumbered by 13 refuge and flowage easements (figure 13).

The Lake Thibadeau Refuge is located about 15 miles north of the city Havre in central Hill County. The four main water units of this limited-interest refuge are Thibadeau Diversion Dam (16.4 acres), Lake Thibadeau (120.7 acres), Grassy Lake (152.4 acres), and Mud Lake (100 acres). These large wetland basins are surrounded mostly by cropland and very little native prairie. When established as a refuge in 1937, there were only 480 acres of prairie left within the refuge boundary. Over the last 70 years, there has been additional conversion of the native prairie to cropland, resulting in a loss of about 140 acres of prairie. Current cropland totals about 3,139 acres (figure 14).

Of the four refuge wetlands, only Mud Lake and the diversion unit hold any significant amounts of water. The diversion dam diverts waters from Lehman Coulee. An unnamed drainage flows from the north and east into Mud Lake; when Mud Lake reaches capacity it overflows into Grassy Lake. Water development projects in these two drainages have significantly affected the watershed above these wetland units. Lake Thibadeau and Grassy Lake are farmed every season, and Mud Lake is farmed in most years. The refuge and flowage easement does not give the Service any rights to control the uses of these uplands, including farming activities, except for the control of hunting. Lake Thibadeau National Wildlife Refuge provides only marginal waterfowl habitat, except during the wettest years. Intensive agriculture in the area is probably contributing pesticides and fertilizers to the wetlands. There is no public access to this refuge.

Natural gas exploration and extraction occurs within the refuge boundary and surrounding area. All of this activity occurs on the private land portions within the refuge boundary. The refuge and flowage easements do not prohibit these activities on the uplands. The Service controls only hunting on the uplands.

Bowdoin Wetland Management District

The Bowdoin Wetland Management District, established in 1973, is spread over a four-county area consisting of Blaine, Hill, Phillips, and Valley counties in north-central Montana (figure 15). There are several types of Refuge System lands within the wetland management district:

- Waterfowl production areas, which are acquired in fee title
- Perpetual wetland easements, which protect privately owned wetlands from being drained, filled, or leveled, while the landowner retains control of all public access
- Perpetual grassland easements, which protect privately owned rangeland and hayland from conversion to cropland, and the landowner retains control of all public access
- Perpetual FmHA (Farmers Home Administration) conservation easements to help farmers reduce their debt load on farmland and protect wetlands and grasslands

More than a million acres of potholes in the prairie States were drained between 1943 and 1961 (Briggs 1964). The Prairie Pothole Region once produced up to 15 million ducks each year but now produces about one-third that amount. This loss of habitat is the main reason for the reduced production (Belrose 1976). Other causes include the destruction of upland nest cover by the cultivation of land adjacent to wetlands and sloughs (Belrose 1976). These two significant factors led to conservation movements by citizens and pressure from waterfowl-hunting interests to reverse the loss of wetland habitat. In response to this pressure, the Service issued Duck Stamps to fund a program of wetland acquisition and the purchase of conservation easements (van der Valk 1989).

Waterfowl production areas and easements are purchased from willing sellers through the Small Wetlands Acquisition Program authorized by Congress in 1958—an amendment to the Migratory Bird Hunting and Conservation Stamp Act of 1934.

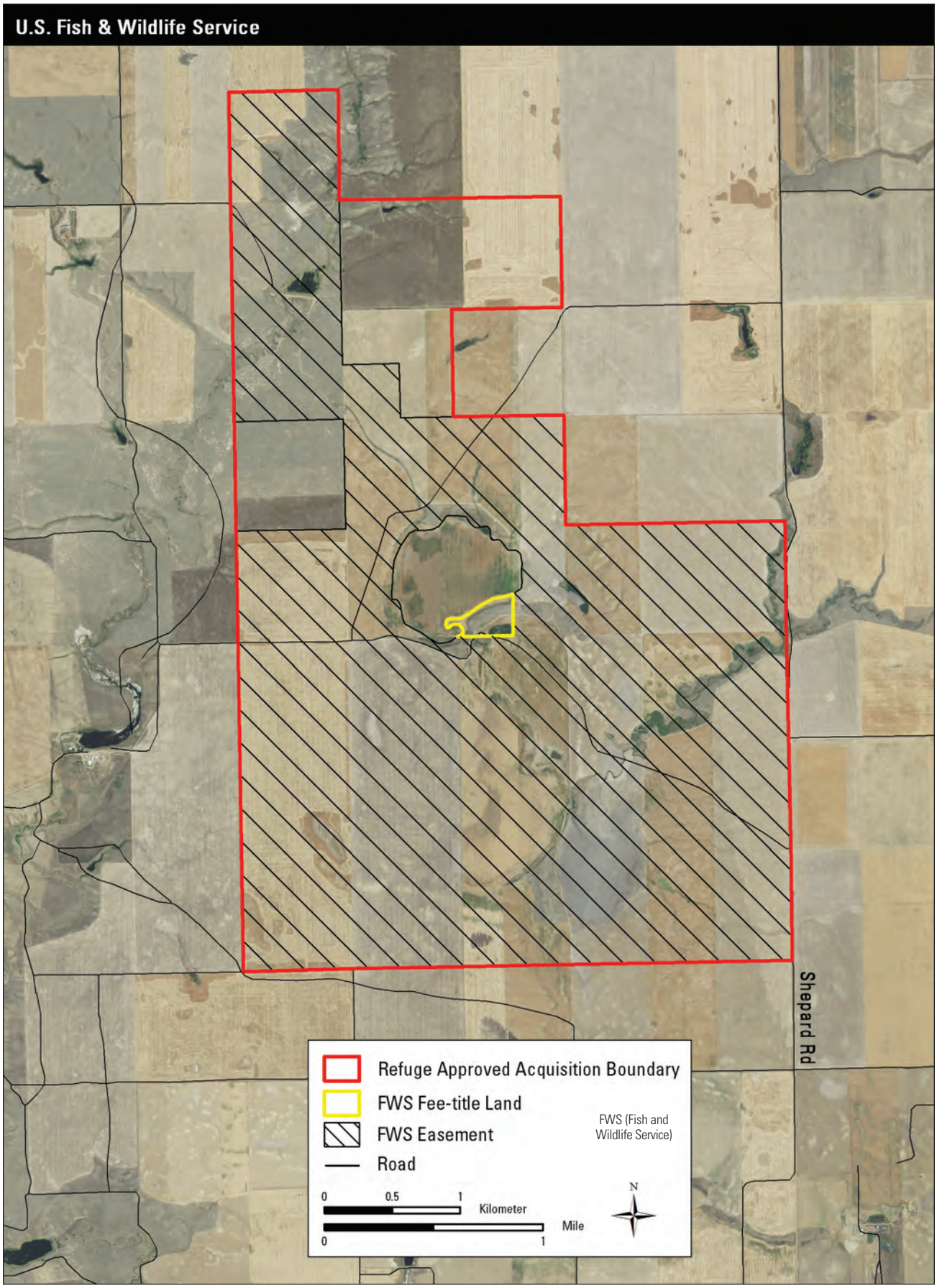


Figure 13. Base map of Lake Thibadeau National Wildlife Refuge, Montana.

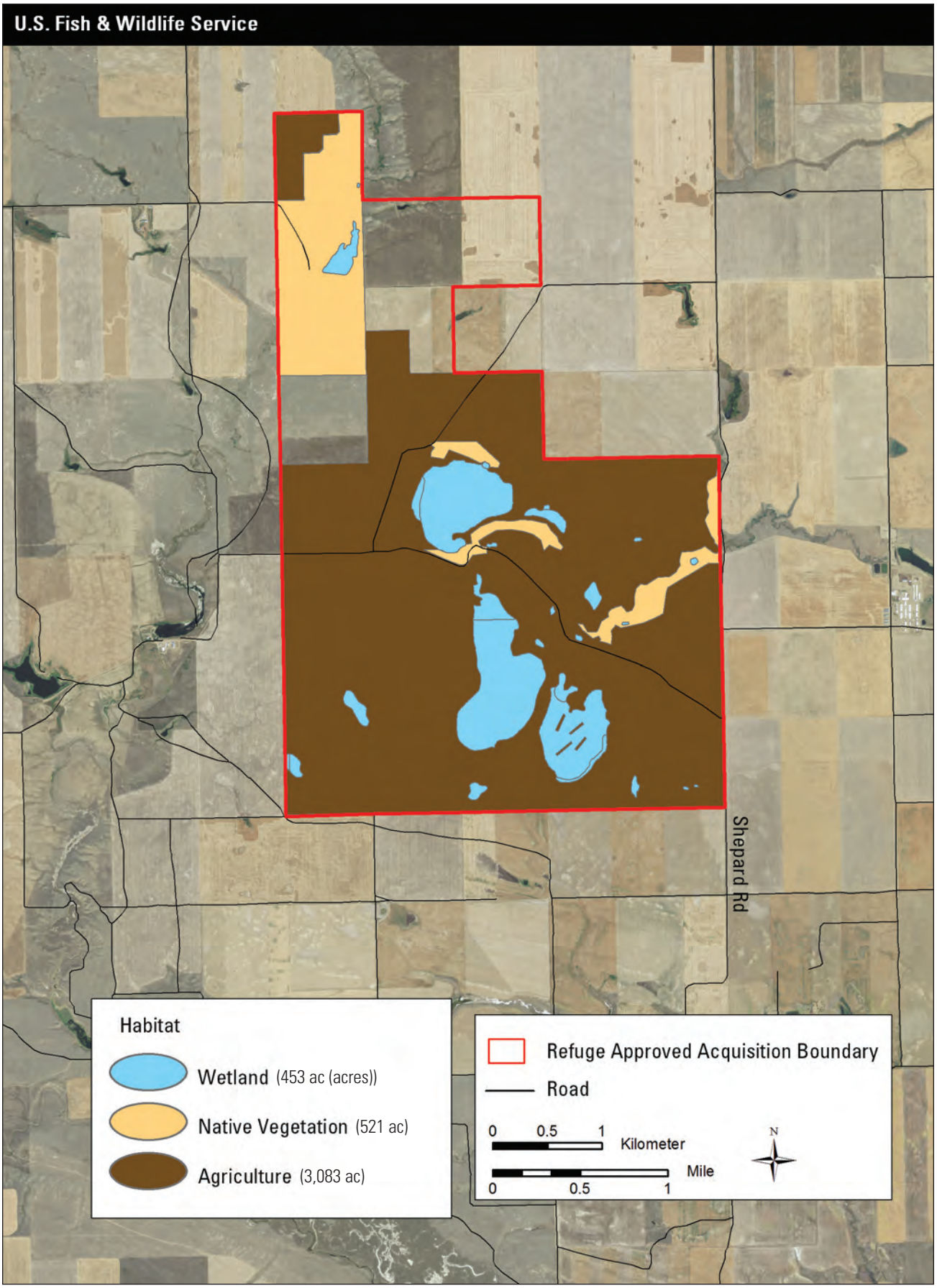


Figure 14. Map of habitat types at Lake Thibadeau National Wildlife Refuge, Montana.

This program is funded by the sale of Federal Duck Stamps and loans against future Duck Stamp sales. The purpose of this important program is to ensure the long-term protection of breeding habitat, primarily within the Prairie Pothole Region of the United States, for waterfowl and other migratory bird species.

The Service owns waterfowl production areas in fee title and manages them to provide breeding waterfowl with quality wetlands for courtship and brood rearing, as well as suitable grasslands for nesting. Habitats are managed using techniques such as prescribed grazing, haying, and fire; farming and reseeding of former cropland; and rest from crop production. These areas are open to hunting (with the exception of the Holm WPA), fishing, and trapping according to State seasons. Hunting opportunities attract hunters from across the United States and Canada.

Wetland easements are perpetual and prohibit filling, leveling, draining, and burning of wetlands under easement. Wetland easements are real-property interests that the Service buys from willing landowners and are permanent fixtures to land titles. The land remains in private ownership and the landowner controls public access. Since 1962 when the Small Wetlands Acquisition Program began, the Service has acquired a perpetual, real-property interest in more than two million wetland acres for waterfowl production in the Great Plains States, which include Montana.

Conversion of grassland to cropland has generated a need for protection of upland habitat adjacent to wetlands. The loss of upland-nesting cover and plant foods has reduced the value and productivity of wetlands for nesting waterfowl and their broods, other migratory birds, and other wildlife. Grassland easements, like wetland easements, are perpetual and protect both existing and restored habitat. The purposes of the perpetual grassland easement program are (1) to improve and protect the water quality of wetlands, (2) maintain upland-nesting habitat for ground-nesting birds, (3) protect highly erodible soils, and (4) provide an alternative to the purchase of uplands in fee title, leaving land in private ownership. Grassland easements are real-property interests that the Service buys from willing landowners to prohibit a loss of grassland cover from cropland conversion, development, or other causes. This agreement also protects nesting birds by prohibiting haying or mowing until after July 15. The land remains in private ownership. Grazing is not prohibited or regulated under the grassland easement. Funding for grassland easements comes from a variety of sources including the Migratory Bird Hunting and Conservation Stamp Act (with Governor approval), North American Wetland Conservation Act grants, and the Land and Water Conservation Fund.

FmHA conservation easements were developed by Congress under the Consolidated Farm and Rural Development Act of 1985 to establish easements for conservation, recreation, and wildlife purposes on properties that were foreclosed on by the Federal Government ("inventories" properties). The Service was designated as the easement manager on those easements worthy of inclusion into the National Wildlife Refuge System.

As of December 1, 2009, the Bowdoin Wetland Management District included nine waterfowl production areas totaling 9,504 acres: Beaver Creek, Black Coulee, Dyrdahl, Hewitt Lake, Holm, Korsbeck, McNeil Slough, Pearce, and Webb WPAs. Major habitat types on these areas follow: 1,390.8 acres of freshwater wetlands, 4,103.91 acres of native prairie, and 4,008.91 acres of prior cropland.

- *Beaver Creek WPA*: Located about 3 miles east of the Bowdoin Refuge, the waterfowl production area was purchased in 1992 and added two new tracts in 2000 and 2003. This 2,125.8-acre area consists of wetlands (325.3 acres), riparian areas (35.9 acres), DNC (1,504.5 acres), and native prairie (260.1 acres).

- *Black Coulee WPA*: This 184.8-acre area, acquired in 1982, has 49.2 acres of wetland and 135.6 acres of native prairie. This waterfowl production area lies within the Executive boundary of the Black Coulee National Wildlife Refuge.

- *Dyrdahl WPA*: Acquired in 1985, this waterfowl production area is 8 miles northwest of Loring in Phillips County, Montana. The 1,327.17-acre area consists of wetland (140.2 acres), DNC (800 acres), and native grassland (386.97 acres).

- *Hewitt Lake WPA*: Of this waterfowl production area's 320 acres (bought in 1992), 120.6 acres are wetland and 199.4 acres are native prairie. The area is within the Executive boundary of Hewitt Lake National Wildlife Refuge.

- *Holm WPA*: This waterfowl production area was the first to be acquired, in 1977, and is the only waterfowl production area in the district that is closed to hunting. The property was sold to the Service by the three Holm brothers who wished to have their farm (located north of Chinook) preserved as a sanctuary for Canada geese. Habitat types on this 2,250.46-acre follow: 245.7 acres of wetlands (natural, constructed or enhanced, and prairie stream), DNC (332 acres), and native prairie (1,672.76 acres).

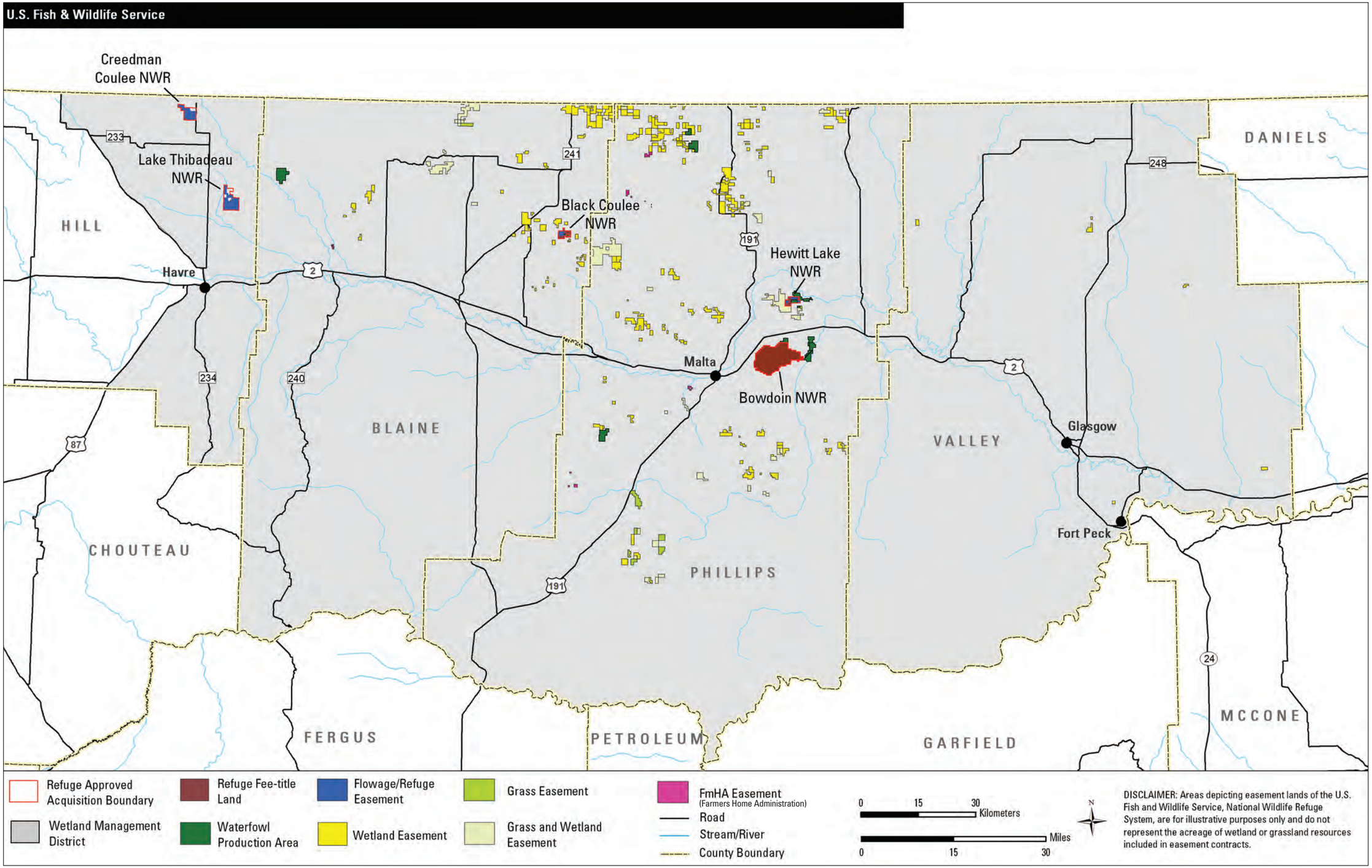
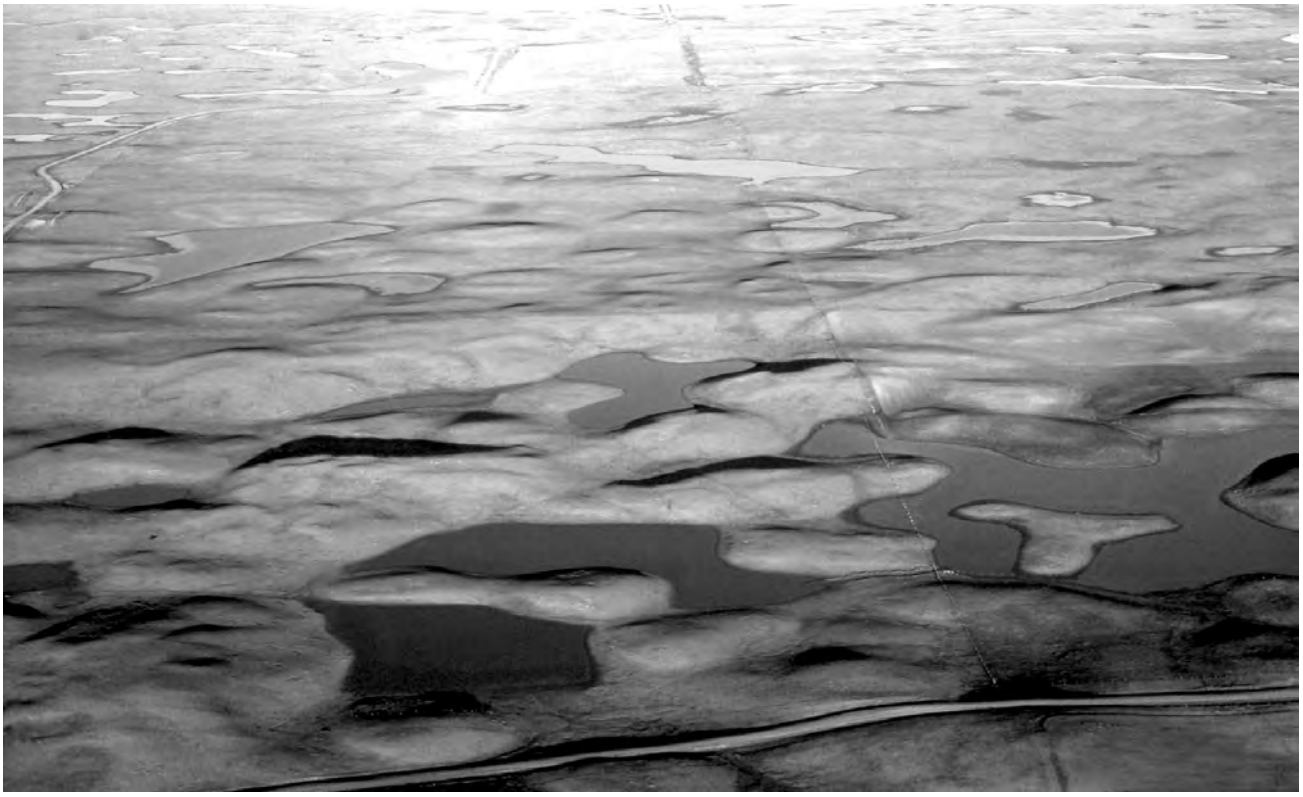


Figure 15. Map of conservation easements and waterfowl production areas in Bowdoin Wetland Management District, Montana.



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Dyrdahl Waterfowl Production Area consists of wetland, dense nesting cover, and native grassland.

- *Korsbeck WPA*: Acquired in 1990, this waterfowl production area is 12 miles south of Dodson in Phillips County, Montana. The 1,041.15-acre unit consists of wetlands (203.2 acres), DNC (440 acres), and native prairie (397.95 acres). The Service also holds a State of Montana grazing lease on 320 acres of native prairie, which is managed as part of the waterfowl production area.

- *McNeil Slough WPA*: The most recent purchase in the wetland management district was in May of 2008 when an inholding (139.52 acres) on McNeil Slough WPA was acquired. These acres were added to the lands acquired in 1992, for a total size of 1,339.18 acres. The Milk River borders this waterfowl production area for 4 miles along its north boundary. It is also bordered by Big McNeil Slough to the south and Hewitt Lake Refuge to the west. The habitat types found on this area are wetland (118.6 acres), DNC (602.52 acres), and native grassland (618.06 acres).

- *Pearce WPA*: Purchased in 1977, this waterfowl production area is adjacent to the northeastern boundary of Bowdoin Refuge. The 438.47-acre unit contains wetland (84.4 acres), DNC (132 acres) and native grasslands (222.07 acres).

- *Webb WPA*: This waterfowl production area is 1 mile north of Dyrdahl WPA and was acquired in 1978. The 476.59-acre area contains wetlands (67.7 acres), DNC (197.89 acres), and native prairie (211 acres).

The remaining wetland management district includes 125 perpetual wetland easements, 33 perpetual grassland easements, a 6-acre perpetual flowage easement, 4 perpetual FmHA conservation easements—totaling 958 acres—and a State of Montana grazing lease. As of 2009, the district's easement program has protected 10,635.4 acres of wetland and 39,766.6 acres of grassland. These easement acres change frequently depending on priorities in the Service's Mountain–Prairie Region (Region 6) and the availability of funding from the North American Wetland Conservation Act grants and the Migratory Bird Conservation Fund.

Summary of Land Acquisition History

Tables 2 and 3 summarize the above-detailed history of land acquisition for the five refuges and one district in the Bowdoin Refuge Complex.

Table 2. Land acquisition history for refuges in Bowdoin National Wildlife Refuge Complex, Montana (1937–89).

National wildlife refuge	*Acres*	*County*	*Date acquired*	*Tract number*	*Means of acquisition*
Black Coulee	108.88	Blaine	05/18/1937	5M	Easement
	240	Blaine	06/18/1937	3M	Easement
	320	Blaine	06/18/1937	4M	Easement
	640	Blaine	01/28/1938	1	Primary withdrawal
Bowdoin	11,937.08	Phillips	02/14/1936	1	Primary withdrawal
	640	Phillips	06/23/1937	2	Primary transfer
	115.39	Phillips	1937–59	Various	Donations
	2,859.5	Phillips	09/20/1989	1g	Primary withdrawal
Creedman Coulee	8	Hill	05/29/1937	5F	Easement
	160	Hill	05/25/1937	6F	Easement
	560	Hill	11/15/1937	8F	Easement
	120	Hill	11/16/1937	9F	Easement
	600	Hill	11/17/1937	7F	Easement
	480	Hill	08/15/1938	4F	Easement
	640	Hill	12/10/1938	3F	Easement
	80	Hill	03/08/1939	3F–1	Easement
	80	Hill	10/25/1941	1	Primary withdrawal
Hewitt Lake	320	Phillips	04/09/1937	3F–1	Easement
	320.49	Phillips	07/03/1937	500bn	Primary transfer
	160.43	Phillips	08/03/1937	3F	Easement
	400	Phillips	03/07/1938	1	Secondary withdrawal
	160	Phillips	08/30/1938	2F	Easement
Lake Thibadeau	240.14	Hill	04/03/1937	4F	Easement
	160.15	Hill	04/10/1937	5F	Easement
	320.68	Hill	04/12/1937	6F	Easement
	320	Hill	04/12/1937	7F	Easement
	546.86	Hill	04/12/1937	10F	Easement
	153.54	Hill	04/13/1937	11F	Easement
	318.4	Hill	04/14/1937	12F	Easement
	309.06	Hill	04/19/1937	9F	Easement
	19.42	Hill	09/23/1937	1	Primary withdrawal
	160	Hill	03/23/1938	13F	Easement
	320	Hill	03/29/1938	14F	Easement
	640.23	Hill	04/04/1938	15Fa	Easement
	40	Hill	04/06/1938	8F	Easement
	320	Hill	12/10/1938	3F	Easement
Total	24,817.28				

Table 3. Land acquisition history for Bowdoin Wetland Management District (1977–2008).

Waterfowl production area	*Acres*	*County*	*Date acquired*	*Tract number*
Holm	2,250.46	Blaine	04/19/1977	10
Pearce	438.47	Phillips	04/22/1977	10
Webb	316.59	Phillips	08/01/1978	48
Addition–1	160	Phillips	04/27/1979	20
Black Coulee[1]	184.8	Blaine	05/24/1982	35
Dyrdahl	765.35	Phillips	07/12/1985	27
Addition–1	561.82	Phillips	10/02/1989	76
Korsbeck	1041.15	Phillips	01/03/1990	75
McNeil	1,199.66	Phillips	01/10/1992	77
Burgess Addition	139.52	Phillips	05/02/2008	106
Hewitt Lake[2]	320	Phillips	01/10/1992	77
Beaver Creek	560	Phillips	01/10/1992	77
Masters Addition	965.8	Phillips	08/18/2000	86
Copple Addition[3]	600	Phillips	02/20/2003	90
Total	9,503.62			

[1] *Part of Black Coulee National Wildlife Refuge.*
[2] *Part of Hewitt Lake National Wildlife Refuge.*
[3] *51 acres donated.*

2.2 Purposes

Every national wildlife refuge and wetland management district has a purpose for which it was established. This purpose is the foundation on which to build all refuge and district programs—from biology and public use, to maintenance and facilities. No action undertaken by the Service or public may conflict with this purpose. The refuge and district purposes are found in the legislative acts or Executive actions that provide the authorities to either transfer or acquire a piece of land for one of these units. Over time, an individual refuge or district may contain lands that have been acquired under various transfer and acquisition authorities, giving the unit more than one purpose. The goals, objectives, and strategies proposed in the draft CCP (refer to chapter 7) are intended to support the individual purposes for which each refuge or district was established.

Four of the refuges within this refuge complex are encumbered by refuge and flowage easements acquired on private lands in the late-1930s. All but one are perpetual. The Executive order or legislative purposes only apply when the Service buys the easement lands. Until that time, the only purpose for that area is the language found in the refuge or flowage easement.

Bowdoin National Wildlife Refuge

The purposes of the Bowdoin National Wildlife Refuge are:

- As "a refuge and breeding ground for migratory birds and other wildlife […] and that such part of said lands as the Secretary of Agriculture may deem proper be reserved for use as a shooting area to be operated under a cooperative agreement or lease with the Montana State Game Commission or such other operating agency as may be approved. The reservation of these lands as a migratory waterfowl refuge is subject to the use thereof by [the Department of the Interior] for irrigation and other incidental purposes." (Executive Order 7295, February 14, 1936)

- As "a refuge and breeding ground for migratory birds and other wildlife […] subject to their use pursuant to the reclamation laws, and for the purpose of oil and gas development […] and for purposes incidental thereto." (Executive Order 8592, November 12, 1940)

- For "any other management purpose, for migratory birds." (Migratory Bird Conservation Act)

Black Coulee National Wildlife Refuge

The purposes of the Black Coulee National Wildlife Refuge are:

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes, […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." (Three refuge and flowage easement agreements, 1937–38)
- As "a refuge and breeding ground for migratory birds and other wildlife." (Executive Order 7801, January 28, 1938)

Creedman Coulee National Wildlife Refuge

The purposes of the Creedman Coulee National Wildlife Refuge are:

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes, […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." (Eight refuge and refuge and flowage easement agreements, 1937–39)
- As "a refuge and breeding ground for migratory birds and other wildlife." (Executive Order 8924, October 25, 1941)

Hewitt Lake National Wildlife Refuge

The purposes of the Hewitt Lake National Wildlife Refuge are:

- For "water conservation, drought relief, flood control, stock water, migratory waterfowl and wildlife conservation purposes, […] and operate and maintain a closed refuge for migratory birds and other wildlife." (Revocable easement signed August 30, 1938; section 16 land [State-owned lands set aside for schools])
- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes, […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." (Two refuge and refuge and flowage easement agreements, 1937–38)
- As "a refuge and breeding ground for migratory birds and other wildlife […] nothing herein shall affect the disposition of the oil and gas deposits therein." (Executive Order 7833, March 7, 1938, applies to easements within the Executive boundary only when purchased)
- For "purposes of a land conservation and land utilization program." (Bankhead–Jones Farm Tenant Act)
- For "use and administration under applicable laws as refuges for migratory birds and other wildlife." (Secretarial Order 2843, November 17, 1959)

Lake Thibadeau National Wildlife Refuge

The purposes of the Lake Thibadeau National Wildlife Refuge are:

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes, […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." (13 refuge and flowage easement agreements, 1937–38)
- As "a refuge and breeding ground for migratory birds and other wildlife." (Executive Order 7713, September 23, 1937)

Bowdoin Wetland Management District

The purposes of the Bowdoin Wetland Management District are:

- As "Waterfowl Production Areas subject to […] all of the provisions of such Act [Migratory Bird Conservation Act] […] except the inviolate sanctuary provisions." (Migratory Bird Hunting and Conservation Stamp)
- For "any other management purpose, for migratory birds." (Migratory Bird Conservation Act)

2.3 Vision

A vision is a concept, including desired conditions for the future, that describes the essence of what the Service is trying to accomplish. The following vision for the Bowdoin National Wildlife Refuge Complex is a future-oriented statement designed to be achieved through refuge and district management throughout the life of this CCP and beyond.

Under seemingly limitless skies, Bowdoin National Wildlife Refuge Complex provides vast expanses of gently rolling native mixed-grass prairie, dotted with an array of diverse wetlands.

Recognized as one of the most important migratory bird refuges in the State of Montana, these habitats are managed to ensure that grassland- and wetland-dependent waterfowl, shorebirds, songbirds, and native wildlife species thrive.

Visitors recognize these unique and wondrous qualities and experience a sense of solitude and a connection to the land that fosters a desire to conserve this and other remnants of the northern Great Plains.

2.4 Goals

The Service developed a set of goals for the refuge based on the National Wildlife Refuge System Improvement Act, the purposes of the refuge complex, and information developed during project planning. A goal is a descriptive, broad statement of desired future conditions that conveys a purpose but does not define measurable units. The goals direct efforts toward achieving the vision and purposes of the refuge and outline approaches for managing refuge resources. The Service established five goals for the entire refuge complex.

Goal for Upland Habitat and Associated Wildlife

Protect, enhance, and restore grassland habitat for breeding and migratory birds and other wildlife while maintaining the biological diversity and integrity of native prairie grasslands.

Goal for Wetland Habitat and Associated Wildlife

Provide, protect, and manage wetland habitat for breeding and migratory birds and other wildlife that maintains the biological diversity and integrity of prairie pothole wetlands.

Goal for Visitor Services

Provide visitors of all abilities with wildlife-dependent recreation, interpretation, and environmental education opportunities that foster an appreciation and understanding of the unique wildlife, plant communities, and cultural resources of the Montana Prairie Pothole Region.

Goal for Partnerships

Maintain and expand partnerships that preserve, restore, and enhance healthy and productive prairie-wetland complexes on Bowdoin National Wildlife Refuge and within Bowdoin Wetland Management District.

Goal for Operations

Prioritize for wildlife first and emphasize the protection of trust resources in the use of staff, funding, partnerships, and volunteer programs.

2.5 Special Values

Early in the planning process, the planning team and public identified the outstanding qualities or special values of the Bowdoin National Wildlife Refuge Complex. These special values are characteristics and features of the refuge complex that make it special, valuable for wildlife, and worthy of refuge status. It was important to identify the special values of the refuge complex to recognize its worth and to ensure they are conserved, protected, and enhanced through the planning process. These special values can be unique biological resources, as well as something as simple as a quiet place to see a variety of birds and enjoy nature.

Part of a National System

The Bowdoin National Wildlife Refuge Complex is part of a national system of lands. In the 1920s, public agencies and private organizations attempted to elevate the public's awareness of wetland loss and to take positive steps to slow it. The Migratory Bird Conservation Act of 1929 authorized the Federal Government to acquire wetlands and associated uplands to conserve them as waterfowl habitat and thus create a chain of stepping stones along major migration routes. The law also established a commission of Federal and State officials to evaluate lands for possible acquisition, and in so doing it established the National Wildlife Refuge System (Adair 2003).

Migratory Birds

The lands of the refuge complex were established to protect and provide habitat for migratory birds, especially waterfowl, that cross State lines and international borders and are by law a Federal trust responsibility.

The refuge complex is located primarily in the central flyway (figure 16). This makes Bowdoin National Wildlife Refuge Complex an acutely important and strategic stopover point for migratory birds during spring and fall migrations and as resting, feeding, and nesting habitat.

In eastern Montana, there are very few natural wetlands the size of Lake Bowdoin (including the surrounding array of wetland complexes) with the necessary food and habitat resources for ducks, shorebirds, and other waterbirds. Most importantly, the refuge complex—located in the Prairie Pothole Region in north-central and northeastern Montana—has very high duck-nesting success.

The Bowdoin Refuge Complex is of such great value to waterfowl and shorebirds, as well as other migrating waterbird species, because of its diversity of wetland and upland habitats that provide for the diverse life cycle requirements of these species. In addition, the refuge complex serves as a valuable research site for the study of migratory birds, plant communities, and grassland and wetland management.

Prairie Pothole Region

The refuge complex is within the Prairie Pothole Region, which the North American Waterfowl Management Plan (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1986) identifies as the number one priority geographical conservation area in North America.

Furthermore, the refuge complex is within the Prairie Pothole Joint Venture, which is a collaboration between agriculture groups, conservationists, and other partners to protect wetlands, waterfowl, and other wildlife. In Montana, the Prairie Pothole Joint Venture works in 21 counties (including the 4 counties in the refuge complex) that cover more than 60,500 square miles. Within this region, 27 percent of the wetlands and 50 percent of the grasslands have already been lost to drainage and conversion (Ducks Unlimited 2003).

Wetlands of the Bowdoin National Wildlife Refuge Complex provide habitat for a large variety of plants and animals including the threatened piping plover. The primary attractant is the availability of suitable habitat for food and reproduction. These wetlands are very important as areas of great biodiversity and biological productivity.

Early accounts of Bowdoin National Wildlife Refuge note its significance to waterfowl and hunters: "Lake Bowdoin, Montana's most important collective breeding-ground for waterfowl. Famed throughout eastern and central Montana since pioneer days as a hunting-ground […] Lake Bowdoin under Federal supervision should be even more important as a breeding and feeding area for waterbirds than it has been in the past" (Weydemeyer and Marsh 1936).

At least 300 of the more than 800 migratory bird species in North America rely on the Prairie Pothole Region for breeding and nesting habitat during the spring and summer and feeding and resting habitat during spring and fall migrations (Ducks Unlimited 2003). More than 260 species of birds depend on the refuge complex for their life cycle requirements.

Figure 16. Map of waterfowl flyways in North America.

Special Designations

Bowdoin National Wildlife Refuge has been designated as part of the Western Hemisphere Shorebird Reserve Network, an organization that monitors and protects key shorebird areas throughout the hemisphere. To be selected, an area must host a minimum of 20,000 shorebirds during migration.

In March 2001, Bowdoin National Wildlife Refuge was designated as a Globally Important Bird Area by the American Bird Conservancy (now managed by the National Audubon Society). The refuge was noted for its high value for the conservation of birds and bird habitats.

Native Prairie

Large, intact native prairie communities can still be found throughout the refuge complex. This is important, because 50 percent of native grasslands have been lost in the Prairie Pothole Region of Montana (Ducks Unlimited 2003). Visitors to the area can experience the vastness and big sky of relatively undisturbed prairie landscapes. Native prairie areas are important to grassland-dependent species such as black-tailed prairie dog and mountain plover, as well as other species of concern such as northern pintail, burrowing owl, and swift fox. These wildlife species favor large expanses of native prairie and are sensitive to its development and conversion to agricultural uses.

Conservation Easements

The refuge complex's conservation easement program protects existing native prairie areas and wetlands in perpetuity through the acquisition of grassland and wetland conservation easement on private lands as well as through fee-title areas called waterfowl production areas. Since April 14, 1977, the Service and surrounding landowners have protected more than 60,000 grassland and wetland acres.

Cultural History

The Bowdoin Refuge Complex has a rich cultural history of Native American inhabitants, explorers, frontiersmen, outlaws, and early settlers. Evidence of early human occupation in the State of Montana dates back 11,000 years (Brumley 2006).

The Lewis and Clark expedition traveled the Missouri River, approximately 70 miles south of Bowdoin National Wildlife Refuge, and parts of the Milk River.

Public Use

The refuge complex is valued by hunters for its quality hunting opportunities and by other visitors for its opportunities to view and photograph wildlife and their habitats.

The refuge complex attracts many visitors and tourist dollars to the communities surrounding the refuges and waterfowl production areas. Employment and nonsalary refuge expenditures (maintenance and operations) greatly benefit the local community, county, and State in the form of income, jobs, taxes, and personal spending. In Phillips County, Bowdoin National Wildlife Refuge's annual budget in 2004 generated $806,700 in economic output, 8.6 jobs, $411,600 in job income, and $163,500 in taxes (Caudill and Henderson 2005).

2.6 Planning Issues

Several key issues were identified following the analysis of comments collected from refuge complex staff and the public and a review of the requirements of the Improvement Act and the National Environmental Policy Act. A public meeting, news releases in the local and regional press, a presentation to the Malta Chamber of Commerce, an announcement in the Federal Register, and planning updates were used to solicit public input on which issues the CCP should address. Substantive comments (those that could be addressed within the authority and management capabilities of the Service) were considered during formulation of the alternatives for future management. These key issues are summarized below.

Upland Habitat and Associated Wildlife

The refuge complex has outstanding ecological features and vegetation communities (previous figures 6, 8, 10, 12, 14, and 15) that should be conserved, particularly unique landforms such as the prairie potholes and the large expanses of native prairie. The prairie is considered native where the sod is unbroken and the soil composition is generally intact. Nonnative and invasive plant species may become established in these areas, but some native plants and a native seed source may still persist.

The refuge complex's primary purpose is to provide optimal habitat conditions for migratory birds and, to a lesser extent, the native resident wildlife. To achieve goals and objectives, aggressive management of upland habitat, including use of prescribed fire and treatment of invasive species, has been conducted. In addition to native prairie areas, the refuge complex also includes previously farmed uplands that have since been converted to various mixes of tame and native grasses.

Historically, the northern Great Plains was a grassland-dominated system where fire and native grazers restricted natural tree growth to riparian floodplains, wooded draws, islands within lakes, and small patches downwind of wetland edges (Higgins 1986). These large expanses of treeless prairies have been fragmented by cropland, shelterbelts, and human settlement. Grassland bird populations are declining faster and more consistently than any other group of North American birds (Samson and Knopf 1994) due to habitat fragmentation and loss of native grasslands. A growing body of literature indicates that trees in prairie landscapes, such as the nonnative Russian olive trees found throughout Bowdoin Refuge, are often associated with negative consequences to numerous bird groups including ducks (Rumble and Flake 1983, Gazda et al. 2002), wetland-dependent birds (Naugle et al. 1999), prairie grouse (Hanowski et al. 2000, Niemuth 2000, Grant et al. 2004), and even ring-necked pheasants (Snyder 1984, Schmitz and Clark 1999). These fragmented grasslands make it easier for predators to successfully locate and capture vulnerable birds, including their nests and young. The nonnative trees also serve as perches for these predators to successfully survey

these fragmented grasslands while hunting, increasing their success. Habitat loss and fragmentation has been one of the greatest threats to declining grassland-dependent birds.

Loss of Sharp-tailed Grouse Leks

A "lek" or "dancing ground" is an area used by the males of species like sharp-tailed grouse and greater sage-grouse to attract females for mating. A lek consists of bare, grassy, or sparse shrubland. Males select hilltops, ridges, or any place with a good field of view for leks, so they can see the surrounding displaying males, approaching females, and predators (Johnsgard 2002, Manske and Barker 1987, Sisson 1969). The same leks may be used year after year and may be active for decades if not destroyed by cultivation, invasion of dense woody vegetation, or tree planting. Males commonly roost overnight near the lek and, before sunrise, will move to the lek and display (strut). This will continue for a couple of hours following sunrise from March through May.

There have been nine documented sharp-tailed grouse leks on Bowdoin Refuge; however, the most leks used by sharp-tailed grouse in any one year was seven. Use of leks on consecutive years ranged from as many as 18 years to as few as 2 years. Since 1984, the number of leks on the refuge has continued to steadily decline from nine known sites to one lek, and in more recent years none.

Research supports the current theory that the loss of these leks on Bowdoin Refuge is a direct result of the encroachment of trees and woody plants near sharp-tailed grouse leks.

- Gregg (1987) and Prose (1987) showed preferred lek sites by sharp-tailed grouse are characterized by low, sparse vegetation and that an excess of woody cover within 2,625 feet of the lek site (well over half a mile), has a negative effect on the number of dancing males.

- Berger and Baydack (1992) examined 21 years (1965–86) of aerial photographs of habitat around prairie sharp-tailed grouse leks; they found that leks were abandoned when aspen forest increased beyond 56 percent and prairie fell below 15 percent of the total area within 0.6 mile of the lek. In 1976, at least 12 leks existed within their study area, but by 1986 only 5 remained.

- Moyeles (1981) and Swenson (1985) both concluded that the invasion of woody vegetation and trees into leks also caused displaying males to abandon the leks. Moyles (1981) observed an inverse relationship of lek attendance by males with an increase in quaking aspen within 0.5 mile of leks in the parklands of Alberta, Canada.

USFWS

A male sharp-tailed grouse performs a courtship display at a lek.

- A study by Hanowski et al. (2000) showed that active sharp-tailed grouse leks had significantly lower proportions of upland forest and brush cover types and higher percentages of native grasses than inactive leks in Minnesota. They also noted sharp-tailed grouse were sensitive to even small increases in the amount of woody vegetation and that the reduction in the population on their study area appeared to be associated with the loss of prairie habitat.

Despite the decline of the number of leks on Bowdoin Refuge, sharp-tailed grouse are observed on lands surrounding the refuge during the mating season and throughout the year. Sharp-tailed grouse use the refuge in the fall and winter months for feeding and roosting.

Wetland Management at Bowdoin National Wildlife Refuge

Bowdoin Refuge relies on runoff, precipitation, and delivered water from the Milk River to supply the water needed to manage refuge wetlands. The quantity of water received is dependent on both weather and the availability of water from the Milk River and, at times, irrigation water from the Milk River Project. The semiarid climate of this region provides just over 12 inches of precipitation annually and an annual evaporation rate of more than 2 feet. Subsequently, the refuge is more reliant most years on delivered water from the Malta Irrigation District.

Through an MOA, Reclamation allows the refuge to use its allotted water supply of 3,500 acre-feet

from the Milk River, which is delivered to the refuge by the Dodson South Canal. The Service pays an operations and maintenance fee to the Malta Irrigation District for every acre-foot of water delivered to the refuge. During drought years or low-water years when there is insufficient water to meet the needs of all users, the refuge water supply is reduced along with that of all other irrigators. Nevertheless, the original purpose of the Milk River Project was for irrigation, and many people consider any irrigation water used for wildlife purposes as secondary to irrigation purposes.

In some years, the refuge receives only the 3,500 acre-feet, and only if sufficient water is available to all irrigators. This minimal water supply is insufficient to properly manage all wetlands as well as manage the refuge's salinity problem. For example, Piping Plover Pond, a wetland developed specifically for the threatened piping plover, is unable to be flooded in most years. With the current water transfer system, the wetlands in line before Piping Plover Pond must be sufficiently flooded before transferring water to this wetland. This pond remains dry and unavailable as nesting habitat for the plover in many years because of the refuge's limited water supply.

The preferred period to deliver water to provide wetland habitat is in the early spring and before the arrival of waterbirds. In some years, it is necessary to deliver water to wetland units during late summer (at the end of the irrigation season and when the chance for a botulism outbreak is minimal) to provide migration habitat for the following spring and also to provide waterfowl-hunting opportunities on Lake Bowdoin and Drumbo Pond during the fall. Although this is not the preferred method to manage refuge wetlands, the Service bases its decision on climate conditions at the time, weather forecasts for the following season, and the possibility that there may be very little or no water available to provide wetland habitat the following spring.

Water is moved through the refuge using a series of canals and water control structures. The refuge attempts to mimic natural wetland cycles—flooding during the spring and drying throughout the summer—to provide quality habitat for nesting and migratory waterbirds and other wetland-dependent wildlife. However, on average, the refuge is unable to flood and properly manage all its wetlands using its annual water supply alone.

In wetter years, additional water may be available for purchase from the Malta Irrigation District over the 3,500 acre-feet. The refuge does pay for this added water supply, but with static budgets, it is becoming very difficult to get the necessary money to acquire the added water needed to properly manage wetland habitat.

Lake Bowdoin Salinity Concentrations

The most significant issue addressed through this planning process was the salinity problem in Lake Bowdoin. "Chapter 6–Analysis of Salinity," goes into greater detail about this situation including the causes and effects of the increased salinity.

Several factors contribute to increased salinity levels in Lake Bowdoin—climate, geology, sources of water, development of surrounding lands, and infrastructure of the refuge. These factors, summarized below, prevent natural flooding and have created a closed basin:

- *Climate*—The high evaporation loss due to a harsh, semiarid climate concentrates salts in the water.
- *Geology*—There are naturally occurring soluble salts in the soil.
- *Water*—Water sources for the lake contain salts.
- *Development*—The railroad, constructed in 1887, intercepts the natural flow of floodwater from Beaver Creek, keeping the water from entering the refuge. The Dodson South Canal prevents natural runoff from entering the refuge. Surrounding lands have been converted to irrigated farmland and used for dryland farming.
- *Refuge Infrastructure*—Roads, dikes, and water control structures along Lake Bowdoin and Dry Lake were constructed by the Service to hold more water. Lake Bowdoin has been converted from a flow-through basin to a closed basin.

If no action is taken to improve water quality on the refuge, the progressively increasing salinity levels in Lake Bowdoin and the blowing salts out of Dry Lake will continue to threaten migratory birds, other wildlife, wetland habitats, and, potentially, neighboring landowners and downstream irrigators.

Water Resources within Bowdoin Wetland Management District

In the wetland management district, the Korsbeck and Holm WPAs and all of the satellite refuges have

reservoirs that rely on the runoff from precipitation events to fill and maintain the wetlands. Since establishment of the satellite refuges in the 1930s, there has been extensive water development in the watersheds. Runoff is being captured or diverted up stream of these wetlands. This water once sustained the wetlands. This has resulted in a decrease in the amount of waterbird habitat on these refuges and waterfowl production areas, changing them from semipermanent to seasonal wetland habitat.

The Service uses irrigation water rights acquired with the land purchase for the Pearce, Beaver Creek, and McNeil Slough WPAs. The water is used to provide waterfowl habitat during spring and fall migration. Landowners surrounding these waterfowl production areas have expressed concern about the Service's use of irrigation water for wildlife, but the State of Montana recognizes benefits to wildlife as a beneficial use of the water.

Beaver Creek WPA is the only unit that requires monitoring of the salinity levels of water that is used in filling wetland units. The preferred time to exercise the Service's water rights is during spring runoff when water quality is at its best. Filling wetlands at any other time of the year requires monitoring, and the water is not used if elevated salt levels are recorded.

Riparian Habitat and Associated Wildlife

Riparian habitat is the green area next to streams, rivers, and lakes. Riparian areas are identified by the presence of vegetation that requires large amounts of water. Within the refuge complex, this habitat occurs along Beaver Creek, which borders the east boundary of Beaver Creek WPA, and the Milk River, which borders the north boundary of McNeil Slough WPA. Beaver Creek is dominated by grasses, shrubs, and willows. The Milk River is dominated by cottonwoods and willows. Cottonwood trees are dependent on stream and riverine processes for regeneration.

Riparian habitat serves many functions including filtering sediments and nutrients, building streambanks, storing water, recharging aquifers, providing fish and wildlife habitat, and dissipating stream energy. Riparian habitats are important to a diversity of species such as neotropical birds, fish, reptiles, invertebrates, and mammals for feeding, nesting, escape cover, and breeding. Riparian areas provide economic and recreational benefits as well.

Threats to riparian areas are invasive plants, streambank erosion, and lack of cottonwood regeneration.

Wildlife Disease

Several wildlife diseases are of concern within the Bowdoin National Wildlife Refuge Complex either due to a history of occurrence or a concern that the disease could spread to the immediate area in the near future. Most of these diseases have been well documented on Bowdoin National Wildlife Refuge but have been absent or only noted incidentally throughout the rest of the refuge complex. The diseases that have had the most impact on wildlife species in the refuge complex are avian botulism, West Nile virus, and epizootic hemorrhagic disease. Little or nothing can be done to control the spread of most wildlife diseases, but all employees are required to review the refuge complex's Disease Contingency Plan so they are aware of the possible risks of handling sick or dead animals.

Avian botulism has been documented almost every year since Bowdoin Refuge was established in 1936, with losses of less than 100 birds and up to as many as 20,000 birds. The disease is left to run its course naturally, although water management is still used to help minimize attracting birds into an affected area.

West Nile virus was first documented in the surrounding area in 2003. Although a variety of migratory birds, especially young pelicans, are susceptible to this disease, the biggest concern is for the human population. Service staff is provided with training and materials to avoid mosquito bites as much as possible. Nevertheless, in 2008, a seasonal employee was diagnosed with spinal meningitis brought on by West Nile virus.

Epizootic hemorrhagic disease has killed both white-tailed deer and pronghorn throughout the refuge complex. The disease is not contagious from one animal to another, and it is not transferable to humans. The last significant outbreak was in the summer of 2001, when the disease swept through much of the Milk River watershed, killing at least 26 deer and 5 pronghorn within the refuge complex. It occurs in the driest part of the year when conditions are just right for biting gnats, the carriers of the disease. The disease is fatal, because these animals become emaciated after they stop eating due to illness. At present, there is little that can be done to prevent or control this disease.

Piping Plover

Approximately 3,325 acres of Bowdoin National Wildlife Refuge has been designated as critical habitat for the Great Plains population of piping plover, federally listed as threatened (figure 17).

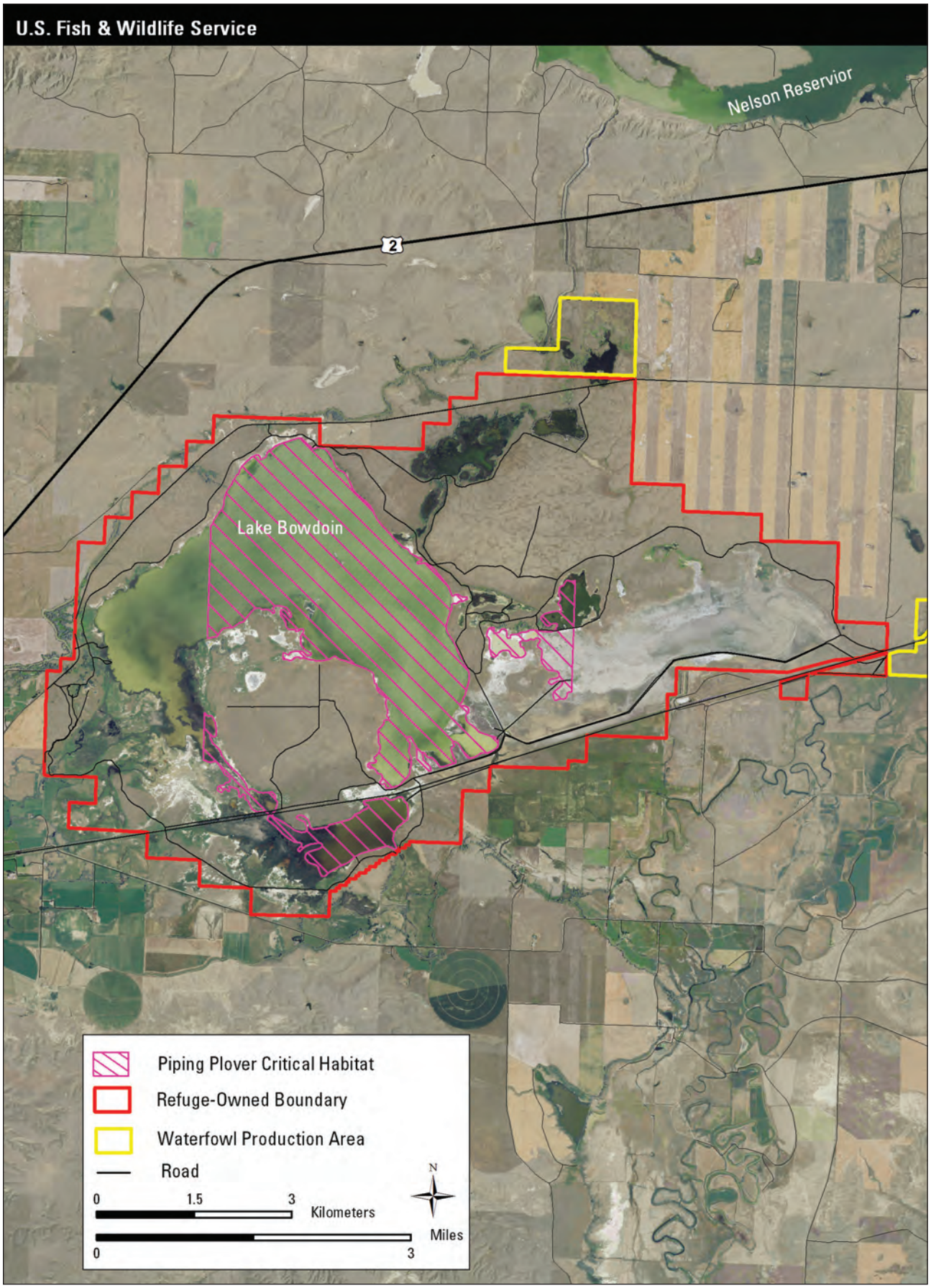

Figure 17. Map of critical habitat for piping plover at Bowdoin National Wildlife Refuge Complex, Montana.

However, since 2000, there have been no known piping plover nests on Bowdoin Refuge, primarily due to insufficient water supplies necessary to create attractive nesting habitat. Through partnerships with Reclamation and Ducks Unlimited, the Service created Piping Plover Pond and enhanced the habitat by adding gravel to nesting beaches and removing Russian olive trees used by predators as perches to locate and kill these threatened birds. Since piping plovers establish territories and begin breeding activities almost as soon as they arrive in May, habitat must be made available before the spring migration or the birds will simply bypass the refuge, choosing less protected areas to breed and nest. The pond has to be filled either in late fall, before the Dodson South Canal is "dewatered," or in early spring through the Malta Irrigation District or runoff. Since this water is transported through other wetlands, no water is delivered after May 15 to prevent the flooding of over-water nesters in these other units. In most years, there is not enough water available to fill this entire system sufficient to deliver it all the way to the pond.

Bill Byrne / USFWS

The piping plover nests on open shorelines.

Invasive Plants, Nonnative Plants, and Noxious Weeds

According to the National Invasive Species Management Plan, an invasive species is defined as 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 (National Invasive Species Council 2008). Management of invasive plants, nonnative plants, and noxious weeds has been an issue throughout the refuge complex for many years. A portion of the refuge complex's resources are directed to control introduction and spread of these species through integrated pest management strategies such as herbicides, prescribed burning, grazing, mowing, and farming.

One of the most challenging and damaging nonnative plant species throughout the refuge complex is the Russian olive tree. This species was first planted by refuge managers in the 1940s as an ornamental for windbreaks and wildlife food and cover. Although this tree is currently not designated as an invasive species in Montana, its ability to outcompete native species and fragment habitat is well documented. As with most nonnative species, Russian olive trees have spread rapidly across the refuge complex, taking over many prairie wetland zones, drainages, water conveyance systems, and some uplands and riparian areas. Russian olive trees can outcompete native vegetation, interfere with natural plant succession and nutrient cycling, and tax water reserves. The largest infestation is on Bowdoin National Wildlife Refuge.

The areas where most of these nonnative trees now dominate were historically unfragmented, native grassland. Although these trees do provide some benefit to wildlife, particularly for food and cover in the winter, these trees and the resulting fragmentation of grassland habitat create ideal conditions for predators such as fox, raccoon, and skunks to find and kill imperiled grassland-nesting birds and their young and to destroy their nests. These trees also serve as perches for predators such as great-horned owls and hawks and for nest parasites such as brown-headed cowbirds. Many grassland-nesting birds and upland-nesting waterfowl avoid areas adjacent to trees or have lower nest success due to predation.

Crested wheatgrass is the primary invasive grass species and leafy spurge, perennial pepperweed, and Canada thistle are the primary invasive forb species. Left unmanaged these invasive plant species can have a detrimental effect on the diversity of native plants, wildlife species, and habitat quality.

Mike Artmann / USFWS

Russian olive trees in the upland east of Lakeside Extension at Bowdoin Refuge.

New invasive species such as saltcedar and spotted knapweed pose additional threats to refuge complex lands. The best control methods for small infestations of invasive plants are early detection and a quick management response. Due to the scattered nature of land holdings in the refuge complex, this is not easily monitored or achieved.

Habitat Protection and Acquisition

Native prairie and wetland are the most productive habitat types in Montana, particularly in the Prairie Pothole Region. Although there are some laws that protect these areas, particularly wetland, these vital habitats continue to be lost. Most of these habitat types occur on private lands. The Service has committed to work with willing landowners in Montana to compensate them for protecting these habitats, primarily through perpetual wetland or grassland conservation easements. With limited acquisition funding, easements are the most cost-effective method rather than the traditional fee-title acquisition. Easements are less expensive and the landowner retains ownership, using their land much in the same way as before the easement purchase. Landowners also continue to maintain their fences, signs, and control of noxious weeds and other invasive plants. As of 2009, willing landowners have been compensated for protecting more than 50,000 acres of grassland and wetland habitat.

The easement program was developed by the Service to protect the natural resource on the landscape while minimally affecting normal farming and ranching practices. Habitat protection needs to be evaluated through a priority system so that critical areas are identified and the most effective means of protection, through either fee title or easement, can be determined.

Visitor Services

Hunting, fishing, wildlife observation, photography, environmental education, and interpretation are identified in the National Wildlife Refuge System Improvement Act of 1997 as the priority public uses that may be accommodated on a national wildlife refuge if they are found compatible with the establishing purposes. All six of these public uses are offered, to various degrees, on the lands administered by the refuge complex. Appendix D contains the required compatibility determinations (draft) for these six uses.

An estimated 25,000 visitors come to explore the refuge complex annually. This may be an underestimate given that the refuge complex is spread out across four counties, making it difficult to estimate visitor numbers. The refuge complex is located in north-central Montana, an area commonly known at the Hi-line and with one of the smallest population densities in the State. A major attraction for wildlife observers and hunters, the refuge complex is also popular with local school groups. There has never been any visitor services staff so these and other interested groups are accommodated as staff and time allows.

Bowdoin Refuge is well known by professional and amateur wildlife photographers and filmmakers; requests for expanded access to the refuge have increased over the last 10 years.

There is a general lack of understanding about the mission and purposes the National Wildlife Refuge System and the refuge complex. Many visitors do not know they are on a national wildlife refuge. There are boundary signs and some interpretive panels throughout the refuges and waterfowl production areas and several displays in the visitor contact area, but there are opportunities to do more.

The refuge complex is starting to see an increase in visitation as the public has become more interested and educated about locating and exploring natural areas. The Service will need to address if and how to offer expanded opportunities for compatible, wildlife-dependent public use while better educating the public about the value and purposes of these lands and the National Wildlife Refuge System.

Partnerships

The Service's partners include Federal, State, and local government agencies; schools and universities; nongovernmental organizations; and individual landowners. The Service's mission is to work with others to promote stewardship activities that restore, enhance, and protect fish and wildlife habitats. Effective communication and diverse partnerships are important for the refuge complex to be able to meet habitat and conservation goals and objectives. Furthermore, through partnerships the refuge complex has opportunities to garner support and awareness for the Refuge System and the refuge complex and to promote Service programs designed to increase habitat restoration and protection.

The activities on surrounding lands greatly affect and enhance the Service's abilities to manage its own resources. Some of the most important partnerships are with surrounding landowners, who have vast areas of intact wetland and grassland habitat that provide the greatest opportunities for habitat protection, enhancement, and restoration for sustaining migratory birds and other wildlife.

Operations

The Service is responsible for protection and management of the refuge complex's 85,713 acres spread across a four-county area. Due to the large size of the management area, limited staff and funding, and long travel times, some lands can only be inspected once a year for maintenance and management needs. Service lands closest to the refuge complex office receive the greatest attention because they are logistically easier to manage and maintain.

The Bowdoin National Wildlife Refuge Complex is responsible for maintaining a vast system of lands, roads, trails, fences, signs, buildings, and other equipment and infrastructure necessary to manage habitats and public use programs. The facilities found on the refuge complex follow:

- 137 water control structures
- 34 pullouts/parking areas
- 10 bridges
- 62 miles of roads including a self-guided auto tour (15 miles)
- Three boat launches (one handicap accessible)
- Accessible hiking trail (0.4 mile)
- 90 miles of boundary fence
- 32 miles of canals and dikes
- Two low-lift water pumps
- Five ground water wells
- 10 buildings—refuge headquarters, two residences with unattached double-car garages, an apartment for seasonal housing with three storage bays, a building for all-terrain vehicles and equipment storage, two cold storage buildings, one seed storage building, and one shop with seven parking bays

The storage facilities are insufficient to store existing vehicles; most vehicles remain outside and are exposed to the harsh weather of this area. The refuge headquarters is sufficient for existing staff, including seasonal employees. The office areas would need to be expanded if additional permanent staff were added. Although recently remodeled, the bunkhouse is still not adequate to provide housing for seasonal and volunteer staff. This housing is critical to recruiting seasonal staff, because rental housing is very limited in the surrounding rural communities.

Currently, the refuge complex staff consists of five permanent full-time employees: a refuge manager, one nonsupervisory wildlife refuge specialist who also serves as the collateral law enforcement officer, a wildlife biologist, a maintenance worker, and an administrative support assistant. Since 1998, the refuge complex has lost two positions including a permanent-seasonal biological technician and a permanent-seasonal maintenance worker. The current staffing level remains well below the minimum prescribed in the minimum staffing model developed by the Service for all refuges (USFWS 2008c). The

model recommends adding an additional five and one-half full-time equivalents: (1) five full-time positions—maintenance worker, deputy refuge manager, visitor services specialist, law enforcement officer, and wildlife refuge specialist; and (2) one permanent-seasonal biological science technician. Additional staff and funding is critical for implementing habitat management projects, facilities maintenance, and meeting the purposes of the refuge complex.

Natural Gas Development

Oil and gas leasing is at the discretion of the Secretary of the Interior who has delegated the Bureau of Land Management authority to administer the laws, but has by regulation restricted oil and gas leasing on lands of the Refuge System to those involving drainage (43 CFR 3101.5–1, 3100.2).

In conformance with the policy set forth in 50 CFR 27, the Service usually recommends against leasing when the Bureau of Land Management asks for comments. In the case of non-federally owned oil and gas rights, it is the policy of the Service to protect project resources to the maximum extent possible without infringing on the rights of subsurface owners.

Extraction of natural gas within the Bowdoin Wetland Management District has occurred since the 1940s (figure 18). In most cases, when the Service acquired lands through fee title or easement, the mineral rights were reserved or excepted by the landowner or the Bureau of Land Management. In the case of Hewitt Lake Refuge, the Executive order establishing the refuge notes that the refuge land was within a known geologic structure of a producing gas field. The refuge purpose states that, "nothing should affect the disposition of its oil and gas deposits under the Mineral Leasing Act of 1920."

There are 104 natural gas wells in production status on Service-interest lands. Annual activities on these lands include mineral exploration, well drilling and maintenance, pipeline construction and maintenance, road building and maintenance, and hauling offsite of produced water. Many of these activities can fragment habitats and disturb wildlife. For example, Ingelfinger (2001), found that roads associated with natural gas development in sagebrush-steppe reduced the guild of sagebrush-dependent species such as sage-grouse by 50 percent within 328 feet of roads.

Production companies operating within the Bowdoin natural gas dome estimate that drilling is expected to last for about 10–15 years, with a project life of 30–50 years (Bureau of Land Management 2008). To minimize impacts to Service interests, the refuge complex staff works directly with the lessee or operator during exploration or extraction of private minerals. To develop stipulations and conditions of approval to minimize the impacts, the Service works closely with the Bureau of Land Management to manage leasing or leases of Federal minerals below Service-interest lands. The Service outlines stipulations for accessing extraction sites in a special use permit, which the lessee or operator signs.

Prioritization of Refuge Complex Lands

The refuge complex staff is charged with managing habitat and protecting trust resources (such as migratory birds and threatened and endangered species) on 14 different tracts of fee-title land scattered throughout a four-county area. Limited staff, funding, and other resources require the Service to set priorities for lands, so those with the greatest management potential or most vulnerable resources are recognized, protected, and enhanced.

Research, Inventory, and Monitoring

In 2007, Bowdoin National Wildlife Refuge completed a 10-year study, in cooperation with the Division of Migratory Birds, to assess the productivity and habitat needs of grassland-nesting birds in the mixed-grass prairie. This research has been very beneficial to management of the Bowdoin Refuge and other grassland-nesting bird habitat.

Research throughout the Bowdoin National Wildlife Refuge Complex has been minimal and sporadic, and some past projects have not adequately addressed management issues. As a result, some current management actions are based on outside research, not necessarily designed to address critical refuge issues, and may not follow an established management plan.

Recent inventories carried out within the refuge complex include fish surveys (2000–2003), a small mammal trapping study on Bowdoin Refuge (2000), and an inventory of aquatic plants in Lake Bowdoin. Other much-needed inventories for amphibians, reptiles, vegetation, invertebrates, and invasive plants have not taken place due to lack of staff and funding.

Some limited monitoring of migratory birds (waterfowl, raptors, and shorebirds) and other wildlife (pronghorn) take place as staff availability and time allows.

Further research and monitoring to better understand the hydrologic conditions that control the

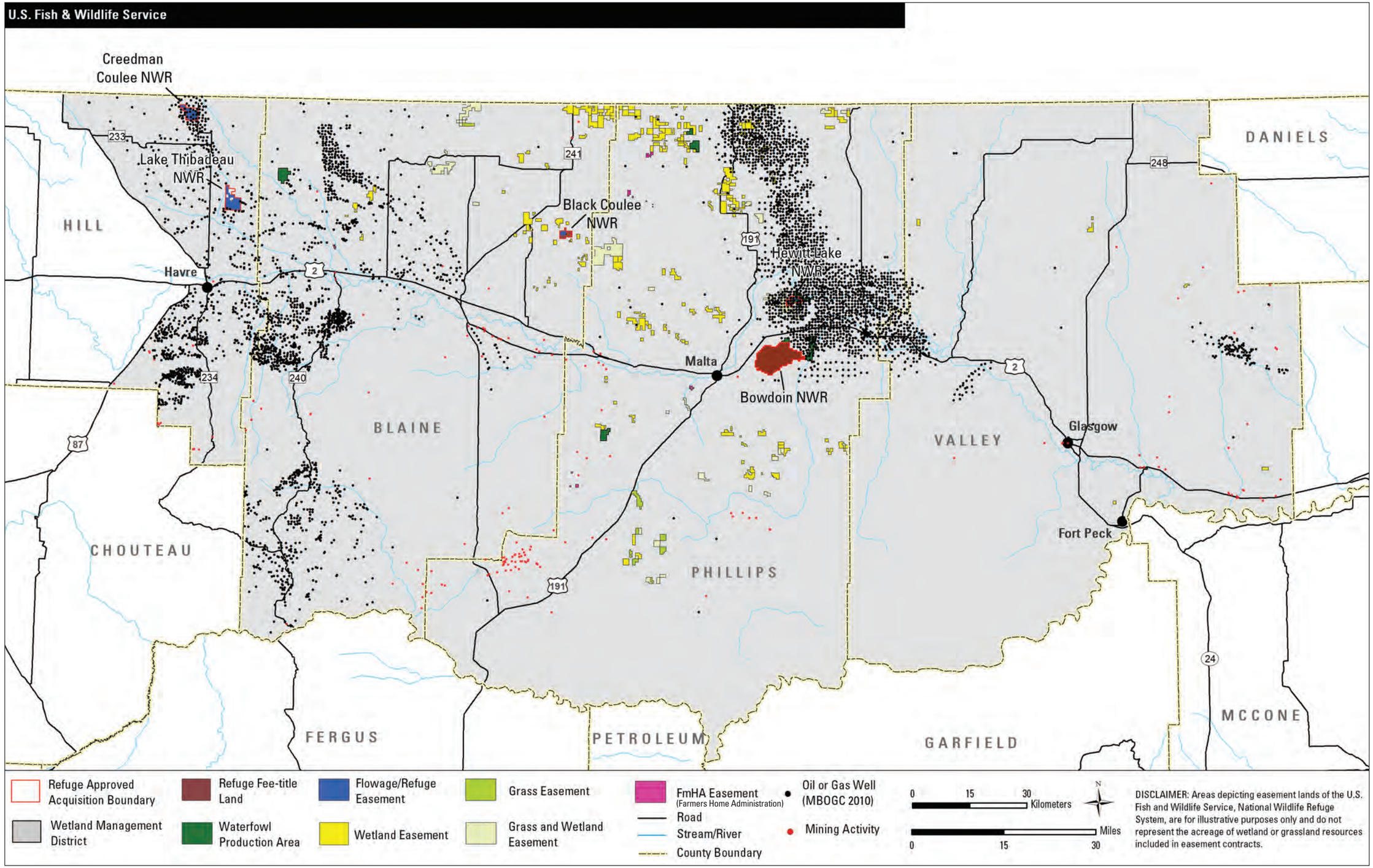

Figure 18. Map of oil and gas activities in and around Bowdoin National Wildlife Refuge Complex, Montana. *Source: MBOGC (2010).*

chemical characteristics of Lake Bowdoin, Drumbo Pond, and Dry Lake as well as the effect of water chemistry on plant and invertebrate communities and bird physiology, would provide valuable knowledge that could be used to preserve and better manage these wetlands for migratory birds.

The Bowdoin National Wildlife Refuge Complex is responsible for controlling invasive plants on Service-owned lands within the four counties in the districts. As visitors from across the Nation and Canada come to these lands, there is a greater opportunity for transporting and introducing various invasive species from other parts of the country and Canada. In addition to educating visitors, the Service needs to monitor these lands to detect and respond to any new or expanding invasive plant and noxious weed species. The Service needs to develop a more strategic inventorying and monitoring program to prevent introduction and spread of current and new harmful species. This could be challenging given the widespread area that needs to be monitored, combined with the limited time and staff available.

The refuge complex recently hired a wildlife biologist for the first time in many years. They will need to begin identifying the research, inventory, and monitoring needs for the refuge complex and to work with Service staff, universities, and other biologists to develop studies that benefit the refuge complex and address the wildlife and habitat goals.

Lake Thibadeau National Wildlife Refuge

Lake Thibadeau National Wildlife Refuge was established in 1937 as what the Service now calls a limited-interest refuge. During the era of water shortages, the Great Depression, and the call for conservation across the country, the United States began acquiring refuge and flowage easements from willing landowners across Montana, North Dakota, and South Dakota. In the past 70 years since these easements were first acquired, some lands have been further protected through additional easements or fee-title acquisition and have become productive, functioning national wildlife refuges or waterfowl production areas. This is not the case with Lake Thibadeau. Except for the 19.4 acres in the center of the refuge that are reserved from public domain, the remaining acres remain in private ownership.

The refuge and flowage easements give the Service the right to control hunting and trapping and the uses of the main bodies of water including impoundments, lakes, and streams, and the uses that occur on those waters. The Service was not given the right to control uses of the upland areas including farming, grazing, and development.

This refuge is in essence a working farm and ranch. Habitat loss has been significant over the decades; the refuge currently has little value to wildlife and the purpose for which this area was first established has been lost. Native prairie areas that may have existed when the refuge was first established are now farmed intensively. Due to upstream development that captures water for irrigation and stock watering, Lake Thibadeau, Grassy Lake, and Mud Lake are often dry and farmed in most years, offering limited value for migratory birds. Public use on this refuge is negligible, as permission to cross private land remains the right of the landowner. During this planning process, the Service will be evaluating whether to keep Lake Thibadeau in the National Wildlife Refuge System.

CHAPTER 3—Alternatives

John and Karen Hollingsworth / USFWS

Pair of Blue-winged Teal

The purpose of this chapter is to describe the management alternatives considered for the Bowdoin National Wildlife Refuge Complex, Montana. Alternatives are different approaches to unit management that are designed to achieve the refuge complex purposes, vision, and goals; the mission of the Refuge System; and the mission of the Service. Alternatives are developed to address the substantive issues, concerns, and problems identified by the Service, the public, and other partners during public scoping and throughout the development of the draft CCP.

Two topics received separate analyses: (1) the proposed divestiture (the selling or release of Service interests) of Lake Thibadeau National Wildlife Refuge (refer to section 3.1 below); and (2) the proposed action related to the salinity and blowing salts issue at Lake Bowdoin on the Bowdoin National Wildlife Refuge (refer to chapter 6). Alternatives A–C for the refuge complex, as described in section 3.3 below, apply to the remaining four refuges and one wetland management district in the refuge complex. The salinity and blowing salts alternative supports the actions outlined in alternative B (proposed action) for the refuge complex.

3.1 Divestiture of Lake Thibadeau National Wildlife Refuge

The Service developed two alternatives for the proposal to divest Lake Thibadeau National Wildlife Refuge: (1) keeping the refuge, with little to no maintenance of facilities; and (2) divesting the refuge and voluntarily relinquishing the water right back to the State.

Lake Thibadeau Refuge Alternative 1 (Current Management—No Action)

Lake Thibadeau National Wildlife Refuge would continue to be an easement (limited-interest) refuge comprised almost exclusively of private lands encumbered by refuge and flowage easements. These easements only provide the Service the right to impound water and to control the uses that occur on that water. The Service also has the right to control

hunting and trapping. The easements do not allow the Service to control any uses that occur on the uplands, including agricultural uses and development. The refuge would continue to not achieve its purposes as a resting place for migratory birds and wildlife due to almost a complete loss of wildlife habitat, primarily due to extensive development and agricultural use. The Service would minimally maintain the dams, spillways, and water control structures, even though most water resources no longer reach this impoundment due to upstream development. The landowner would continue to control access to the refuge. The 19.42 acres reserved from public domain lies in the center of the refuge and would remain inaccessible to the public.

Lake Thibadeau Refuge Alternative 2 (Divestiture–Proposed Action)

The Service would divest its interest in Lake Thibadeau National Wildlife Refuge, removing it from the National Wildlife Refuge System. The planning team used the Service's Mountain–Prairie Region divestiture model to make this initial determination. The full analysis and resulting documentation are in "Appendix E–Divestiture Model Results for Lake Thibadeau National Wildlife Refuge." This proposal was further evaluated through an analysis of the consequences of maintaining or divesting this refuge (summarized in table 4). This combined analysis determined that the refuge cannot achieve its purposes nor does it meet any of the goals of the Refuge System. If divested, the easements would be relinquished and all rights returned to the landowner. The dams, spillways, and water control structures would be transferred to the landowner or removed, and the water rights would be voluntarily relinquished to the State of Montana. This divestiture would be carried out within 5 years of CCP approval. To prepare the final divestiture proposal, the refuge staff would work with the Mountain–Prairie Region's Division of Realty and Division of Refuge Planning to prepare a full divestiture proposal. The divestiture of Lake Thibadeau National Wildlife Refuge would require an act of Congress.

Summary

Table 4 summarizes the analysis of two alternatives for management or divestiture of Lake Thibadeau National Wildlife Refuge.

Pasqueflower
© Cindie Brunner

Table 4. Comparison of alternatives and environmental consequences for keeping or divesting Lake Thibadeau National Wildlife Refuge, Montana.

Lake Thibadeau Refuge alternative 1 (current management–no action)	*Lake Thibadeau Refuge alternative 2 (divestiture–proposed action)*
Habitat and wildlife—actions	
Due to limited water resources caused by upstream development, maintain only passive management of the impoundment. Minimally maintain the dams and water control structures when funding is available but as a low priority compared with other maintenance needs. Continue to retain the authority to control hunting, trapping, and the uses that occur on the water. The landowner would continue to retain the authority to control all other uses that occur on the uplands. Due to the poor quality of wildlife habitat, acquire no lands or waters within the refuge through fee-title or easement programs.	Divest this limited-interest refuge and revoke the easements. Voluntarily relinquish water rights to the State. Turn over to the landowner, or remove, the dam and other structures. Revoke the 19.42 acres of land reserved from public domain.
Habitat and wildlife—environmental consequences	
Management and use of the uplands would continue to be under complete control of the landowner, excluding hunting and trapping. No nesting habitat would be available for waterfowl and other grassland-dependent birds, including in the uplands adjacent to the impoundments and wetlands. Waterbird use on the impoundments would continue to be minimal, similar to that found on stock water ponds found around the refuge. The refuge would continue to not meet its purpose as a refuge and breeding ground for migratory birds and other wildlife.	Same as alternative 1, *plus:* The potential removal of the water control structures, dams, and water delivery would remove the ability to artificially impound and divert water. Waterbirds that might have used this water for loafing would likely relocate to other similar stock water ponds off the refuge. Wetland basins would most likely revert back to natural hydrologic periods. If the structures were retained, the landowner would be responsible for the maintenance. The Service would no longer use limited staff and resources on a refuge that does not support any goals of the Refuge System.
Visitor services—actions	
Continue to allow hunting with access controlled by the landowner.	Same as alternative 1.
Visitor services—environmental consequences	
The landowner would continue to control public access to the refuge for all visitors, providing little to no recreational opportunities. Most visitors would remain unaware that these private lands are even part of the Refuge System due to the lack of wildlife habitat and access to these private lands.	Same as alternative 1.
Cultural resources—actions	
Provide minimal protection as required by existing laws on the portion of Service-owned land reserved from public domain and the dams and other water control structures covered under the flowage easement.	The landowner would have responsibility to protect cultural resources as required by law on private lands.

Table 4. Comparison of alternatives and environmental consequences for keeping or divesting Lake Thibadeau National Wildlife Refuge, Montana.

Lake Thibadeau Refuge alternative 1 (current management–no action)	*Lake Thibadeau Refuge alternative 2 (divestiture–proposed action)*
Cultural resources—environmental consequences	
The refuge staff would continue to consult with the regional archeologist on any repairs and or improvements to water control structures, dams, or water delivery canals that may be determined eligible for the National Historic Register. The Service archeologist would prepare documentation to meet the requirements under the National Historic Preservation Act for such structures.	Divestiture of the water control structures, dams and water delivery canals at Lake Thibadeau would be an adverse effect to the property under the National Historic Preservation Act and would require mitigation. Mitigation would entail consultation with the Montana State Historic Preservation Office and Advisory Council on Historic Preservation to determine the appropriate measures that would satisfy all the consulting parties. On completion of the mitigation, relinquishment of the easement would not leave the landowner with any mandatory responsibilities to maintain the historic value of the property. Landowner responsibilities as they pertain to the eligible historical structures would be provided to them once the Service completes the required mitigation. Once the Service meets the mitigation requirements of the National Historic Preservation Act, the landowner may remove any structures they would not need.
Operations—actions	
Rehabilitate only those dams, spillways, and water control structures that pose a threat to health and safety.	Give control of structures to the landowner or remove.
Operations—environmental consequences	
The maintenance or removal of water control structures, dams, and water delivery canals would continue to be the responsibility of the Government. Dam inspections would continue to occur every 4–6 years to inspect and identify deficiencies. Repairs would only occur if money became available; maintenance of these structures would be a low priority compared with other maintenance.	The landowner would maintain any structures, dams, and canals necessary for their needs. If the landowner does not want to maintain these structures, the Service may remove them before divestiture, removing any capability to store even limited water resources that could be used by the landowner for agricultural purposes.
Partnerships—actions	
Continue communication with landowners only when updates to the Emergency Action Plan for the Lake Thibadeau Diversion Dam are made.	The Service would work with the landowners throughout the divestiture process.
Partnerships—environmental consequences	
The Service would continue to provide the landowners annual updates to the Emergency Action Plan and the Standard Operating Procedures for the Lake Thibadeau Diversion Dam.	The Service would work with the landowners throughout the divestiture process so they understand the process and the rights that would be returned to them.
Easement rights—actions	
Maintain the right to impound water and to control hunting, trapping, and the uses that occur on the water.	Give the rights acquired in the easement agreements back to the landowner. Voluntarily relinquish the water rights to the State.

Table 4. Comparison of alternatives and environmental consequences for keeping or divesting Lake Thibadeau National Wildlife Refuge, Montana.

Lake Thibadeau Refuge alternative 1 (current management–no action)	*Lake Thibadeau Refuge alternative 2 (divestiture–proposed action)*
Easement rights—environmental consequences	
The Service would maintain the flowage rights to impound water on the land and to inspect and correct deficiencies to the water control structures, dams, and water delivery canals. The water resources that reach the impoundment would continue to be minimal due to upstream development.	The landowner would no longer be required to hold water. The landowner would have control over hunting, trapping, and the uses that occur on the water.
Socioeconomics—actions	
Continue with no public access to the refuge. Minimally maintain wetland management structures as money becomes available.	Remove the wetland management structures or transfer ownership to the landowner if they wish to retain the ability to capture the limited water resources.
Socioeconomics—environmental consequences	
There would be no economic benefits to the Service or public in retaining this refuge in the Refuge System. Most of the public would continue to be unaware this area is a wildlife refuge. There would be costs associated with maintaining the structures, which would lessen the Service's ability to enhance more productive areas on the refuge complex.	The Service could use money that may be allotted for maintaining these impoundment structures on other more critical, productive projects, which may provide additional areas for the public to enjoy wildlife and their habitats. If the landowners choose to retain the impoundments, they may have some costs associated with maintaining the structures.

3.2 Development of Alternatives for the Refuge Complex

The alternatives represent different approaches for permanent protection and restoration of fish, wildlife, plants, habitats, and other resources. The Service assessed the planning issues identified in chapter 2, the existing biological conditions described in chapter 4, and external relationships affecting the refuge. This information contributed to the development of alternatives; as a result, each alternative presents different approaches for meeting long-term goals. Each alternative was evaluated according to how well it would advance the vision and goals of the refuge complex and the Refuge System and how it would address the planning issues.

Each of the three alternatives incorporates various concepts and approaches intended to achieve the goals for the refuge complex outlined in chapter 2 and is discussed in terms of how it could meet each goal.

Alternative A, the no-action alternative, describes the current, ongoing management activities throughout the refuge complex. This alternative might not meet all the CCP goals. It is provided as a basis for comparison with the other alternatives.

Alternatives Considered but Eliminated

There were no alternatives considered but eliminated from detailed study.

3.3 Description of Alternatives for the Refuge Complex

This section describes the alternatives considered by the planning team to achieve the proposed vision and goals and to address the issues. These alternatives include not only the current management (alternative A) but also the Service's proposed action (alternative B), which reflects the draft CCP and is further described in chapter 7. Table 5 in section 3.4 below has a summary of the alternatives' actions with associated consequences. Details about the consequences are in "Chapter 5–Environmental Consequences."

The following alternative descriptions summarize each alternative's focus, and then provide details related to meeting each goal for the refuge complex.

Elements Common to All Alternatives

There are some consistencies in the three alternatives. For example, all alternatives including the no-action alternative emphasize the same target species and protection of threatened and endangered species. This section identifies the following key elements that will be included in the CCP regardless of the alternative selected:

- The Service would ensure that management of the refuge complex complies with all Federal laws and regulations that provide direction for managing units of the Refuge System.
- Each alternative would attempt to eradicate invasive species through an integrated pest management approach that includes biological, chemical, and mechanical treatment methods.
- No adjacent landowners would be adversely affected by any action taken by the Service without a mutual agreement and adequate compensation.
- Each alternative would provide equal protection and management of cultural resources.

Alternative A (Current Management–No Action)

Alternative A is the no-action alternative, which represents the current management of the refuge complex. This alternative provides the baseline against which to compare the other alternatives. It also fulfills the requirement in the National Environmental Policy Act that a no-action alternative be addressed in the analysis process.

Under alternative A, management activity being conducted by the Service would remain the same. The Service would not develop any new management, restoration, or education programs at the refuge complex. Current habitat and wildlife practices benefiting migratory species and other wildlife would not be expanded or changed. The staff would perform limited, issue-driven research and monitor only long-term vegetation change. No new funding or staff levels would occur and programs would follow the same direction, emphasis, and intensity as they do at present. The Service would continue to manage the Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges as unstaffed satellite refuges.

Upland Habitat and Associated Wildlife

The following upland habitat discussion covers native grassland, disturbed grassland, invasive species, shelterbelts, habitat protection and acquisition, and greater sage-grouse.

Native Grassland. With available staff and funding, the Service would continue to manipulate native grasslands using various techniques including prescribed fire, treating invasive plants, grazing, and resting periods.

Currently, most management actions are based on outside research and do not follow an established management plan. Approximately 10 percent of the refuge complex's uplands would continue to be grazed periodically. When management actions such as grazing or burning do occur, there would be minimal evaluation of habitat response.

Disturbed Grassland. Disturbed grasslands are areas that were once native prairie, were converted to cropland, and then were planted to a mix of nonnative pasture grasses, also called DNC (dense nesting cover). Disturbed grasslands would continue to be treated periodically using various techniques including prescribed fire, treating invasive plants, grazing, haying, and resting periods.

As resources became available, cropland on waterfowl production areas would be restored to native grasses and forbs; however, DNC would continue to be seeded on highly erodible lands in the wetland management district. Dense nesting cover fields on Bowdoin Refuge would be converted to native forbs and grasses.

Invasive and Nonnative Plant Species. The Service would continue to use mechanical and chemical methods to control existing and new Russian olive infestations. Control would continue to be focused within the interior of the management units, with priority given to those areas where tree removal would result in large contiguous blocks of native grassland. The control effort would continue to be slow and inefficient due to a lack of staff and funding to address the tremendous expanse and invasion by these nonnative trees.

Early detection and rapid response would continue to be used to attack initial infestations of invasive plant species such as leafy spurge, perennial pepperweed, and spotted knapweed. Larger infestations of invasive plants such as crested wheatgrass would continue to be given little to no attention due to the extent of infestation and the lack of resources and staff.

Shelterbelts. The only management of shelterbelts on Service lands within the refuge complex would be the continued, systematic removal of non-native Russian olive trees.

Habitat Protection and Acquisition. The highest priority would be to continue the annual protection and enforcement of current Service grassland and wetland easements. The refuge complex would continue to seek potential grassland and wetland easement acquisitions from willing sellers, as time and staff permits. As funding and opportunities arise, the priority for fee-title acquisition would be given to acquiring inholdings from willing sellers that are adjacent to or within the boundary of the refuges and waterfowl production areas.

Greater Sage-Grouse. The Service would continue to provide and protect the existing habitat for greater sage-grouse but no sagebrush restoration efforts would be conducted.

Wetland Habitat and Associated Wildlife

The following wetland habitat discussion covers managed wetlands, natural wetlands, riparian habitat, water rights, habitat protection and acquisition, wildlife disease, invasive species, and threatened and endangered species.

Managed Wetlands. These are wetlands (natural or created) that have been enhanced to provide for water delivery to them or manipulate water levels by means of a water control structure using such mechanisms as stoplogs or screw gates (hydraulic engineering control elements that are used to adjust water levels or flow rates). Management of enhanced wetlands would attempt to mimic natural wetland conditions that provide migratory waterbirds with spring and fall migration habitat, as well as breeding and nesting habitat. Effective management of these wetlands within the refuge complex is limited by the Service's available water and funding.

Bowdoin National Wildlife Refuge would continue to receive 3,500 acre-feet of water annually to manage all its wetland units including Lake Bowdoin. This use is part of Reclamation's water right that was made available to the Service through the negotiated MOA. Lake Bowdoin would remain a closed wetland system with no intentional water release into Beaver Creek to improve water quality.

The Service would continue to exercise its water rights on all of its waterfowl production areas in the refuge complex for the benefit of migratory birds and its associated habitat. Due to the vast area, lack of resources, and limited staff, there would be minimal monitoring of the response to these management actions. This monitoring would primarily consist of spring surveys of waterfowl and other breeding birds.

Most water management structures (such as dikes and levees) would remain in good working order due to recent repairs and upgrades completed through annual deferred maintenance funding and partnerships. The infrastructure of water manage-

Mike Artmann / USFWS

This bay structure allows water into Dry Lake from Lake Bowdoin via the conveyance channel.

ment facilities would continue to be maintained as needed and as funding became available.

Water elevations in the wetlands would be monitored to aid in the manipulation of managed wetlands to meet habitat objectives.

Natural Wetlands. There is no single scientifically acceptable definition of all wetlands because of their tremendous diversity and because they lie along a continuum or gradient between deepwater habitats and uplands or between purely aquatic and terrestrial ecosystems (Cowardin et al. 1979). According to Cowardin et al. (1979), wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For the purpose of this plan, natural wetlands refer to those various types of wetlands that have not been enhanced or drained.

Under alternative A, natural wetlands would continue to be monitored for invasive plant species and wildlife use. Management practices such as prescribed burning, grazing, and invasive plant control would be used to maintain and restore the productivity of these wetlands for migratory bird habitat.

Potential sites for wetland restoration have been identified throughout the refuge complex; these sites would be restored if additional money became available. Through partnerships and grants, the Service would pursue resources to identify and protect critical wetland complexes for breeding and nesting waterfowl through easements or fee acquisition.

Riparian Habitat. Refuge and waterfowl production area boundaries would continue to be fenced to eliminate the negative effects of trespass livestock grazing. Riparian areas would continue to be allowed to rest and revegetate naturally. The Service would use early detection and rapid response (chemical, biological, and mechanical methods) to treat initial infestations of invasive plant and mammal species.

Water Supply and Rights. The Service would continue to exercise its water rights in the refuge complex, including the Reclamation right available to Bowdoin Refuge through the MOA, to provide habitat for migratory birds using ground water wells, low-lift pumps, water conveyance systems, and delivered water from the Milk River Project when water is available.

Habitat Protection and Acquisition. The Service would continue to protect native prairie and natural wetlands within the Bowdoin Wetland Management District through easements and fee-title purchases from willing sellers within refuge acquisition boundaries and the Bowdoin Wetland Management District. The priority for acquisition money would be to buy borderlands from willing sellers (including "round-outs") that make it difficult to manage and protect refuge boundaries. The remaining priorities would be to acquire, in order, inholdings, new wetland and grassland easements, and waterfowl production areas. The Service would annually monitor all new and existing wetland and grassland easements for compliance.

Wildlife Disease. To minimize or deter avian botulism outbreaks on Bowdoin National Wildlife Refuge, the Service would continue to avoid water-level fluctuations during the summer months (mid-May until early September) when conditions are favorable for botulism outbreaks. This would keep the number of birds exposed to this disease to a minimum. Refuge staff would monitor wetlands on Bowdoin Refuge for bird mortalities on a weekly basis throughout the summer months until the chances of an avian botulism or West Nile virus event are gone. Sample carcasses would be sent to the National Wildlife Health Center for analysis. An event history form would be completed for each outbreak; one copy would be sent to the National Wildlife Health Center and one would be placed in the refuge complex's filing system.

Refuge complex staff would continue to cooperate with the U.S. Interagency Avian Influenza Working Group to monitor the refuge complex for signs of avian influenza. The refuge complex's Disease Contingency Plan would be kept up-to-date and new policies would be adopted as needed. All staff would be trained to recognize the causes and effects of avian diseases, which would increase early detection of outbreaks.

Invasive and Nonnative Species. The Service would continue to use early detection and rapid response to treat initial infestations of invasive plant and mammal species. Chemical and mechanical treatments would be periodically used to set back invasive plants, and nonnative species such as Russian olive, as necessary to restore habitat for migratory bird use. There would be some mapping and monitoring completed throughout the refuge complex, primarily through the efforts of the Service's invasive species strike team.

Threatened and Endangered Species. The Service would continue to survey and monitor the activity of piping plover at the Bowdoin and Hewitt Lake National Wildlife Refuges. All documented piping plover nests would be monitored until chicks have fledged or the nest has been abandoned or destroyed. Nest cages would only be erected over nests that are in immediate danger of being trampled or of being destroyed by predators (others birds and mammals). The staff would continue to provide information on these monitoring activities to the Service's Division of Ecological Services and remain a member of the Montana Piping Plover Recovery Committee.

Visitor Services

The following visitor services discussion covers hunting and trapping, fishing, wildlife observation and photography, environmental education and interpretation, public access, and cultural resources.

Hunting and Trapping. The Service would continue to allow hunting of upland game birds and waterfowl in select areas of Bowdoin National Wildlife Refuge. The current hunting programs on the satellite refuges and waterfowl production areas would also continue at current levels, primarily following State seasons and limits. The public would continue to need landowner permission to access easement lands within the satellite refuges, and Holm WPA would remain closed to public hunting.

The late-season (starting no earlier than December 1) upland game bird hunt on Bowdoin Refuge would continue on those areas that are normally closed to public use. The first 2 days of this December hunt would continue to be designated for young hunters only. This special season would be contingent on all waterfowl having left the refuge, typically by November 30.

The Service would maintain the accessible boat dock and parking area on Lake Bowdoin and the accessible hunting and photography blind and parking area at Pearce WPA.

Hunters on Bowdoin National Wildlife Refuge would still be required to sign in and out at the hunter registration kiosk. Brochures with current public use regulations would be available at the registration kiosk and from the refuge Web site.

The Service would continue to issue special use permits to a limited number of trappers on Bowdoin Refuge to remove beavers and other burrowing animals that threaten to damage or cause failure of structures including water control structures, roads, dikes, and canals. This trapping program would also be used to help the Service in its efforts to control mammalian predators such as skunks and nonnative raccoons that are negatively affecting migratory birds. In these situations, the Service would continue to use only live traps to ensure that only targeted predator species are removed from the area.

In addition, trapping would also help reduce the spread of the diseases many of these predators carry. Trappers could continue to use body-gripping traps, commonly known as Conibear® traps, and live traps; leg-hold traps would continue to be prohibited.

In the establishing legislation, recreational trapping is permitted on the waterfowl production areas. Unless otherwise noted, the trapping season on these areas would continue to follow State regulations and limits.

Fishing. Recreational fishing opportunities would continue to be allowed along the Milk River at McNeil Slough WPA and along Beaver Creek at Beaver Creek WPA. The remainder of the wetlands within the refuge complex have minimal habitat or do not support game fish. Fishing would not be permitted at Bowdoin, Black Coulee, Creedman, Hewitt Lake, or Lake Thibadeau National Wildlife Refuges. These refuges have minimal habitat or high salinity levels, or both, and do not support game fish.

Wildlife Observation and Photography. The Service would maintain the following facilities for wildlife observation and photography: (1) the self-guided, 15-mile auto tour route and accompanying interpretive signs and brochure; (2) the accessible photo blinds at Bowdoin Refuge and Pearce WPA; and (3) the accessible Display Pond Trail, a national recreation trail, with observation deck and interpretive panel around Display Pond.

The Bowdoin Refuge bird list and the Northeastern Montana Birding Trail brochure would be updated as needed and made available to refuge complex visitors.

Environmental Education and Interpretation. Environmental education programs would continue to be opportunistic, presented as staff and time allow. Interpretive panels and brochures would be maintained and updated to reflect changes in information or policy and to meet the Service's graphic standards.

The Service would maintain the refuge Web site and provide periodic updates of news and activities for the refuge complex to the local media and chamber of commerce.

Public Access. The Service would continue to provide the current level of access throughout the refuge complex for visitors to participate in compatible, wildlife-dependent, public use activities. All areas within the refuge complex would continue to be open to foot traffic except for the area surrounding the shop, residences, and equipment storage.

Cultural Resources. The Service would continue to perform cultural resource inventories only as needed for compliance with section 106 of the National Historic Preservation Act and would continue using Montana's statewide inventory list of cultural resources to determine sensitive sites before activities. The refuge complex staff would continue documenting cultural resource sites that are found during the course of other duties and ensure their protection.

Partnerships

The following partnerships discussion covers partnership development and maintenance and energy development on Service lands.

Partnership Development and Maintenance. Existing partnerships would be maintained by combining resources and knowledge to achieve goals of mutual interest. Community-based public outreach programs would be conducted as time and staff allows.

Energy Development on Service Lands. Following current laws and policies, the Service would work with energy developers who are extracting reserved and excepted oil, gas, and mineral rights on grassland easements and fee-title lands to minimize impacts from their operations. Physical occupancy would be kept at the minimum space compatible with efficient mineral operation.

Operations

The following operations discussion covers staff, operations, facilities, and signs and boundary designation.

Staff. The current staff of five full-time employees would be maintained: a maintenance worker, an administrative officer, one refuge operations specialist with collateral law enforcement duties, a wildlife biologist, and a refuge manager (see table 8 under section 4.10 in chapter 4). The annual recruitment of up to two seasonal biological technicians, a maintenance worker, and one or more volunteers would continue only if funding were available. Due to the volume of maintenance projects, limited funds would first be used to continue recruiting for a 6-month seasonal maintenance worker. A biologist for the Partners for Fish and Wildlife Program would remain stationed at Bowdoin Refuge to work with private landowners and governmental and nongovernmental agencies to restore and create wetland and upland habitat on private and agency lands.

Operations. Money for operations would remain fairly consistent, except for some annual increases primarily due to inflation. Operations for the refuge complex would consist of maintenance of the following: (1) equipment such as vehicles and heavy machinery; (2) facilities including refuge housing and the headquarters; and (3) most of the management and public use structures such as dikes, roads, trails, and water control structures. Extensive replacement, repair, and rehabilitation of facilities and equipment would be completed as money became available.

Facilities. No additional facilities or infrastructure would be constructed unless money became available. Due to limited storage facilities, vehicles and equipment would continue to be stored outside year-round.

Signs and Boundary Designation. Most units in the refuge complex, including all waterfowl production areas, have both the proper entrance signs and boundary signs to orient visitors. Refuges that have more than 40 percent of the land within the boundary in fee title have also been identified by entrance signs. Service boundary signs would continue to be replaced as needed, and boundary fencing would be maintained and replaced as time and staff allows. Entrance signs would be maintained and replaced if funding became available. Fences would be maintained to prevent trespass livestock grazing.

The Service would continue discussions with the landowner adjacent to Hewitt Lake National Wildlife Refuge to exchange fee-title lands needed to create a more manageable and enforceable refuge boundary and bring awareness of the effects of trespass livestock grazing.

Carmen Luna / USFWS

Alternative B (Proposed Action)

Alternative B for the Bowdoin National Wildlife Refuge Complex would conserve natural resources by restoring, protecting, and enhancing native mixed-grass prairie and maintaining quality nesting habitats for targeted migratory and resident birds within the refuge complex. There would be an increase in control and eradication of invasive plant species that are causing habitat fragmentation and impacts to grassland-dependent birds. These treated areas would be restored to native plant species, monitored, and treated for reinfestations. Enhanced wetlands would be managed to mimic natural conditions for wetland-dependent migratory birds during spring and fall migrations and during the breeding and nesting season.

For visitor services, the Service would develop additional access for visitors of all abilities to improve opportunities for wildlife-dependent uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation). These enhanced programs would encourage a greater understanding of the purposes of the refuge complex and an appreciation for Federal trust species including migratory birds, other native wildlife, the unique mixed-grass prairie, and the missions of the Service and the Refuge System.

The success of these additional efforts and programs would depend on added staff, research and monitoring programs, operations funding, infrastructure, and new and expanded partnerships. Appendix D contains the required compatibility determinations (draft) associated with this alternative.

Upland Habitat and Associated Wildlife

The following upland habitat discussion covers native grassland, disturbed grassland, invasive species, shelterbelts, habitat protection and acquisition, and greater sage-grouse.

Native Grassland. The Service would attempt to restore native grasslands by mimicking the natural processes of burning and grazing (including timing and frequency) to meet the specific habitat requirements of target species of resident and migratory birds and restoring the dominant historical plant communities that are still found within the refuge complex.

Using prescribed fire during bird-nesting seasons can lead to nest destruction or increased nest predation. Islands of unburned areas may be targeted by nest predators such as coyote, skunk, and raccoon. However, birds will typically re-nest but may produce fewer eggs. This initial loss of nests and potential reduction in production is offset in future years by improved habitat conditions, which lead to improved nesting conditions and numbers. Grazing may have similar effects due to trampling but, again, the long-term benefits eventually outweigh the short-term losses.

A grassland-habitat management plan (within the habitat management plan) would be completed based on tested methods for preserving and enhancing the native grassland habitats found throughout the refuge complex.

The Service would conduct research to determine the most effective methods for enhancing native species and addressing species that have become monocultures, such as clubmoss.

Disturbed Grassland. The Service would gradually convert disturbed grasslands to a diversity of grasses, forbs, and shrubs native to the site and that have the greatest potential to survive and outcompete invasive species while providing habitat to targeted grassland-dependent migratory and resident birds. Invasive nonnative plant species would be controlled in all restored areas. Dense nesting cover would be seeded on highly erodible lands on the wetland management district.

Invasive and Nonnative Species. Same as alternative A, except that the refuge complex staff would work with the Service's Montana Invasive Species Strike Team and partners to ensure that treated areas are mapped, restored with native plant species, monitored, and re-treated (as necessary) to prevent reinvasion.

The Service would increase treatment of Russian olive, giving priority to areas where tree removal would create more contiguous blocks of grassland habitat. Through partnerships, the Service would develop an education and outreach program that discusses the impacts of Russian olive trees on native habitat and wildlife. In addition, the outreach program would provide information on native trees to plant (instead of nonnative Russian olive) for areas where trees were present historically.

The Service would conduct experiments to determine the best methods for reducing crested wheatgrass and for restoring treated sites to native grasses.

Shelterbelts. The Service would begin to systematically remove all shelterbelts in the refuge complex. These areas would be restored to native grasses, forbs, and shrubs to create more contiguous blocks of grassland habitat for targeted migratory and resident birds. Treated sites would be monitored for infestations of invasive plant species. Future shelterbelts of invasive species would not be permitted anywhere on the refuge complex.

Dr. Thomas G. Barnes / USFWS

Silver sagebrush is an important habitat component for sage-grouse.

Habitat Protection and Acquisition. Same as alternative A, plus the Service would use grants for acquisition of grassland easements and fee title from willing sellers. Future acquisitions would be prioritized by working with HAPET (Habitat Assessment and Population Evaluation Team) to identify the most critical waterfowl breeding and nesting sites that need protection. The Service would form partnerships with conservation groups to acquire lands for transfer.

Greater Sage-Grouse. Same as alternative A, except the Service would monitor greater sage-grouse population levels and trends. Sage-grouse habitat would be identified throughout the refuge complex and maintained or enhanced. Silver sagebrush would be planted on the Korsbeck and Beaver Creek WPAs to provide additional breeding, nesting, and feeding habitat for sage-grouse.

Wetland Habitat and Associated Wildlife

The following wetland habitat discussion covers managed wetlands, natural wetlands, riparian habitat, water rights, habitat protection and acquisition, wildlife disease, invasive species, and threatened and endangered species.

Managed Wetlands. Same as alternative A, plus the Service would acquire funding for a permanent maintenance worker and equipment necessary to maintain, repair, or replace water management structures. These improvements would be necessary to carry out the proposed changes to the wetland management program to provide quality habitat for targeted wetland bird species. Additional biological and refuge management staff would also be required to carry out and monitor the proposed enhancement, restoration, creation, protection, and maintenance of managed wetlands.

The Service would pursue funding to buy additional delivered water (when available) from the Malta Irrigation District for Lake Bowdoin during the spring or fall, or both seasons. This would be important to protect habitat for the threatened piping plover and other targeted wetland-dependent species.

New ground water wells would be developed to supplement wetland management needs. Water pumping sites would be developed at the Beaver Creek and McNeil Slough WPAs to create wetland habitat for migratory birds.

The Service would identify and map potential wetland enhancement projects that would protect critical wetland complexes for breeding and nesting waterfowl. Working with partners, the Service would pursue resources for easements or fee-title acquisition from willing sellers in these priority areas.

Natural Wetlands. Same as alternative A, except the Service would acquire additional money to restore natural wetlands used by migratory birds and other native species, primarily by treating invasive plants and noxious weeds that have impacted habitat quality. Additional biological staff would be needed to monitor and plan management of these natural wetlands.

Riparian Habitat. Same as alternative A, plus the Service would work with the Service's Montana Invasive Species Strike Team and partners to identify and map the locations and extent of invasive species in riparian areas. Treatments would be documented and sites would be restored with native plant species, and monitored (re-treating as necessary) to prevent reinvasion.

Water Supply and Rights. Same as alternative A, except the Federal reserved water rights and compact between the State of Montana and the Service for Bowdoin National Wildlife Refuge would be adjudicated. The Service would acquire more money to pay for added deliveries of water (beyond the original 3,500 acre-feet provided through the MOA with Reclamation) from the Malta Irrigation District when water is available and is needed to meet refuge habitat objectives.

Habitat Protection and Acquisition. Same as alternative A, plus the Service would work with partners and prepare grant proposals to pursue resources for acquisitions of grassland and wetland easements and fee-title lands from willing sellers. Future acquisitions would be prioritized by working with HAPET to identify the most critical waterfowl breeding and nesting habitat that needs protection.

Wildlife Disease. Same as alternative A.

Invasive and Nonnative Species. Same as alternative A, plus the refuge complex would work with the Service's Montana Invasive Species Strike Team and other partners to identify and map the locations and extent of invasive species within wetlands. Treated areas would be mapped and monitored and continue to be managed to prevent reinvasion. Russian olive trees and other vegetation that are impeding the function of water level management structures (such as dikes, ditches, and levees) would be removed.

Threatened and Endangered Species. Same as alternative A, except the Service would work with other agencies to acquire additional water resources and improve the current water delivery system, primarily to Piping Plover Pond, to better manage or increase piping plover habitat on Bowdoin National Wildlife Refuge.

Visitor Services

The following visitor services discussion covers hunting and trapping, fishing, wildlife observation

and photography, environmental education and interpretation, public access, and cultural resources.

Hunting and Trapping. Same as alternative A, plus the refuge would work with the State to determine the feasibility of providing an accessible and limited big game archery hunt on portions of Bowdoin Refuge currently open to public use. The refuge would address the safety of refuge visitors including hunters when making this determination.

Fishing. Same as alternative A.

Wildlife Observation and Photography. Same as alternative A, plus the Service would provide, at least monthly, wildlife observation programs for refuge complex visitors. These tours would be contingent on hiring a visitor services specialist. A new accessible observation site, parking area, interpretive kiosk, and two spotting scopes would be provided along the auto tour route at Bowdoin Refuge. The mammal, reptile, and amphibian lists would be updated for the refuge complex and a wildlife list would be developed in the Service's graphic standards.

Environmental Education and Interpretation. Same as alternative A, plus the Service would expand the environmental education and interpretation opportunities to further expand the public's appreciation and understanding of the resources of the refuge complex and the mission of the Refuge System. The staff would develop and present environmental education programs for students and adults primarily at Bowdoin Refuge and at off-refuge sites such as schools and local organization sites. Additional interpretive panels would be developed for the refuge complex.

The Service would develop a Friends group and work with the Malta Chamber of Commerce and Phillips County Historical Society to develop informational kiosks and interpretive displays to place in the town of Malta.

Many of these proposed actions would be contingent on hiring a visitor services specialist.

Public Access. Same as alternative A, except the east side of Bowdoin National Wildlife Refuge would be closed to all foot traffic from the start of the waterfowl season until at least November 30 to provide sanctuary, primarily for migratory waterfowl and shorebirds. The auto tour route through the closed portion of the refuge would remain open to vehicle traffic, but visitors would have to remain inside their vehicles.

The Service would work with Phillips County to rehabilitate the remaining portion of old U.S. Highway 2 that runs through the north end of Bowdoin National Wildlife Refuge.

The road and parking area on Black Coulee National Wildlife Refuge would be developed to improve access for compatible wildlife-dependent activities.

Cultural Resources. The Service would complete a comprehensive cultural resource inventory for the entire refuge complex by working with the zone archeologist, contractors, local tribes, universities, and other partners to accomplish the project.

Partnerships

The following partnerships discussion covers partnership development and maintenance and energy development on Service lands.

Partnership Development and Maintenance. Same as alternative A plus, using the private lands and other programs, the Service would pursue additional partnerships to restore, maintain, and protect wildlife habitats on public and private lands, particularly those areas that impact refuge lands and waters. A partnership with Phillips County would be pursued to improve the surface of old U.S. Highway 2 through Bowdoin Refuge.

Energy Development on Service Lands. Same as alternative A, plus the Service would determine the energy development potential and the associated impacts of all proposed fee-title or easement acquisitions as part of evaluating and prioritizing these opportunities. When the policy on energy development on Service lands is completed, the refuge would modify its program to support the direction and objectives of this new policy.

Operations

The following operations discussion covers staff, operations, facilities, and signs and boundary designation.

Staff. Same as alternative A, plus the Service would add to the refuge complex's current staff an additional six and one-half permanent, full-time positions to achieve the goals and supporting objectives described in this alternative: (1) one maintenance worker, WG (Wage Grade)–4749–08; (2) one park ranger (visitor services specialist), GS (General Schedule)–025–09; (3) one refuge manager, GS–485–13; (4) current wildlife biologist position upgraded to GS–486–12; (5) one law enforcement officer, GS–025–09; (6) one biological science technician, GS–404–08; (7) one office automation clerk, GS–326–07; and (8) one permanent-seasonal maintenance worker, WG–3502–05. The current administrative support assistant position would be upgraded to a GS–9 administrative officer, and the current G–12 refuge manager position would be converted to a supervisory wildlife refuge specialist, functioning as the deputy refuge manager. Additional funding

Mike Artmann / USFWS

Clumps of Baltic rush (middleground) and bulrush (background) grow on the southern tip of Lakeside unit, an area that floods when the refuge pumps water in the spring.

would be required to recruit four seasonal biological science technicians. Volunteers would be recruited from universities and colleges throughout the region and from local communities. In addition, the Service would work with universities to develop a volunteer program that would provide college credits in exchange for volunteer work experience. With additional funding, the Youth Conservation Corps program would be reinstated with at least four youth positions and one social services aid, GS–186–05, to head the program.

Operations. Same as alternative A except additional resources would be pursued to achieve refuge and district purposes and achieve the goals, objectives, and strategies identified for this alternative. This alternative would require additional equipment and five additional vehicles for added staff. Outdated heavy equipment such as the road grader, scraper, farm tractor, and front-end loader would be replaced. Attachments for the farm tractor would be needed for habitat management purposes (for example, farm disc, grapple fork, and mowers). The Service would buy a mower and marsh master to manage vegetation in wet areas for control of undesirable plant species and to create open-water habitat. The additional maintenance staff would operate and maintain this new equipment.

Facilities. Same as alternative A, plus facilities would need to be expanded or enhanced to accommodate the additional staff with equipment and an expanded visitor services program. The energy supplied to the Bowdoin Refuge headquarters, apartment, two houses, and shop buildings would be converted to more "green" technologies such as solar and wind power. A separate ground water well would be needed for the two refuge complex residences. The bunkhouse would be expanded to accommodate up to 8 people. One site with a concrete pad, septic and water systems, and electricity would be developed to accommodate a volunteer with a recreational vehicle.

The Service would construct one 10-bay storage facility for existing vehicles plus five additional field vehicles for new staff. An additional four-bay cold storage building would be needed to house additional heavy equipment.

New interpretive display and education materials would be added to the current visitor contact area. The public access road and parking at Black Coulee Refuge would be expanded and improved.

Signs and Boundary Designation. Same as alternative A, plus the Service would evaluate the need for existing fencing to manage a prescriptive grazing program. The retained fencing would be systematically replaced using wildlife-friendly materials and techniques including replacing the bottom fence wire with smooth wire and placing it no less than 18 inches from the ground.

Alternative C

Under alternative C, tame grasslands would be systematically restored to native species to provide the diverse habitats needed for target species of resident and migratory birds. Additional water management infrastructure (such as water delivery systems, dikes, and levees to manipulate individual wetlands) would be developed to create a more diverse and productive wetland complex. Biological staff would monitor the level of sedimentation occurring in natural wetlands and plan for its removal to restore the biological integrity of these wetlands.

Through partnerships, the Service would increase the acreage of invasive and nonnative species treated annually with an emphasis on preventing further encroachment of crested wheatgrass and Russian olive into native grassland. The Bowdoin Refuge would serve as a conservation learning center for the local area. Public access would be improved to Creedman Coulee National Wildlife Refuge.

Upland Habitat and Associated Wildlife

The following upland habitat discussion covers native grassland, disturbed grassland, invasive species, shelterbelts, habitat protection and acquisition, and greater sage-grouse.

Native Grassland. Same as alternative B.

Disturbed Grassland. Same as alternative B.

Invasive and Nonnative Species. Same as alternative B, except through partnerships, the Service would increase the number of acres treated annually with an emphasis on preventing further encroachment of crested wheatgrass and Russian olive into native grassland.

Shelterbelts. Same as alternative B.

Habitat Protection and Acquisition. Same as alternative B.

Greater Sage-Grouse. Same as alternative B.

Wetland Habitat and Associated Wildlife

The following wetland habitat discussion covers managed wetlands, natural wetlands, riparian habitat, water rights, habitat protection and acquisition, wildlife disease, invasive species, and threatened and endangered species.

Managed Wetlands. Same as alternative B, plus the Service would develop additional infrastructure (such as water delivery systems, dikes, and levees to manipulate individual wetlands) to create a more diverse and productive wetland complex. On Bowdoin Refuge, a water delivery canal would be constructed through the Lakeside wetland unit and directly connect to the Dry Lake Canal. This water delivery canal would also include two water structures to manage both halves of the Lakeside unit. This would enable the Service to deliver water to wetlands below the Lakeside unit without having to fill Lakeside first. Biological staff would monitor the level of sedimentation occurring in modified wetlands and plan for its removal to restore the biological integrity of the wetland.

Natural Wetlands. Same as alternative B, plus the biological staff would monitor the level of sedimentation occurring in natural wetlands and plan for its removal to restore the biological integrity of the wetland.

Riparian Habitat. Same as alternative B, except the natural vertical structure in riparian corridors would be restored using native species such as cottonwood, willows, and native shrubs to provide habitat for migratory birds and other native wildlife.

Water Supply and Rights. Same as alternative B.

Habitat Protection and Acquisition. Same as alternative B.

Wildlife Disease. Same as alternative A.

Invasive and Nonnative Species. Same as alternative B.

Threatened and Endangered Species. Same as alternative B.

Visitor Services

The following visitor services discussion covers hunting and trapping, fishing, wildlife observation and photography, environmental education and interpretation, public access, and cultural resources.

Hunting and Trapping. Same as alternative B.

Fishing. Same as alternative B.

Wildlife Observation and Photography. Same as alternative B.

Environmental Education and Interpretation. Same as alternative B, plus the Bowdoin Refuge would serve as a conservation learning center for the

surrounding schools and communities to educate students and public about the values of wildlife and wetland and grassland conservation. Biannual teacher workshops would educate teachers about these same values and instruct them on how to use the refuge as an outdoor classroom. A refuge-specific curriculum would be developed.

Public Access. Same as alternative B, plus the Service would work with private landowners within the Executive boundary of Creedman Coulee National Wildlife Refuge to increase and improve access for wildlife-dependent recreational opportunities at the refuge.

Cultural Resources. Same as alternative B, plus the Service would create an interpretive display at the Bowdoin National Wildlife Refuge office depicting the early history of the refuge complex.

Partnerships

The following partnerships discussion covers partnership development and maintenance and energy development on Service lands.

Partnership Development and Maintenance. Same as alternative B, plus the Service would establish a new partnership with Burlington Northern Santa Fe Railroad to help address litter and limit the spread of invasive plants on Bowdoin Refuge where the railroad passes. Additional partnership with the Malta Irrigation District would focus on removing Russian olive trees along the Dodson South Canal, a major seed source for future infestations of trees on Bowdoin Refuge.

Energy Development on Service Lands. Same as alternative B, except the Service would not acquire easements or fee-title lands on properties where the Service could not acquire the mineral rights or guarantee that future extraction operations would not occur.

Operations

The following operations discussion covers staff, operations, facilities, and signs and boundary designation.

Staff. Same as alternative B.

Operations. Same as alternative B.

Facilities. Same as alternative B.

Signs and Boundary Designation. Same as alternative B, plus the satellite refuges would be posted using the new limited-interest boundary sign proposed for these similar private land refuges in North Dakota.

3.4 Summary of Alternatives and Consequences

Table 5 summarizes all aspects of management of the refuge complex under alternatives A–C, other than for Lake Thibadeau National Wildlife Refuge and the salinity and blowing salts issue at Lake Bowdoin:

- As described in section 3.1 above, Lake Thibadeau Refuge alternative 2 (divestiture) is the proposed action for this refuge. Alternatives A–C below apply to the remaining four refuges and one wetland management district in the refuge complex.

- Salinity alternative 4 is the proposed action for resolution of this issue at Lake Bowdoin (refer to "Chapter 6–Analysis of Salinity"). This salinity and blowing salts alternative supports the actions outlined in alternative B (proposed action) for the entire refuge complex.

Mike Artmann / USFWS

Pronghorn graze in the eastern uplands along Lake Bowdoin.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
GOAL for Upland Habitat and Associated Wildlife. Protect, enhance, and restore grassland habitat for breeding and migratory birds and other wildlife while maintaining the biological diversity and integrity of native prairie grasslands.		
Native grassland—actions		
Manipulate native grasslands using various techniques such as burning, spraying, grazing, and resting periods. Base management actions on outside research and do not follow an established management plan. Allow periodic cattle grazing of about 10 percent of the refuge complex uplands with no evaluation of response.	Actively manage native grasslands for targeted grassland birds to mimic the natural processes of burning and grazing (timing and frequency) to enhance native grassland with emphasis on dominant historical communities that still exist in the refuge complex. Prepare a grassland habitat management plan (within the habitat management plan) based on tested methods for preserving and enhancing native grassland.	Same as alternative B.
Native grassland—environmental consequences		
Native grasslands would be maintained at current conditions, providing habitat for many grassland-nesting birds. Native grassland protected through fee title or easement would be protected in perpetuity from development or conversion to agricultural purposes. This would provide expanded grassland habitats for dependent species. Protected grassland would reduce our carbon footprint. Prescribed burning and grazing of native grassland would reduce excess residual plant material and improve seed germination and plant vigor. Continuing to rest the native grasslands would maintain the dominance of clubmoss, prohibiting the regeneration of other native grasses and forbs. A continued lack of on-refuge experimentation, management, planning, and monitoring may result in undesirable habitat modifications and loss of native grasslands.	Same as alternative A, *except*: Managing for selected bird species may reduce habitat for other nonselected but desirable species. Inventory and monitoring would be limited to targeted species to save time and resources. Native plant species diversity would increase, providing improved habitat for most native grassland-nesting birds and other resident wildlife. Management practices such as grazing may result in invasive plant infestations and trampling that could contribute to nest predation. However, these would be short-term effects offset by the long-term improvements to habitat, which would increase nesting production and success. Using prescribed fire during the nesting season can lead to nest destruction and increased nest predation; however, birds will typically renest but may produce fewer eggs. In the long-term, production would increase with the improved habitat conditions. Developing a grassland habitat management plan would focus resources and effort on the highest priority habitat needs.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Disturbed grassland—actions		
Periodically treat disturbed grasslands, also known as DNC, using various techniques such as burning, spraying, grazing, haying, clipping, and resting periods. Restore cropland on waterfowl production areas mainly to native grasses and forbs at a rate of 50 acres per year. Continue to seed DNC on highly erodible lands in the wetland management district. Convert DNC fields on the Bowdoin Refuge to native forbs and grasses.	Gradually convert all disturbed grasslands to native grasses, forbs, and shrubs that have the greatest potential to survive and outcompete invasive species while providing habitat to targeted grassland-dependent birds. Ensure that all invasive species are controlled in restored areas.	Same as alternative B.
Disturbed grassland—environmental consequences		
Disturbed grassland (DNC) provides valuable nesting habitat for grassland birds. With minimal funding, seeding of cropland areas to DNC or replanting DNC is less expensive and easier to establish than native grass. Without rejuvenation (such as reseeding) most of the disturbed grasslands would lose optimal species composition and structure needed for nesting grassland birds. Gradual restoration of croplands to native grasses and forbs would increase plant diversity and grassland bird-nesting habitat. Planting DNC would stabilize erodible soils while providing cover and nesting habitat for some grassland-nesting birds.	Same as alternative A, *plus*: Habitat would be provided for candidate species and species of management concern. Managing for selected bird species may reduce habitat for other nonselected but desirable species. Converting disturbed grasslands and croplands to native grasses and forbs would provide greater plant species diversity and attract a wider variety of grassland-nesting birds. Native plantings may take longer to become established, resulting in low-quality habitat in the short-term with a greater possibility of infestation by invasive plants. Species of birds that prefer DNC may be impacted.	Same as alternative B.
Invasive and nonnative species—actions		
Use mechanical and chemical methods to control the spread of Russian olive. Focus control in the interior of the management units. Give priority to areas where tree removal results in large contiguous blocks of grassland. Use early detection and rapid response to attack initial infestations of invasive plant and mammal species such as leafy spurge, whitetop, and spotted knapweed. Give little to no attention to larger infestations of invasive species such as crested wheatgrass due to lack of resources and staff.	Same as alternative A, *except*: Work with the Service's Montana Invasive Species Strike Team and partners to ensure that treated areas are mapped, restored with native plant species, monitored, and retreated as necessary to prevent reinvasion. Increase treatment of Russian olive by at least 25 additional acres. Give priority to areas where tree and shrub removal would create more contiguous blocks of grassland habitat.	Same as alternative B, *except*: Through partnerships, increase the number of acres treated annually with an emphasis on preventing further encroachment of crested wheatgrass and Russian olive trees into native grassland.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Invasive and nonnative species—actions (continued)		
	Through partnerships, develop an education and outreach program that discusses the impacts of Russian olive on native habitat and wildlife and provide information on native tree alternatives to Russian olive trees. Through partnerships, conduct experiments to determine the best methods for reducing crested wheatgrass to restore treated sites to native grasses.	
Invasive and nonnative species—environmental consequences		
Without comprehensive and consistent treatment of rapidly spreading Russian olive trees, they would continue to fragment native grasslands, which would impact grassland-dependent birds. Loss of this habitat would prevent the refuge complex from meeting its purposes. This process has been slow and inefficient due to a lack of staff and funding to address the tremendous expanse and invasion by these trees. Habitat would be protected by controlling or eradicating small infestations of invasive plants and noxious weeds. More widespread infestations such as crested wheatgrass would continue to provide low-quality nesting habitat for native birds and continued spread into native areas would degrade upland-nesting habitat. Russian olive trees would provide food, cover, nesting, and perching sites for some birds and mammals including nest predators (magpies, raccoons, and skunks) and some game birds. Predation of grassland birds and their nests would increase due to habitat fragmentation caused by Russian olive.	Same as alternative A, *except*: Identifying and mapping invasive species would allow more efficient use of resources through improved awareness, planning, treatment, and monitoring. Restoration and followup treatments would eradicate Russian olive trees from target areas, which would improve and restore upland-nesting habitat while preventing additional invasive plant problems. Large, contiguous blocks of grassland habitat would be restored with the removal of nonnative woody vegetation. These large blocks of unfragmented grassland habitat would provide nesting and cover habitat for a variety of grassland-dependent birds and other native wildlife. Predation of nests and young would be reduced and additional nesting territories would be provided. Species that use Russian olive trees for food and cover would move to other treed areas on the refuge complex or migrate to wooded habitats off the refuge complex. Educating the public about the impacts of Russian olive trees may reduce off-refuge seed sources and increase off-refuge native plantings for the benefit of native wildlife. Experimental treatments of crested wheatgrass would result in an effective, long-term treatment program and restore native grasslands, improving habitat for most grassland-dependent birds.	Same as alternative B, *except*: Monotypic stands of Russian olive trees and crested wheatgrass infestations would be reduced more quickly while native prairie habitat would be improved and restored. This increased effort would require additional cost and resources and additional monitoring to ensure areas are not reinfested.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Shelterbelts—actions		
Remove Russian olive trees as the only active management of shelterbelts.	Excluding the office compound, begin removing all shelterbelts to create more contiguous blocks of grassland habitat and restore it to prevent invasive species from encroaching. Permit no additional shelterbelts.	Same as alternative B.
Shelterbelts—environmental consequences		
Shelterbelts would deteriorate while continuing to cause fragmentation of the surrounding grassland and serve as seed sources for invasive trees and shrubs. Shelterbelts would provide marginal habitat to various wildlife species, many undesirable. This includes food, cover, nesting, and perching sites for some birds and mammals including nest predators (magpies, raccoons, and skunks) and some game birds.	Upland-nesting conditions would be immediately improved with restoration and less fragmentation. Grasslands would no longer be fragmented by new plantings of shelterbelts. This would reduce predation and maintain and improve habitats for grassland-nesting birds. Seed sources for invasive plants would be eliminated.	Same as alternative B.
Habitat protection and acquisition—actions		
Continue annual protection and enforcement of current Service grassland easements as first priority. Continue to seek potential grassland easements to acquire from willing sellers as time and staff permits. Give priority for fee-title acquisition to private inholdings adjacent to or within boundaries of the refuges and waterfowl production areas and from willing sellers, as funding and opportunities arise.	Same as alternative A, *plus*: Prepare grant proposals to pursue resources for future acquisitions of grassland easements and fee title from willing sellers. Work with HAPET to identify critical waterfowl breeding and nesting sites that need protection. Establish partnerships with conservation groups to acquire lands for transfer.	Same as alternative B.
Habitat protection and acquisition—environmental consequences		
Through fee-title and easement acquisitions, more quality habitat would be permanently protected and managed for the benefit of wildlife. Fee-title lands would provide additional public use opportunities. Enforcement of easements and regulations on Service lands with current law enforcement capabilities would continue to be marginal due to the size of the refuge complex, logistics, and travel involved.	Same as alternative A, *plus*: Grants and partnerships would provide additional resources for acquisitions and more flexibility in working with willing sellers, resulting in more immediate protection of upland habitats. Identification of priority areas for protection would ensure that the most critical waterfowl breeding and nesting habitats are protected as resources and opportunities become available.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Greater sage-grouse—actions		
Continue to provide habitat for greater sage-grouse.	Same as alternative A, *plus*: Monitor population levels and trends. Identify and maintain or enhance sage-grouse habitat throughout the refuge complex. Target greater sage-grouse for future upland habitat management actions. Plant silver sagebrush on the Korsbeck and Beaver Creek WPAs to provide additional breeding, nesting, and feeding habitat for greater sage-grouse.	Same as alternative B.
Greater sage-grouse—environmental consequences		
Protecting existing greater sage-grouse habitat would continue to provide protected quality habitat for this resident species, which has been recently designated as a candidate for listing as a threatened species.	Same as alternative A, *plus*: Identifying all potential sage-grouse habitat would allow the Service to better manage, protect, and restore or enhance it. Restoring sagebrush habitat to these waterfowl production areas would provide additional nesting and feeding habitat for greater sage-grouse.	Same as alternative B.
GOAL for Wetland Habitat and Associated Wildlife. Provide wetland habitat for breeding and migratory birds and other wildlife that maintains biological diversity and integrity of prairie pothole wetlands.		
Managed wetlands—actions		
Flood and draw down wetlands in an attempt to mimic natural wetland hydroperiods to provide migration habitat and breeding and nesting habitat for wetland-dependent migratory birds. Because the Bowdoin Refuge's wetland program is dependent on the availability of natural runoff, delivered water, and periodic flood events from Beaver Creek, continue to exercise Service water rights throughout the refuge complex, including the Reclamation water right for Bowdoin Refuge provided through a perpetual MOA.	Same as alternative A, *except*: Add more staff and equipment to maintain, repair, and replace all water level management structures. Add biological and maintenance staff to achieve enhancement, restoration, creation, protection, and maintenance of managed wetlands throughout the refuge complex. Acquire funding to buy additional delivered water from the Malta Irrigation District (when available) to properly manage wetlands on Bowdoin Refuge and Pearce WPA, including piping plover nesting habitat. Install new ground water wells to supplement wetland management needs. Add water-pumping sites on the Beaver Creek and McNeil Slough WPAs to create wetland habitat for migratory birds.	Same as alternative B, *plus*: Construct additional infrastructure such as water delivery systems, dikes, and levees to manipulate individual wetland units to create a more diverse and productive wetland complex. Construct a water delivery canal on Bowdoin Refuge that goes through the Lakeside wetland unit and directly connects to the Dry Lake Canal, enabling the Service to deliver water to wetlands below Lakeside. Monitor the level of sedimentation occurring in managed wetlands and plan for its removal to restore the biological integrity of the wetlands.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Managed wetlands—actions (continued)		
Continue maintenance of water management structures (such as dikes and levees) as funding became available (most have been repaired and upgraded through annual deferred maintenance funding and partnerships). Identify and map potential wetland creations and enhancement projects. Use prescribed fire, grazing, haying, and other mechanical and chemical treatments to create habitat diversity and provide open-water habitat for migratory waterbirds, primarily waterfowl and shorebirds.	Identify and map potential wetland creations and enhancement projects.	
Managed wetlands—environmental consequences		
Management promotes a diverse wetland complex that helps increase the likelihood of meeting the habitat needs of wetland-dependent species. Typically, there is an inadequate supply of water for Bowdoin Refuge to fill and properly manage these wetlands for wetland-dependent migratory birds. Effective management of managed wetlands within the refuge complex would remain limited by the Service's water rights and funding. Without adequate monitoring and documentation, it would be difficult to determine if management actions were improving habitat conditions for desired species and whether they should be continued. This could result in loss of desired habitats and wasted resources. Managed wetlands with adequately maintained water control structures would facilitate proper management and control of invasive plants and avian botulism through planned drawdowns. There would always be the potential for an accidental spill of highly saline water into Beaver Creek by natural means (such as a significant rain event) or failure of a water control structure, which could negatively affect downstream habitats and water users.	Same as alternative A, *except*: More staff and equipment would improve the Service's ability to maintain, repair, and manage facilities (such as water control structures, levees, and dikes) needed to adequately manage modified wetlands. Mapping would help identify critical habitat areas for migratory birds the Service should be targeting for further wetland creation. With additional biological staff, modified wetlands could be better monitored for effectiveness of management practices, and staff could conduct biological studies to improve management capabilities and wildlife use. With additional staff, herbicide application would be used more effectively to restore wetland habitat. Use of herbicides in wetlands could have potential, short-term, negative effects on aquatic vegetation, invertebrates, and nesting habitat for some bird species. These short-term effects would be offset by the long-term improvements to wetland habitat. Acquiring additional water resources would increase the availability and quality of habitat for wetland-dependent migratory birds, including the threatened piping plover.	Same as alternative B, *plus*: New infrastructure would facilitate and improve wetland management capabilities of managed wetlands, increasing habitat for migratory wetland birds. This new infrastructure could be expensive to construct initially and would need maintenance. Monitoring sedimentation would determine maintenance needs and ensure the health and survival of created wetlands.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Managed wetlands—environmental consequences (continued)		
The use of prescribed fire, grazing, haying, and other mechanical and chemical treatments would continue to improve the quality of wetland habitat for migratory birds and other wetland-dependent wildlife. Reduction in the extent of cattails should also improve migratory habitat for ducks and shorebirds as wetlands are flooded during spring and fall migration periods.		
Natural wetlands—actions		
Continue to monitor natural wetlands for invasive plant species and wildlife use. Use management practices such as prescribed burning, grazing, and invasive plant control to maintain the natural productivity of the wetlands to restore habitat for migratory birds. Restore potential wetland restoration sites that have been identified if money became available. With partners, pursue resources to identify and protect critical wetland complexes for breeding and nesting waterfowl through easements or fee-title acquisition.	Same as alternative A, *except*: Acquire additional money to restore natural wetlands. Use additional biological treatments to treat invasive plants and noxious weeds. Monitor and plan management needs on natural wetlands with additional biological staff.	Same as alternative B, *plus*: Monitor the level of sedimentation occurring in natural wetlands and plan for its removal to restore the biological integrity of the wetlands.
Natural wetlands—environmental consequences		
The lack of resources and staff to effectively restore, manage, and maximize the potential of natural wetlands results in many missed opportunities to provide important habitat for wetland-dependent wildlife. With current staffing levels, control of invasive plants and cattail in wetlands would continue on a small scale; therefore, some wetland habitat for migratory birds would be improved as noxious weeds and invasive plants were controlled or eradicated. Critical wetland complexes would be protected, expanding available habitat for wetland-dependent wildlife.	Same as alternative A, *except*: Additional natural wetlands would be restored while current wetlands would be properly managed. This includes the treatment of invasive plants and noxious weeds. Restored natural wetlands would provide quality wetland habitat for wetland-dependent migratory birds and other wildlife.	Same as alternative B, *plus*: Monitoring sedimentation would determine maintenance needs and ensure the health and survival of natural wetlands.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Riparian habitat—actions		
Continue to fence the boundaries of the refuges and waterfowl production areas to eliminate the negative effects of trespass livestock grazing. Continue to rest riparian areas, so they can revegetate naturally. Use early detection and rapid response (chemical, biological, and mechanical methods) to treat initial infestations of invasive plant species.	Same as alternative A, *plus*: The refuge complex would work with the Services Montana strike team and partners to identify and map the locations and extent of invasive species within the riparian areas. Treatments would be documented and sites would be restored with native plant species, and monitored (re-treating as necessary) to prevent reinvasion. Russian olive trees would be removed and these areas would be revegetated with native species, as needed. Treated sites would be monitored and re-treated to prevent reinvasion.	Same as alternative B, *plus*: Natural vertical structure would be restored in riparian corridors using native species, such as cottonwood trees, willows, and native shrubs, to provide habitat for migratory birds and other native wildlife.
Riparian habitat—environmental consequences		
Excluding cattle from riparian areas should allow for these areas to revegetate naturally with the potential of introducing nonnative or invasive species. Riparian habitat would be protected and improved by controlling or eradicating small infestations of invasive and noxious species including Russian olive.	Same as alternative A, *except*: Identifying and mapping invasive species would allow more efficient use of resources through improved awareness, planning, treatment, and monitoring. Monitoring of treated areas would help in determining the best method of control and would also remove the seed source for reinvasion. Restoration of native species would provide habitat for riparian-dependent wildlife species. Species that feed and roost on Russian olive trees may relocate to native forested areas on the refuge complex or onto adjacent wooded lands.	Same as alternative B, *plus*: Native tree plantings would provide vertical structure and additional nesting, roosting, and food sources for native birds and other wildlife. Planting trees would be costly and time-consuming.
Water supply and rights—actions		
Continue to exercise the Service's current water rights and the use described in the MOA with Reclamation to provide habitat for migratory birds. When additional water is available to meet habitat objectives, continue to pay for additional deliveries of water from the Malta Irrigation District as refuge budgets allow.	Same as alternative A, *except*: Complete the adjudication of the Federal reserved water rights and compact between the State of Montana and the Service. Acquire funding to purchase additional water deliveries when they are made available to Bowdoin Refuge and Pearce WPA.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Water supply and rights—environmental consequences		
Water delivery costs continue to rise, yet refuge complex budgets for purchasing delivered water is stagnant, resulting in less wetland habitat available for migratory birds. Current budgets do not permit the Service to buy enough additional irrigation water to adequately manage Bowdoin Refuge and Pearce WPA.	Same as alternative A, *except*: Additional water resources for Bowdoin Refuge and Pearce WPA would allow the Service to better manage wetland resources, improve water quality, and provide more wetland habitat for migratory birds. Additional water resources would also provide nesting habitat for the threatened piping plover on Piping Plover Pond on Bowdoin Refuge. More money would be needed to consistently pay for additional water deliveries, when available.	Same as alternative B.
Habitat protection and acquisition—actions		
Annually inspect all wetland easements for compliance. Continue to protect natural wetlands through easements and fee-title purchases from willing sellers within the refuge acquisition boundaries and within the wetland management district. Give first priority to the continued annual protection and enforcement of current wetland easements. Give second priority to continue to protect natural wetlands through Service easements from willing sellers. Give third priority to fee-title acquisition from willing sellers.	Same as alternative A, *plus*: Work with partners and prepare grant proposals to pursue resources for future acquisitions of wetland easements and fee-title from willing sellers. Work with HAPET to identify critical waterfowl breeding and nesting sites that need protection.	Same as alternative B.
Habitat protection and acquisition—environmental consequences		
Additional protected habitats would provide expanded resting and breeding areas for wetland-dependent wildlife.	Same as alternative A, *plus*: Protection of identified, critical habitat for waterfowl breeding and nesting would be expanded using additional resources. This would provide important habitat for waterfowl and other migratory waterbirds and wetland-dependent wildlife in perpetuity.	Same as alternative B.
Wildlife disease—actions		
Plan water deliveries during early spring (through May 15) and late summer (early September) to avoid rising or fluctuating water levels on areas susceptible to avian botulism outbreaks. As temperatures rise in summer, monitor wetlands weekly for disease outbreaks. Send sample carcasses to the National Wildlife Health Center for analysis.	Same as alternative A.	Same as alternative A.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Wildlife disease—actions (continued)		
Collect dead birds only if a disease outbreak posed a human health risk (the larger botulism outbreaks cannot be prevented by human intervention) or in high public use areas as determined by the Service. Continue to allow the U.S. Interagency Working Group to monitor the refuge complex for any avian influenza outbreaks. When approved, implement the Mountain–Prairie Region policy for a mosquito control plan to address potential outbreaks of West Nile virus and avian influenza.		
Wildlife disease—environmental consequences		
Water level management would lessen the chances of an outbreak of avian botulism but not completely eliminate it. Larger avian botulism outbreaks would be permitted to run their course, since recent studies indicate retrieving dead birds does little to reduce the effects of the disease. This may require the refuge to notify and educate the public about this natural process. Monitoring for diseases that may be transferred to humans, could limit their spread.	Same as alternative A.	Same as alternative A.
Invasive and nonnative species—actions		
Use early detection and rapid response to treat initial infestations of invasive plant and mammal species. Use chemical and mechanical treatments such as prescribed fire, haying, and grazing to periodically set back invasive plants and noxious weeds as necessary to restore habitat for targeted resident and migratory birds.	Same as alternative A, *plus*: Work with the Service's Montana Invasive Species Strike Team and partners to identify and map the locations and extent of invasive species in wetlands. For treated areas, map, monitor, and re-treat as necessary to prevent reinvasion. Investigate the availability and effectiveness of biological treatments. Remove Russian olive trees and other vegetation that impedes the function of water level management structures (such as dikes, ditches, and levees).	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Invasive and nonnative species—environmental consequences		
Early detection and rapid response would facilitate control and possible eradication of small infestations of new invaders around wetlands and protect the integrity and manageability of dikes and water delivery systems. Mechanical and chemical treatment of invasive plants and noxious weeds would create open-water habitat for targeted resident and migratory birds, promote native vegetation, and improve recreational opportunities.	Same as alternative A, *plus*: Identifying and mapping invasive species would allow more efficient treatment and use of resources through improved awareness, planning, treatment, and monitoring. This awareness would help the refuge complex in working with the surrounding counties to identify seed sources and prioritize treatment sites. Water level management capabilities, thus habitat, would be improved on areas where Russian olive trees are removed from water level management structures. Wildlife using existing Russian olive trees would resort to using native cover and food sources found on the refuge complex or would use neighboring lands.	Same as alternative B.
Threatened and endangered species—actions		
Take no action to acquire water adequate water to properly manage critical habitat for piping plovers on Bowdoin Refuge to attract nesting birds.	Acquire additional water resources (see "Water Supply and Rights" above) to properly manage piping plover habitat on Bowdoin National Wildlife Refuge and monitor response. Create additional piping plover habitat as additional water is acquired. Protect all nests from flooding and predation. Monitor hatched young until they fledge.	Same as alternative B.
Threatened and endangered species—environmental consequences		
Lack of adequate water supply on Bowdoin National Wildlife Refuge would continue the lack of adequate habitat for the threatened piping plover. The plovers have moved to other, less protected areas, which may affect their survival and nesting success.	Additional water would permit the Bowdoin Refuge to manage wetlands specifically to attract piping plovers. This would give the plover added protection not currently found on off-refuge nesting sites. Artificially protecting nests and young would increase survival of eggs and nestlings but may result in abandonment.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
GOAL for Visitor Services. Provide visitors of all abilities with wildlife-dependent recreation, interpretation, and education opportunities that fosters an appreciation and understanding of the unique wildlife, plant communities, and cultural resources of the Montana Prairie Pothole Region.		
Hunting and trapping—actions		
Continue to allow current hunting of upland birds and waterfowl in select areas on the refuges to manage wildlife and provide compatible, priority, wildlife-dependent public use. Permit late-season hunting of upland game birds on previously closed areas at Bowdoin Refuge after waterfowl have left (first 2 days are for young hunters only) but no sooner than December 1. Continue current compatible hunting program on waterfowl production areas. Retain the accessible boat dock (Lake Bowdoin), parking, and hunting blind (Pearce WPA). Require all hunters on Bowdoin Refuge to sign in and out at the informational kiosk, where refuge hunting regulations and maps are provided. Continue to issue special use permits to a limited number of trappers on Bowdoin Refuge to remove burrowing animals that threaten refuge infrastructure or to protect migratory birds. Continue to prohibit leg-hold traps. Continue to permit trapping on the waterfowl production areas according to State and Federal regulations.	Same as alternative A, *plus*: Work with the State to determine the feasibility of providing an accessible, limited, big game archery hunt on portions of Bowdoin Refuge currently open to public use. Address the safety of refuge visitors and the wildlife and habitat response.	Same as alternative B.
Hunting and trapping—environmental consequences		
Hunter numbers and satisfaction would remain relatively unchanged. Roads, trails, and water management structures on Bowdoin Refuge would continue to be protected from burrowing animals. The success of grassland- and wetland-nesting birds would increase due to a reduction in mammalian predators such as skunks and raccoons.	Same as alternative A, *plus*: The Service and the State would be able to collect the necessary information and evaluate all the options needed to determine if and how a safe big game archery hunt could be found compatible on Bowdoin Refuge in the future.	Same as alternative A.
Fishing—actions		
Continue compatible, recreational fishing opportunities on waterfowl production areas with suitable fishing habitat (currently, two of the seven waterfowl production areas).	Same as alternative A.	Same as alternative A.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Fishing—actions (continued)		
Continue to not permit recreational fishing on any of the refuges, including Bowdoin, which have minimal habitat or high salinity levels, or both, and do not support a game fishery.		
Fishing—environmental consequences		
Fishing opportunities and angler satisfaction would remain relatively unchanged.	Same as alternative A.	Same as alternative A.
Wildlife observation and photography—actions		
Retain the 15-mile auto tour route and an accompanying interpretive brochure for Bowdoin Refuge. Retain two accessible photo blinds, one on Bowdoin Refuge and one on Pearce WPA. Retain the paved 0.4-mile accessible trail around the Display Pond on Bowdoin Refuge including interpretive panels and an observation deck.	Same as alternative A, *plus*: Provide, at least monthly, wildlife observation and photography programs for refuge complex visitors. Develop stop number 5 along the auto tour route to accommodate more accessible parking and install interpretive kiosks and two spotting scopes for observing wildlife.	Same as alternative B.
Wildlife observation and photography—environmental consequences		
Wildlife observation and photography opportunities would remain constant. Maintaining the 15-mile auto tour route would continue to provide visitors of all abilities with quality wildlife observation and photography opportunities.	Same as alternative A, *plus*: Wildlife observation and photography opportunities would be expanded and enhanced, creating a greater understanding and appreciation of the refuge complex resources. Enhanced and expanded wildlife-viewing opportunities may cause additional disturbance to wildlife and increase conflicts with other users. Uses would need to be monitored and evaluated to minimize and mitigate any adverse effects.	Same as alternative B.
Environmental education and interpretation—actions		
Continue opportunistic environmental education programs as time and staff allow. Retain the up-to-date interpretive panels and brochures, and update others as resources become available. Create a public use regulation brochure for the satellite refuges and waterfowl production areas. Maintain the refuge complex's Web site to provide information on the resources of the area and public use opportunities.	Same as alternative A, *except*: Expand opportunities for environmental education and interpretation to foster appreciation and understanding of the Refuge System and the resources of the refuge complex. Update the refuge complex's mammal, reptile, and amphibian lists; develop a wildlife list to the Service's graphic standards. Develop a Friends group for the refuge complex that could work with visitors and students.	Same as alternative B, *plus*: Serve as a conservation learning center for the surrounding schools and communities to educate students and adults about the values of wildlife, wetland, and grassland conservation. Develop a refuge-specific curriculum with help from local teachers. Conduct biannual workshops for grade school and university teachers.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Environmental education and interpretation—actions (continued)		
Prepare periodic news articles on refuge complex activities and values of local natural resources. Provide monthly updates to the local chamber of commerce on public use opportunities.	Work with the city of Malta to install an informational kiosk providing refuge complex information and directional maps. Develop a display at the Phillips County museum highlighting the history of the refuge complex.	
Environmental education and interpretation—environmental consequences		
Environmental education would minimally meet the public demand. Opportunities to educate students and the public about the values and purposes of the refuge complex and the Refuge System would be lost. This lack of understanding and appreciation would result in a loss of support for the refuge complex and the Refuge System. Public outreach and interpretation would meet minimum Service requirements. Visitors would be provided adequate resources to independently learn about the refuge complex environment; however, there would be minimal contact with refuge complex staff to answer questions and offer further interpretation.	There would be greater public understanding and appreciation of the refuge complex's resources and issues due to expanded interpretive, outreach, and educational programs. A Friends group could provide additional staff and resources to conduct refuge and visitor services programs, which would increase awareness about the refuge complex and its resources. Visitation by the public, schools, and other groups would increase, providing opportunities to reach a broader audience. If not managed properly, increased use may lead to additional disturbance to wildlife and habitat.	Same as alternative B, *plus*: Increased use of the refuge as an outdoor classroom by schools and other organizations would result in a greater awareness and appreciation for preserving the area's natural resources. By educating teachers, a greater number of students would receive this environmental education.
Public access—actions		
Continue to provide adequate public access for visitors to participate in compatible, wildlife-dependent public uses. Excluding the office compound, keep the refuge complex open to foot traffic year-round.	Same as alternative A, *except*: Close the east end of Bowdoin Refuge to all foot traffic at the start of the waterfowl hunting season (through November 30) to provide sanctuary areas for migratory waterfowl and shorebirds. Keep the auto tour route open but require visitors to remain in their vehicles in designated sanctuary areas. Construct a road and parking area on Black Coulee Refuge to improve access to waterfowl hunting opportunities. Work with Phillips County to determine the feasibility of rehabilitating the remaining portion of old U.S. Highway 2 that runs through the north end of Bowdoin Refuge.	Same as alternative B, *plus*: Work with the landowners on Creedman Coulee Refuge to determine their interest in providing additional access and opportunities for compatible, wildlife-dependent public uses.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Public access—environmental consequences		
Public access to the refuge complex would remain constant, allowing visitors to access public lands. There would continue to be some disturbance to waterfowl residing on the refuge during periods of higher visitation.	Same as alternative A, *except*: Sanctuary would be provided for migrating waterfowl and other waterbirds during the waterfowl-hunting season at Bowdoin Refuge. Conflicts between hunters and nonhunters may increase during the hunting season due to closure of the eastern portion of Bowdoin Refuge to foot traffic. Nonhunter satisfaction may decrease due to a reduction in access opportunities. Hunter satisfaction may decrease due to an increase in wildlife disturbance within the hunting zone. However, hunters may have more opportunities to hunt waterfowl, because this sanctuary area may encourage birds to remain on the refuge, including the areas open to hunting. Public use opportunities and satisfaction would increase on Black Coulee Refuge with improved access to the reservoir. Maintenance needs would increase. If the county was able to rehabilitate the remaining portion of U.S. Highway 2, the road would be safer and provide better public access to the refuge. Increased traffic on the road could lead to more littering, and increased driving speeds could lead to more vehicle–wildlife collisions.	Same as alternative B, *plus*: With improved access through landowner cooperation, public use opportunities and visitor satisfaction may increase on Creedman Coulee Refuge.
Cultural resources—actions		
Use the Montana statewide cultural resource inventory list to determine sensitive sites before activities. Document cultural resource sites and ensure their protection.	Working with the zone archeologist, contractors, local tribes, the State Historic Preservation Office, universities, and other partners, start a comprehensive cultural resource inventory.	Same as alternative B, *plus*: Create a display at the office interpreting the early history of the refuge complex.
Cultural resources—environmental consequences		
Inventory of the refuge complex's cultural resources would continue at a minimal level. This lack of knowledge would make it more difficult to adequately protect cultural resource sites from theft and vandalism.	Knowledge of the early history of the refuge complex would increase. Increased awareness and mapping of cultural resources would enhance protection of these resources from Service and public activities. More information would help to interpret the unique cultural history of the area.	Same as alternative B, *plus*: Public knowledge and appreciation for the early history of the refuge complex would increase.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
GOAL for Partnerships. Maintain and expand partnerships that preserve, restore, and enhance healthy and productive prairie/wetland complexes on Bowdoin National Wildlife Refuge and within the wetland management district.		
Partnership development and maintenance—actions		
Pursue partnership opportunities to achieve activities of mutual interest. Continue working with Montana Department of Fish, Wildlife, and Parks to conduct habitat improvement projects in areas open to hunting. Continue to support the private land work of the Partners for Fish and Wildlife Program. Periodically provide easement landowners with information about additional opportunities for compensated added protections. Also, send information about the conservation easement program to other potential landowners.	Same as alternative A, *plus*: Expand efforts to develop, coordinate, and manage new partnerships to benefit the refuge complex. Work with landowners within the approved boundaries of Hewitt Lake, Black Coulee, and Creedman Coulee refuges to provide willing landowners with opportunities to receive compensation for added protections (grassland and wetland easements and fee title). Continue expanding partnerships with the four counties surrounding the refuge complex to improve roads that provide public access. Work with other Federal land managers to determine if their infrastructure and management actions could be used to enhance the refuge complex's wetland system. Develop a Friends Group for the refuge complex.	Same as alternative B, *plus*: Pursue a partnership with the Burlington Northern Railroad Company to address litter and invasive species issues related to their railroad right-of-way. Develop a partnership with the Malta Irrigation District to control Russian olive trees along the Dodson South Canal.
Partnership development and maintenance—environmental consequences		
Expanded partnerships would increase the Service's ability to provide quality habitats for wildlife. Continued support of the Partners for Fish and Wildlife Program would improve relationships between the Government and landowners while protecting additional habitat on private lands, some that have the potential to affect refuge complex lands and waters. Periodic easement landowner contacts would reduce the potential for easement contract violations. There may be additional opportunities to acquire easements on private lands that have high wetland densities and large tracts of native prairie.	Same as alternative A, *plus*: Expanded partnerships would provide additional resources to address management issues of common interest while reducing potential impacts from offsite activities on neighboring lands. Hewitt Lake, Black Coulee, and Creedman Coulee refuges would provide additional upland habitat for migratory birds. Improving county road surfaces would provide a better experience for wildlife-dependent recreationists. Increased traffic through the refuge complex may result in higher human to wildlife interactions.	Same as alternative B, *plus*: A partnership between Bowdoin Refuge and the railroad would provide for a cleaner landscape and a quality experience for visitors. Invasive species brought into the refuge via the railroad right-of-way would be controlled and monitored. Removal of Russian Olive trees on the Dodson South Canal would eliminate a major seed source for invasion of Russian Olive trees on Bowdoin Refuge.
Energy development on Service lands—actions		
Following Service procedures, work with energy developers who are extracting reserved and excepted oil, gas, and mineral rights on grassland easements and fee-title lands to minimize impacts from their operations.	Same as alternative A, *except*: Evaluate all future, land acquisition projects to determine the status of the reserved and excepted oil, gas, and mineral rights to evaluate the potential impacts of energy development on wetland and grassland habitats.	Same as alternative B, *except*: Do not buy easements or fee-title lands on properties where the Service cannot acquire the mineral rights or guarantee that future extraction operations would not occur..

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Energy development on Service lands—actions (continued)		
Keep physical occupancy at the minimum space compatible with efficient mineral operation. Work with energy developers who hold mineral leases on Service lands to complete habitat improvement projects in exchange for disturbances caused by their exploration and development activities. Manage impacts using the FWS Oil and Gas handbook and 50 CFR.	When the policy on energy development on Service lands is completed, modify the program to support the direction and objectives of this new policy.	
Energy development on Service lands—environmental consequences		
Partnerships with energy developers would encourage good stewardship. This may help to minimize impacts while preserving the maximum amount of wetland and grassland habitats. Energy development would be conducted with minimal interference to the operation of the refuge complex. Impacts to wildlife and habitat would increase as energy demand increases.	Same as alternative A, *plus*: The Service would be able to better determine potential impacts of energy development on lands proposed for protection. This evaluation would help the Service in making decisions that are more informed and in setting priorities for proposals.	Impacts to future easements caused by oil and gas development may be lessened, but landowners may be discouraged from entering into any agreements with the Service, thus limiting the quantity and quality of lands available for easement.
GOAL for Operations. Prioritize for wildlife first and emphasize the protection of trust resources in the utilization of staff, funding, partnerships, and volunteer programs.		
Staff—actions		
Retain the current staff of five full-time equivalent employees (refuge manager, GS–485–12; wildlife biologist, GS–486–11; wildlife refuge specialist (collateral law enforcement officer), GS–485–9; administrative assistant, GS–303–7; and maintenance worker, WG–4749–8). To ensure the success of refuge complex programs, recruit one seasonal maintenance worker, two seasonal biological technicians, and volunteers, as funding is available. Retain the biologist for the Partners for Fish and Wildlife Program to be stationed at the refuge complex.	Same as alternative A, *plus*: Increase the staff by six and one-half new positions including a GS–13 refuge manager position. Convert the current manager position to a supervisory wildlife refuge specialist to serve as deputy refuge manager. Recruit a GS–326–5 office automation clerk and upgrade the administrative support assistant to an administrative officer, GS–341–9. Recruit an additional WG–4749–8 maintenance worker and a career-seasonal WG–3502–5 laborer. Recruit a GS–025–9 visitor services specialist and a GS–025–9 law enforcement officer. Upgrade the wildlife biologist to a GS–486–12. Recruit a permanent, full-time GS–404–8, biological science technician. Annually recruit at least four temporary biological technicians, GS–404–3/4/5.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Staff—actions (continued)		
	Recruit volunteers from around the country and through State and regional universities and colleges. Reinstate the Youth Conservation Corps program, hiring four youths and one social services aid, GS–186–05, to lead the program. Work with Montana universities to develop a volunteer program by providing college credits in exchange for volunteer work experience.	
Staff—environmental consequences		
Programs would be maintained at the current levels, which means that habitats would continue to degrade due to a significant lack of resources. There would continue to be minimal monitoring of habitat and wildlife responses to management actions. A backlog of maintenance projects would continue to accumulate. As public use continued to increase, it would become more challenging for a single collateral-duty, law enforcement officer to enforce regulations and protect resources.	Same as alternative A, *plus*: Additional funding would be required for the salary, equipment, facilities, and office space for the additional positions. Additional staff and volunteers would be able to adequately manage and protect the refuge complex habitats and provide visitors with additional quality wildlife-dependent programs and recreational opportunities. Research and monitoring could be conducted and would be used to evaluate management actions and adapt programs. Facilities and equipment would be maintained and maintenance issues would be resolved.	Same as alternative B.
Operations—actions		
Continue funding for operations at current levels. Continue to maintain vehicles, heavy equipment, other equipment, buildings and refuge housing, and other refuge complex facilities and infrastructure needed to achieve management goals. Replace equipment as funding became available.	Same as alternative A, *except*: Acquire additional resources to achieve refuge and district purposes and achieve the goals, objectives, and strategies identified the draft CCP. Acquire five additional field vehicles and field equipment for additional staff. Replace outdated heavy equipment such as the road grader, scrapper, farm tractor, and front-end loader. Acquire attachments (such as a farm disc, grapple fork, and mowers) for the farm tractor for habitat management purposes. Acquire a mower and marsh master to manage vegetation in wet areas for control of undesirable plant species and to create open-water habitat.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Operations—environmental consequences		
Current levels of funding are inadequate to acquire the needed staff, facilities, equipment, and other resources necessary to properly manage and protect refuge complex resources, maintain facilities and equipment, and provide quality visitor services programs across a four-county area. This would continue to result in habitat being degraded and a growing backlog of maintenance projects.	Added funding and equipment would ensure enhancement and protection of refuge complex resources and facilities while improving safety and expanding opportunities for visitors to participate in wildlife-dependent uses. A significant increase in annual funding for staff, equipment, and supplies would be necessary to carry out this alternative.	Same as alternative B.
Facilities—actions		
Construct no additional facilities or infrastructure unless funding became available. Due to limited storage facilities, continue to store vehicles outside year-round.	Expand or enhance facilities to accommodate six and one-half additional staff, expanded visitor services programs, and new equipment. Construct a 10-bay storage facility for existing vehicles plus five additional field vehicles for new staff. Construct a four-bay cold storage building to house additional heavy equipment. Expand the visitor contact area and improve the interpretive displays and materials. Construct a separate ground water well for the two refuge complex residences. Expand the bunkhouse to accommodate up to eight people. Convert the Bowdoin Refuge headquarters, apartment, two houses, and shop buildings to a solar power system. Develop one camping site with a concrete pad, septic and water systems, and electricity for a volunteer with a recreational vehicle.	Same as alternative B.
Facilities—environmental consequences		
Current office space is sufficient for current, permanent staff only but would not accommodate any new or seasonal staff or volunteers. The visitor contact area is small and does not allow for interpretive materials such as displays and educational materials, resulting in lost opportunities to educate and interact with visitors. Insufficient seasonal housing makes it difficult to recruit the seasonal staff and volunteers needed to conduct refuge programs.	Equipment would be protected from environmental damage, reducing maintenance costs. Visitors would feel more welcome in an expanded visitor contact area and have new opportunities to learn about the refuge complex's resources through interpretation. Additional office and living space for seasonal staff and volunteers would accommodate the additional staff needed to properly manage and protect the refuge complex resources while providing visitors quality, safe, wildlife-dependent recreation and programs.	Same as alternative B.

Table 5. Summary of CCP alternatives for Bowdoin National Wildlife Refuge Complex, Montana.

Alternative A (current management–no action)	*Alternative B (proposed action)*	*Alternative C*
Facilities—environmental consequences (continued)		
Facilities to house vehicles and heavy equipment are inadequate and all heavy equipment and many vehicles are stored outside. Continual exposure to the elements may cause them to deteriorate more rapidly due to ultraviolet light and extreme weather patterns of heat, cold, and wind. Vehicles, boats, and other equipment not stored in secure buildings would be susceptible to theft and vandalism.	The refuge complex would reduce its carbon footprint by using renewable energy and green technologies.	
Signs and boundary designation—actions		
Retain the proper boundary signs and fences to prevent trespass livestock grazing. Continue discussions with a landowner on Hewitt Lake Refuge to exchange fee-title lands needed to create a more manageable and enforceable boundary and bring awareness of the refuge boundary. Retain entrance signs at refuges that have more than 40 percent of lands within their boundaries in fee title. Retain entrance signs at all of the waterfowl production areas.	Same as alternative A, *plus*: Acquire funding to replace dilapidated boundary fences, gates, and parking areas. Evaluate the need for existing fences for managing a prescriptive grazing program; systematically replace retained fences using wildlife-friendly materials and techniques.	Same as alternative B, *plus*: Post the portions of the satellite refuges that are privately owned with the new boundary signs proposed for similar limited-interest refuges in North Dakota.
Signs and boundary designation—environmental consequences		
Refuge visitors and neighbors would remain aware of the refuge locations, boundaries, and permitted activities. Exchanging lands on Hewitt Lake Refuge would make enforcement of the refuge boundary more manageable and less confusing for visitors.	Same as alternative A, *plus*: Wildlife losses from fences would be reduced and wildlife would be able to migrate more freely through the refuge complex.	Same as alternative B, *plus*: A unique boundary sign would reduce confusion over ownership and the permitted uses on these privately owned refuge areas.
Socioeconomics—environmental consequences		
There would not be any notable changes in the net economic contribution of the refuge complex to the local economy through visitor spending or employee earnings.	There would be a significant increase in the net economic contribution of the refuge complex to the local economy (an increase of $457,500 over current levels) through visitor spending and employee earnings.	Same as alternative B, *except*: There would be a slightly more significant increase in visitor spending in the area (an increase of $487,500 over current levels) generated by increased visitation as a result of enhanced outreach efforts, programming, and public access.

CHAPTER 4—Affected Environment

USFWS

The Bowdoin Refuge has one of only four nesting colonies of American white pelicans in Montana.

This chapter describes the characteristics and resources of the Bowdoin National Wildlife Refuge Complex, Montana, under these topic headings:

- Physical environment
- Biological resources
- State and Federal listed species
- Cultural resources
- Special management areas
- Visitor services
- Management uses
- Socioeconomic environment
- Partnerships
- Operations

4.1 Physical Environment

The following sections describe aspects of the physical environment that may be affected by implementation of the CCP. Physical characteristics include climate, climate change, physiography and geography, soils, water resources, and air quality.

Climate

The climate of the Bowdoin National Wildlife Refuge Complex is "semiarid continental," which is characterized by cold, dry winters and warm, dry summers. Average annual precipitation between 1905 and 2009 was 12.5 inches, most of which fell as rain from May to September, with June being the wettest month. The 10-year average, high temperature for January is 26 °F (degrees Fahrenheit) with a low of 2 °F. In July, the average high is 87 °F and the low is 56 °F. Temperature extremes range from 113 °F in the summer to –60 °F in the winter. The average growing season is 122 days.

Prevailing winds vary from southwest to northwest with periods of strong winds common throughout the year. Average annual pan evaporation (estimate of lake evaporation) is about 35–40 inches (Dunne and Leopold 1978). On refuge complex lakes, the average evaporation ranges from 26–30 inches (URS 2009). During the winter, warm Chinook winds can bring rapid temperature increases of 30–40 °F within a few hours.

Precipitation measurements from 1905 to 2008 show a slight downward trend in annual precipitation totals (figure 19). There is also a downward trend in the long-term precipitation totals for February, which is historically the driest month for the refuge complex, and for June, which is historically the wettest month (figures 20 and 21).

Average daily maximum temperatures and average daily minimum temperatures taken from 1969 to 2008 for February show a slight upward trend (figures 22 and 23.). The average daily maximum temperature for June from 1969 to 2008 showed a slight decrease while the average daily minimum temperature for June has slightly increased (figures 24 and 25).

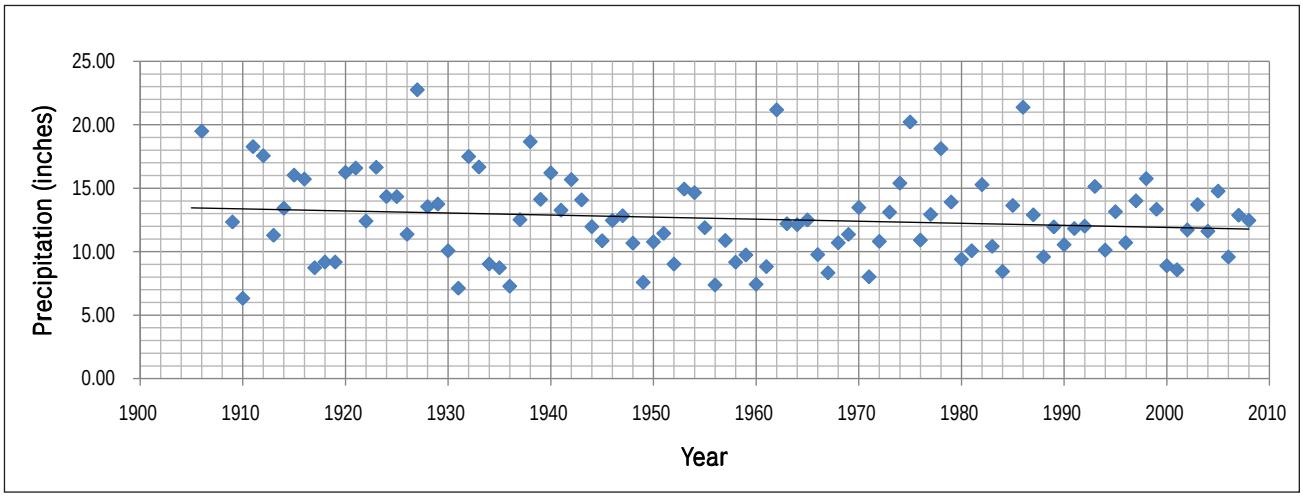

Figure 19. Graph of total annual precipitation at Bowdoin National Wildlife Refuge, Montana (1905–2008).

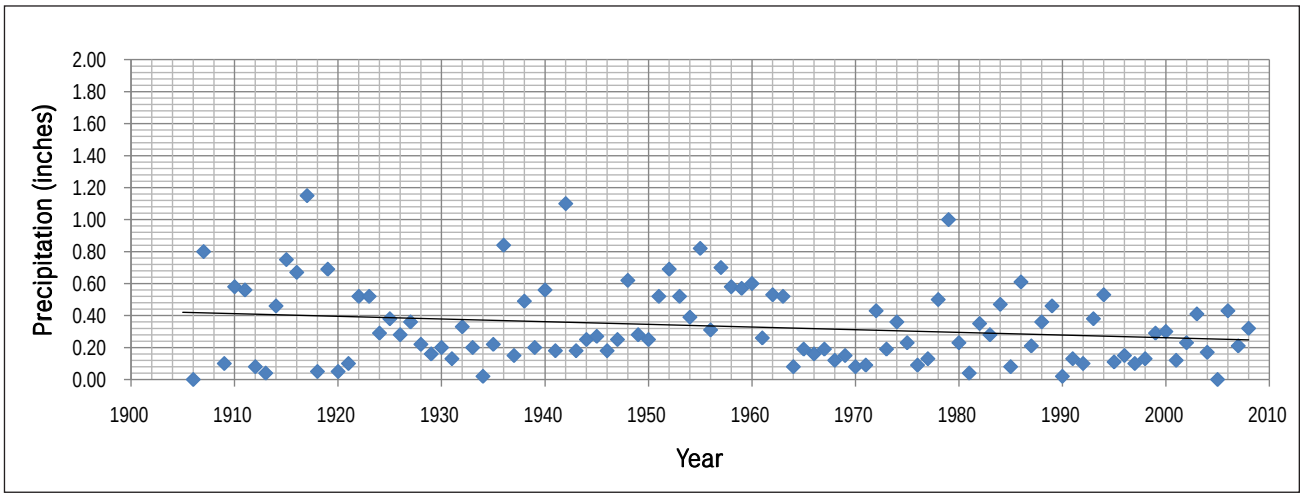

Figure 20. Graph of total February precipitation at Bowdoin National Wildlife Refuge, Montana (1905–2008).

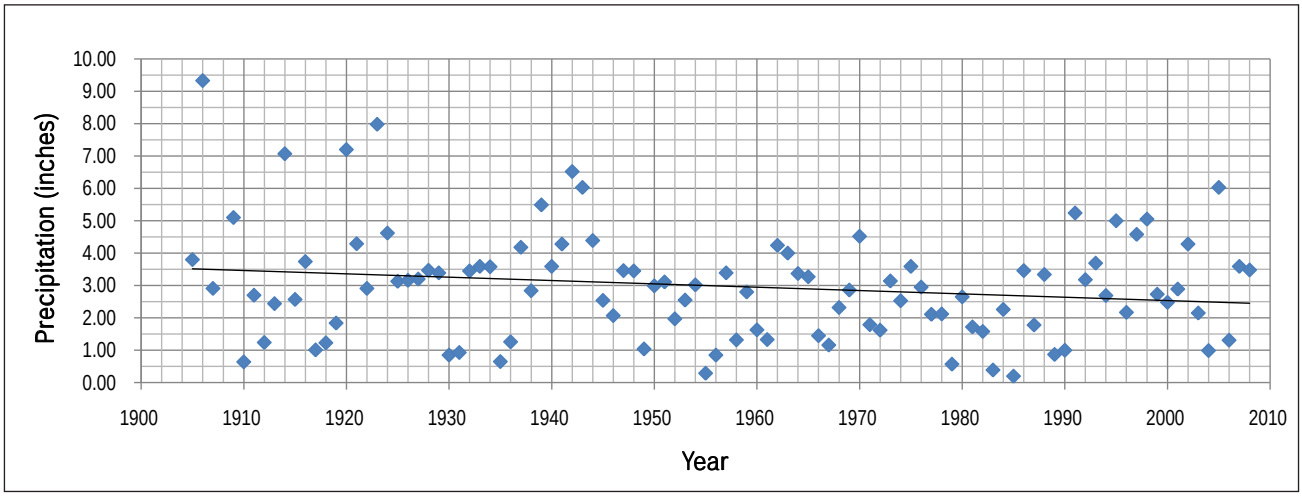

Figure 21. Graph of total June precipitation at Bowdoin National Wildlife Refuge, Montana (1905–2008).

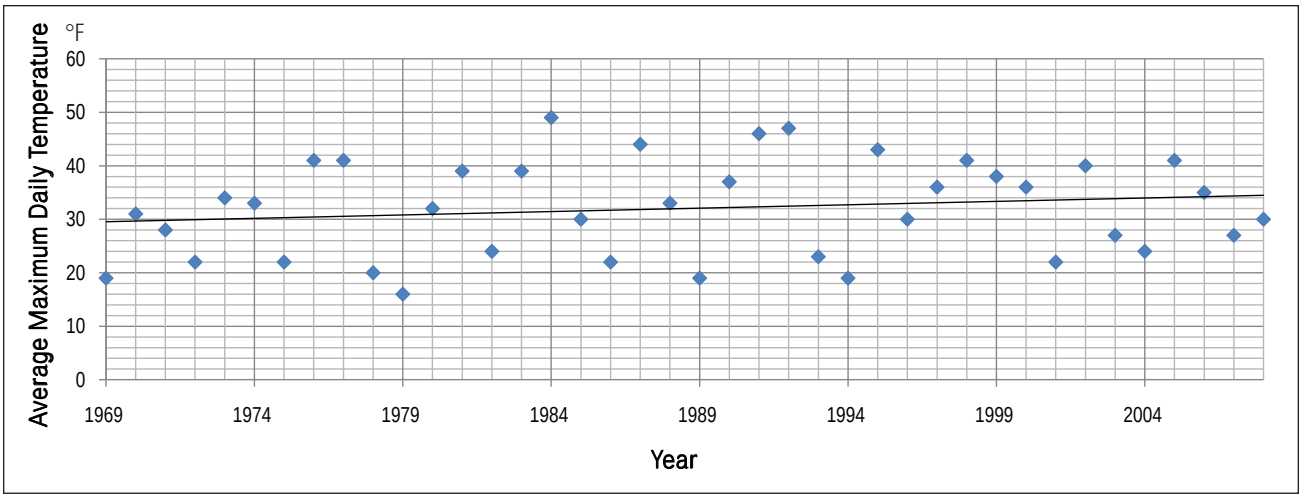

Figure 22. Graph of average maximum daily temperature for February at Bowdoin National Wildlife Refuge, Montana (1969–2008).

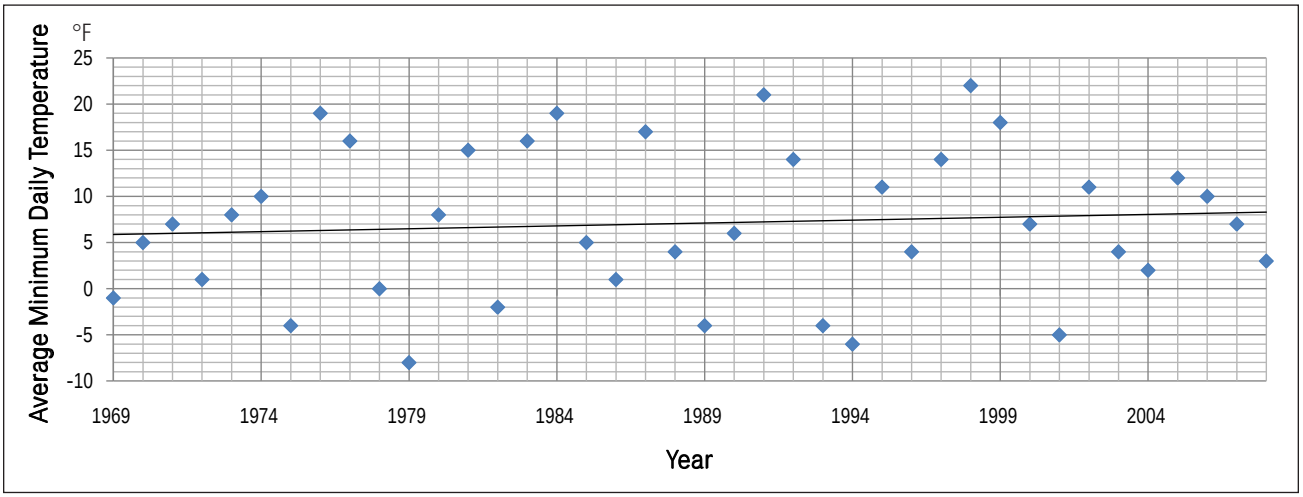

Figure 23. Graph of average minimum daily temperature for February at Bowdoin National Wildlife Refuge, Montana (1969–2008).

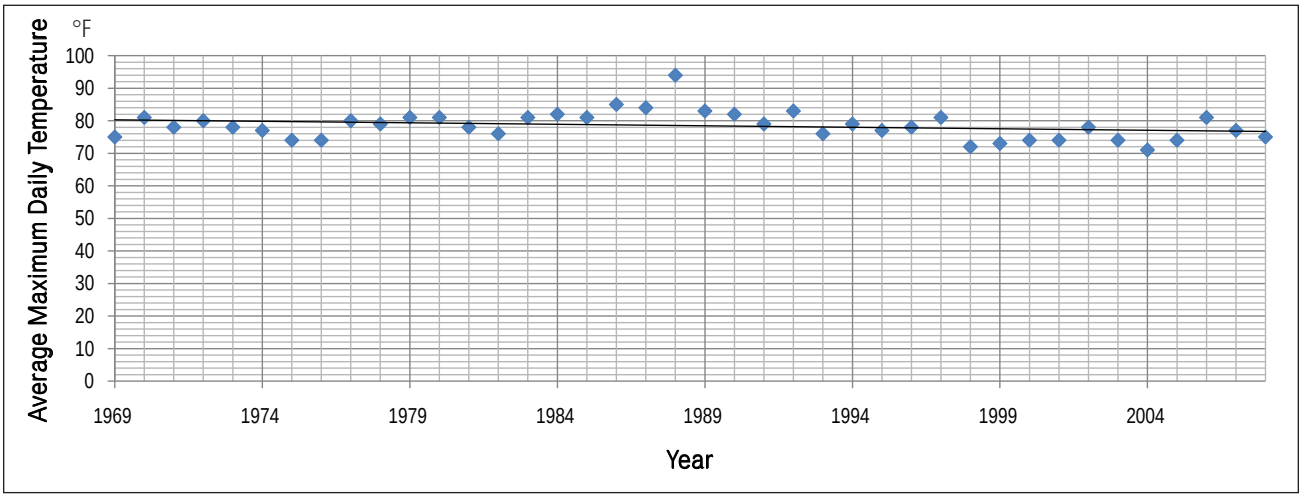

Figure 24. Graph of average maximum daily temperature for June at Bowdoin National Wildlife Refuge, Montana (1969–2008).

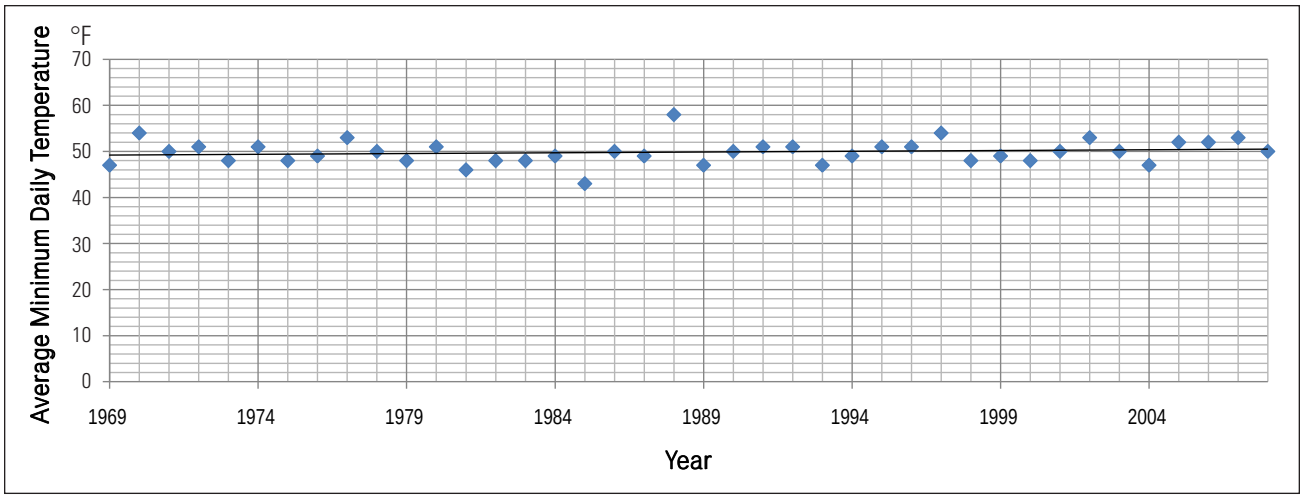

Figure 25. Graph of average minimum daily temperature for June at Bowdoin National Wildlife Refuge, Montana (1969–2008).

Climate Change

The U.S. Department of the Interior issued an order in January 2001 requiring Federal agencies under its direction that have land management responsibilities to consider potential climate change effects as part of long-range planning endeavors. The U.S. Department of Energy's report, Carbon Sequestration Research and Development (1999), concluded that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. The report defines carbon sequestration as "the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere" (1999).

The increase of CO_2 (carbon dioxide) within the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as global warming. In relation to comprehensive conservation planning for Refuge System units, carbon sequestration constitutes the primary, climate-related effect to be considered in planning.

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

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

Climate data for this area does demonstrate a slight reduction in annual precipitation and increases in temperatures over the last 100 years. Although slight, in such an arid climate, this can have a significant effect on water resources, including decreasing the supply of water while demand for water increases. This change in climate could also alter vegetation patterns and species, possibly allowing for additional invasive species to become established. Invasive plants could spread more rapidly and would likely be able to survive the milder climates, thereby outcompeting the native plants.

Stronger and more frequent droughts associated with climate change could cause ducks and other waterfowl to lose breeding and migration habitat. In addition, changes in the timing of migration and nesting could put some birds out of synchronization with the life cycles of their prey. Natural food sources for wildlife, as well as the grain fields on which some migratory birds feed during the fall months, could be reduced or eliminated. Avian botulism outbreaks could be more frequent, and other wildlife diseases may increase.

As surface water supplies might decrease with climate change, the refuge complex could become more dependent on subsurface water sources; this would increase management costs due to the challenges of pursuing ground water that has also been depleted by increased demand. Less ground water recharge, along with a greater demand for human consumption and irrigation, could limit water available for wildlife purposes. There is the potential for managed wetlands dependent on runoff and delivered water to not receive adequate amounts of water for waterbird habitat. Lake Bowdoin might go dry more often and for possibly longer periods of time; as the lake dried, accumulated salts would be

blown away during the hot, dry summers. In addition, there could be the potential for more frequent heavy winds, creating dust storms and wind erosion.

Compatible public use activities may be affected on Service lands due to degraded habitats and less wildlife.

Physiography and Geology

Glaciation has been the predominant factor in the development of the soils and topography of the Prairie Pothole Region. The Bowdoin National Wildlife Refuge Complex area was glaciated about 15,000 years ago, but does not have the abundance of semi-permanent and permanent wetlands found in the glaciated prairie to the east. Bedrock underlying the glacial materials consists of the Claggett Formation, Judith River Formation, and Bearpaw Shale, all of the Cretaceous age. These sedimentary rock formations consist mostly of nearly impermeable marine shale, alternating in places with sandstone beds. Topography of the area is typical of the glaciated plains, with flat to gently rolling terrain and elevations ranging from 2,205 feet to 2,300 feet above sea level.

Soils

A comprehensive soil survey of Bowdoin National Wildlife Refuge was completed in 1966; 11 soil types were identified, and 13 mapping units were delineated. The predominant soils on the refuge are clays and clay-loams. The most common clay-loam associations are Phillips-Elloam, Phillips-Kevin, Arvada-Bone, Scobey-Phillips, and Kevin-Sunburst. Soils are of a fine to loamy texture and have a montmorillonite component that commonly contains a substantial amount of selenium. Soluble calcium and sodium salts are dispersed in much of the profile and also tend to accumulate in subsoil horizons. The soils range from mildly to strongly alkaline.

The Bowdoin Wetland Management District falls primarily within the northern glaciated plains ecoregion. This ecoregion has gently undulating to rolling, continental, glacial till plains formed in the last ice age during the Pleistocene epoch about 15,000–30,000 years ago. The glacial till is largely underlain by Cretaceous shales of marine origin and Lower Tertiary nonmarine sedimentary rocks. Numerous wetlands characteristic of the Prairie Pothole Region of the north-central Great Plains are common throughout the district. Common soil series in the district are Elloam, Scobey, Phillips, and Kevin; these soils are largely deep and well-drained, consisting of glacial till parent material (Natural Resources Conservation Service 2008).

Water Resources

Water resources for Bowdoin National Wildlife Refuge consist of annual precipitation and runoff events, wells, established water rights, Milk River Project irrigation water, irrigation return flows, floodwater from Beaver Creek, and ground water seepage from off-refuge lands. Water resources for the other four refuges and the wetland management district consist of annual precipitation and runoff events, wells, established water rights, Milk River Project irrigation water, Beaver Creek and Milk River floodwaters, and ground water seepage from Nelson Reservoir.

Although spring and summer rains contribute to the water supply, most rain during this period is absorbed in the soil or lost through evapotranspiration. Significant runoff can occur if the soil is frozen or during an extremely heavy rainstorm.

Milk River Watershed

The Bowdoin National Wildlife Refuge Complex lies within the Milk River watershed (figure 26). The watershed originates in Glacier County, covers about 23,800 square miles, and crosses the Canadian border twice. The Milk River flows from the United States through Canada for about 215 miles before reentering the United States about 20 miles upstream of Fresno Reservoir. The watershed is used primarily for the production of livestock, alfalfa, native hay, oats, wheat, and barley.

Bowdoin National Wildlife Refuge lies between two natural tributaries: Milk River to the north and its Beaver Creek tributary to the south (figure 27). The Milk River is a 729-mile-long prairie stream with its headwaters in the Rocky Mountain Front, north of the town of Browning. It flows northward into Alberta, Canada, then curves eastward and south into Montana again, finally meandering its way to the Missouri River near the town of Fort Peck. The Milk River was given its name by Captain Meriwether Lewis of the Lewis and Clark Expedition, who described the river in his journal (DeVoto 1953):

> *"The water of this river possesses a peculiar whiteness, being about the colour of a cup of tea with the admixture of a tablespoonfull of milk. from the colour of its water we called it Milk river."*

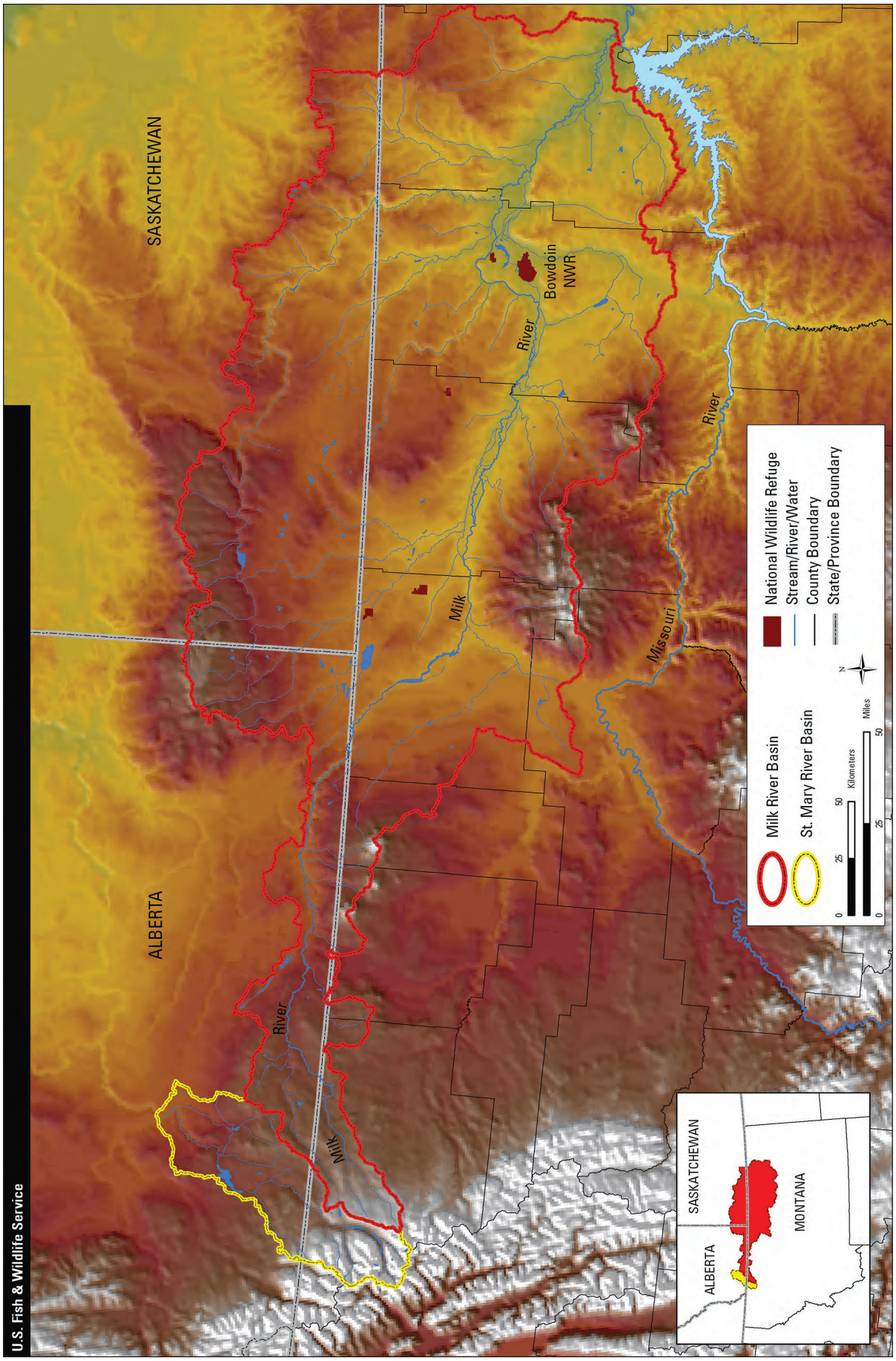

Figure 26. Map of Bowdoin National Wildlife Refuge Complex within the Milk River watershed.

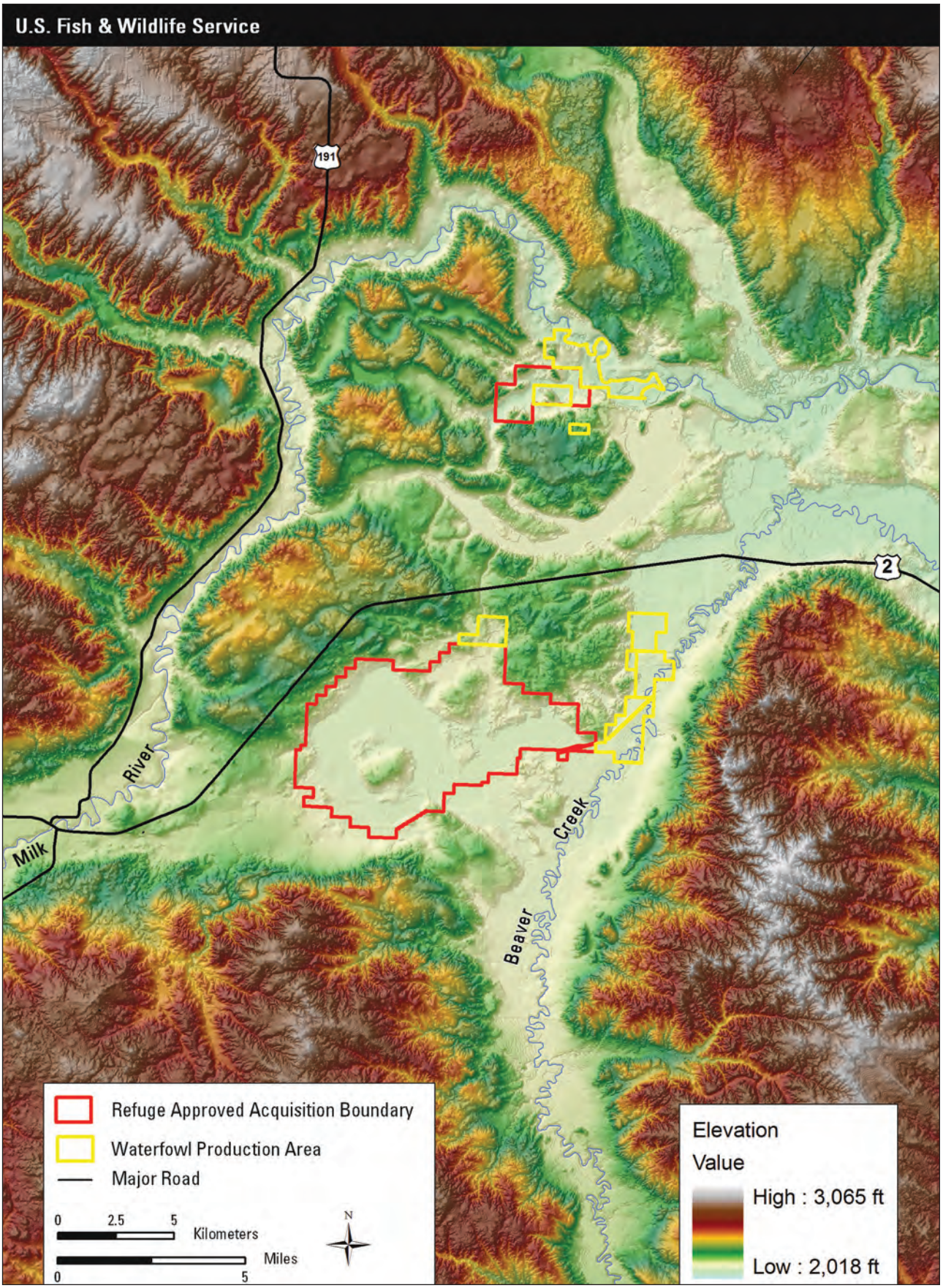

Figure 27. Map of Bowdoin National Wildlife Refuge Complex located between the Milk River and Beaver Creek watersheds.

The river's milky appearance results from fine sediment or glacial till picked up in the lower part of the Milk River watershed.

Beaver Creek is a major right bank tributary of the Milk River. The Beaver Creek rises in the Little Rocky Mountains south of Malta, Montana, between Zortman and Lodgepole. The watershed is 195 miles long and has a drainage area of 2,060 square miles. The area is used primarily for livestock production, and bottomlands are extensively irrigated for the production of hay (U.S. Army Corps of Engineers 1965).

Geologic history indicates that Lake Bowdoin was once an oxbow of the preglacial Missouri River channel. Today, the Missouri River is nearly 70 miles south of Bowdoin Refuge. Historically, Lake Bowdoin acted as a large catch basin for precipitation, Beaver Creek floods, and runoff events. Lake levels fluctuated a great deal from year to year, depending on runoff conditions and evaporation during the hot, dry summers.

The Milk River Project and St. Mary River Facilities

When Bowdoin National Wildlife Refuge was established, it was an overlay on Bureau of Reclamation lands. Before refuge establishment, Lake Bowdoin was managed as a sump for irrigation return flows from the Milk River Project. The Milk River Project, started in 1907, is one of the earliest Reclamation projects developed by the Federal Government (Cosens 2006). The project was designed to provide a reliable source of water for irrigating more than 100,000 acres of lands along the Milk River. Early settlers coming to the arid Milk River watershed had realized that a supplemental source of water would be necessary if they were to produce agricultural products and survive.

The Milk River rises from the plateau region just east of the St. Mary River watershed (figure 27); however, the river is cut off from the mountain water supply by a low divide separating the Milk River and St. Mary River watersheds. The best alternative to provide additional water for the Milk River watershed users was to divert water from the St. Mary River watershed in Glacier National Park by constructing a 29-mile canal and pipeline that emptied into the Milk River. From there, the water flows through Canada for 216 miles before returning to the United States. After reentering the United States, the water flows into two reservoirs where it is stored until needed by downstream irrigators: Fresno Reservoir (104 miles west of Bowdoin Refuge) and Nelson Reservoir (4.5 miles northeast of the refuge). Fresno Reservoir is owned and operated by Reclamation, and Nelson Reservoir is owned by Reclamation but operated by the Malta Irrigation District. The distribution systems are operated by the Malta, Glasgow, and Dodson irrigation districts, in which the refuge complex is located.

Along with irrigation benefits, the Milk River Project provides many recreational and wildlife benefits. Lake Sherburne, in Glacier National Park, is a popular spot for fishing and windsurfing. Boating and water skiing are popular activities at Fresno Reservoir, and fishing and camping are popular activities offered at Nelson Reservoir. Bowdoin National Wildlife Refuge provides protected habitat for migrating, breeding, and feeding migratory birds and other wildlife. In addition, the refuge provides public use activities such as waterfowl and upland game hunting, wildlife viewing and photography, and environmental education and interpretation facilities and programs.

James Graham / USFWS

Ducks abound at Pearce Waterfowl Production Area.

Facilities on the St. Mary River have been in operation for more than 90 years. Most of the structures have exceeded their designed life and are in need of major repairs or replacement. The economy of the Hi-Line Region (the northern tier of Montana counties) has been built around the stable water supply provided by these facilities. Without the needed rehabilitation, this aging system may soon suffer significant failure. Failure of these facilities would have a devastating effect to communities, agriculture, wildlife, and recreational opportunities throughout the Milk River watershed as well as for water-dependent migratory birds and other wildlife on the Bowdoin Refuge.

Wells

Only one well supplies domestic water to all the buildings at the Bowdoin Refuge headquarters. Another operating well supplies water to Display Pond, a wildlife observation area close to the headquarters. In addition, two wind-generated wells on the east end of the refuge have not been used since livestock grazing ended in the 1970s.

Water Quality

A significant amount of water provided to the Bowdoin Refuge and the Pearce WPA originates in the Milk River. The Milk River has good water quality upstream of Havre, Montana. Below Havre, it becomes progressively poorer downstream because of agricultural returns and municipal discharges over the summer (Montana Department of Natural Resources and Conservation 1977). Because the Milk River watershed is underlain by glacial till and shale containing high concentrations of soluble salts, the irrigation return flows and ground water seepage in the watershed are major sources of saline water.

The State water quality classification for the Milk River drainage from the International Boundary with Canada to the Missouri River ranges from B to D: (1) B means water supply for drinking, culinary, and food processing purposes; and (2) waters with a D classification are to be maintained suitable for agricultural purposes and secondary contact recreation (Montana Department of Environmental Quality 2006).

Lake Bowdoin, the primary water feature on Bowdoin Refuge, was first used as a sump by Reclamation after the completion of the Dodson South Canal in 1915 (before refuge establishment). The lake was used to capture irrigation return flows from the Milk River Project and seepage from adjacent irrigation activities. The Dodson South Canal was constructed along the north boundary of what is now Bowdoin National Wildlife Refuge. The canal conveys water from the Milk River at Dodson Dam for irrigated lands upstream of the refuge and transfers water to Nelson Reservoir for storage. This canal also conveys Milk River water to Bowdoin Refuge, but this water use is secondary to irrigation needs. The canal intercepts much of the local runoff, which limits the amount of water that would otherwise naturally flow into the refuge's lakes and wetlands. This canal water is normally higher in dissolved solids (salts) than seepage, which flows downhill through the naturally saline soils toward Lake Bowdoin. Over the years, large saline seeps have developed between the lake and the canal due to increased water infiltration rates and ground water seepage from agricultural lands north of the refuge. Rain and runoff events wash these deposits into the lake.

Saline lakes occur naturally throughout the western half of North America (Langbein 1961); however, geothermal energy development, irrigation return flows, and alterations in the hydrology of natural lake systems can unnaturally increase salts even in lakes that are not naturally saline. Hydrologic barriers such as roadbed construction can disrupt the natural flow and mixing, causing a lake to function as a hydrologic sump and concentrating salts at abnormal levels (Swanson et al. 1984).

The influx of saline water into Lake Bowdoin, combined with evapoconcentration (the concentration of chemical constituents in a liquid due to evaporative processes), has caused salt concentrations in the lake to increase exponentially (Kendy 1999). The total dissolved solids (salts) for Lake Bowdoin in September 2009 were about 10,500 mg/L (milligrams of salt per liter), which places the lake in the subsaline category (Gleason et al. 2009). In most years, surface water does not flow out of Lake Bowdoin because of a limited water supply.

Water quality in and near Bowdoin Refuge is monitored annually at 19 surface sites and 14 shallow, ground water wells. Sixteen additional surface sites off the refuge and 18 wells along the Dodson South Canal are also monitored (refer to figure 29 in chapter 6). Water-quality monitoring begins in the spring when the ice thaws and ends in the fall when the water freezes. All sites are tested every 2 weeks for temperature, specific conductance, pH, and depth. Specific conductance is a measure of how well water can conduct an electrical current. This can be used to determine the presence of dissolved solids such as phosphate, magnesium, calcium, and sodium.

Past water management at Bowdoin National Wildlife Refuge was aimed at maintaining high water levels in all refuge wetlands. Due to an inadequate water supply, this philosophy did not provide for periodic drawdowns and flushing, except during the infrequent flooding by Beaver Creek. The long-

term effect has been increased salinity, as measured by specific conductance, in not only Lake Bowdoin but in Dry Lake and Drumbo Pond.

Historically, the only means to remove these excessive concentrations of salts from lakes and wetlands was after a runoff and or flood event. The excess water would drain away, and much of the remaining water would be lost to evaporation over the summer months and leave behind dissolved salts. These salts were naturally blown away by strong winds or partially flushed out of the lakes during the next heavy runoff or flood event.

Construction of water facilities during the 1980s significantly improved water management capabilities on Bowdoin Refuge. Present Service management emphasizes maintenance of freshwater conditions in smaller wetland units such as Lakeside, Lakeside Extension, Bootleg Marsh, Teal Ponds, and Farm Ponds. These wetlands and ponds are managed to mimic natural wetlands, allowing periodic drawdowns or dry periods. Current management also focuses on how to reduce salinity levels in Lake Bowdoin, Dry Lake Pond, Dry Lake, and Drumbo Pond to address the effects on wildlife and neighboring landowners.

The Service is trying to better understand how to use additional water supplies, when available, for effective dilution and flushing. Subsequently, the Service and the Montana Reserved Water Rights Compact Commission have spent more than 2 years evaluating methods to improve the water quality on Bowdoin Refuge. This salinity team has developed five proposals, or alternatives, for addressing the increasing salinity levels. This analysis and proposed actions are summarized in chapter 6.

Water Supply and Rights

Water supply and rights are described in this section for the units of the Bowdoin National Wildlife Refuge Complex.

Bowdoin National Wildlife Refuge. Bowdoin Refuge has a complex system of dikes, canals, and water control structures for moving water between water units and for handling floodwaters entering from Beaver Creek (figure 29 in chapter 6 shows the location of this infrastructure and the refuge wetlands). The Montana Water Court has identified the Beaver Creek watershed as basin 40M. Water right filings for Bowdoin Refuge (table 6) have a complicated history, involving agreements and coordination with Reclamation during construction of the Milk River Project. In the 1930s, the Service was able to negotiate an agreement with Reclamation for a perpetual delivery of its water right in return for the Service contributing $40,000 toward the construction of the Fresno Reservoir near Havre, Montana. During years the Milk River has normal runoff, Reclamation will furnish a maximum of 3,500 acre-feet of water to the refuge each calendar year for improvement and maintenance of the refuge. If runoff is below normal, the refuge is to receive that portion of 3,500 acre-feet that natural conditions and Federal Reclamation Law permits.

In the past, the refuge has been able to obtain water in excess of 3,500 acre-feet through deliveries of water using the Malta Irrigation District facilities. This has averaged 4,877 acre-feet, when considering all recorded deliveries. The Service has had to pay a delivery fee to the irrigation district for this extra water. Based on the maximum delivery of water from the Milk River on record—11,540 acre-feet—the Service filed a historical use claim of 8,000 acre-feet at a delivery rate of 280 cubic feet per second.

Receiving this additional water was has been critical to the management of the refuge's wetland habitats. Nevertheless, in many years there is insufficient delivered water and runoff necessary to fill and manage all wetlands within the refuge.

For additional information on the water supply and rights for Bowdoin Refuge, refer to "Chapter 6–Analysis of Salinity."

Bowdoin Wetland Management District. All waterfowl production areas except Webb WPA have recorded water rights (table 7). Sources for these rights include ground water wells, overland runoff, pumping from named watercourses, and created diversions. The Service uses these water rights to flood several wetland units on the waterfowl production areas to provide migration and brood habitat for migratory birds. Pearce WPA, located just downstream of Bowdoin Refuge on the Dodson South Canal, has a water right through Reclamation. When the Pearce WPA was purchased in 1976, the Service assumed responsibility of the contract for water that was previously held between the landowner and Reclamation; the contract was established in 1961 when the landowner requested water from the Milk River Project. The contract was for the irrigation of 50 acres of land and 100 acre-feet of water per full irrigation season. Reclamation granted the permanent contract with the requirement that the landowner pay a share of the construction cost of the irrigation project; semiannual payments would be made against the $2,500 construction liability. The contract was amended in 1969, which reduced the construction repayment cost to $1,941 and set the semiannual payment amount at $23.03. When the Service acquired the property and assumed responsibility of the contract, there were 27 years left on the payment schedule; the construction payment was paid in full in 2003.

The Service still pays an annual operation and maintenance charge for the water and will con-

Table 6. Water rights for Bowdoin National Wildlife Refuge, Phillips County, Montana.

Owner	*Water right number*	*Source name / type*	*Priority date*	*Water right type*	*Purpose*	*Maximum flow rate*[2]	*Maximum volume (acre-feet)*	*Current capacity (acre-feet)*	*Surface area (acres)*	*Period of use*	*Reservoir*	*Ditch name*
Bureau of Reclamation	40J–40937–00	Milk River / Surface water	11/02/1903	Statement of claim	Fish and wildlife	600 cfs	3,500	—	—	Mar. 1 to Nov. 15	—	Dodson South Canal
Fish and Wildlife Service	40J–189872–00	Milk River / Surface water	03/09/1937	Statement of claim	Fish and wildlife	280 cfs	8,000	24,100	6,765	Jan. 1 to Dec. 31	Lake Bowdoin Drumbo Pond Lakeside Dry Lake	Dodson South Canal
Fish and Wildlife Service	40M–187361–00	Beaver Creek / Surface water	11/12/1940	Compact[1]	Fish and wildlife	—	24,714	24,714	6,769	—	Lake Bowdoin Drumbo Pond Lake Pond Dry Lake Pond	—
Fish and Wildlife Service	40M–187362–00	Black Coulee / Surface water	11/12/1940	Reserved claim	Fish and wildlife	—	—	—	—	Jan. 1 to Dec. 31	—	—
Fish and Wildlife Service	40M–187363–00	Spring, Unnamed tributary of Beaver Creek / Ground water	11/12/1940	Compact	Fish and wildlife	—	1	1	0.3	Jan. 1 to Dec. 31	—	—
Fish and Wildlife Service	40M–187364–00	Ground water	11/12/1940	Compact	Wildlife	20 gpm	1.39	—	—	Mar. 1 to Nov. 19	—	—
Fish and Wildlife Service	40M–187365–00	Ground water	11/12/1940	Compact	Wildlife	5 gpm	0.31	—	—	Mar. 1 to Nov. 19	—	—
Fish and Wildlife Service	40M–189874–00	Ground water	11/12/1940	Compact	Institutional	30 gpm	2	—	—	Jan. 1 to Dec. 31	—	—
Fish and Wildlife Service	40M–25539–00	Ground water	11/12/1940	Compact	Domestic	55 gpm	4	—	—	Jan. 1 to Dec. 31	—	—

[1]*Compact (memorandum of agreement) with Montana Reserved Water Rights Compact Commission.*
[2]*Maximum flow measured in cfs=cubic feet per second; gpm=gallons per minute.*

Table 7. Water rights for the waterfowl production areas and satellite refuges of Bowdoin National Wildlife Refuge Complex, Montana.

Refuge complex unit[1]	*County*	*Water right number*	*Source name*	*Priority date*	*Water right type*	*Purpose*	*Maximum flow rate*[2]	*Maximum volume*	*Current capacity (acre-feet)*	*Surface area (acres)*	*Period of use*	*Reservoir*	*Maximum acres*
Beaver Creek WPA	Phillips	40M–5987–00	Beaver Creek	09/08/1900	Statement of claim	Irrigation	14.26 cfs	—	—	—	Feb. 1 to Sep. 30	—	500
	Phillips	40M–22930–00	Unnamed tributary of Beaver Creek	09/08/1900	Statement of claim	Irrigation	20.83 cfs	—	—	—	Mar. 25 to Sep. 30	—	180
	Phillips	40M–169663–00	Beaver Creek	09/08/1900	Statement of claim	Irrigation	20.05 cfs	—	—	—	Apr. 15 to Sep. 30	—	303
	Phillips	40M–22928–00	Unnamed tributary of Beaver Creek	07/11/1903	Statement of claim	Irrigation	—	528 acre-feet	—	—	—	—	264
	Phillips	40M–19581–00	Spring, Unnamed tributary of Beaver Creek	12/31/1930	Statement of claim	Stock	—	30 gallons/day/ animal unit	—	—	Jan. 1 to Dec. 31	—	—
Dyrdahl WPA	Phillips	40J–167498–00	Natural pit, Unnamed tributary of interior drainage	12/31/1911	Statement of claim	Stock	—	24 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40K–167499–00	Surface water	12/31/1911	Statement of claim	Stock	—	30 gallons/day/ animal unit	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167505–00	Unnamed tributary of interior drainage	01/30/1923	Statement of claim	Irrigation	—	4.8 acre-feet	—	—	Jan. 1 to Dec. 31	On-stream	—
	Phillips	40J–167516–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock	—	14.4 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167517–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock	—	1.5 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167518–00	Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock	—	4.8 acre-feet	—	—	Jan. 1 to Dec. 31	On-stream	—
	Phillips	40J–167519–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock	—	8.76 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167521–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock	—	28.64 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167506–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	15.6 acre-feet	—	—	Jan. 1 to Dec. 31	—	—

[1]WPA=*waterfowl production area;* NWR=*national wildlife refuge.*
[2]*Maximum flow measured in cfs=cubic feet per second; gpm=gallons per minute.*
[3]*Compact (memorandum of agreement) with Montana Reserved Water Rights Compact Commission.*

Table 7. Water rights for the waterfowl production areas and satellite refuges of Bowdoin National Wildlife Refuge Complex, Montana.

Refuge complex unit[1]	*County*	*Water right number*	*Source name*	*Priority date*	*Water right type*	*Purpose*	*Maximum flow rate*[2]	*Maximum volume*	*Current capacity (acre-feet)*	*Surface area (acres)*	*Period of use*	*Reservoir*	*Maximum acres*
Dyrdahl WPA (continued)	Phillips	40J–167507–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	12 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167508–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	2.4 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167509–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	8.4 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167510–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	3.6 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167511–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	8.4 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167512–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	3 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167513–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock	—	14 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40K–167497–00	Unnamed tributary of closed basin	05/10/1940	Statement of claim	Stock	—	4 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167504–00	Natural pit, Unnamed tributary of interior drainage	12/31/1945	Statement of claim	Stock	—	2.88 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–167522–00	Ground water	06/05/1964	Statement of claim	Stock	6 gpm	—	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–34882–00	Ground water	08/23/1981	Ground water certificate	Stock	40 gpm	3.98 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
	Phillips	40J–47460–00	Ground water	12/07/1981	Ground water certificate	Domestic and Stock	35 gpm	3.95 acre-feet	—	—	Jan. 1 to Dec. 31	—	—
Holm WPA	Blaine	40J 183201 00	Unnamed tributary of Hay Coulee	03/06/1942	Statement of claim	Stock	—	236 acre-feet	—	—	Jan. 1 to Dec. 31	Hom #1 Hom #2	—

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[2]*Maximum flow measured in cfs=cubic feet per second; gpm=gallons per minute.*
[3]*Compact (memorandum of agreement) with Montana Reserved Water Rights Compact Commission.*

Table 7. Water rights for the waterfowl production areas and satellite refuges of Bowdoin National Wildlife Refuge Complex, Montana.

Refuge complex unit[1]	*County*	*Water right number*	*Source name*	*Priority date*	*Water right type*	*Purpose*	*Maximum flow rate*[2]	*Maximum volume*	*Current capacity (acre-feet)*	*Surface area (acres)*	*Period of use*	*Reservoir*	*Maximum acres*
Korsbeck WPA	Phillips	40J–43760–00	Unnamed tributary of interior drainage	12/31/1905	Statement of claim	Stock	—	10 acre-feet	—	—	Jan. 1 to Dec. 31	On-stream	—
	Phillips	40J–43936–00	Constructed pit, Unnamed tributary of West Alkali Creek	12/31/1945	Statement of claim	Stock	—	1 acre-foot	—	—	Jan. 1 to Dec. 31	On-stream	—
	Phillips	40J–43940–00	Constructed pit, Unnamed tributary of West Alkali Creek	12/31/1954	Statement of claim	Stock	—	1 acre-foot	—	—	Jan. 1 to Dec. 31	On-stream	—
	Phillips	40J–102275–00	Ground water	10/06/1958	Statement of claim	Stock	6 gpm	—	—	—	Jan. 1 to Dec. 31	—	—
McNeil Slough WPA	Phillips	40J–163022–00	Unnamed tributary of Milk River	06/21/1930	Statement of claim	Wetlands	2,500 gpm	—	—	—	Apr. 15 to Sep. 30	McNeil Slough	159
Pearce WPA	Phillips	14–06–600–59081	—	10/17/1961	Statement of claim	—	—	100 acre-feet	—	—	—	Irrigation canal	—
Black Coulee NWR	Blaine	Compact[3]	Black Coulee	—	Compact[3]	—	—	—	—	—	—	—	—
Creedman Coulee NWR	Hill	40J–183197–00	Creedman Coulee	05/25/1937	Statement of claim	Fish and wildlife	—	862 acre-feet	—	—	Jan. 1 to Dec. 31	Creedman Reservoir	—
Hewitt Lake NWR	Phillips	40J–183198–00	Unnamed Tributary to Spring Coulee	07/16/1902	Statement of claim	Fish and wildlife	—	2,311 acre-feet	—	—	Jan. 1 to Dec. 31	Hewitt Reservoir	—
Lake Thibadeau NWR	Hill	40J–187366–00	Unnamed Tributary to Redrock Coulee	10/25/1937	Statement of claim	Fish and wildlife	—	6,129 acre-feet	4,431	470	Jan. 1 to Dec. 31	Grassy Lake, Lake Thibadeau	—
	Hill	40J–187367–00	Lohman Coulee	10/25/1937	Statement of claim	Fish and wildlife	150 cfs	6,550 acre-feet	4,742	516	Jan. 1 to Dec. 31	Grassy Lake, Lake Thibadeau, On-stream	—
	Hill	40J–188170–00	Martin Coulee	10/25/1937	Statement of claim	Fish and wildlife	—	2,323 acre-feet	1,177	240	Jan. 1 to Dec. 31	Grassy Lake	—

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[2]*Maximum flow measured in cfs=cubic feet per second; gpm=gallons per minute.*
[3]*Compact (memorandum of agreement) with Montana Reserved Water Rights Compact Commission.*

tinue to do so in perpetuity or until the contract is amended.

Satellite Refuges. The four satellite refuges in the refuge complex all have recorded water rights (see table 7). Each refuge has a dam built by the Government in the 1930s that impounds water, primarily on private land, for the purposes of water conservation, drought relief, and migratory bird and wildlife conservation. The Government obtained perpetual flowage easements from the original landowners; these easements grant the Service the right to manage the uses of structures and associated impoundments, lakes, streams, and rivers within easement boundaries. The flowage easements did not grant any rights for management or protection of other natural, shallow depressions except for control of hunting.

Air Quality

Air quality is a global concern. The U.S. Environmental Protection Agency has lead responsibility for the quality of air in the United States; through the 1990 Clean Air Act, the agency sets limits on the amount of pollutants that can be discharged into the air. More than 170 million tons of pollution is emitted annually into the air within the United States, through either stationary sources (such as industrial and power plants) or mobile sources (such as automobiles, airplanes, trucks, buses, and trains). There are also natural sources of air pollution such as fires, dust storms, volcanic activity, and other natural processes. The U.S. Environmental Protection Agency has identified six principal pollutants that are the focus of its national regulatory program: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.

Air quality problems in Montana are usually related to more urban areas and mountains or river valleys that are sensitive to temperature inversions. Carbon monoxide and particulate matter are the air pollutants that have the greatest adverse effect on Montana's air quality. Particulate matter is tiny liquid or solid particles in the air that are able to be breathed in through the lungs.

In the area of the refuge complex, air quality is considered to be exceptionally good; there are no nearby manufacturing sites or major sources of air pollution. At Bowdoin Refuge, however, salts on the east end of the refuge are sometimes blown into the air during high wind events. As water evaporates from Lake Bowdoin throughout the summer, the shoreline is left with the solids or salts that can be carried away by high winds. Most of the blowing salts historically came from Dry Lake after water transferred from Lake Bowdoin to create shallow wetlands for ducks and shorebirds would eventually evaporate and leave large concentrations of dried salts. In the past 10 years, no water has been transferred from Lake Bowdoin, and Dry Lake has remained dry except for some occasional, natural runoff. Any remaining salts in Dry Lake from past management activities are gone. Furthermore, much of Dry Lake has become vegetated, which has reduced the ability of salts to become airborne.

The refuge complex periodically uses prescribed fire to manage habitat and control invasive and nonnative species. Both prescribed fires and wildfires produce numerous gasses and particulate matter that affect air quality. Prescribed fires are conducted under strict smoke and air regulations as established by the Montana and Idaho Airshed Group—all prescribed fires conducted on the refuge complex have met permitted requirements. The Service is assessed an annual fee based on the previous year's tons of particulate matter produced from prescribed burning on a statewide basis. Each year, the refuge complex's fire management officer applies for and submits payment to DEQ (Montana Department of Environmental Quality).

4.2 Biological Resources

The following sections describe the biological resources that may be affected by the implementation of the CCP. The biological features detailed below are vegetative habitat types and the associated birds, mammals, amphibians, reptiles, fishes, and insects. The quality of these habitats varies throughout the refuge complex particularly due to water quality and quantity, the presence of invasive and nonnative species, impacts from surrounding land uses, and the Service's ability to properly manage and protect a particular area.

The major habitat types that occur on the refuge complex follow:

- *Uplands*—vast expanses comprised primarily of mixed-grass prairie and disturbed grasslands, including dense nesting cover

- *Wetlands*—natural and enhanced freshwater and saline wetlands and associated riparian areas, lakes, rivers, and ponds

Unless otherwise noted, most of the following information is from unpublished Service data located in files at the refuge complex headquarters.

Al Schneider / USDA–NRCS PLANTS Database

Blue grama is a common prairie grass.

Larry Allain / USDA–NRCS PLANTS Database

Fringed sagewort is one of the many forbs on the Bowdoin Refuge Complex.

Uplands

At least 50 percent of native grassland habitat has been converted to other uses in Montana's Prairie Pothole Region (Ducks Unlimited 2003). However, large, intact, native prairie communities can still be found throughout the Bowdoin Refuge Complex, with more than 10,400 acres of fee-title lands in the refuge complex in native prairie. In addition, grassland conservation easements on private lands are protecting almost 40,000 acres of native prairie and tamegrasses.

Native prairie is defined as areas of previously unbroken, unfarmed (virgin) sod where the soil composition is generally intact. Grasses in the prairie found in this area are a mixture of western wheatgrass, needlegrasses, blue grama, and upland sedges. Interspersed within the grasses are numerous species of forbs such as fringed sagewort, scarlet globemallow, coneflowers, and yarrow. Shrubs include winterfat, silver sage, and greasewood. In addition, clubmoss and prickly pear cactus are common.

While clubmoss is a natural component of native uplands, overgrazing, drought, and lack of fire have allowed it to increase as herbaceous cover decreased. It has been theorized that clubmoss outcompetes other vegetation by forming dense mats that intercept water and prevent seed germination (Majorowicz 1963, Heady 1952). Other studies have rejected these hypotheses and suggest that clubmoss does not affect water use by other plants (Colberg and Romo 2003) and that seed germination is more affected by the species of seeds in the seed banks (Romo and Bai 2004). Clubmoss may also reduce runoff, increase water infiltration, and prevent invasive plants from becoming established in native grasslands that have been stressed by past overgrazing or drought.

In presettlement times, the frequency of wildfire across the northern Great Plains was highly variable depending on climate and soil type (Higgins 1986, Umbanhowar 1996). Other factors such as moisture, plant species composition, topography, and grazing by native animals also played a role in fire frequency, intensity, and duration (Askins et al. 2007, Madden et al. 2000). Fire-return intervals of 5–10 years have been estimated for the northern Great Plains (Frost 1998), and intervals averaging 6 years have been reported for studies in North Dakota (Madden et al. 1999). However, very little research has been conducted regarding fire in the drier prairies of north-central Montana. Askins et al. (2007) suggest that grazing and a lack of moisture maintained grass as the dominant vegetation with fire playing a lesser role and estimated a fire-return interval of 10–26

years for Montana. Historically, wildfires on the refuge complex were suppressed and prescribed fire was used sporadically. Since 2001, the Service has made a concerted effort to restore wildland fire to this prairie system, burning more than 13,000 acres throughout the refuge complex. Burning stimulates plant growth, returns nutrients to the soil, reduces residual cover, scarifies native seed, can reduce or increase competition from invasive plants, and restores upright structure. Following a prescribed fire, a more diverse native plant community returns, providing nesting and feeding habitat for migratory birds and other wildlife. To create a mosaic of habitat across the landscape, the Service staggers these prescribed fires, burning only 5–10 percent of the burnable acres in a single year.

Vast herds of bison once roamed throughout this area of north-central Montana. When the bison were eliminated, domestic cattle were brought to graze this expansive grassland habitat. The uplands may have been grazed even more heavily by livestock than other parts of the refuge complex because of the reliable water source in Lake Bowdoin. When Bowdoin Refuge was established in 1936, domestic cattle grazing went through several periods of use and nonuse until it was phased out between 1973 and 1977. In 2001, the Service began a prescriptive cattle grazing program throughout to meet specific objectives for enhancing native grasslands and treating invasive plants.

Since the refuge complex was established, the Service has planted 4,477 acres of uplands to various grass species to create dense nesting cover. All of the 4,008 acres on the waterfowl production areas were prior cropland and 469 acres of native prairie on the Bowdoin Refuge were broken (tilled) to plant DNC. These areas are referred to as disturbed grasslands. All of the disturbed grasslands on the waterfowl production areas were once farmed; shortly after Service acquisition, these acres were seeded to herbaceous cover consisting of a cool-season vegetation mix of wheatgrasses and legumes. The predominant grass species used were intermediate wheatgrass, tall wheatgrass, slender wheatgrass, pubescent wheatgrass, and western wheatgrass; the legumes were alfalfa and sweetclover. These species, commonly referred to as dense nesting cover, were chosen based on research that showed they are highly attractive and beneficial to waterfowl (Duebbert 1969). The remaining 469 acres of disturbed grasslands, located on Bowdoin National Wildlife Refuge, were planted into broken native prairie in the 1970s specifically to provide ducks a denser nesting cover than the surrounding upland. Rationale for this type of management action was likely based on research conducted in the late 1960s and 1970s, which indicated ducks were experiencing higher nesting success in DNC than in surrounding upland habitats (Duebbert 1969, Duebbert and Lokemoen 1976, Kaiser et al. 1979). Many of the DNC fields are in poor condition with respect to plant diversity. The lifespan of a DNC seeding is about 15 years (Higgins and Barker 1982, Lokemoen 1984), and most of the DNC fields on the refuge complex are well past this lifespan.

Invasive and Nonnative Species in Uplands

Although most of the native prairie is free from invasive and nonnative plants, there is some encroachment of crested wheatgrass, Russian olive, and Japanese brome. Leafy spurge, spotted knapweed, and Canada thistle can be found in disturbed uplands including along roadsides and railroad tracks.

Crested Wheatgrass. Crested wheatgrass has been the most commonly planted exotic grass in western North America since the early 1900s. Invasion of this species into native rangeland can have a negative effect on plant and wildlife diversity (Reynolds and Trost 1981, Christian and Wilson 1999, Davis and Duncan 1999). When it invades native prairie, crested wheatgrass often eliminates its native competitors and can form vast monocultures that create ecological traps for nesting grassland birds (Lloyd 2005). According to Lloyd (2005), nests in native

Cassondra Skinner / USDA–NRCS PLANTS Database

Crested wheatgrass is a nonnative species that can have a negative effect on plant and wildlife diversity.

prairie were depredated 17 percent less often than nests in a field of crested wheatgrass. Survey data for grassland birds nesting on Bowdoin Refuge indicates fewer nests in the crested wheatgrass areas adjacent to the native grassland fields. Crested wheatgrass was used to landscape areas around the refuge headquarters area in the 1930s and to replace the small plots of wildlife food crops on the west end of the Bowdoin Refuge as they were phased out. Throughout the refuge complex, scattered monocultures of crested wheatgrass are slowly spreading and are overtaking native grasslands. It is difficult to effectively treat and eradicate this invasive grass.

Russian Olive. This species is adaptable in semiarid and saline environments and has been promoted as a source of food and cover for some wildlife species (Natural Resources Conservation Service 2002), particularly ring-necked pheasant. With this in mind, refuge staff planted Russian olive trees on Bowdoin National Wildlife Refuge in the 1950s until the 1970s. The trees were allowed to spread, because the biological opinion at the time was that Russian olive trees played a very beneficial role to the landscape and to wildlife. Over the years, the trees have encroached into native prairie, fragmenting grassland habitats throughout the refuge complex, but particularly on Bowdoin Refuge. This fragmentation causes avoidance of these areas by some nesting grassland birds and increased predation of nests, adults, and juvenile grassland-dependent birds (Delisle and Savidge 1996, Gazda et al. 2002, Helzer 1996, Johnson and Temple 1990). In Bowdoin Wetland Management District, Pearce WPA has the greatest infestation of Russian olive trees; the McNeil Slough, Beaver Creek, and Korsbeck WPAs have a few Russian olive trees as well. The greatest infestation of Russian olive is on Bowdoin Refuge, which has more than 140 acres of this species scattered throughout the refuge. The eastern end of the refuge has relatively pristine, native prairie, and Russian olive trees were encroaching into this area. Control of Russian olive on the refuge began in 2000 with tree cutting and treating the stumps with an herbicide (Arsenal® or Garlon® 3A); in some treated areas, the remaining tree stumps sprouted and readily propagated, becoming difficult for the refuge staff to control. The Service began by removing these single, scattered trees, and then turned its attention to larger, older infestations. Inefficient control methods combined with a lack of staff has slowed progress in reducing the infestation.

Japanese Brome. This grass has been present in the refuge complex for many years with almost no attention given to estimating the size of the infestations or treating them.

Leafy Spurge. Leafy spurge was first discovered growing on Bowdoin National Wildlife Refuge during the summer of 1989. There is a 0.7-acre patch on both sides of the railroad tracks on Big Island that has been treated with mowing and spraying since it was discovered. McNeil Slough WPA was infested with leafy spurge when it was purchased in 1991; the infestation is extensive but sparse and has been treated sporadically with spraying. In 1996, about 2,000 *Aphthona lacertosa* flea beetles were released in this infestation at McNeil Slough WPA, with no apparent effect. There was a small patch (25 feet square) discovered in 2004 at Korsbeck WPA, which has been treated annually with chemicals.

Spotted Knapweed. In 2004, a few spotted knapweed plants were discovered along the auto tour road to the main boat ramp near the Bowdoin Refuge office. The infestation has been treated by pulling and spraying.

Elaine Haug / USDA–NRCS PLANTS Database

Spotted Knapweed

Canada Thistle. Canada thistle has been prevalent for many years on Bowdoin Refuge, Pearce WPA, and McNeil WPA; thistle patches are found near many roads and other disturbed areas. Some dense stands have been treated with success, but most areas go untreated.

Yellow Toadflax. On Bowdoin Refuge, a small stand of yellow toadflax was discovered growing along the railroad tracks on Big Island (near the leafy spurge patch) in 1993 and has been hand-pulled sporadically over the years.

Upland-Associated Wildlife

There are 119 species of birds that have been documented breeding and nesting on the refuge complex. About 29 species use upland habitats, particularly native grassland, for nesting. From 1995 to 2008, the most abundant breeding and nesting passerines using the native grasslands were chestnut-collared longspur, Savannah sparrow, grasshopper sparrow, Baird's sparrow, Sprague's pipit, and western meadowlark. Also documented were clay-colored sparrow, lark bunting, and vesper sparrow.

The importance of this area to breeding and migrating waterfowl and shorebirds has long been recognized, serving as a catalyst for establishment of Bowdoin National Wildlife Refuge and the remaining refuge complex. The most common upland-nesting ducks are mallard, gadwall, northern pintail, northern shoveler, and blue-winged teal. Several upland-nesting shorebirds are also found in native prairie habitats including marbled godwit, willet, upland sandpiper, long-billed curlew, and Wilson's phalarope.

Sharp-tailed grouse are one of the few native prairie birds that are year-round residents. During the early 1980s, Bowdoin Refuge had up to seven leks that were used each spring by 50–100 sharp-tailed grouse. The number of leks and birds per lek have decreased dramatically since that time. By 1999, there was only one active lek on the refuge and it had less than 20 birds. Despite this decline on the refuge, sharp-tailed grouse are observed on lands around the refuge throughout the year; many of these grouse move onto Bowdoin Refuge in the fall and stay through the winter months. It is not clear why the birds stopped using the refuge for displaying, breeding, and nesting purposes.

Although not abundant, sage-grouse, a federal candidate species, has been documented on Beaver Creek, McNeil Slough, Hewitt Lake, and Korsbeck WPAs. Other bird species include raptors such as northern harrier, ferruginous hawk, burrowing owl, and short-eared owl, which are commonly seen hunting or nesting in the uplands. The nonnative ring-necked pheasant is also common on most of the refuge complex. Introduced to the area in the 1930s primarily for hunting, pheasant have become a permanent part of the upland wildlife, nesting and feeding in grassland habitat.

Native grazers such as pronghorn, white-tailed deer, and mule deer browse and graze the uplands. Some of the other mammals found in native grasslands on the refuge complex are coyote, white-tailed jackrabbit, badger, and Richardson's ground squirrel. In 2000, a small mammal-trapping study on Bowdoin Refuge found deer mouse, meadow vole, western harvest mouse, house mouse, and least weasel. Other species observed included masked shrew, northern pocket gopher, white-footed mouse, and western jumping mouse.

There have been no formal amphibian or reptile surveys on the refuge complex. Some of the documented reptiles are gopher snake, prairie rattlesnake, yellow-bellied racer, plains garter snake, and common garter snake.

The diversity of insects in the refuge complex has not been quantified, but prairie and tame grassland produce large numbers of grasshoppers, leafhoppers, butterflies, beetles, and spiders.

Target Upland Birds

The Service has identified a diverse group of target bird species for uplands in the refuge complex: Baird's sparrow, chestnut-collared longspur, greater sage-grouse, long-billed curlew, Sprague's pipit, and marbled godwit. The life history needs of these species are described below, excepting the godwit—an upland-nesting shorebird that is a target species for both uplands and wetlands and is described under "Target Waterbirds."

Baird's Sparrow. The Baird's sparrow is a true grassland specialist, requiring grasslands on both its breeding and wintering grounds. This sparrow breeds exclusively in the northern mixed-grass prairie from southeastern Alberta and southern Saskatchewan (Canada) through North Dakota and eastern Montana. Populations of many grassland birds including Baird's sparrows have declined due to habitat loss from conversion to cropland, overgrazing, and poor rangeland management (Dechant et al. 2003).

Baird's sparrows nest in idle to lightly grazed native prairie that has some residual litter cover and few shrubs. In wetter, eastern portions of their range frequent fires may be required to prevent shrub invasion. Drier, western grasslands do not require the same frequency (Dechant et al. 2003). In Alberta, the highest densities of Baird's sparrows were found in sites not burned for 5–15 years (Green et al. 2002), and a fire-return interval of up to 25 years has been recommended for dry mixed-grass prairie (Askins et al. 2007, Dechant et al. 2003). On Bowdoin Refuge, Baird's sparrows were common in prairie that had not burned for at least 70 years. Although they prefer native prairie, the sparrows will use tamegrass pastures and some exotic grass species that are structurally similar to native prairie.

Baird's sparrows arrive at Bowdoin Refuge around mid-May and begin nesting in late May (Jones et al. 2010). A long-term grassland bird study

© Bob Gress

Baird's Sparrow

at the refuge compared vegetation measurements taken at nest sites to measurements taken at random sites throughout four study plots (445 acres total). The sparrows preferred nesting habitat with greater litter depth (averaging 8 inches) and taller vegetation (averaging 14 inches) than that found at random sites (Dieni and Jones 2003). In addition, they have been found to select sites devoid of clubmoss (Dieni and Jones 2003) and bare ground (Dieni and Jones 2003, Green et al. 2002).

Dechant et al. (2003) made the following management recommendations for Baird's sparrow:

- Protect native grasslands that support breeding populations of Baird's sparrow
- Prevent encroachment of woody vegetation
- Encourage vegetative diversity within grasslands
- Provide large tracts of grassland
- Use fire-return intervals appropriate for the area
- Prevent overgrazing in pastures used by Baird's sparrows

Chestnut-collared Longspur. Chestnut-collared longspurs breed only in short- and mixed-grass prairie of the western and northern Great Plains and are the most abundant grassland songbird species that breeds at Bowdoin Refuge (Jones et al. 2010). Their breeding range extends from southern Alberta to southern Manitoba in Canada, south through eastern Montana and Wyoming, and east through North Dakota and South Dakota to western Minnesota.

Longspurs nest in open prairie with minimal shrubs and litter. They prefer native grasslands that have been recently disturbed by fire, grazing, or mowing (Hill and Gould 1997). Optimal grazing intensity is dependent on soil productivity, geographic area, and climate. In dry, sparse, mixed-grass prairie, light to moderate grazing is more appropriate, and heavy grazing or overgrazing may be detrimental (Dechant et al. 2003). Longspurs will nest in tamegrass pastures but in lower abundance than in native prairie, and they do not nest in cropland (Hill and Gould 1997).

Chestnut-collared longspurs arrive at Bowdoin Refuge in mid-April and begin nesting in early to mid-May (Jones et al. 2010). A long-term study of grassland birds at the refuge found that longspurs nest in sparser areas than Sprague's pipits or Baird's sparrows, with less grass and litter cover and more clubmoss cover than the other two species (Dieni and Jones 2003).

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The chestnut-collared longspur is a species of global concern that the Service has documented on Bowdoin Refuge.

Dechant et al. (2003) made the following management recommendations for chestnut-collared longspurs:

- Protect native prairie from plowing and cultivation
- Avoid managing for idle, dense vegetation, as longspur densities decrease with increased vertical density, diversity, and litter depth
- Graze at light to moderate intensity in dry, mixed-grass prairie and avoid overgrazing
- Use mowing to improve habitat by decreasing vegetation height and density

Greater Sage-Grouse. The historical range for sage-grouse covered portions of 16 states and three Canadian provinces (MSGWG 2005). The species presently occurs in 11 western states and two provinces, having disappeared from scattered areas around the periphery of its original range due to alteration or elimination of sagebrush habitat. In March 2010, the greater sage-grouse was listed as a candidate species, meaning it warrants protection under the Endangered Species Act but is precluded by higher priority species.

Greater sage-grouse require different habitat conditions, often across broad landscapes, to meet

Dr. Thomas G. Barnes / USFWS

A greater sage-grouse male on a lek, or dancing ground, in sagebrush-steppe habitat.

yearlong needs for breeding, nesting, brood-rearing, and wintering habitat. Regardless of the season, they require large expanses of sagebrush habitats with healthy, diverse understories of grasses and forbs. In the spring, displaying males require relatively open areas as lek sites, or dancing grounds, where breeding takes place. Females nest in a variety of cover types, but the most suitable nesting habitat is a mosaic of sagebrush with horizontal and vertical structural diversity (Dechant 2003b). Shrub height of sagebrush most commonly used by nesting sage-grouse ranges from 11.5 to 31 inches, with a grass-canopy height greater than 7.2 inches and a diversity of forbs (MSGWG 2005).

Brood-rearing habitats for sage-grouse are typically mosaics of upland sagebrush and other habitats such as wet meadows and riparian areas that, together, provide abundant insects and forbs for hens and chicks (Dechant 2003). Succulent forbs, a preferred food source for sage-grouse broods, are a key component of summer habitat (MSGWG 2005). While sage-grouse are associated with sagebrush throughout the year, it is essential during winter when the birds mostly occupy sagebrush habitats with greater than 20-percent canopy cover (MSGWG 2005).

Conserving sagebrush habitats on private and public lands is by far the most effective approach to assuring long-term maintenance of sage-grouse abundance and distribution (MSGWG 2005). Other management recommendations (Dechant et al. 2003) follow:

- Maintain, conserve, and restore large blocks of intact sagebrush with a healthy understory of native grasses and forbs
- Protect from alteration lek sites and adjacent habitat (up to 11 miles from the lek)
- Manage breeding habitats to maintain sagebrush canopy cover of 15–25 percent and perennial herbaceous cover of at least 15-percent grasses or at least 10-percent forbs, with grasses and forbs at least 7.1 inches tall
- Eliminate or control invasive, nonnative plants in sagebrush-steppe
- Use prescribed fire in sagebrush-steppe with caution, especially in the more arid portions of sage-grouse range, and attempt to maintain a mosaic of habitats following the burn
- Manage livestock grazing through stocking rates and season of use on all seasonal ranges of sage-grouse to avoid habitat degradation
- Minimize human disturbance in sage-grouse habitats, especially around leks and nesting habitat, for example: reduce or avoid development of mining and other resource extraction industries such as coal-bed methane, and avoid construction of power lines especially within 1.86 miles of seasonal habitats

Long-billed Curlew. The long-billed curlew, or "sickle-bill," is the largest shorebird in North America. There is no accurate estimate of the current population size, but the species is considered vulnerable throughout its range. Continued loss of grassland breeding habitats is thought to be the greatest threat to population stability (Poole 2005).

Standing 16 inches tall, this curlew has an extremely long, down-curved bill (5–6 inches for males and 6.5–8 inches for females) and long legs. Their long bills and legs are feeding adaptations for walking and probing for food in deep mud and for probing in soft soil and animal burrows. They feed on insects, marine and freshwater invertebrates, mollusks, amphibians, and wild fruits. When foraging in uplands they feed on grasshoppers, beetles, and other invertebrates in low-growing grassy areas (Montana Bird Distribution Committee 1996).

Curlews breed in the shortgrass and mixed-grass prairie habitats of the Great Plains, the Great Basin, and the intermontane valleys of southwestern

Lee Karney / USFWS

Long-billed Curlew

Canada and the United States including Montana, except the Rocky Mountain region (Montana Bird Distribution Committee 1996). Curlews rely on the cover and openness of native-prairie grasslands and pastures to nest and rear their young. Adequate, short-growth grassland for nesting habitat may be the single most important factor in sustaining long-billed curlew populations (Allen 1980, Cochrane and Anderson 1987, King 1978). In the northern Great Plains, the highest curlew densities were in lightly grazed grasslands on dry soils and in heavily grazed areas on moister soils (Kantrud and Kologiski 1982). Grazing generally has a positive effect on breeding densities because grazing produces the short grass and open ground favored for predator detection and chick mobility (Jenni et al. 1981, King 1978, Pampush 1980). The best rotation system should include grazing through early spring, so vegetation height and density are low during courtship and egg laying (Jenni et al. 1981). Overgrazing in drier, shortgrass habitats may be a threat to long-billed curlews and should be avoided (Bock et al. 1993, Strong 1971). Timing and intensity of grazing treatments should be adjusted according to local climate and habitat characteristics (Bicak et al. 1982, Bock et al. 1993). In addition, prescribed fire can improve habitat for curlews by removing shrubs and increasing habitat openness (Pampush and Anthony 1993).

Accounts of spring arrival dates for long-billed curlews in Montana are from early to mid-April. Habitat requirements for breeding curlews are grassland vegetation less than 12 inches tall, which enables curlews to forage without restricting the maneuverability of their long bills. They also prefer a range of 35–120 acres of suitable breeding and nesting habitat depending on the topographic and vegetative diversity of an area. Curlews nest in shortgrass prairie, grazed mixed-grass uplands and pastures, wet and dry meadows, grassy floodplains, alkali flats, and occasionally in hayfields, cropland, and fallow or stubble fields 3–9 inches high. Nests are usually formed in a shallow depression that is lined with grasses or weeds to protect the eggs. Curlew nests are often located close to standing water, within 100–450 yards, and near conspicuous objects including livestock dung piles, rocks, and dirt mounds (Allen 1980, Cochrane and Anderson 1987, King 1978). Individuals may intentionally place nests near these objects, possibly to provide shade, increase camouflage, or facilitate nest location by a breeding pair.

Nesting usually takes place in May and June (Gillihan and Hutchings 2000). The female lays four eggs, which are incubated by both birds for 27–29 days. The young are precocial (covered with down and capable of moving about) and, once hatched, are ready to leave the nest almost immediately; most young birds leave their nests during the months of June and July. After hatching, the adults move the chicks to areas of taller grasses and scattered forbs and shrubs, apparently for protection from predators and weather extremes. However, the adults avoid dense vegetation, possibly due to low visibility and difficulty of travel for chicks (Dechant et al. 1999). The female typically abandons the brood 2–3 weeks after hatching and leaves brood care to the male. The remaining groups of birds leave their breeding grounds by the end of August (Dechant et al. 1999). Curlews typically depart Montana in late August to early September.

Sprague's Pipit. Sprague's pipit breeds only in the northern mixed-grass prairie, and its range is similar to that of Baird's sparrow. However, while Baird's sparrow numbers have been stable since the 1980s, Sprague's pipit numbers have continued to decline, causing it to be listed in 2010 as a candidate species in the United States.

Pipits nest in native prairie with high plant species diversity and few shrubs. They prefer lightly to moderately grazed pastures throughout much of their breeding range (Jones 2010); however, grazing can have a dramatic negative effect in drier, less densely vegetated, mixed-grass prairie (Robbins et al. 1999).

Burning can have short-term, adverse effects on the abundance of Sprague's pipit; however, burning may have long-term benefits through improved habitat quality if it occurs at an appropriate frequency (Jones 2010). In drier portions of their range, pipits were common on native grassland that had not been burned for more than 15–32 years (Jones 2010, Robbins et al. 1999). Unlike Baird's sparrows, Sprague's pipits are uncommon in tame pasture and have not been documented to nest in cropland, Conservation Reserve Program land, or in dense nesting cover planted for waterfowl habitat (Jones 2010).

Sprague's pipits arrive at Bowdoin Refuge in late April and begin nesting in mid-May (Jones et al. 2010). A long-term study of grassland birds at the refuge found that pipits used nest sites with intermediately tall (averaging 12 inches), vertically dense, vegetation and nest patches (16-foot radius plot around the nest) with greater litter cover and depth, while avoiding areas with prickly pear cactus (Dieni and Jones 2003). This is similar to what has been reported in other published studies such as that by Sutter (1997). The pipits selected areas with less than 20-percent clubmoss cover, few shrubs, and little bare ground (Dieni and Jones 2003).

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Sprague's Pipit

According to the Sprague's Pipit Conservation Plan (Jones 2010), management should consist of the following:

- Keep large native prairie grasslands intact
- Remove woody vegetation from the interior of grassland patches
- Increase patch size and minimize the amount of edge habitat
- Remove exotic plant species from native prairie
- Apply prescribed fire (with frequency highly dependent on soil productivity, geographic area, and climate, particularly in the drier portions of their range)
- Use low-intensity or no grazing in the semiarid mixed-grass prairie

Wetlands

Wetlands are classified using several attributes—vegetation, water regimes (the length of time water occupies a specific area), and water chemistry. Wetland vegetation refers to plants that grow in water or in soils that are saturated for most of the growing season. Emergent plants are those rooted in the substrate and having foliage that grows partially or entirely above the water surface. Some emergent plants found on the refuge complex are broadleaf cattail, alkali bulrush, hardstem bulrush, common three-square, and smartweed. Other notable species that occur along the shores of lakes and marshes include pickleweed and saltgrass. Submergent plants are those having roots in the substrate but do not emerge above the surface of the water, except some that have floating leaves. Submergent plants found in refuge complex wetlands include northern watermilfoil, widgeongrass, sago pondweed, and flatstem pondweed. Many wetland plants have broad salt tolerances and can be found in freshwater and saline wetlands; however, species richness for both emergents and submergents decreases as salinity increases (Johnson 1990). In a study conducted on Bowdoin Refuge in 1987 and 1988, five species of emergent plants and six species of submergent plants were found in freshwater wetlands, but only one emergent species and four submergent species were found in saline wetlands (Johnson 1990).

In 1971, Stewart and Kantrud developed a wetland classification system to differentiate and

describe natural and modified wetland basins (or ponds) and lakes in the Prairie Pothole Region and also reflects seasonal, regional, and local variations in the environment. Stewart and Kantrud's (1971) investigations indicated that the use of prairie ponds and lakes by waterfowl is strongly influenced by water permanence, depth, and chemistry and by land use. They also stated any marked variations in wetlands are usually reflected in differences in life form, cover interspersion, species composition, and species dominance. Differences in vegetation are easily discernible in the field and are the principle criteria for the Stewart and Kantrud (1971) classification system.

Seven major classes of wetlands of natural basins are recognized based on ecological differentiation. Each class is distinguished by the vegetation zone occurring in the central or deepest part and occupying 5 percent or more of the total wetland area (Stewart and Kantrud 1971). Four wetland classes are found on the refuge complex: temporary, seasonal, semipermanent, and permanent.

- The primary function of temporary wetland basins is to provide isolation for breeding pairs of waterfowl and supply invertebrate foods early in the nesting period (Kantrud et al. 1989). The rapid warming of these shallow wetlands in the spring results in early development of invertebrate populations (Swanson et al. 1974).

- Seasonal wetland basins are a major source of invertebrate protein for laying female ducks early in the breeding season, and these basins provide isolation for paired waterfowl and sites for overwater nests (Kantrud et al. 1989). During wet years, seasonal wetlands are also highly attractive as breeding habitat (Talent et al. 1982) and molting areas. They usually receive considerable use by spring-migrating waterfowl and shorebirds but normally are dry by fall.

- Semipermanent wetland basins supply most of the needs of common prairie-nesting waterfowl and their broods. Use of semipermanent wetlands by breeding waterfowl seems to be greatest when amounts of emergent cover and open water are approximately equal (Weller and Spatcher 1965). They are the last to become ice-free in the spring and, therefore, are not an early source of invertebrate foods for waterfowl and shorebirds. In addition, semipermanent wetlands are the main habitat for staging and fall-migrating waterfowl (Kantrud et al. 1989).

- Permanent wetlands remain flooded throughout the year. Due to year-round flooding, permanent wetlands support a diverse, but usually not abundant, population of invertebrates. Submerged aquatic vegetation may occur if adequate water clarity exists. These wetlands are important in mid- to late summer when other wetlands may dry up and when ducks are molting their flight feathers; the deep water and dense cover provide protection from predators.

Many of the wetlands on Bowdoin Refuge have been sampled and fall into the following salinity classes defined by Stewart and Kantrud (1972):

- *Slightly brackish (320–1,280 mg/L salinity)*—Black Coulee Pond, Display Pond, Farm Ponds, and Lakeside

- *Moderately brackish (1,280–3,200 mg/L)*—Goose Island Pond, Patrol Road Pond, and Strater Pond

- *Brackish (3,200–9,600 mg/L)*—Dry Lake Pond and Drumbo Pond

- *Subsaline (9,600–28,800 mg/L)*—Lake Bowdoin

These wetlands have a diverse distribution of sizes, types, locations, and associations; according to Service data, there are more than 10,000 acres of wetlands in the refuge complex. The chemistry of surface waters in these wetlands tends to be dynamic because of interactions among numerous factors, such as the position of the wetland in relation to ground water flow systems, chemical composition of ground water, surrounding land uses, and climate (LaBalugh et al. 2004, Swanson et al. 1988, Winter 2004).

Invasive and Nonnative Species in Wetlands

The refuge complex has several invasive and nonnative wetland-loving plant species such as *Phragmites* (reed), Russian olive, perennial pepperweed, saltcedar, and reed canarygrass. Although the Service has been working to control these invaders through an integrated pest management program, these species are very hardy, spread rapidly, and easily outcompete the more vulnerable, native, wetland plant species.

Phragmites. Samples of *Phragmites* plants were collected from Bowdoin Refuge and Beaver Creek WPA in 2005 and sent to Cornell University for identification. The refuge sample was identified as a native species. However, the sample from the waterfowl production area was identified as an introduced species; the Service is currently conducting control

methods to stop the spread of this small, 1-acre infestation.

Russian Olive. Russian olive trees were planted on Bowdoin National Wildlife Refuge in the 1950s until the 1970s, under the belief that they were beneficial to the landscape and wildlife. Over the years, the trees have encroached into wetland edges and along canals and ditches, making it difficult for refuge staff to maintain these water delivery systems. Russian olive grows well in wet-saline environments and is shade tolerant; as a result, Russian olive trees have become established in the understory of the native cottonwood trees that surround several refuge wetlands and saline areas throughout the refuge complex. Russian olive trees were encroaching into the eastern end of Bowdoin Refuge, in drainages and around small wetlands. Control of Russian olive on the refuge began in 2000 with tree cutting and treating the stumps with an herbicide (Arsenal® or Garlon® 3A); in some treated areas, the remaining tree stumps sprouted and readily propagated, becoming difficult for the refuge staff to control. The Service began by removing these single, scattered trees, and then turned its attention to larger, older infestations. Inefficient control methods combined with a lack of staff has slowed progress in reducing the infestation.

Perennial Pepperweed. In 2004, an infestation of perennial pepperweed was discovered on the Big Island dike road at Bowdoin Refuge. The pepperweed has spread into the surrounding wetlands, and the size of the infestation varies depending on water levels. The infestation has been mapped with GPS (Global Positioning System) and chemically treated every year.

Saltcedar. One saltcedar tree was discovered growing on the east end of Bowdoin Refuge in 2007 and was cut down and treated with herbicide. In 2009, an infestation was discovered in the northern wetlands of Beaver Creek WPA; the area was surveyed and all saltcedar plants found were documented using GPS and sprayed with herbicide.

Reed Canarygrass. This grass has been present in the refuge complex for many years with almost no attention given to estimating the size of canarygrass infestations or treating them.

Wetlands within Bowdoin Refuge

Wetlands in the Bowdoin Refuge are diverse in size and type including the following: permanent wetlands (4,187 acres); semipermanent wetlands (1,146 acres); and seasonal or temporary wetlands (3,342 acres) (refer to figure 29 in chapter 6).

Lake Bowdoin is a large 5,459-acre natural, subsaline, permanent wetland that, during the early history of Bowdoin Refuge, was modified to create additional wetland habitat for migratory birds and to prevent outbreaks of avian botulism. With Montana's hot, dry climate, the lake has an evaporation loss of more than 2 feet annually. Most of the water in Lake Bowdoin would evaporate during the summer, leaving a small pool of water in the deepest portion of the lake or drying completely in some years. In years when only a small pool of water was left, there would be an outbreak of avian botulism, killing thousands of waterfowl and other migratory birds in one season. Modifications to the lake consisted of installing two water control structures and a dike system or auto tour road (which acts as a dike) around the southern portion of the lake, and two low water or "Texas crossings." This infrastructure holds delivered water and captures runoff and Beaver Creek floodwaters.

Lake Bowdoin attracts thousands of ducks, swans, and geese during the spring and fall migrations. The lake provides breeding and nesting habitat for overwater nesters such as white-faced ibis, Franklin's gull, black tern, eared grebe, lesser scaup, and redhead. The islands in the lake as well as its shoreline provide breeding and nesting habitat for American white pelican, great blue heron, northern pintail, mallard, Wilson's phalarope, marbled godwit, and willet. In late summer and early fall, Lake Bowdoin affords quality roosting habitat for thousands of migrant Canada geese, ducks, and sandhill cranes.

All of the wetlands can be manipulated by water deliveries and or water control structures to produce valuable migration, breeding, feeding, and nesting habitat for migratory birds. The corresponding bird use is generally quite diverse.

Dry Lake is a large natural wetland; the 1,019-acre lake is a brackish (somewhat salty), shallow, and seasonal wetland. Dry Lake was modified to create additional wetland habitat for migratory birds by installing one water control structure, a 4-mile dike along the lake's entire length, and two low wa-

Mike Artmann / USFWS

This "Texas crossing" on the eastern end of Dry Lake is a water control structure that also serves as a road.

ter or "Texas crossings." Being a shallow seasonal wetland, Dry Lake goes dry most years. The infrastructure was constructed to hold as much delivered water as possible and to capture as much runoff and Beaver Creek floodwaters as possible. When at least 50-percent full, Dry Lake attracts a tremendous diversity of shorebirds and waterfowl, particularly during spring migration. It can also be significant wetland habitat for shorebirds and waterfowl during fall migration when delivered water is available from the Malta Irrigation District.

When Piping Plover Pond is at least half full, it attracts a diversity of shorebirds, particularly during May and from July through September. These shorebird species have included the threatened piping plover, which was last documented nesting along the shoreline in 2000.

Patrol Road Pond (4 acres), Black Coulee Pond (8 acres), and Strater Pond (17 acres) are permanent, moderately brackish wetlands, because they are difficult to manage for migratory birds due to ground water seepage and irrigation return flows from neighboring private lands. These wetlands have been modified by levees and water control structures to capture water and provide habitat for migratory birds. These wetlands act as deepwater impoundments with emergent vegetation such as bulrush and cattails and are important nesting, brood-rearing, and feeding sites for diving duck species such as canvasback, redhead, and lesser scaup. The emergent vegetation provides escape cover, shelter, and nesting sites for these species as well as marsh wren, blackbirds, coot, eared grebe, and sora rail.

Lakeside Pond (296 acres), Lakeside Extension (46 acres), Upper Farm Pond (15 acres), and Lower Farm Pond (5 acres) are slightly brackish, semipermanent wetlands. Water levels in these wetlands can be manipulated with timely water deliveries and water control structures to mimic natural wetland conditions. These conditions provide important, diverse wetland habitat for breeding, feeding, roosting, and brood rearing by waterfowl species such as northern pintail, mallard, lesser scaup, and eared grebe. In addition, the ponds' emergent vegetation is cover for nesting black terns, blackbirds, marsh wrens, and white-faced ibises. The shoreline can provide important foraging habitat for shorebirds during spring and fall migrations and during the breeding and nesting seasons.

Drumbo Pond is a 207-acre natural, brackish, semipermanent wetland. Water levels in this unit can be manipulated with timely water deliveries and by two water control structures to mimic natural wetland conditions and to provide diverse wetland habitat for migratory birds. This wetland is also affected by the uncontrolled entry of irrigation return flows from neighboring private lands. Although the Service cannot control this flow of water into the pond, the Service can manipulate the water control structures to accomplish its wetland habitat management goal. Aquatic vegetation such as sago pondweed and widgeongrass grows profusely and provides valuable food for tundra swans, coots, and waterfowl such as canvasbacks and wigeons. Drumbo Pond provides important spring and fall migration habitat for waterfowl such as northern pintail and tundra swan, as well as shorebirds such as Wilson's phalarope and marbled godwit. Waterfowl species such as mallard and lesser scaup find important breeding, feeding, roosting, and brood-rearing habitat at the pond. In addition, the pond's emergent vegetation is cover for nesting black terns, blackbirds, marsh wrens, and white-faced ibises.

George F. Russell / USDA–NRCS PLANTS Database

Broadleaf cattail is an emergent plant species in wetland habitat.

Wetlands within Bowdoin District

Wetlands habitat in the Bowdoin Wetland Management District are predominantly seasonal wetland basins. The Service manages some of these basins by delivering water and manipulating the levels by using water control structures and dams. Riparian habitat and intermittent prairie streams are also found on the district. There are 1,391 acres of wetlands on Service-owned land in the district including the following:

- 45 acres of permanent wetlands
- 449 acres of semipermanent wetlands
- 881 acres of seasonal or temporary wetlands
- 16 acres of riverine or intermittent wetlands

Some of these wetlands are created and others have been enhanced by the construction of an earthen

R.A. Howard / USDA–NRCS PLANTS Database

Widgeongrass is a submergent plant species, which grows completely under water.

dam. Wetlands that can receive delivered water—by either pumping or gravity flows or whose water levels are influenced by water control structures—are considered managed wetlands. There are currently 928 acres of managed wetlands.

Temporary wetlands at the wetland management district are areas where the wet meadow zone dominates the deepest part of the wetland area. A peripheral low-prairie zone is usually present. Wet meadow vegetation occupies the central areas of many of the shallower pond basins and commonly occurs as a peripheral band in most of the deeper ponds and lakes. Most of the more numerous plant species in the normal emergent phase are fine-textured grasses, rushes, and sedges of relatively low stature. Wet meadow zones in the central areas of shallow pond basins are restricted to fresh or slightly brackish wetlands. Examples of temporary wetlands that the Service manages are Pearce WPA (basins P11 and P12), McNeil Slough WPA (Jack's Pond and Pintail Pond), and Beaver Creek WPA (Bergum Ponds).

Seasonal ponds are the shallow-marsh zones that dominate the deepest part of the wetlands. Peripheral wet meadow and low-prairie zones are usually present. Shallow-marsh vegetation dominates the central areas of pond basins that normally maintain surface water for an extended period in spring and early summer but frequently are dry during late summer and fall. In shallow alkali ponds, it may occur as a band between wet meadow and intermittent alkali zones. Examples of seasonal managed wetlands in the wetland management district are Pearce WPA (P4), Beaver Creek WPA (Beaver Creek oxbow and the North Cell and South Cell wetlands), and McNeil Slough WPA (Bruce's, Dowitcher, Woodduck, and Fidelity Ponds).

Semipermanent ponds are where the deep-marsh zone dominates the deepest part of the wetland area. Shallow-marsh, wet meadow, and low-prairie zones are usually present, and isolated marginal pockets of fen zones (bog zones) occasionally occur. Deep-marsh vegetation dominates the central areas of pond basins that ordinarily maintain surface water throughout the spring and summer and frequently maintain surface water into fall and winter. Occasionally in deeper ponds with other zones, a narrow border of surrounding low prairie is inundated during unusually high water. Examples of semipermanent managed wetlands in the wetland management district are Pearce WPA (Upper Slough and Big wetland), Beaver Creek (Masters Oxbow and unnamed tributary), and McNeil Slough WPA (Turtle Pond and Bureau of Reclamation Ponds).

Wetland-Associated Wildlife

Many mammals use wetlands and surrounding vegetation for water and cover but muskrats, mink, raccoon, and beaver are those most commonly associated with the lakes and wetlands in the refuge complex.

There have been no formal amphibian or reptile surveys in the refuge complex, but wetland species that have been recorded on Bowdoin Refuge include leopard frog, chorus frog, and painted turtle.

Due to the shallow nature of prairie lakes and wetlands, they may be dry for several months to several years. As a result, many refuge complex wetlands do not support fish. In 2002 and 2003, a fish-trapping study was conducted on Bowdoin Refuge on several small wetlands (Display Pond, Bowdoin Intake Canal, and Black Coulee Pond); carp, fathead minnow, spottail shiner, white sucker, yellow perch, brassy minnow, and brook stickleback were documented.

Wetlands normally carry high insect (invertebrate) populations. Nesting waterfowl, waterfowl broods, marsh birds, waterbirds, and shorebirds are highly dependent on these protein food sources for healthy, vigorous growth. Common aquatic macroinvertebrates documented on the Bowdoin Refuge are midges, scuds, water boatman, snails, damsel-

flies, mayflies, and water fleas (Johnson 1990). The same insect species may be found in fresh and saline wetlands, but the total diversity decreases with increased salinity (Johnson 1990).

Concentrations of thousands of migrating shorebirds are found throughout most of the refuge complex, particularly in drier years when low water levels leave large areas of exposed shoreline. Thirty-seven species of shorebirds have been observed in the refuge complex; of these, 13 species including the spotted sandpiper and threatened piping plover will breed in the refuge complex (refer to "Appendix F–Species Lists"). In 2002, Bowdoin National Wildlife Refuge was designated as a site of regional importance by the Western Hemisphere Shorebird Reserve Network. It was given this distinction for documenting at least 20,000 shorebirds using the refuge annually or at least 1 percent of the biogeographic population for a species (Western Hemisphere Shorebird Reserve Network 2009).

As part of the central flyway, wetlands in the refuge complex are used by many waterfowl species as important stopover sites on migration routes (refer to "Appendix F–Species Lists"). Other bird species are common around the wetlands, such as sora rail, black-necked stilt, American avocet, yellow-headed blackbird, and marsh wren. Lake Bowdoin provides habitat for colonial-nesting and overwater-nesting waterbirds including western grebe, eared grebe, American coot, white-faced ibis, black-crown night-heron, American bittern, ring-billed gull, double-crested cormorant, great blue heron, and American white pelican.

Target Waterbirds

The Service has identified a diverse group of target waterbird species for wetlands: northern pintail, mallard, redhead, tundra swan, marbled godwit, Wilson's phalarope, white-faced ibis, and Franklin's gull. The life history needs of these species are described below.

Mike Artmann / USFWS

Bootleg Marsh is full of Baltic rush (center) and surrounded by curly dock (dark vegetation in middleground).

Northern Pintail. The northern pintail is the most widely distributed dabbling duck (surface feeder) in the Northern Hemisphere. It frequents lakes, rivers, marshes, and ponds in grasslands, and areas where water is lined with trees are avoided (DeGraaf et al. 1991, Johnsgard 1979, Madge and Burn 1988).

Pintails have a tendency to avoid areas that are flooded too deeply if shallow sites are also present. These ducks feed in shallow waters of marshes, ponds, and wet meadows or in grain fields, consuming seeds, roots, and leaves of aquatic plants, emergents, and many terrestrial plants (Belrose 1980, DeGraaf et al. 1991). Specifically, plants commonly eaten by pintails include pondweeds, sedges, smartweed, fall panicum, brownseed paspalum, panic grass, bulrush, widgeongrass, chufa, and saltgrass (Belrose 1980, DeGraaf et al. 1991). Many well-managed wetlands have the potential to provide an abundant supply of high-energy and nutritionally complete foods for pintails when water depths are less than 18 inches and preferably less than 6 inches. Optimal foraging depth is less than or equal to 18 inches. Water more than 18 inches can still provide important roost sites and give security from predators (Fredrickson 1991).

Pintails regularly breed in the shortgrass prairies of the northern United States and southern Canada and are especially attracted to large expanses of shallow open water where visibility is good and small seeds and invertebrates are readily available (Fredrickson 1991). These ducks migrate early in spring and move northward as soon as wetlands become ice-free (Fredrickson 1991). They normally initiate nesting earlier in spring and summer than other dabblers. The first nests appear in early April during normal years, and nesting activity peaks during the first 2 weeks of May. The preferred nesting habitat is short grass where temporary ponds are abundant nearby. The highest nesting densities occur in open habitats where vegetation is low and sparse such as areas dominated by prairie grasses, whitetop, nettle, spikerush, rushes, and buckbrush or snowberry (Fredrickson 1991). The northern pintail builds its nest in a hollow on dry ground, generally within 300 feet of water (Madge and Burn 1988, Musgrove and Musgrove 1943). Grazing programs that leave good residue ground cover but remove robust growth can enhance nesting cover for pintails (Fredrickson 1991).

Mallard. Another dabbler, the mallard is one of the most familiar of ducks found throughout North America. Mallards use all wetland habitat types and depend on wetland areas and the associated upland habitats to survive. They feed on insects and larvae, aquatic invertebrates, seeds, acorns, aquatic vegetation, and grain. They are well adapted to eating

both natural and domestic foods such as waste grain from crop harvests. Most of their diet is made up of wetland plants and grains such as wheat, barley, rice and oats (Montana Field Guide (no date(b)).

Mallards tend to leave their wintering areas early to reach the breeding grounds, usually departing in February and March. Migration periods in the Bozeman, Montana, area occur from February 25 to April 20 and from October 15 to January 1, with peaks on March 20 and December 1 (Skaar 1969). Among dabbling ducks, the mallard is one of the latest fall migrants. In the northern tier of States (like Montana), local breeding populations of mallards are not appreciably augmented by more northerly birds until early October. Peak population numbers are reached in early November and begin to gradually decline as the season changes and waters begin to freeze.

Mallard hens prefer to nest in dense vegetation about 24 inches high, regardless of other cover qualities. The mallard begins to nest between April 10 and April 30 over vast reaches of its breeding range (Belrose 1980). Each spring, the female mallard's diet switches from plants to aquatic invertebrates. This diet provides her with the nutrition and energy she needs to lay and incubate a clutch of eggs. Mallard duck eggs usually hatch from late April to late May. As soon as the ducklings are dry, within the first 12 hours of hatching, the hen mallard leads them to water (Belrose 1980).

Redhead. The redhead is a diving duck found in shallow freshwater lakes, ponds, and marshes (Belrose 1980). The redhead is a breeding bird of the northern prairies and associated parklands and the intermountain marshes of western Montana (Belrose 1980). The largest populations of breeding birds are found in South Dakota and western Montana as well as Canada (Belrose 1980). They prefer semipermanent to permanently flooded wetlands that support persistent emergent vegetation.

Redheads obtain their food by diving in water 3.3–9.8 feet deep, but they can dive as deep as 45.9 feet. They feed in shallow waters by tipping up so they can reach the bottom from the surface. Ninety percent of their diet is plants and the other 10 percent are animals. The redhead's diet consists of pondweed seeds, tubers, leaves, muskgrass, bulrush seeds, wild celery, duckweeds, water lily seeds, sedges, grasses, wild rice, widgeongrass, and coontail. During spring migration and the breeding season, adult redheads are opportunistic and omnivorous. In the spring in North Dakota and Canada, redheads forage in large, deep, open areas (more than 1 acre) with submersed aquatic vegetation; they feed primarily on protein-rich invertebrates, including *Diptera* larvae and *Trichoptera* (more than 50 percent by volume). Much of their remaining diet consists of bulrush seeds and sago pondweed buds (less than or equal to 15 percent by volume) (Custer 1993). In fall and winter, they primarily eat leaves, stems, seeds, and tubers of aquatic plants, mostly submergents, with smaller amounts of aquatic insects (Custer 1993).

John and Karen Hollingsworth / USFWS

Northern Pintail

Gene Nieminen / USFWS

Mallard Pair

Donna Dewhurst / USFWS

Redheads feed in large, open areas.

Most redheads depart wintering areas in the Laguna Madre of Texas within 2 weeks in early March and from the Atlantic Coast in mid-March. They are considered midseason migrants, because they migrate later than species such as mallard and northern pintail (Custer 1993). They reach breeding areas in the northern prairies of the United States in early April and numbers rapidly increase through the month (Belrose 1980). Redheads begin to appear on migration areas adjacent to their breeding grounds in September, reach peak numbers by mid-October, and are largely gone by mid-November (Belrose 1980).

The redhead uses smaller, shallower permanent to semipermanent wetlands with blocks of dense emergent vegetation for nesting—laying and incubating eggs (Custer 1993). Many nest studies reveal that redheads have a strong preference for hardstem bulrush beds over other types of vegetation, with cattails a second choice and sedges third (Belrose 1980). Deeper water with invertebrates or shallow water with moist-soil plants should be made available during the prelaying period. Water levels should be kept constant during the laying and incubation periods to reduce losses of clutches from flooding or from predators if the area becomes too dry. Recently flooded areas with high invertebrate populations should be available during the first few weeks of the brood period and should be followed by access to deeper water with ample pondweeds (Custer 1993).

Tundra Swan. The tundra swan, once known as the whistling swan in North America, is the most numerous and widespread of the two swan species native to this continent. Tundra swans are attracted to large open wetlands for roosting and foraging (Earnst 1994). Its long neck allows it to feed in water up to 3.3 feet deep as it forages in shallow ponds, lakes, and riverine marshes. The swan will also feed in harvested agricultural fields and fields growing winter cereal grain. Tundra swans prefer wetlands containing sago pondweed regardless of wetland size or extent of open water (Limpert and Earnst 1994). Tubers and seed of the sago pondweed were the exclusive diet of swans collected in the Great Salt Lake marshes (Sherwood 1960).

Tundra swans migrate in flocks comprised of family groups or in small flocks comprised of several families and some nonbreeders. The swans begin to leave their wintering grounds and push northward with the first spring thaw in March. Tundra swans arrive on Bowdoin Refuge in the spring as early as mid-March and are gone by the end of the month. A large portion of the eastern population of tundra swans migrates through the central flyway in fall and spring, primarily through the province of Saskatchewan and the States of Montana, North Dakota, and South Dakota. Staging areas are confined to southern Saskatchewan, northeastern Montana, large portions of North Dakota, and northeastern South Dakota (Vrtiska et al. 1999). They leave their major breeding grounds in Alaska in late September and early October (Belrose 1980). They appear again on Bowdoin Refuge in the fall, around the last week in September and depart by mid- to late November. Censuses of tundra swans at Freezeout Lake, Montana, made by Dale Witt from 1963 to 1969 revealed that the swans start arriving early October, build up to peak numbers by the end of the month or early November, and depart rapidly thereafter.

Marbled Godwit. The marbled godwit is a large shorebird with a long, upturned bill. Most nest in

Mike Artmann / USFWS

Tundra swan, Canada goose, and other waterfowl species at Lake Bowdoin.

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Marbled Godwit

© Dominic Sherony

Wilson's phalarope is a small "wader."

prairies of north-central United States and south-central Canada (midcontinental population). Within these grasslands, godwits require complexes of wetlands that represent a broad diversity of sizes and types—ranging from temporary to permanent (Melcher et al. 2006, Ryan et al. 1984). Godwits feed at water depths of 2–5 inches and in dry years, when temporary wetlands are limiting, the birds will shift to semipermanent wetlands. Such shifts underscore the need for conserving wetland complexes as opposed to single wetlands (Melcher et al. 2006).

Northbound migration for the midcontinental population peaks from late April to mid-May, with later peaks generally occurring at more northern latitudes. Typical of most shorebirds, the marbled godwit's southbound migration is quite drawn out. Suspected nonbreeders and unsuccessful breeders begin to form large flocks at staging sites within core areas of the breeding range as early as the first week of June. By late June and early July, successful breeders and, later, juveniles join staging flocks. Godwits may continue moving southward into November, although southbound migration peaks in mid-July to mid-September (Melcher et al. 2006).

The godwit breeds in the center of North America and winters along the coasts (Gratto-Trevor 2000). It is not well-known whether, or how, godwit breeding distributions are affected by annual changes in climatic or other conditions. Bowdoin Refuge data shows that banded individuals come back to the same location in subsequent breeding seasons. They will nest on occasion in tamegrass habitats, including hayfields and idle pastures (Ryan et al. 1984), especially if the vegetative structure is similar to that of native, shortgrass habitats. Typically, nesting birds avoid dense grass cover and rarely nest in croplands or stubble fields (Dechant et al. 2003). Adults with broods, however, are often found near taller grass (6–24 inches) than that used for nesting, which provides escape cover and protection from exposure (Ryan et al. 1984). Godwits in the midcontinental breeding range appear to prefer large, contiguous blocks of habitat (Melcher et al. 2006). They nest on the ground in native prairie areas, a considerable distance from water (Montana Field Guide (no date (c)). Most authorities agree that marbled godwits in the midcontinental breeding range nest preferentially in sparse (less than 75-percent canopy coverage) to moderately (more than 75-percent canopy coverage) vegetated, native shortgrass (less than 6 inches) habitats—often grazed or recently idled from grazing (Melcher et al. 2006).

Wilson's Phalarope. Wilson's phalaropes are small wading birds that use both fresh and alkali wetlands with three characteristics: open water, emergent vegetation, and open shoreline (Hohn 1967, Naugle 1997, Prescott et al. 1995, Saunders 1914, Stewart 1975, Stewart and Kantrud 1965). Phalarope need protected wetland complexes with both seasonal and semipermanent wetlands to provide suitable habitat during both wet and dry years (Colwell and Oring 1988b, Kantrud and Stewart 1984). The phalarope feeds by swimming or "spinning" or walking along the shoreline of shallow grassy ponds or lakes and picking insects and crustaceans from the surface (Johns 1969). On its breeding grounds, Wilson's phalarope forages on open water and flooded meadows, less frequently in upland habitats and along beaches (Colwell and Jehl 1994).

Wilson's phalarope usually appears on the breeding grounds of Montana during the first week of May. In the central and northern Great Plains (Minnesota, Nebraska, and North Dakota), Wilson's phalaropes arrive on the breeding grounds from mid-April to early May and depart from mid-August to early September (Howe 1972, Johnsgard 1980, Murray 1983, Roberts 1932). Females arrive on the

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White-faced ibis are large wading birds.

breeding grounds earlier than males (Colwell 1987, Reynolds et al. 1986), and commonly depart from breeding areas earlier than males, usually from early June to early July (Colwell 1987; Colwell and Oring 1988a,c; Dechant et al. 2003; Hohn 1967; Howe 1972).

Wilson's phalarope begins nesting in June in sparse to dense vegetation. Its nest is a grass-lined depression (Davis 1961). Nesting habitat varies widely and includes wetlands, wet meadows, upland grasslands, and road rights-of-way (Bent 1962, Bomberger 1984, Colwell 1987, Colwell and Oring 1990, Dinsmore and Schuster 1997, Einemann 1991, Faanes and Lingle 1995, Hohn 1967, Murray 1983, Roberts 1932, Stewart 1975). Phalarope need wet meadows near deeper wetlands during the breeding season (Colwell and Oring 1988b). This may make it easier for adults to move young from nests to wetlands by decreasing overland travel distance. Nest site selection varies seasonally—the birds nest in upland vegetation early in the breeding season and in wet meadow vegetation later in the season (Colwell and Oring 1990). They usually nest no more than 328 feet from shorelines (Colwell and Oring 1990, Eldridge 1992, Hatch 1971, Hohn 1967). Burning can be used to improve nesting habitat (Eldridge 1992). In pastures that contain wetlands important to breeding Wilson's phalaropes, grazing should be deferred until after July 15 (Prescott et al. 1993). Idle grasslands and previously grazed areas provide habitat for nesting, but areas with cattle present during the breeding season are less suitable (Kantrud and Higgins 1992, Renken 1983, Renken and Dinsmore 1987).

White-faced Ibis. Much larger than the phalarope, the white-faced ibis is a wader that probes deep in the mud with its long bill and feeds in shallow water or on the water surface (Cogswell 1977). Ibises typically feed on crayfish, frogs, fishes, insects, newts, earthworms, and crustaceans in freshwater marshes (Terres 1980). In the Central Valley of California they preferentially selected foraging sites with biomass that is significantly higher for midges (Chironomidae) and significantly lower for earthworms (Safran et al. 2000).

Most white-faced ibis arrive in Montana in May (Montana Bird Distribution 2002). In late summer they disperse throughout the State before beginning the fall migration to their wintering habitat (Ryder and Manry 1994). Most begin their southern movement in August, and by September they are usually gone from the State (Montana Bird Distribution 2002).

Breeding habitat is typically freshwater wetlands including ponds and marshes with pockets of emergent vegetation. The white-faced ibis also uses flooded hay meadows and agricultural fields as feeding locations. Ibises nest in areas where water surrounds emergent vegetation, bushes, shrubs, or low trees. In Montana, they use old stems in cattails, hardstem bulrush or alkali bulrush over shallow water as their nesting habitat (DuBois 1989). Water conditions usually determine whether nesting occurs in a particular area; therefore, ibis nesting sites can often move around from year to year. White-faced ibis is a fairly adaptable species but does require colony and roosting site isolation. Nesting colonies

are often shared with black-crowned night-herons and Franklin's gulls.

Franklin's Gull. A small gull found in the wetlands of the interior of North America, the Franklin's gull is listed in Montana as a species of concern. It prefers large, relatively permanent, prairie marsh complexes. The gulls feed on insects, earthworms, fish, mice, and seeds. It forages while walking in fields, swimming, or in dense flocks in fields being cultivated by a plow. It is also very adept at catching flying insects on the wing (Burger and Gochfeld 1994). At Freezeout Lake, Montana, stomach contents of Franklin's gulls included insects, earthworms, spiders, unidentified vertebrates, and plant material believed to be taken incidentally to consuming animals (Montana Field Guide (no date (a)).

Franklin's gulls return to Montana in mid-April and are gone by early to mid-October. In Montana, the extreme migration dates for this species are April 4, (recorded in 1971 at Benton Lake Refuge (Casey 2000) and October 11, recorded in 1955 at Medicine Lake Refuge (Montana Field Guide (no date (a), Reichel 1996).

The gull nests in colonies and builds its nests over water on a supporting structure of emergent vegetation including cattails and bulrushes (Burger and Gochfeld 1994). Typical water depth is 12–24 inches. One key feature of selected nesting sites is water levels that remain high enough throughout the nesting period, or at least until the young can fledge, to provide protection from predators (Casey 2000, Montana Field Guide (no date(a)). Breeding is localized and occurs mainly in the northern portion of States in the plains region (Montana, North Dakota, South Dakota, and western Minnesota), prairie region of Canada, and in the Southwest (Nevada). Franklin's gulls are known to nest in five locations in Montana and may account for as many as 34,000 breeding pairs (Reichel 1996). In 1994–95, the number of nesting pairs for each of the locations were recorded: Medicine Lake National Wildlife Refuge (50–500 pairs); Bowdoin National Wildlife Refuge (20 pairs, previously up to 7,500 pairs); Benton Lake National Wildlife Refuge (16,000 pairs); Freezeout Lake Wildlife Management Area (16,000 pairs); and Red Rock Lakes National Wildlife Refuge (200 pairs; Reichel 1996). Possible breeding has been reported at other locations in Montana but without details (Lenard et al. 2003, Montana Field Guide (no date(a)).

Avian Disease

The Bowdoin Refuge has a history of botulism outbreaks dating back to pre-refuge establishment, but efforts to document the severity and exact location of die-offs were not recorded until the 1940s. Botulism has been documented in Lake Bowdoin, Drumbo Pond, Lakeside, Dry Lake, and the Dry Lake Canal. Outbreaks generally begin in early to mid-July and may last into September. The numbers of waterfowl affected has varied greatly from year to year, while the location of disease hotspots—areas with the highest mortalities—has changed little. These hotspots are in the southwestern and southeastern bays of Lake Bowdoin, the northeast shore of Big Island in Lake Bowdoin, and the northwest portion of Drumbo Pond.

The first confirmed cases of West Nile virus in Phillips County, Montana, were documented in 2003. A small number of horses and humans became ill and unknown numbers were exposed to the virus. Many people reported finding dead birds of various species throughout the area. In early August 2003, a sudden die-off of pelicans was observed on Lake Bowdoin; sample carcasses sent in to the National Wildlife Health Center tested positive for West Nile virus. The disease has been documented in the area every year since this time, but the number of cases have varied greatly. Outbreaks have begun as early as mid-July and can last into fall when colder nighttime temperatures control the mosquito population.

Highly pathogenic avian influenza has not yet been documented in North America but, because of the serious health risks to humans and domestic fowl, the Service has entered into an interagency agreement to develop an early detection system should this influenza migrate to the continent.

The refuge complex staff completed a Disease Contingency Plan in 2006 for the Bowdoin National Wildlife Refuge Complex. This plan would be reviewed annually and updated as new information becomes available.

Riparian Areas

According to Montana's Comprehensive Fish and Wildlife Conservation Strategy, riparian areas support the greatest concentration of plants and animals yet only constitute 4 percent of Montana's land cover (Montana Fish, Wildlife & Parks 2005). Plant species composition in riparian areas is influenced largely by water quality, water permanence, and soils.

The Bowdoin National Wildlife Refuge Complex manages two waterfowl production areas that are either bordered or crossed by riparian habitat: Beaver Creek WPA and McNeil Slough WPA. Beaver Creek, which flows through portions of Beaver Creek WPA, can be classified as a mixed riparian area—"riparian areas dominated by a mix of shrub and herbaceous species, with codominance of shrub and grass species present and tree cover is less than

15 percent" (Montana Fish, Wildlife & Parks 2005). Western wheatgrass, bluejoint reedgrass, rose, willow, silver sage, and snowberry are common plants along Beaver Creek. The Milk River, which borders McNeil Slough WPA, is classified as a broadleaf riparian area "dominated by broadleaf (cottonwood) forest, with total tree cover from 20 to 100 percent" (Montana Fish, Wildlife & Parks 2005). Associated shrub species are alder, bunchberry, serviceberry, thimbleberry, common chokecherry, and willow. Some of the more common invasive and nonnative plants found in riparian areas are Russian olive, Canada thistle, and leafy spurge.

Riparian Area–Associated Wildlife

Across the State, there are 149 bird species, 22 mammal species, 16 amphibian species, and 6 reptile species that depend on riparian and wetland habitat for breeding and survival. An additional 72 species of wildlife regularly use these habitats and benefit from riparian and wetland conservation (Sullivan 2008).

Birds observed on and near McNeil Slough WPA include raptors such as golden eagle, red-tailed hawk, northern goshawk, American kestrel, snowy owl, and western screech-owl. A great variety of passerines (perching birds and songbirds) use riparian habitat, including northern flicker, western wood-pewee, gray catbird, brown thrasher, cedar waxwing, loggerhead shrike, yellow warbler, and Baltimore oriole.

Although assessments of the refuge complex's riparian areas have not been completed, a small mammal-trapping survey was conducted in 2004 on a State-owned wildlife management area near McNeil Slough WPA. The study found little brown myotis, silver-haired bat, deer mouse, northern grasshopper mouse, western jumping mouse, striped skunk, and three species of vole (Carson et al. 2004). Other mammals that use riparian areas are white-tailed deer, beaver, raccoon, porcupine, and red fox.

In 2000 and 2001, fish surveys in Beaver Creek on Beaver Creek WPA documented the presence of fathead minnow, black bullhead, carp, yellow perch, brook stickleback, pumpkinseed, white sucker, brassy minnow, black crappie, spottail shiner, and smallmouth bass.

4.3 Federally and State-listed Species

The Service has not documented any species listed as endangered under the Endangered Species Act using any lands or water within the Bowdoin National Wildlife Refuge Complex. The Great Plains population of the piping plover, federally listed as threatened in 1985, has been found on Bowdoin Refuge.

Many species found in the refuge complex have been designated as species of concern by Montana Fish, Wildlife & Parks and the Montana Natural Heritage Program (2009a, 2009b) or as birds of conservation concern by the Service (2008a).

Two bird species on the refuge complex are designated as Federal candidate species under the Endangered Species Act—greater sage-grouse and Sprague's pipit. The Service has determined that both of these species warrant protection, but that listing is precluded by the need to address other listing actions of a higher priority. Both will remain classified as candidate species until listing proposals can be prepared. Until listed as threatened or endangered, candidate species do not receive statutory protection under the Endangered Species Act.

The mountain plover, which is found on Hewitt Lake National Wildlife Refuge within the refuge complex, is currently proposed for listing as a threatened species. The Service is still developing scientific information regarding the mountain plover's life history, ecology, and habitat use to determine its status and eligibility for listing.

Gene Nieminen / USFWS

The Bowdoin Refuge has critical habitat for piping plover.

Piping Plover

Piping plovers occur in three distinct populations: Atlantic Coast, Great Lakes, and northern Great Plains. Of the roughly 6,000 piping plovers left in the world, about half breed in the northern Great Plains. Unlike the Atlantic Coast and Great Lakes populations, the northern Great Plains population is declining, somewhere between 6 percent and 12 percent annually (Larson et al. 2002, Plissner and Haig 2000, Ryan et al. 1993). This population is expected to go extinct in 50–100 years unless significant conservation activities are started. The decline and poor prognosis led to the listing of this population in the mid-1980s as threatened under the Endangered Species Act in the United States and endangered in Canada.

The first recorded sighting for piping plovers in Montana was in 1967 in Phillips County (Prellwitz et al. 1989). Bowdoin National Wildlife Refuge is located on the extreme western edge of the breeding range for the northern Great Plains population. Piping plovers nest on wide, sparsely vegetated sand or gravel beaches and on islands in rivers. In the northern Great Plains, flooding of nests and chicks from precipitation or untimely discharges of water from dams has been a major cause of reproductive failure. The refuge has suitable breeding and nesting habitat for piping plovers; nevertheless, use has been very sporadic and in low numbers (nesting was last documented in 2000). Because of its history of piping plover use, 3,325 acres of Bowdoin Refuge has been designated as critical habitat for the piping plover.

The Bowdoin Refuge participates in the International Piping Plover Breeding Census every 5 years and is a member of the Montana Piping Plover Recovery Committee. In addition, refuge staff conducts annual surveys for piping plover on Bowdoin and Hewitt Lake refuges and at nearby Nelson Reservoir. The reservoir lies approximately 4.5 miles, as the plover flies, northeast of Bowdoin Refuge and is administered by the Bureau of Reclamation. This 4,559-acre irrigation reservoir has approximately 34 miles of primarily gravel shoreline at a normal pool elevation of 2,221 feet. This extensive shoreline often supports several nesting pairs of piping plover. Since the nearest Reclamation office is 200 miles away in Billings, Montana, the Service entered into an agreement with Reclamation to have the nearby refuge staff monitor plover use of the reservoir during the migration, breeding, and nesting seasons. Reclamation has provided the funding, and refuge staff has been responsible for the monitoring. In 2009, the Service no longer had the staff to continue this monitoring program. Future agreements to continue this partnership would be contingent on the addition of a biologist or permanent biological technician to the refuge complex staff to carry out this additional work.

In cooperation with Reclamation, the refuge staff has improved nesting habitat on Nelson Reservoir by adding gravel to historical nesting areas and by periodically removing vegetation from those sites as needed. The Service has also collaborated with Reclamation and Ducks Unlimited to create Piping Plover Pond on the west end of Dry Lake. In addition, portions of the alkali beach on the pond have been enhanced with gravel to improve nesting habitat.

Plant Species

No federally listed plant species are known to occur at Bowdoin Refuge or within the Bowdoin Wetland Management District; however, comprehensive vegetation inventories have not been done for most of the district.

Animal Species of Concern

Species of concern are native animals breeding in Montana that are considered to be at risk due to their declining population trends, threats to their habitats, or restricted distribution (Montana Natural Heritage Program 2009a, 2009b). The Service identifies birds of conservation concern as migratory and nonmigratory birds of the United States and its territories that have declining populations, naturally or human-caused small ranges or population sizes, threats to habitat, or other factors. This designation helps stimulate coordinated and proactive conservation actions among Federal, State, tribal, and private partners. Bird species considered for inclusion on this list include nongame birds, game birds without hunting seasons, subsistence-hunted nongame birds in Alaska, birds that are candidates or proposed as threatened or endangered under the Endangered Species Act, and birds that recently have been removed from a Federal listing (USFWS 2008a).

The refuge complex has documented more than 80 wildlife species that are listed as State species of concern or Federal birds of conservation concern, or both (refer to "Appendix F–Species Lists"). In particular, many grassland-nesting birds such as Baird's sparrow, Sprague's pipit, and McCown's longspur use the refuge complex for nesting and migration habitat each year. These birds, along with many others using the refuge complex, are identified on both the State and Federal lists as species that require special attention to prevent them from becoming threatened or endangered.

4.4 Cultural Resources

Based on radiocarbon dating, evidence of human occupation within the northwestern plains of the greater Missouri River drainage extends back at least 11,000 years (Brumley 2006). Excavations from this area indicate that prehistoric inhabitants evolved significantly over time by adopting new methods of hunting, gathering, and preparing food. Cultural phases can be identified by the types or styles of projectile points used, means of food preparation, and presence or absence of certain items such as ceramics.

Carmen Luna / USFWS

Rocks define a tipi ring at the Bowdoin Refuge.

Prehistoric Occupation

The cultural sequence for prehistoric occupation in this area is often split into three major subdivisions based on these phases—early, middle, and late prehistoric.

Early Prehistoric

Dating back 11,000–7,700 years ago, early prehistoric or paleo-Indian peoples appear to have used heavy throwing or stabbing spears to hunt primarily big game such as mammoth and early bison. Evidence from this period in northern and central Montana is limited and most finds have been found on the surface.

Middle Prehistoric

Middle prehistoric humans occupied the area 8,000–1,300 years ago and may have hunted a larger variety of animal species as well as gathered and processed wild plant foods. Projectile points from this period were presumably designed for a spear thrower, known as an atlatl. Evidence also shows that the bow may have coexisted and eventually replaced the atlatl. Signs of stone boiling and the appearance of pottery indicate changes in food processing and storage.

Late Prehistoric

Dating from 100 A.D. to historical times, this period is characterized by projectile points used with the bow and arrow. Bison were still the primary game, but communal kills that involved driving animals over a cliff, into corrals, or into natural traps were more common. There is also significant evidence of the use of pottery and ceramics.

Protohistoric and Historic Native Americans

The protohistoric period is the period of time between the arrival of horses and manufactured goods in the area and before the arrival of white traders and explorers. This time period lasted only about 100 years in this area due to the arrival of the Lewis and Clark expedition in the early 1800s.

On arrival of the early white explorers, northern Montana was occupied primarily by three tribal groups: the Gros Ventres or Atsina, the Piegan of the Blackfoot Confederacy, and the Assiniboine. As a result of warfare and migration of Euro-Americans, the Sioux (Fort Peck Reservation), Chippewa, and Cree (Rocky Boy's Reservation) had also moved into northern Montana by the late 1800s (Wolfgram and Nemeth 1998). Cultural remnants from these groups can be found scattered over most undisturbed areas within the Bowdoin National Wildlife Refuge Complex. Lodges, tipi rings, and rock cairns are the most common remains encountered.

Historic Euro-Americans

The post-Lewis and Clark historic period in central and northern Montana can be divided into three generalized periods based on the major type of economic activity—fur trade era, ranching and railroad era, and homestead era (Wolfgram and Nemeth 1998).

Fur Trade Era

The fur trade era began in Montana a year after the Lewis and Clark Expedition returned to St. Louis. By the 1840s, trading posts were established along the Missouri River and most of its major tributaries including the Milk, Marias, Musselshell, and Yellowstone Rivers. Most of these posts were small, independent ventures and lasted little more than a

year. In addition, a network of military posts was established throughout central and northern Montana.

By the mid-1880s, much of the Plains Region of northern Montana was ceded by the Native American tribes present there, and these peoples were moved to smaller reserves with boundaries similar to those found today. The fur trade era came to an end at the same time, and most of the trade and military posts were closed.

Unreserved public domain in northern Montana was opened to settlement in 1887, and that same year the Great Northern Railway was built along the Milk River valley. Large cattle and sheep operations quickly moved into the area.

Ranching and Railroad Era

The ranching and railroad era in northern Montana coincided with a major boom in the market for beef cattle. The slaughter of the once-vast herds of bison and the considerable increase in the human population after the Civil War created an almost insatiable market for beef. The railroad development across northern Montana meant that large numbers of cattle could be shipped throughout the United States. Many of the branch lines that extended from what is now called the Burlington–Northern Railroad have since been abandoned, but many of the towns that were established along those branches as well as along the main railway remain today. These communities were service points for the coal-fired locomotives or as sidings for freight (railway sections where one section is lowered to allow two trains on the same rail to pass). These towns became important to the farmers who came to the region during the homestead era. One siding town that experienced the rapid boom and just as rapid bust of the railroad era was Bowdoin, for which the refuge was named. The old town site is located on the southeast boundary of Bowdoin National Wildlife Refuge.

Homestead Era

The homestead era in northern Montana lasted only 18 years between 1900 and 1918. Before 1900, farmers considered the region to be much too dry, and the open, rolling grasslands were not conducive to the farming techniques of the time. As dryland farming techniques improved—and with the passing of the Enlarged Homestead Act of 1909 and the Three Year Homestead Act of 1912—the stage was set for a major land rush in Montana. Individuals were provided with a free 320-acre homestead and, after only 3 years, could lay full claim to the land even if they only lived on it for 5 months of the year.

In 1902, the Newlands Reclamation Act committed the Federal Government to develop and manage irrigation systems along the major rivers in Montana. Also in 1902, the Bureau of Reclamation came into existence with funding from the sale of public lands. Since there was a lack of reliable, stable water in the Milk River system, a plan was developed to divert spring and floodwaters from the St. Mary River in western Montana into the Milk River system and store it for later use in downstream reservoirs. The Milk River Project would irrigate and reclaim more than 250,000 acres of agricultural land along the Milk River valley and was one of the first projects of this type in the United States interior.

The period between 1909 and 1916 was wetter than normal and individuals were able to exist off their 320-acre farms. However, by the mid-1920s the situation had changed, and it became clear that farms had to be significantly larger to provide a living. Many homesteaders went broke and their lands were purchased by those who had been able to persevere.

History of Bowdoin Refuge Complex

The establishment and early history of the Bowdoin National Wildlife Complex is tied to the Emergency Relief Act and the Works Progress Administration program. Created by President Franklin D. Roosevelt during the Great Depression and the Dust Bowl era of the mid-1930s, these programs were developed to employ the maximum number of people to work on public lands. The Civilian Conservation Corps was never assigned to work on any areas of the refuge complex (Speulda and Lewis 2003).

Works Progress Administration crews performed construction on the refuges in the refuge complex between 1936 and 1941. Their activities focused not only on buildings, roads, and other facilities, but also on the construction of dams and levees to impound water. Recognizing the importance of the Milk River system to the Lake Bowdoin Migratory Waterfowl Refuge (now Bowdoin National Wildlife Refuge), the Bureau of Biological Survey (now U.S. Fish and Wildlife Service) contributed funds for the construction of the Fresno Reservoir Dam near Havre, Montana, in exchange for a 3,500 acre-foot water right. This agreement was signed on March 7, 1937, and the Milk River Project still serves as the main source of water for Bowdoin National Wildlife Refuge.

Construction projects completed by the Works Progress Administration at the Bowdoin Refuge headquarters were a residence for the manager, an office, a shop and service building, vehicle storage, an observation tower, and a road to the headquar-

ters area. The office building and residence were unique for the time—instead of the concrete block buildings common in this era, the crews built wood structures due to the availability of salvaged wood from dismantled farmsteads on other refuges. The shop building burned down soon after being built, and a new structure was built on the concrete foundation. Crews also landscaped the headquarters area, constructed the two stone pillars that still stand at the refuge entrance driveway, put in flagstone walks, developed a 10-acre garden and orchard, and installed overhead electric lines from Malta to the new headquarters.

Early habitat projects completed by Works Progress Administration crews on Bowdoin Refuge included planting trees, shrubs, and aquatic vegetation, collecting rock, constructing nesting islands on Lake Bowdoin, and constructing water delivery and control systems. Many other refuge projects were also accomplished by the Works Progress Administration "boys" when refuge managers were able to get funding and workers, which was often difficult according to refuge narratives. While none of the buildings or bridges constructed by the Works Progress Administration crews survived, most of the dams, dikes, ditches, and a few water control structures still exist. In addition, a small National Youth Administration crew was employed in 1937 to conduct a nest and brood count throughout Bowdoin Refuge.

The Works Progress Administration was pivotal to the establishment of all four satellite refuges. During this Dust Bowl era, the country and the Government were very focused on capturing and conserving water for wildlife, particularly waterfowl, and agricultural operations. Water impoundments were popularized when the connection was made to employing out-of-work citizens to build the structures needed to impound and manage limited water resources. Most of this work was completed on public lands, except for the privately owned easement refuges, known today as limited-interest refuges. These limited-interest refuges are encumbered by a refuge or flowage easement, or both, and the Service has acquired less than 10 percent of the refuge acquisition boundary. By definition, only Lake Thibadeau is considered a limited-interest refuge, but the remaining satellite refuges (Black Coulee, Creedman Coulee, and Hewitt Lake) have their origins in this program. These types of refuges are found not only in Montana, but also in North Dakota and South Dakota. Most of the land within these refuges is still in private ownership and the refuges do not fully function as fee-title refuges, hence the name, limited interest. The Works Progress Administration constructed dams, spillways and water control structures on the private lands of what was to become Black Coulee, Greedman Coulee (now Creedman Coulee), Hewitt Lake, and Lake Thibadeau National Wildlife Refuges. Willing landowners signed perpetual refuge and flowage easements granting the Government the right to construct and maintain these structures; control the uses that occur on these impoundments and other

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Crews from the Works Progress Administration constructed several buildings for the Bowdoin Refuge headquarters (1961).

lakes, rivers, and streams; and control hunting and trapping. The real benefit to these landowners was a more reliable water source; as an added benefit, some of these landowners were also employed by the Government to build these impoundments. Most of the structures are still functioning, but due to development in the watershed, much of the water that once flowed into these impoundments is captured before it ever reaches some refuges. Some habitat work was conducted by the Works Progress Administration crews including planting seed balls of sago pondweed (a desirable aquatic plant) in Hewitt Lake and constructing a nesting island at Black Coulee.

4.5 Special Management Areas

Areas with official designations are managed to retain the special features that led to their designation. While not suitable for wilderness, the Bowdoin National Wildlife Refuge has been identified as an important bird area.

Wilderness Review

A wilderness review is the process used for determining whether to recommend Service lands or waters to Congress for designation as wilderness. The Service is required to conduct a wilderness review for each refuge as part of the CCP process. Lands or waters that meet the minimum criteria for wilderness would be identified in a CCP and further evaluated to determine whether they merit recommendation for inclusion in the Wilderness System. To be designated a wilderness, lands must meet certain criteria 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 to make practicable its preservation and use in an unimpaired condition
- May also contain ecological, geological, or other features of scientific, educational, scenic, or historical value

Bowdoin Refuge is the only unit in the refuge complex that meets the wilderness criteria for size and for scientific, scenic, and ecological value. In 1973, the refuge was evaluated for inclusion in the Wilderness System by the Bureau of Sport Fisheries and Wildlife (now the U.S. Fish and Wildlife Service). The report concluded that Bowdoin Refuge was not suitable for this designation due to the extensive development and intensive management needed to meet refuge objectives (Bureau of Sport Fisheries and Wildlife 1973). This still holds true today. The refuge landscape has been altered by roads, fences, and extensive human effects from livestock grazing and wetland modifications that would preclude it from being designated a wilderness.

Important Bird Area

Bowdoin National Wildlife Refuge has been designated as an important bird area through a program administered by the National Audubon Society. This program is a global effort to identify and conserve areas that are vital to birds and for biodiversity. Important bird areas are sites that provide essential habitat for one or more species of birds. These areas include sites for breeding, wintering, or migrating birds. Important bird areas may be a few acres or thousands of acres, but usually they are discrete sites that stand out from the surrounding landscape. Important bird areas may include public or private lands, or both, and they may be protected or unprotected (National Audubon Society 2010). To qualify as an important bird area, sites must satisfy at least one of the following criteria to support the following types of bird species groups:

- Species of conservation concern (for example, threatened and endangered species)
- Restricted-range species (species vulnerable because they are not widely distributed)
- Species that are vulnerable because their populations are concentrated in one general habitat type or biome
- Species or groups of similar species (such as waterfowl or shorebirds) that are vulnerable because they occur at high densities due to their behavior of congregating in groups

More than 260 species of birds have been documented on the Bowdoin National Wildlife Refuge. The list of species breeding on the refuge has 19 species of global and continental conservation concern.

- *Global Concern*—ferruginous hawk, piping plover, long-billed curlew, red-headed woodpecker, Sprague's pipit, Brewer's sparrow, chestnut-collared longspur

- *Continental Concern*—northern harrier, Swainson's hawk, upland sandpiper, marbled godwit, Wilson's phalarope, common tern, burrowing owl, short-eared owl, willow flycatcher, loggerhead shrike, Baird's sparrow, McCown's longspur

© Michael Forsberg

The upland sandpiper uses habitats on the refuge complex and is a species of continental concern.

The Bowdoin Refuge has one of only four nesting colonies of American white pelicans and one of only five nesting colonies of Franklin's gulls in Montana.

Western Hemisphere Shorebird Reserve Network

Because of the concentrations of migrating shorebirds, the Western Hemisphere Shorebird Reserve Network recognizes Lake Bowdoin as a site of regional importance.

4.6 Visitor Services

Visitors to the Bowdoin Refuge Complex enjoy a variety of wildlife-dependent, public use activities such as hunting, fishing, wildlife observation, photography, environmental education, and interpretation. Most visitors use the Bowdoin Refuge's 15-mile auto tour route. Brochures containing area maps, public use regulations, bird species, and general information are available for the units in the refuge complex.

The Bowdoin National Wildlife Refuge office is open Monday–Friday, 7:30 a.m.–4:00 p.m. The auto tour route and remainder of the refuge are open from dawn to dusk, except during hunting season when hunters are allowed reasonable time to access hunting areas when arriving before dawn and leaving after dusk. The report Banking on Nature 2004—The Economic Benefits to Local Communities of National Wildlife Refuge Visitation shows that in 2004, 7,147 individuals made 5,217 recreational visits to Bowdoin National Wildlife Refuge (Caudill and Henderson 2005). About 83 percent of these visits were by nonresidents. Hunting accounted for about 23 percent of the visits while the remainder of the outings is attributed to other activities such as wildlife observation, photography, and hiking. Hunters are required to register at a kiosk located in front of the headquarters building so these numbers are fairly accurate. Visitors are asked to sign the guest register at the headquarters entrance, but registration is not mandatory. Nonhunting use is estimated each year based on the guest register and headcounts of education and interpretation groups.

No documented visitation data is available for the rest of the refuge complex; nevertheless, the Service estimates that current visitor use throughout the refuge complex is approximately 25,000 annually.

Hunting

In addition to the site-specific regulations mentioned below, all State of Montana hunting regulations apply to Service lands in the refuge complex. Shotgun hunters may only possess and use nontoxic shot on lands within the refuge complex, and vehicle travel and parking is restricted to roads, pullouts, and parking areas.

Bowdoin National Wildlife Refuge

Public hunting of migratory game birds (ducks, geese, coot, swan, sandhill crane, and mourning dove), upland game birds (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge), fox, and coyote is permitted in the designated portions

USFWS

Carmen Luna / USFWS

Waterfowl hunting continues to be popular at the Bowdoin Refuge Complex (1940 top photo; 2009 bottom photo).

(about 40 percent) of Bowdoin Refuge (figure 28). An accessible boat dock, pier, and parking area are available at the west boat launch on Lake Bowdoin. Boating is only allowed on the refuge during the hunting season and only in those areas open to hunting. A 25-horsepower boat motor limit protects submerged aquatic vegetation in the refuge's shallow wetlands. Big game hunting is not allowed at the refuge and predator hunting (fox and coyote) requires a special use permit approved by the refuge manager.

Since 2002, the eastern portion of the refuge that is normally closed to hunting has been opened to upland game bird hunting throughout December. The first 2 days of the special opening are limited to only young hunters. Waterfowl generally remain on Bowdoin Refuge until freeze up. To avoid disturbance to these migratory birds, the opening of the late-season hunt for upland game birds is contingent on waterfowl being gone by November 30.

Black Coulee National Wildlife Refuge

Black Coulee comprises fee-title refuge lands and waterfowl production areas, which are surrounded by private lands encumbered by Service easements. The hunters wanting access to these private lands must get permission from the landowner. Another portion of the refuge was acquired as Black Coulee WPA; hunting here can be challenging, because public use regulations for refuges are different from those for waterfowl production areas. Hunting is open to the general public on the waterfowl production area. Hunting on the refuge is open but requires landowner permission to access private lands. The refuge is otherwise open to hunting for big game, migratory game birds (ducks, geese, coot, swan, sandhill crane, and mourning dove), and upland game (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, fox, and coyote). Hunters must follow State game laws including seasons and limits when hunting on this refuge.

Creedman Coulee National Wildlife Refuge

Most of the land within the refuge boundary is private land and hunters wanting access must get permission from the landowner. The refuge is otherwise open to hunting for big game, migratory game birds (ducks, geese, coot, swan, sandhill crane, and mourning dove), and upland game (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, fox, and coyote). Hunters must follow State game laws including seasons and limits when hunting on this refuge.

Hewitt Lake National Wildlife Refuge

A portion of the land within the refuge boundary is private land and hunters wanting access to this inholding must get permission from the landowner. A portion of the land within the Executive boundary was acquired as Hewitt Lake WPA. The refuge is otherwise open to hunting for big game, migratory game birds (ducks, geese, coot, swan, sandhill crane, and mourning dove), and upland game (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, fox, and coyote). Hunters must follow State game laws including seasons and limits when hunting on this refuge.

Lake Thibadeau National Wildlife Refuge

Most of the land within the refuge boundary is private land and hunters wanting access must get permission from the landowner. The refuge is otherwise open to hunting for big game, migratory game birds (ducks, geese, coot, swan, sandhill crane, and mourn-

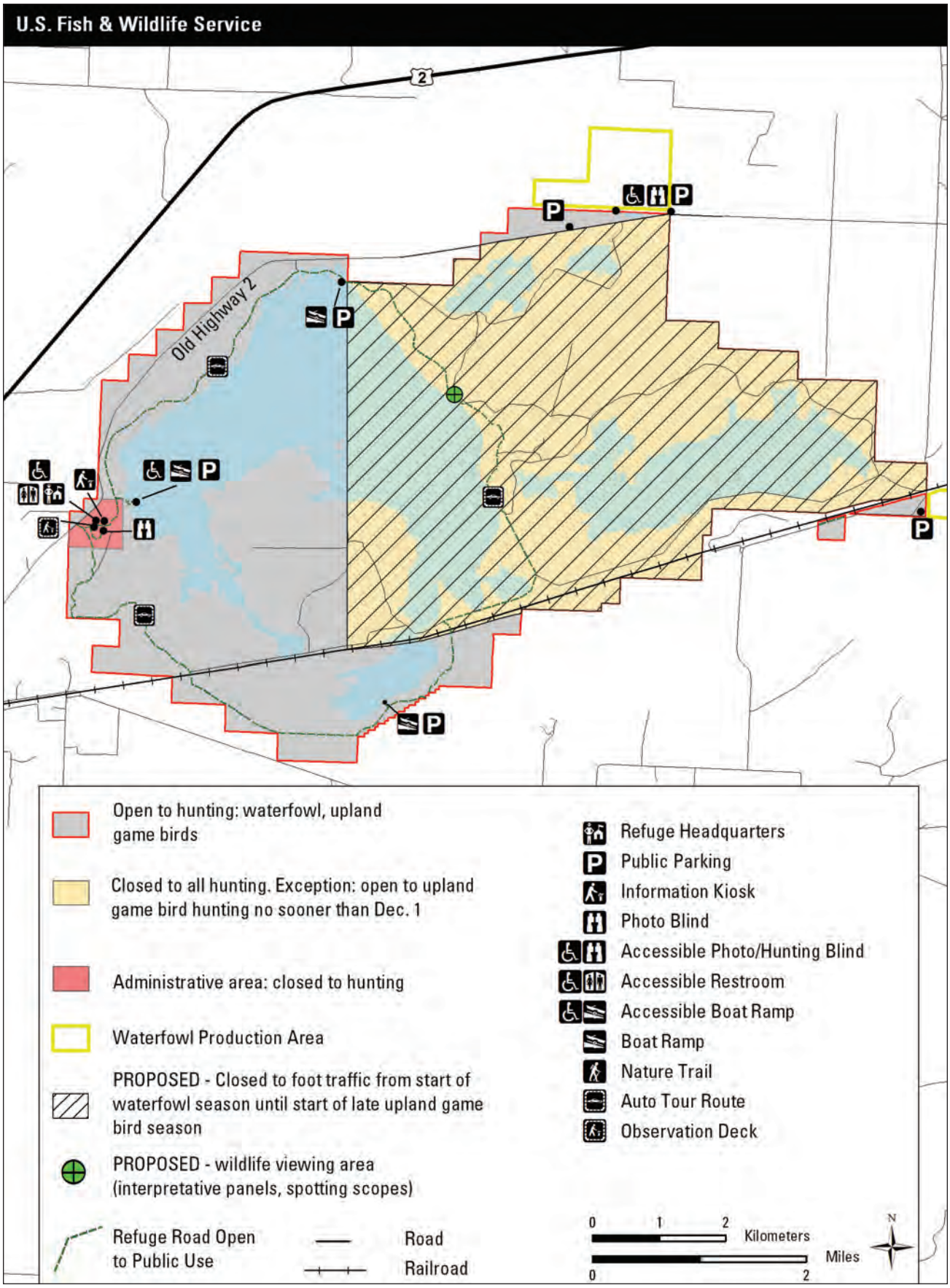


Figure 28. Map of current and proposed public use sites and activities at Bowdoin National Wildlife Refuge, Montana.

ing dove), and upland game (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, fox, and coyote). Hunters must follow State game laws including seasons and limits when hunting on this refuge.

Waterfowl Production Areas

Except for Holm WPA, all waterfowl production areas within the Bowdoin Wetland Management District are open to hunting big game, migratory birds, upland game, and furbearers according to State game laws and regulations. Big game hunting on McNeil Slough WPA is restricted to archery, muzzleloader, and shotgun only. The Pearce WPA has an accessible hunting and photography blind and a parking area.

Fishing

Although recreational fishing opportunities are available on McNeil Slough WPA (Milk River) and Beaver Creek WPA (Beaver Creek), the Service does not actively manage sport fisheries within the Bowdoin Wetland Management District. The remaining wetlands within the refuge complex have only minimal habitat or high salinity levels, or both, and do not support a game fishery. Bowdoin Refuge is closed to fishing to provide a refuge for migratory birds and due to the poor fish habitat as a result of high salinity levels.

Anglers have many quality fishing opportunities on other public lands around the refuge complex including Nelson Reservoir, Cole Ponds, Milk River, Missouri River, Fort Peck Lake, and stocked ponds on both public and private lands (Missouri River Country 2007).

Wildlife Observation and Photography

Opportunities for wildlife observation and photography are abundant within the Bowdoin National Wildlife Refuge Complex, and more than 25,000 people visit annually for these purposes.

The Bowdoin Refuge's bird list can be used across the entire refuge complex. The Bowdoin Refuge's 15-mile auto tour route guides visitors through a variety of wildlife habitats. The auto tour route is graveled and is maintained throughout the year but may be closed periodically due to impassable or hazardous conditions. Binoculars and field guides can be checked out at the refuge headquarters. Near the headquarters office, the 0.4-mile Display Pond Trail (walking) features a photography blind for visitors including those with disabilities. The refuge is also a designated stop on the Northeastern Montana Birding Trail. Walk-in access is allowed anywhere on the refuge except for the closed area surrounding the shop, equipment storage, and residential areas. Boating is only allowed on the refuge during the hunting season and only in those areas open to hunting. A 25-horsepower boat motor limit protects submerged aquatic vegetation in the refuge's shallow wetlands.

Parking and walk-in access is allowed on the satellite refuges and the waterfowl production areas in Bowdoin Wetland Management District. People wishing to access the easement portions of the satellite refuges must gain permission from the affected landowners. The Pearce WPA has an accessible photography blind.

Commercial filmmakers and still photographers must acquire a special use permit to work on Service lands. The permit specifies regulations and conditions that the permittee must follow to protect the wildlife and habitats they have come to capture on film and to prevent unreasonable disruption of other visitors enjoyment of the refuge complex. Commercial filming and photography on Service lands must also demonstrate a means (1) to generate the public's appreciation and understanding of the refuge's wildlife and their habitats and the value and mission of the National Wildlife Refuge System, or (2) to facilitate the outreach and education goals of the refuge complex.

Environmental Education

The diversity of habitats and wildlife found throughout the Bowdoin Refuge Complex make it an ideal "classroom" for the area's environmental education needs. The refuge complex staff has instituted educational programs—such as the wildlife poetry, wildlife art, and centennial quilt contests—to promote an appreciation and understanding of the wildlife and habitats the refuge complex was established to protect. Teacher workshops have been offered at Bowdoin Refuge in cooperation with Montana State University–Northern (Havre, Montana). Unfortunately, limited staff and resources are making environmental education programs increasingly rare and opportunistic, except for annual events such as the following:

- Migratory Bird Day
- Enrichment Days (a 2-day educational event in conjunction with the local schools, area businesses, organizations, and other agencies)
- National Wildlife Refuge Week

A variety of elementary and high school science classes have used the refuge as an outdoor classroom. School groups can check out the wetland teaching trunk, bat teaching trunk, binoculars, birding field guides, and a variety of wildlife videos to use on or off the refuge. Slide presentations about local birds and bats are also available and can be taken to the classroom or used for onsite programs.

Interpretation

Most of the public brochures and interpretive panels have been updated following Service guidelines. Brochures containing area maps, public use regulations, and general information are available for the refuge complex and include the following:

- Auto tour interpretive guide highlighting the numbered stops
- General brochure for Bowdoin Refuge
- Bird list for Bowdoin Refuge

David Brezinski / USFWS

The Baltimore oriole uses riparian habitat.

- Public use regulations for Bowdoin Refuge
- Public use regulations for Bowdoin Wetland Management District, including the satellite refuges

These brochures are available at the refuge complex headquarters and at the main kiosk. The kiosk has three interpretive panels displaying a location map, general refuge information, wetland facts, and information about habitat management techniques. In addition, the refuge complex's Web site provides information about programs and regulations.

The Service has provided local newspapers with periodic news articles on refuge complex activities and informative articles on the values and protection of the area's natural resources. Monthly updates on refuge complex activities are also prepared for the Malta Chamber of Commerce.

4.7 Management Uses

The Service manipulates habitat through several management uses that are carried out under specific, prescribed conditions to meet the needs of wildlife and habitat management and to reduce hazardous fuel loading—cooperative farming, prescribed burning and haying, and prescriptive grazing.

Cooperative Farming

Restoration of cropland and DNC fields back to native species is quite time and labor intensive. Therefore, the refuge complex addresses this habitat need by working with cooperative farmers to gradually convert disturbed grasslands to native grasses, forbs, and shrubs, which have the greatest potential to survive and outcompete invasive species while providing habitat to grassland-dependent migratory birds.

Cooperative farming of Service lands is usually done on a share basis where the Service and the cooperator each receive a share of the crop. The Service may retain its share (1) as standing cover for wildlife forage, (2) in exchange for additional work from the cooperator such as invasive plant control and grass seeding, or (3) in exchange for supplies from the cooperator such as herbicides and fence materials for habitat protection and improvement. Any fees or cash income received by the Service are deposited in the Refuge Revenue Sharing Account. The refuge manager issues farming cooperators a cooperative farming agreement or a special use permit. Subsequently, cooperators are allowed to (1) till, seed, and harvest small grain, (2) control invasive

plants, or (3) harvest hay on the restoration site until native seed can be planted and becomes established. These agreements are generally issued for a 2- to 4-year management prescription but in some cases may extend longer to allow time for establishment of native plants.

Prescribed Burning, Haying, and Grazing

Scientific and management communities largely agree that continuous idling of grassland is a poor management choice in comparison to periodic treatment to rejuvenate grasslands. Continuous idling (for example, more than 10 years) without periodic treatment as a conscious management decision fails to address long-term grassland health (Naugle et al. 2000). Methods used by managers to rejuvenate grasslands are prescribed burning, haying, and grazing. Periodic rejuvenation of vegetation is necessary to maintain optimum plant vigor, remove excessive litter, and stimulate plant height and density. Litter accumulations not only negatively affect the health of stands of vegetation but also negatively affect duck production (Naugle et al. 2000) as well as other wildlife that depend on grassland habitats.

Methods used by managers to rejuvenate grassland are haying (predominantly in seeded grasslands) and burning and grazing (predominantly in native prairie).

Prescribed Burning

Prescribed fire is recommended as a primary grassland management treatment whenever possible, because fire provides the fastest and most effective means of litter removal (Naugle et al. 2000). Most grasses and forbs respond positively to burning in the grassland of the northern Great Plains. Nonetheless, care must be taken when using fire to manage grasslands in drier climates, such as in eastern Montana. The use of fire may have a negative vegetation response due to longer recovery periods attributed to reduced litter and soil moisture, increased evapotranspiration rates and solar radiation, less snow retention, and poorer water infiltration (Henderson 1982, Hulbert 1986, Old 1969, Wright and Bailey 1980).

Bird species native to northern mixed-grass prairie are well adapted to defoliation by fire (Murphy et al. 2005). In general, decreases in species abundance and nesting density during the first growing season after prescribed burning are offset by increases in following years compared to pre-burn levels; nest survival appears unaffected. The short-term unavailability of breeding habitat probably is outweighed by the long-term benefits from using prescribed fire to restore and maintain vegetation structure and to manage the fuel load by reducing accumulated litter and woody vegetation. Data collected by Murphy et al. (2005) in the plains of North Dakota indicates that occurrence and survival of nests of some bird species is negatively associated with the extent of trees and tall shrubs in the landscape. Efforts to reduce these fuels via prescribed fire seem warranted for improving the productivity of grassland birds as well as addressing other prairie restoration objectives.

James Graham / USFWS

The Service uses prescribed fire to rejuvenate grasses and reduce vegetative litter.

In presettlement times, the frequency of wildfire was variable, occurring every 5–10 years (Frost 1998, Wright and Bailey 1980). However, very little research has been conducted regarding fire in the drier prairies of north-central Montana. Askins et al. (2007) suggest that grazing and the lack of moisture maintained grass as the dominant vegetation with fire playing a lesser role; they estimated a fire-return interval of 10–26 years for eastern Montana. Wildfires have been greatly suppressed since settlement by Europeans, and the use of prescribed fire by the Service and other groups or agencies has been sporadic.

Based on information regarding vegetation recovery intervals and bird-nesting studies, Naugle et al. (2000), recommends 3- to 10-year fire intervals in the wetter regions of the northern Great Plains and 10-year or greater intervals in the drier mixed-grass and shortgrass zones. Since 2000, the Bowdoin Refuge Complex has increased the use of prescribed fire as a habitat management tool to improve plant diversity and structure and to improve grassland habitat for upland-nesting birds and other wildlife. However, before an extensive prescribed fire program can occur, a greater understanding of fire frequency in this arid climate is needed.

Mike Artmann / USFWS

Winterfat

Haying

About 4,478 acres of Service-owned uplands had been cultivated by the previous landowner. Since Service acquisition, most of these previously farmed areas have been converted to dense nesting cover or native grasses. The restoration of cropland to seeded grassland such as DNC is relatively easier to establish, less expensive than native prairie restoration, and provides valuable wildlife habitat. In the 1970s, 200 acres of native prairie habitat on Bowdoin Refuge was "broken" to plant DNC to enhance nesting habitat for waterfowl (Duebbert 1969). Of the remaining 4,278 acres, 465 acres have been restored to native grasses. Seeded grasslands such as DNC fields must be periodically rejuvenated to maintain optimal nesting cover for migratory birds and optimal plant vigor. Nesting waterfowl using DNC fields require vigorous stands of vegetation with the tallest, most dense cover form that is possible under prevailing soil and climate conditions (Duebbert et al. 1981).

Restoration of previous cropland areas to DNC or native grasses is initially very time-intensive. It requires seedbed preparation by tilling, use of control measures to reduce or eliminate undesirable plants or weeds, planting of a protective annual crop for 1–2 years, and finally planting of grasses into the remaining crop stubble. Once established, DNC fields require periodic disturbance (mainly haying) every 4–10 years to maintain plant vigor. An exact schedule for disturbance of these fields is not possible because of other contributing variables such as the accumulation of vegetative litter, soil, and climate conditions. The average life expectancy of a DNC field is approximately 20 years, before plant diversity has declined and it becomes necessary to re-establish it. DNC fields in the refuge complex have been established for 20 or more years and are in need of replanting. Given the intensive management requirements along with the limited lifespan of DNC fields, the refuge complex has been gradually working to reseed DNC fields to native grasses. The only fields that will remain as DNC will be parcels of land regarded as highly erodible.

Native grass restoration initially is as intensive as the planting of DNC fields but once established it should never require further restoration other than invasive plant management and periodic disturbance by prescribed fire, haying or grazing. Restoration of fields to native grasses depends on the availability of funds as well as climate conditions and the establishment of native grasses.

Grazing

Historically, vast herds of bison ranged throughout north-central Montana. The mixed-grass prairie evolved and depended on these native grazers for its diversity and productivity. As bison were eradicated, cattle were brought in to graze on the large, expansive grasslands—most of the area that is now the Bowdoin National Wildlife Refuge Complex was extensively grazed by domestic livestock. Bowdoin Refuge uplands were grazed more heavily than other areas because of the presence of a reliable source of water in Lake Bowdoin. Today, native grazers such as pronghorn, white-tailed deer, and mule deer continue to browse and graze the uplands. Their grazing habits are different from that of bison or cattle, but it is not certain what effects these native big game grazers have had on upland vegetation communities, particularly at Bowdoin Refuge. Observations have shown that pronghorn and other native ungulates may be overharvesting plant species that they prefer to eat such as winterfat, resulting in overbrowsing this native plant.

After Bowdoin Refuge was established, grazing continued until it was gradually phased out between 1973 and 1977. The plan at that time was to rest areas indefinitely, and then to resume grazing on a periodic basis as needed, anticipating intervals of 6–10 years. In 1986, a short-duration, high-intensity grazing experiment was conducted on Bowdoin Refuge with an objective to break up large mats of clubmoss. Prescriptive grazing was not used again on the refuge complex until 2001. The objectives of the limited grazing program started in 2001 are to promote a diversity of native species and to control invasive plants by mimicking bison grazing and subsequently benefitting the mixed-grass prairie

through control of vegetative litter and increased plant production and diversity.

The right to graze the lands encumbered by refuge and flowage easements in the four satellite refuges is maintained by the private landowners.

4.8 Socioeconomic Environment

Most of the Bowdoin National Wildlife Refuge Complex is open to public use including the compatible, wildlife-dependent uses of hunting, fishing, wildlife observation, and photography. These recreational opportunities attract outside visitors and bring in dollars to the community. Associated visitor activity—such as spending on food, gasoline, and overnight lodging in the area—provides local businesses with supplemental income and increases the local tax base. Management decisions for the refuge complex about public use, expansion of services, and habitat improvement may either increase or decrease visitation to the refuge complex and, thus, affect the amount of visitor spending in the local economy.

As part of the CCP process, the Service had a contractor prepare an socioeconomic study for the Bowdoin Refuge Complex (BBC Consulting 2010), which is the basis for the following sections described below: population and employment, public use of the refuge complex, and baseline economic activity.

Population and Employment

The refuge complex is located throughout Valley, Phillips and Blaine counties; a portion of the refuge complex is also located within Hill County. The entireties of these four counties comprised the socioeconomic study area.

Population and Demographics

The population of the four-county study area was estimated to be 33,741 in 2008. Hill County has the largest population (16,500) among the included counties while Phillips County has the smallest population (3,900) as well as the most refuges and waterfowl production areas in the refuge complex. Blaine and Valley counties have similarly sized populations (6,500 and 6,900 respectively). The population of the study area declined by 5 percent between 1990 and 2000, from 37,800 to 36,000. The population of Montana grew by 13 percent from 800,000 to 900,000 over the same period. Future population projections for the study area and the State overall are expected to follow historical trends: the study area population is expected to decline slowly, and the State population will increase slowly.

In 1990, about 18 percent of the population was between 45 and 64 years old; that same demographic constituted 22 percent of the population in 2000 and 27 percent in 2008. All other age groups are holding steady or have declined except for young adults whose population has grown slightly since 1990.

Employment

Employment in the four-county study area grew slowly between 2001 and 2007 from 19,700 to 21,000, an increase of 7 percent. Hill County had the largest workforce with 10,414 employees, followed by Valley County (4,820), Blaine County (3,144), and Phillips County (2,687). As of December 2009, the unemployment rate for Blaine County was 5.3 percent, Hill County was 4.9 percent, Phillips County was 6.5 percent, and Valley County was 5.2 percent. These compared favorably with a statewide unemployment level of 6.8 percent (U.S. Bureau of Labor Statistics 2009).

The study area primarily employs individuals in government, farm employment, retail trade, accommodations, food services, and construction. Government establishments employed 22 percent of the workforce while farm employment accounted for 15 percent of the workforce. Retail trade was the largest private, nonfarm source of employment (12 percent).

Public Use of the Refuge Complex

Public use and visitation levels are described below.

Public Use

Wildlife observation, photography, and hiking (nonconsumptive activity) account for 77 percent of visits to the refuge complex (Caudill and Henderson 2005). Most wildlife observers visit in the spring and summer, when the greatest numbers of migratory birds inhabit the area.

Hunting accounts for the remaining 23 percent of visitation to the refuge complex. Public hunting of migratory game birds and upland game birds are most popular. Predator hunting (fox and coyote) is allowed throughout the refuge complex. Big game hunting is allowed throughout the refuge complex except at Bowdoin Refuge and Holm WPA.

Fishing is permitted only on McNeil Slough WPA and Beaver Creek WPA. Most wetlands within the refuge complex have minimal habitat for fish or high salinity levels that cannot support a game fishery. In 2004, there were no fishing recreation visits to the refuge complex (Caudill and Henderson 2005).

Occasionally, Bowdoin Refuge offers environmental education opportunities including school group tours, Migratory Bird Day, Enrichment Days, and National Wildlife Refuge Week.

Camping and fires are not allowed on the refuge complex; however, the Bureau of Land Management oversees land around the refuge complex, which is open for camping. There are also several motels located in the town of Malta as well as two recreational vehicle campgrounds.

Visitation Levels

Annual visitation to the entire Bowdoin National Wildlife Refuge Complex is an estimated 25,000 people according to Service staff. Visitation is most heavily concentrated during wildlife-viewing seasons in the fall and spring and hunting season in the fall. Bowdoin Refuge staff estimates that 90 percent or 22,500 of all visitor days at the refuge complex are from outside the four-county study area. Of the total visitors to the refuge complex, the visitation breakdown follows:

- 12,680 visitor days are for wildlife viewing
- 6,646 visitor days are for hiking and walking
- 5,674 visitor days are for hunting of big game, predators, upland game birds, and migratory birds

Baseline Economic Activity

The refuge complex affects the economy through the nonresident visitor spending it generates and the employment it supports. Combining the effects of Service employment and visitor spending, the total economic activity generated by the refuge complex in the four-county study area is approximately $910,000 annually.

U.S. Fish and Wildlife Service Employment

The refuge complex employs five full-time equivalent employees and has a payroll of $398,553, or about $80,000 per employee. Using the Bureau of Labor Statistics Consumer Expenditure Survey data for individuals in these income categories, roughly 79 percent of annual income is spent locally. Under this assumption, the refuge complex contributes $316,000 to the local economy in employee spending.

Visitor Spending

The refuges and waterfowl production areas in the refuge complex currently experience total visitation of about 22,500 nonresident visitor days per year. Of these, roughly 17,400 visitor days are for nonconsumptive recreational activities and 5,100 are for hunting. Combining these visitation numbers with nonresident spending averages from the Banking on Nature study, total visitor expenditure generated by the refuge complex is estimated to be $594,000 per year. Of this total, about $313,000 comes from nonconsumptive recreational activity and $281,000 comes from hunting.

4.9 Partnerships

The Bowdoin National Wildlife Refuge Complex has a history of fostering partnerships that help accomplish its vision and goals. These organizations and individuals with whom a common goal is shared include county, State, and Federal agencies; nongovernmental organizations and conservation groups; schools, colleges, and universities; and local landowners and private citizens. These partners have assisted in wildlife and habitat management, visitor services and recreational activities, land protection and acquisition, fire protection, law enforcement, and community outreach. Several of these relationships have developed into formalized partnerships with written agreements or memoranda of understanding while others remain more informal.

Private lands and significant acreages of Federal and State lands surround the refuge complex. Activities on and uses of these lands have a tremendous effect on the adjacent Service lands. These neighboring landowners and agencies have been and will continue to be partners in achieving the refuge complex's vision while sharing ideas and resources.

4.10 Operations

Service operations consist of the staff, facilities, equipment, and supplies needed to administer resource management and public use programs throughout the Bowdoin National Wildlife Refuge Complex, which is located across a four-county area totaling 17,183 square miles. Within this area, the

Service is responsible for the protection of 85,713 acres of lands and waters including 17,009 acres of refuge lands, 10,635 acres of wetland easements, 39,767 acres of grassland easements, and 9,504 acres of fee-title waterfowl production areas.

Staff

Currently, the Bowdoin National Wildlife Refuge Complex staff comprises five permanent full-time employees (table 8). Since 1998, the refuge complex has lost two positions—one permanent biological science technician and a permanent maintenance worker. The current staffing level remains well below the minimum prescribed in the June 2008 Final Report—Staffing Model for Field Stations (USFWS 2008c), which recommended 6.5 additional staff including a GS–13 refuge manager, GS–12 wildlife refuge specialist, GS–9 park ranger (visitor services specialist), GS–9 park ranger (law enforcement), GS–12 wildlife biologist, WG–8 maintenance worker, and GS–6 biological science technician (0.5 full-time equivalent employee).

Table 8. Base staff funded in fiscal year 2011 at Bowdoin National Wildlife Refuge Complex, Montana.

Staff group	*Position*
Management	GS–12 refuge manager GS–9 wildlife refuge specialist (assistant refuge manager and collateral duty law enforcement officer)
Biology	GS–11 wildlife biologist
Administration	GS–7 administrative support assistant
Maintenance	WG–8 maintenance worker

Facilities

Facilities are used to support habitat and wildlife management programs and wildlife-dependent public use activities for visitation estimated at 25,000 visitors annually. The refuge complex has one full-time maintenance worker to maintain buildings, fences, and roads.

Facilities have remained fairly updated over the years. The refuge headquarters and shop were built in 1980 and have been maintained in good condition. The headquarters was expanded in 2003, adding five new offices and a mailroom. Two new houses were constructed in 2001 to provide housing for refuge employees. In addition, the apartment building used for seasonal housing was remodeled in 2004 but still does not have sufficient space for the number of volunteers and seasonal employees needed to accomplish field projects. A new cold storage building with five parking bays was constructed in 2009.

Bowdoin Refuge Facilities

- 5,241-square-foot headquarters office building
- 0.25-mile asphalt entrance road and parking area
- 15-mile, self-guided auto tour route (graveled)
- Solar-powered entrance gate with a timer
- Two kiosks including interpretive signs
- 0.4-mile hiking trail (paved) with one photo blind, bench, and overlook
- Two 2,700-square-foot, three-bedroom houses for staff; two unattached two-car garages with houses (684 and 672 square feet)
- 2,184-square-foot, two-bedroom bunkhouse apartment for seasonal staff with three parking bays
  - 3,472-square-foot maintenance shop and storage facility
  - 3,600-square-foot cold storage building with five parking bays
  - 600-square-foot storage shed for the airboat
  - 700-square-foot storage shed for all-terrain vehicles and field equipment
  - 348-square-foot seed storage shed
  - Two aboveground fuel tanks

Bowdoin Refuge Complex Facilities

- 62 miles of road (40 miles are Service-only roads and 22 miles are open to the public)
- 34 pullouts and parking areas
- 10 bridges (2 are Service-only bridges and 8 are open to the public)
- 90 miles of boundary fence
- Eight entrance signs
- 137 water control structures
- 32 miles of canals and dikes

CHAPTER 5—Environmental Consequences

Patience Wiederrick / USFWS

Sunrise at Lake Bowdoin

This chapter provides an analysis of the potential effects on the environment associated with the implementation of the management alternatives for the Bowdoin National Wildlife Refuge Complex, Montana. The U.S. Fish and Wildlife Service assessed the environmental consequences of implementing each of the alternatives on the physical, biological, socioeconomic, and cultural resources of the refuge complex.

Note: Environmental consequences for two separate analyses—(1) proposed divestiture of Lake Thibadeau National Wildlife Refuge, and (2) proposed action to address the salinity and blowing salts issues at Lake Bowdoin—are described in chapters 3 and 6, respectively, and are not repeated here.

5.1 Analysis Methods

The determination of effects is evaluated at several levels including whether the effects are adverse or beneficial and whether the effects are direct, indirect, or cumulative with other independent actions. In addition, the duration of effects is used in the evaluation of environmental consequences.

Direct effects are those where the effect on the resource is immediate and the direct result of a specific action or activity. Examples of a direct effect include the effect of trail construction on vegetation along the trail or the effect of hunting on wildlife.

Indirect, or secondary, effects are those induced by implementation actions but that occur later in time or farther removed from the place of action through a series of interconnected effects. Examples of indirect effects include the effects on downstream water quality from an upstream surface disturbance or the effect that recreational use along a trail may have on nearby plant communities.

A cumulative effect is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7).

Impacts are often described in terms of their context, intensity, and duration. The duration of effects are either short term or long term. Short-term effects would persist for a period of 3–5 years and would consist primarily of temporary disturbance due to habitat restoration or facility construction and subsequent revegetation efforts. Long-term effects would last more than 5 years after project initiation and may outlast the 15-year lifespan of the CCP. Many long-term effects consist of long-term benefits to wildlife habitat resulting from management actions.

5.2 Effects Common to All Alternatives

The following potential effects would be similar under for each of the three alternatives:

- Implementation of the management direction (goals, objectives, and strategies) would follow the refuge complex's best management practices.
- Management activities and programs would avoid and minimize adverse effects on federally threatened and endangered species, to the extent possible and practicable.
- The refuge complex staff, contractors, researchers, and other consultants would acquire all applicable permits, such as those for future construction activities.

The sections below describe in more detail other effects expected to be similar for each alternative.

Regulatory Effects

As indicated in chapter 1 of this draft CCP, the Service must follow Federal laws, administrative orders, and policies in the development and implementation of its management actions and programs. Among these mandates are the National Wildlife Refuge System Improvement Act of 1997, the Endangered Species Act of 1973, the Clean Water Act of 1977, and compliance with Executive Order 11990–Protection of Wetlands and Executive Order 11988–Floodplain Management. The implementation of any of the alternatives described in this draft CCP and EA would not lead to a violation of these or other mandates.

Environmental Justice

Within the spirit and intent of Executive Order 12898–Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations, no actions being considered in this draft CCP and EA would disproportionately place any adverse environmental, economic, social, or health effects on minority or low-income populations compared with the general public.

The Service is committed to ensuring that all members of the public have equal access to the Nation's fish and wildlife resources, as well as equal access to information that would enable them to participate meaningfully in activities and policy shaping.

Cultural Resources

All of the alternatives would enhance cultural resources through protection of existing resources and extension of protection to newly discovered cultural resources.

There have been limited cultural resource surveys performed on the refuge complex, so additional surveys would be required before any new construction or excavation to fully satisfy provisions of the National Environmental Policy Act and other applicable acts and policies related to historical and archaeological resources.

Potentially negative effects from construction of trails or facilities would require review by the Mountain–Prairie Region's archaeologist and consultation with the Montana State Historic Preservation Office.

Climate Change

The actions proposed in this draft CCP and EA would conserve or restore land and habitat, thus retaining existing carbon sequestration throughout the refuge complex. This would contribute positively to efforts to mitigate human-induced global climate change.

The use of prescribed fire, which releases carbon dioxide, would result in no net loss of carbon because new vegetation would quickly replace the burned-up biomass. Overall, there should be little to no net change for carbon sequestered on the refuge complex from any of the management alternatives.

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

The refuge complex would continue to reduce its carbon footprint by using renewable energy and green technologies such as wind and solar energy.

Geology and Soils

All alternatives would positively affect soil formation processes on the refuge complex. Some disturbance to surface soils and topography would occur at locations selected for (1) administrative, maintenance, and visitor facilities; (2) removal and eradication of invasive plant species; and (3) restoration of native habitat.

5.3 Description of Consequences

Management actions are prescribed in the alternatives as a means for achieving the vision and goals for the refuge complex, while responding to issues raised by Service managers, the public, and governmental partners. Because management would differ for each alternative, the environmental and social effects resulting from implementation would likely differ as well.

The environmental consequences discussed in this chapter are the estimated potential effects on a resource from carrying out the actions of an alternative. "Chapter 3–Alternatives" presents the management scenario for each alternative that could create the consequences described here. The effects of each of the three alternatives—alternative A (no action), alternative B (proposed action), and alternative C—are described under the major resource topics described throughout this document.

In addition, table 5 (find in "Chapter 3–Alternatives") summarizes the alternatives' actions and the associated consequences as described below.

Upland Habitat and Associated Wildlife

This section discusses the effects of alternatives pertaining to native grassland, disturbed grassland, invasive species, shelterbelts, habitat protection and acquisition, and greater sage-grouse.

Native Grassland in Alternative A (No Action)

Using various management techniques (including burning, grazing, and resting periods), native grasslands would be maintained at current conditions providing marginal habitat for many grassland-nesting birds. The current management regime would maintain the dominance of clubmoss and increaser species while minimizing the regeneration of other native grasses and forbs. (Increaser species are those plants, primarily grass species, that increase or expand in response to grazing or herbivory. Many of these are introduced species, such as brome, that flourish in less diverse and disturbed habitats.

Currently, management actions are based on outside research and do not follow an established management plan. When management actions such as livestock grazing or burning do take place, there is no evaluation of habitat response. A lack of on-refuge experimentation, planning, and monitoring may result in undesirable habitat modifications and a continued decline of native grasslands.

Native Grassland in Alternative B (Proposed Action) and Alternative C

The Service would manage native grasslands to mimic the natural processes of burning and grazing (including timing and frequency). Rather than just maintaining the grasslands in their current condition, this would enhance the native grasslands with emphasis on restoring dominant historical communities that are still found within the refuge complex. Native plant species diversity would increase, providing improved habitat for most grassland-nesting birds, particularly those identified as target species (refer to table 13 in chapter 7) and other resident wildlife. However, any management practice, such as prescriptive grazing, that disturbs native areas may result in nonnative plant infestations if not closely monitored and treated. This type of monitoring can be very time-consuming and would require additional partners and staff.

Developing a management plan for grassland habitat would focus efforts and resources on the most critical needs using the latest proven technologies while guiding future management.

Disturbed Grassland in Alternative A (No Action)

Disturbed grasslands that were planted to DNC would be periodically treated using various techniques including burning, grazing, haying, clipping, and resting periods. Without rejuvenation (such as reseeding), most of the disturbed grasslands

have lost optimal species composition and structure needed for many nesting grassland birds.

As resources became available, cropland on waterfowl production areas would be restored to mainly native grasses and forbs, which increase plant diversity and nesting habitat for grassland birds and other wildlife. Since native plantings may take time to become established, planting DNC on hillsides and highly erodible lands would quickly stabilize soils while providing cover and nesting habitat for some grassland-nesting birds. To maintain the habitat qualities that make this type of grass seeding attractive to wildlife, these lands would require continual maintenance wherever prescribed management actions are used.

Disturbed Grassland in Alternative B (Proposed Action) and Alternative C

Same as alternative A, plus management would focus on the restoration of historical native plant communities in all disturbed grasslands, not just cropland. Converting these areas to native grasses and forbs that support the habitat needs of the selected target upland species (refer to table 13 in chapter 7) would provide greater plant species diversity and attract a wider variety of grassland-nesting birds. There would be considerable cost and effort to restore and maintain native grasslands.

Two short-term consequences of planting native vegetation would be (1) low-quality habitat for the first few years, and (2) the increased possibility of allowing invasive plants to become established. Due to the arid environment of the Bowdoin National Wildlife Refuge Complex, establishment of the native plantings may take several years and require annual maintenance of invasive plants until native vegetation gains a dominant edge.

By removing DNC from the landscape, some bird species that select for the composition provided by DNC may be displaced. In addition, managing grasslands for target bird species may reduce habitat for other nonselected, but desirable, species.

Invasive and Nonnative Species in Alternative A (No Action)

The Russian olive control effort has been slow and ineffective due to a lack of staff and funding needed to address the tremendous expanse of the invasion. Without comprehensive and consistent treatment of rapidly spreading Russian olive trees, they would continue to fragment the native grasslands, which would negatively affect migratory grassland birds and other native wildlife. This loss of habitat would prevent the refuge complex from meeting the purposes for which its units were established. Russian olive trees provide food, cover, and nesting and perching sites for some birds and mammals, but this includes nest predators (such as magpie, raptors, raccoon, and skunk) and nest parasites (such as brown-headed cowbird).

Using early detection and rapid response to control or eradicate small infestations of invasive and noxious species protects habitat. Lack of treatment on widespread infestations such as crested wheatgrass continues to provide low-quality nesting habitat and allows these infestations to spread into native areas, resulting in degradation of more upland-nesting habitat.

Invasive and Nonnative Species in Alternative B (Proposed Action)

Same as alternative A, except that refuge complex staff would work with the Service's Montana Invasive Strike Team and other partners to ensure that treated areas are mapped, restored with native plant species, monitored, and re-treated as necessary to prevent reinvasion. This would allow more efficient use of resources due to improved awareness, planning, treatment, and monitoring.

Large, contiguous blocks of grassland habitat would be restored with the removal of nonnative woody vegetation, particularly Russian olive trees. These larger blocks of unfragmented grassland habitat would provide nesting and cover habitat for a variety of grassland-dependent birds and other native wildlife, including the target species identified in table 13 in chapter 7. Predation of nests and young would be reduced and additional nesting territories would be provided. Restoration and followup treatments would eradicate Russian olive trees from target areas, preventing additional invasive plant problems. Species that feed and roost on Russian olive trees may migrate to native and other wooded habitats on and off the refuge complex. Initially, there would be some negligible loss of carbon sequestration from the removal of nonnative trees and shrubs, but the restored grassland and benefits to native wildlife would offset this.

Through partnerships, the Service would develop an education and outreach program that discusses the impacts of Russian olive trees on native habitat and wildlife, and would provide information on native trees (instead of nonnative Russian olive trees) to plant. Educating the public about the impacts of Russian olive trees may reduce off-refuge seed sources and increase off-refuge native plantings for the benefit of native wildlife.

Staff would conduct experiments within the refuge complex to determine the best methods for reducing crested wheatgrass and for restoring treated sites to native grasses. These experimental treat-

ments would result in an effective, long-term treatment program and restore native grasslands, which would improve habitat for grassland-dependent birds.

Invasive and Nonnative Species in Alternative C

Same as alternative B, except that, through partnerships, the Service would increase the annual acreage treated, with an emphasis on preventing further encroachment of crested wheatgrass and Russian olive trees into native grassland. This would more quickly reduce monotypic stands of Russian olive trees and crested wheatgrass infestations while native prairie habitat would be improved and restored. This would require additional staff and money to treat, restore, and monitor targeted sites.

Shelterbelts in Alternative A (No Action)

The Service is not currently managing shelterbelts in the refuge complex, so shelterbelts would gradually deteriorate while continuing to cause fragmentation of the surrounding grassland and would serve as seed sources for invasive trees and shrubs. They provide marginal habitat for various wildlife species, including nest predators and parasitic species such as magpie and brown-headed cowbird.

Shelterbelts in Alternative B (Proposed Action) and Alternative C

Excluding the office compound, the Service would remove all shelterbelts to create more contiguous blocks of grassland habitats and restore these areas to prevent invasive plants from encroaching. No additional shelterbelts would be permitted. Upland-nesting conditions would immediately improve, with restoration and less fragmentation, while seed sources for invasive plants would be eliminated.

Habitat Protection and Acquisition in Alternative A (No Action)

Grassland habitat protection would continue at current levels that, over the 15-year time period, could result in 8,000 acres being protected. Most of these acres would be protected under grassland easement contracts from willing sellers. Fee-title acquisitions would be minimal. Land acquisition in fee title would focus on in holdings and "round-outs" of current Service lands. The Service would offer easement contracts to willing sellers within the wetland management district whose lands meet minimum qualifications for the Montana realty program. Through the addition of fee-title land and easement acquisitions, grassland habitat would be permanently protected and managed for the benefit of wildlife.

Alternative funding sources, in addition to yearly allocations of Migratory Bird Stamp Act monies, would be pursued. These additional resources would offer more flexibility in working with willing landowners for acquisitions. Protection of upland habitats would be more immediate and provide long-term protection of grassland for migratory birds and native, resident wildlife.

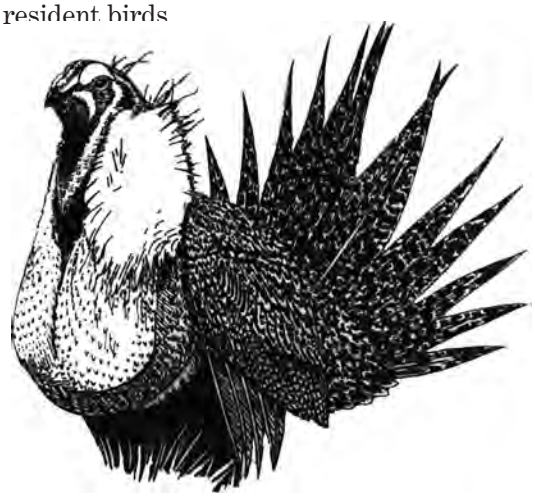
Habitat Protection and Acquisition in Alternative B (Proposed Action) and Alternative C

Same as alternative A, plus the Service would identify, using HAPET data, critical priority areas for protection including large tracts of native prairie with wetland complexes. This would ensure that the most critical waterfowl breeding and nesting habitats are given priority and protected, as resources and opportunities become available. Focusing easement acquisitions on tracts of land with native prairie and wetland complexes would keep the native landscape intact and reduce habitat fragmentation, while accommodating the needs of the livestock grazing community.

New acquisitions for waterfowl production areas would be evaluated, and proposals for purchases would be submitted for approval. Purchases in fee title would not only increase the amount of land managed primarily for wildlife but also provide additional wildlife-dependent recreational opportunities. This would provide additional opportunities for wildlife viewing and would address the overcrowding of areas currently open to hunting.

Greater Sage-Grouse in Alternative A (No Action)

Protecting existing habitat for greater sage-grouse would continue to provide protected, quality habitat for these resident birds.



Greater Sage-Grouse in Alternative B (Proposed Action) and Alternative C

Same as alternative A, except that identifying all potential sage-grouse habitat would allow the Service to better manage, protect, and restore or enhance it. Restoring sagebrush habitat to these waterfowl production areas would provide additional nesting and feeding habitat for greater sage-grouse, currently a candidate species for listing under the Endangered Species Act.

Wetland Habitat and Associated Wildlife

This section discusses the effects of alternatives pertaining to managed wetlands, natural wetlands, riparian habitat, water rights, habitat protection and acquisition, wildlife disease, invasive species, and threatened and endangered species.

Dave Menke / USFWS

The sora finds refuge and a nest site in emergent vegetation.

Managed Wetlands in Alternative A (No Action)

Management of water levels and drawdowns in developed wetlands would continue to mimic natural wetland cycles, thereby maintaining high levels of productivity for wetland plants and invertebrates. By continuing current management activities, the Service anticipates a positive effect on one or more of the following: waterfowl production, shorebird migrations, and production of wetland plant and animal foods.

The use of prescribed fire and prescriptive grazing and haying to consume or remove wetland vegetation would improve nutrient recycling and help control invasive plants. In addition, the Service would treat monotypic stands of cattails and invasive plants such as Canada thistle in dry wetland basins or in wetland edge areas. Reduction in cattails would negatively affect certain species such as red-winged blackbirds and marsh wrens; however, wetland habitats managed with fire, grazing, haying, and other mechanical and chemical treatments should benefit other nesting species such as marbled godwit and Wilson's phalarope. Reduction in the extent of cattails should also improve migratory habitat for ducks and shorebirds. Russian olive trees would be removed as resources allow.

Maintaining perennial grass cover around wetland perimeters would minimize negative effects such as sedimentation.

Managed Wetlands in Alternative B (Proposed Action)

Same as alternative A, except additional emphasis would be placed on improving habitat diversity within wetland habitats. Improving vegetative diversity would also improve plant structural diversity, invertebrate diversity, seed diversity, and food resources within wetlands. More staff and equipment would improve the Service's ability to maintain, repair, and manage facilities (such as water control structures, levees, and dikes) needed to adequately manage modified wetlands. Additional biological staff could enhance management capabilities, thereby improving habitat for wetland birds and other native wildlife.

Herbicide applications, which could be used to expedite the restoration process, potentially could have short-term negative effects; however, herbicide applications are expected to decrease following restoration activities. The short-term negative effects would be offset by the long-term improvements to wetland habitat.

Managed Wetlands in Alternative C

Same as alternative B, except that construction of new infrastructure would facilitate and improve the capability to manage these wetlands, which would increase habitat for migratory wetland birds. The new infrastructure would be expensive to construct initially and to maintain.

With additional biological staff, monitoring of sedimentation in wetlands would be beneficial in maintaining productive and functioning wetlands for migratory birds and other wildlife. Removal of sedimentation would require planning and additional funding and equipment to restore these wetlands.

Natural Wetlands in Alternative A (No Action)

The lack of resources and staff to effectively restore and maximize the potential of natural wetlands would result in many missed opportunities to provide important habitat for wetland-dependent wildlife.

With the current staffing level, control of invasive plants and cattail in wetlands would continue on a small scale; therefore, some wetland habitat for migratory birds would be improved as invasive plants were controlled or eradicated, but many natural wetlands would remain unproductive for most species.

Natural Wetlands in Alternative B (Proposed Action)

Same as alternative A, except additional natural wetlands would be restored while current wetlands would be properly managed and includes the treatment of invasive plants and noxious weeds. This would create more quality habitat for migratory birds.

Natural Wetlands in Alternative C

Same as alternative B, plus monitoring of sedimentation would determine maintenance needs and improve the health and productivity of natural wetlands.

Riparian Habitat in Alternative A (No Action)

Excluding cattle from riparian areas should allow these areas to revegetate naturally with the potential of introducing nonnative or invasive species. Riparian habitat would be protected and improved by controlling or eradicating small infestations of invasive and noxious species, including Russian olive.

Riparian Habitat in Alternative B (Proposed Action)

Same as alternative A, except that identifying and mapping invasive species would allow more efficient use of resources through improved awareness, planning, treatment, and monitoring. Monitoring of treated areas would help in determining the best method of control and would also remove the seed source for reinvasion.

Restoration of native species would provide habitat for riparian-dependent wildlife species. Species that feed and roost on Russian olive trees may relocate to native forested areas on the refuge complex or onto adjacent wooded lands.

Riparian Habitat in Alternative C

Same as alternative B, plus native tree plantings would provide vertical structure and additional nesting, roosting, and food sources for native birds and other wildlife. Planting trees would be costly and time-consuming.

Water Supply and Rights in Alternative A (No Action)

The Service would continue to exercise its water rights on all Service-owned lands. Water supply and rights (provided under the MOA with Reclamation) for the Bowdoin National Wildlife Refuge would continue to be exercised. However, current funding levels would not allow for the purchase of additional water to adequately manage all wetlands in the Bowdoin Refuge, resulting in a loss of habitat for wetland-dependent wildlife, including nesting habitat for the threatened piping plover.

Water Supply and Rights in Alternative B (Proposed Action) and Alternative C

Same as alternative A, except that the Federal reserved water rights would be adjudicated for all Service-owned lands in the refuge complex. A water rights compact for Bowdoin National Wildlife Refuge between the Montana Department of Natural Resources and Conservation and the Service would be finalized. The Service would buy water from the Malta Irrigation District when additional water is available from the Milk River Project. This additional water may improve water quality while providing the water resources necessary to properly manage and expand wetland habitats, including nesting habitat for the threatened piping plover. There may be substantive costs associated with acquiring these additional water deliveries.

Habitat Protection and Acquisition in Alternative A (No Action)

Wetland habitat protection would continue to occur at current rates, which over 15 years would result in protecting about 500 acres. Most of these acres would be protected under wetland easements from

willing sellers; easement contracts would only be offered to willing sellers within the wetland management district. Fee-title acquisitions would be minimal but focus on inholdings and "round-outs" of current Service lands. Through the addition of fee-title land and easement acquisitions, wetland habitat would be permanently protected and managed for the benefit of migratory and native resident wildlife.

Alternative funding sources, in addition to yearly allocations of Migratory Bird Stamp Act monies, would be pursued. These additional resources would offer more opportunities and flexibility in working with willing landowners for acquisitions. Protection of these wetlands would be widespread and immediate.

Habitat Protection and Acquisition in Alternative B (Proposed Action) and Alternative C

Same as alternative A, plus the Service would use HAPET data to identify priority wetland complexes. This would ensure that critical waterfowl breeding and nesting habitats are given priority and protected as resources and opportunities become available. Focusing easement acquisitions on tracts of land with high wetland densities would protect wetland diversity in the landscape. Wetland diversity is essential to the life cycle needs of wetland-dependent wildlife.

New acquisitions for waterfowl production areas would be evaluated, and proposals for purchases would be submitted for approval. Purchases in fee title would not only increase the amount of land managed primarily for wildlife but also provide additional wildlife-dependent recreational opportunities.

Wildlife Disease in Alternative A (No Action), Alternative B (Proposed Action), and Alternative C

Rising or fluctuating water levels would be avoided on areas that are hotspots for outbreaks of avian botulism by continuing to avoid water deliveries to Lake Bowdoin during late spring and summer. Monitoring and checking Lake Bowdoin and other wetland units would help staff to detect disease. Dead bird samples would be sent to the Service's wildlife health lab to determine the cause. In areas where visitors frequent, the Service would collect and dispose of dead birds. This early detection and immediate response to avian disease outbreaks would alert staff and the public to the presence of diseases that can be transmitted to humans, such as West Nile virus.

Ongoing review and updating of the refuge complex's Disease Contingency Plan, along with staff training to recognize causes and effects of disease, would increase early detection of outbreaks. Knowing what to do in the case of an outbreak or an encounter with an individual sick or dead animal would help keep health risks to Service employees and the public to a minimum. Disease monitoring and cleanup can take up a great deal of time, money, and equipment.

Invasive and Nonnative Species in Alternative A (No Action)

The refuge complex would continue to use the current methods of chemical and mechanical treatments (such as prescribed fire, haying, and grazing) to control known infestations of invasive plants and noxious weeds to create open-water habitat for migratory birds. Early detection and rapid response would be used to control and possibly eradicate small infestations around wetlands, dikes, and water delivery systems.

Invasive and Nonnative Species in Alternative B (Proposed Action) and Alternative C

Same as alternative A, plus the Service would use mapping technology to identify and locate areas with invasive plant infestations. Mapping these areas would increase awareness of infestations, assist in planning treatments, help determine the best method for treatment, and monitor the effectiveness of the treatment. The refuge complex would share this information with county weed boards to aid in identifying species, new infestations, and seed sources and to prioritize treatment sites. The removal of Russian olive trees from around wetlands, dikes, and water delivery systems would improve habitat for grassland-nesting birds, protect wetland management infrastructure, and increase the Service's ability to properly manage wetland resources.

Threatened and Endangered Species in Alternative A (No Action)

The Service would continue to conduct surveys and monitoring for piping plovers at the Bowdoin and Hewitt Lake refuges during the breeding and nesting seasons. Staff would continue to work with the Montana Piping Plover Recovery Committee to preserve and improve piping plover habitat on these refuges with the resources that are available.

Without additional water or improved infrastructure for water management, Piping Plover Pond would not receive water before the plover's breeding season during most years. Since this species establishes breeding territories almost immediately on

their spring arrival, they would bypass the refuges for other, less protected areas if the habitat were not available when they arrived. This could have negative effects on the overall survival and nesting success of the species.

Threatened and Endangered Species in Alternative B (Proposed Action) and Alternative C

Same as alternative A, except that additional water would permit the Service to manage wetlands specifically to attract piping plovers, which may keep them from migrating to less protected off-refuge sites. Increased water management would allow the Service to ensure that wetlands with the best habitat for breeding and nesting piping plovers are filled to the desired capacity before the spring migration without having to fill other wetlands first.

Visitor Services

This section discusses the effects of alternatives pertaining to hunting and trapping, fishing, wildlife observation and photography, environmental education and interpretation, public access, and cultural resources.

Hunting and Trapping in Alternative A (No Action)

The hunting and trapping program would continue at current levels and would provide hunters with many opportunities to hunt without compromising the purposes of the refuges and district. Updated public use brochures and the refuge complex Web site would be readily available to hunters. Hunter success and satisfaction would continue to be monitored using the hunter registration kiosk.

Roads, trails, and water management structures on Bowdoin Refuge would continue to be protected from burrowing animals. Trapping of mammalian predators can increase nest success as well as protect vulnerable birds that have been live-trapped for banding or disease detection.

Hunting and Trapping in Alternative B (Proposed Action) and Alternative C

Same as alternative A, plus, working with the State, the refuge would be able to determine if the opportunity for big game archery hunting was compatible and could be provided safely and with minimal impact to other users.

Fishing in All Alternatives

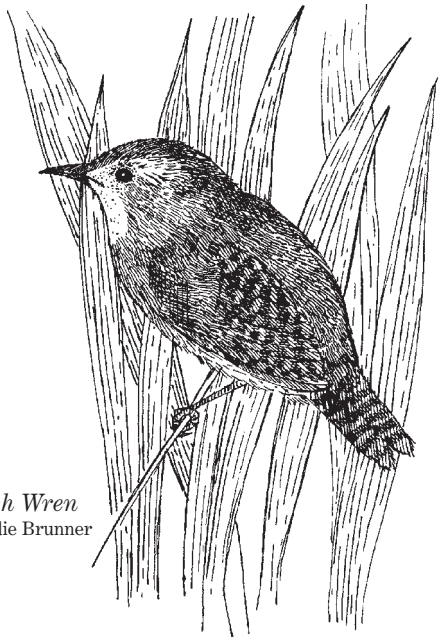
Recreational fishing opportunities would continue to be allowed along the Milk River at McNeil Slough WPA and along Beaver Creek at Beaver Creek WPA. However, these areas would continue to receive little or no use, because there are many superior fishing areas within 100 miles of the Bowdoin Wetland Management District. The remainder of the wetlands within the refuge complex have minimal habitat or do not support game fish and have not traditionally been open to fishing, so there would be no loss of opportunity.

Wildlife Observation and Photography in Alternative A (No Action)

Wildlife observation and photography opportunities would remain constant. Maintaining the 15-mile auto tour route and current established trails and blinds would continue to provide visitors of all abilities with opportunities for quality wildlife observation and photography.

Wildlife Observation and Photography in Alternative B (Proposed Action) and Alternative C

Same as alternative A, plus the wildlife observation and photography opportunities would be expanded and enhanced to create a greater understanding and appreciation of the refuge complex resources. The proposed wildlife-viewing area along the auto tour route and accompanying scopes and informational panels would enhance the visitor experience while educating them about the resources they were viewing.



Marsh Wren
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Expanding opportunities for wildlife observation and photography may lead to increased disturbance to wildlife and trampling of vegetation, particularly if visitors travel off roads and trails. Additional staff and resources would be required to manage the increased public use to minimize disturbance to wildlife and habitat and to educate photographers and wildlife observers about the local resources.

Environmental Education and Interpretation in Alternative A (No Action)

Environmental education would minimally meet the public demand. Opportunities to educate students and the public about the values and purposes of the refuge complex and the Refuge System would be lost. This lack of understanding and appreciation would result in a loss of support for the refuge complex and the Refuge System.

Public outreach and interpretation would meet minimum Service requirements. Visitors would have adequate resources to independently learn about the refuge complex environment; however, there would be minimal contact with refuge complex staff to answer questions and offer further interpretation.

Refuge complex brochures and other independent interpretive materials would continue to minimally meet Service requirements and may not be updated due to limited resources.

Environmental Education and Interpretation in Alternative B (Proposed Action)

With additional resources and greater support from a Friends group and the local community, the Service would be able to expand interpretive, outreach, and educational programs that would increase the public's understanding and appreciation of the refuge complex's purposes, resources, and issues. Visitation by the public as well as school groups and organizations would increase, allowing the Service to reach a broader audience. This increased use of the refuge complex would have to be managed to minimize disturbance to wildlife and habitat.

Environmental Education and Interpretation in Alternative C

Same as alternative B, plus increased use of the Bowdoin Refuge as an outdoor classroom by schools and other organizations would result in a greater awareness and appreciation for preserving the area's natural resources. By educating teachers, a greater number of students would receive this environmental education.

Public Access in Alternative A (No Action)

The Service would continue to provide access for compatible, wildlife-dependent public use by maintaining public roads and trails as needed and providing current public use information and regulations in the refuge complex brochures and Web site. Foot traffic would not be limited except in the closed area surrounding the shop, residences, and equipment storage areas.

Public Access in Alternative B (Proposed Action)

Same as alternative A, except closing the eastern portion of Bowdoin National Wildlife Refuge to all foot traffic from the beginning of the waterfowl-hunting season through November 30 would provide additional sanctuary for waterfowl and shorebirds. Increased use within the hunting portion of the refuge could lead to more conflicts between hunters and nonhunters and a decrease in overall visitor satisfaction during hunting season. However, hunters may have a greater opportunity to hunt waterfowl, because this sanctuary area may encourage birds to remain on the refuge, including the areas open to hunting. Additional staff time and resources would be required to enforce and manage the closure.

The Service would improve public access to compatible wildlife-dependent use activities on Black Coulee National Wildlife Refuge by developing the entrance road and parking for the reservoir. Maintenance costs and needs would increase.

The Service would work with Phillips County to determine the feasibility of rehabilitating the remaining portion of Old U.S. Highway 2 that runs through the north end of the refuge to enhance and expand wildlife-viewing opportunities at Bowdoin National Wildlife Refuge. Although the road would be safer to travel, additional use of this road may lead to increased littering and may cause additional wildlife disturbance and wildlife fatalities from collisions.

Public Access in Alternative C

Same as alternative B, plus, with improved access through landowner cooperation, public use opportunities and visitor satisfaction may increase on Creedman Coulee Refuge.

Cultural Resources in Alternative A (No Action)

The Service would continue to inventory the refuge complex's cultural resources only as required by

section 106 of the National Historic Preservation Act or by documenting incidental findings during the course of other duties. Although this would protect cultural resources from planned Service activities, the lack of a complete inventory for the refuge complex would make it difficult to adequately protect cultural resource sites from vandalism and theft.

Cultural Resources in Alternative B (Proposed Action)

The Service would increase the awareness of local cultural resources by working with the zone archaeologist, contractors, local tribes, and universities to complete a comprehensive inventory for the refuge complex. Increased awareness and mapping of cultural resources would enhance protection of these assets from Service and public activities and would provide additional information to interpret the unique cultural history of this area.

Cultural Resources in Alternative C

Same as alternative B, plus the Service would create an interpretive cultural resource display to educate the public about the early history of the refuge complex. Knowledge of these resources could augment appreciation for local history.

Partnerships

This section discusses the effects of alternatives pertaining to partnership development and maintenance and on energy development on Service lands.

Partnership Development and Maintenance in Alternative A (No Action)

Existing partnerships would be maintained, allowing the refuge complex to expand its capability to restore, maintain, and protect wildlife habitats and complete projects of mutual interest on Federal or private lands where the Service has acquired interest. Continued support of the Partners for Fish and Wildlife Program would improve relationships between the Government and landowners while protecting additional habitat on private lands.

Partnership Development and Maintenance in Alternative B (Proposed Action)

Same as alternative A, plus additional partnership opportunities would be sought to expand the Service's ability to restore, maintain, and protect wildlife habitats on surrounding public and private lands. These new relationships would include private landowners, Federal and State agencies, and nongovernmental organizations. These partnerships would focus on addressing impacts from offsite activities on neighboring land.

Working with Phillips County to determine if it is possible to repair the road surface of old U.S. Highway 2 through Bowdoin Refuge could improve travel conditions and provide a quality experience for wildlife-dependent recreation. Because of these better travel conditions, vehicles may travel at higher rates of speed, which may result in animals being harmed or killed.

Partnership Development and Maintenance in Alternative C

Same as alternative B, plus the Service would develop a new partnership between the Bowdoin Refuge and Burlington Northern Sante Fe railroad, which would provide a cleaner landscape and a quality refuge experience for visitors. Invasive species control and monitoring would also be addressed as train and maintenance vehicle traffic via the railroad right-of-way would be a source for new infestations.

The partnership with the Malta Irrigation District would focus on the removal of Russian olive trees on the Dodson South Canal. The removal of these trees would eliminate a major seed source for invasions on Bowdoin Refuge.

Energy Development on Service Lands in Alternative A (No Action)

As natural gas exploration and production continued to occur within the refuge complex, partnerships with energy developers would continue to encourage good stewardship practices on Service-interest lands. Negotiating surface use activities on lands owned or covered by a Service easement would help minimize impacts while preserving the maximum amount of wetland and grassland habitat. The negotiations for easement disturbance are limited to the reasonable protection of the Service's acquired interest. On Service-owned land, approved energy development operations would be conducted without interference to Service operations and be of minimal size compatible with efficient mineral operations. The refuge complex would modify its operations to support future Service and other related energy policies for Federal lands.

Displacement of wildlife would continue as habitat fragmentation increased due to the growing demand for energy.

Energy Development on Service Lands in Alternative B (Proposed Action)

Same as alternative A, plus the Service would evaluate current or potential effects of energy development on lands proposed for protection. This evaluation would help the Service in making decisions that are more informed and prioritize acquisition proposals.

Energy Development on Service Lands in Alternative C

Same as alternative B, except the Service would not acquire an interest where there is the potential for energy development. This may lessen impacts to future easements caused by oil and gas development, but may discourage landowners from entering into any agreements with the Service, thus limiting the quantity and quality of lands available for easement or acquisition.

Operations

This section discusses the effects of alternatives pertaining to staff, operations, facilities, and signs and boundary designation.

Staff in Alternative A (No Action)

All refuge complex programs would remain at current staffing levels. Service lands would continue to degrade due to a significant lack of resources and staff to conduct adequate monitoring of management actions.

The single maintenance worker would not be able to keep up with the constant demand of maintaining and repairing facilities throughout the refuge complex. This would result in a continued accumulation of maintenance projects and the degradation of facilities and infrastructure.

Refuge complex tours and environmental education programs would continue to be a low priority due to the limited staff and resources available to conduct these programs. There would continue to be a loss of opportunities to interact with and teach visitors about the purposes and values of the lands and waters within the refuge complex. It would become increasingly difficult for a single collateral-duty law enforcement officer to enforce regulations and protect the refuge complex's natural resources while performing the employee's primary duties.

Staff in Alternative B (Proposed Action) and Alternative C

Additional funding would be required for the salary, equipment, facilities, and office space needed for the additional positions needed to accomplish the objectives and strategies in this alternative. Additional staff and volunteers would be able to adequately manage and protect habitats and provide visitors with increased quality wildlife-dependent programs and recreational opportunities. Refuge complex facilities and equipment would be maintained and most maintenance issues would be resolved.

Research and monitoring could be conducted that would be used to evaluate management actions and adapt and improve biological and visitor services programs.

Visitor services, environmental education opportunities, outreach, natural resource protection, and facility and public protection would be enhanced, as well as the total visitor experience.

Operations in Alternative A (No Action)

Current levels of funding would continue to be inadequate to acquire the staff, facilities, equipment, and other resources necessary to properly manage and protect refuge complex resources, maintain facilities

Jeff McMillian / USDA–NRCS PLANTS Database

Cattail

and equipment, and provide quality visitor services programs across a four-county area. This would continue to result in habitat degradation and a growing backlog of maintenance projects.

Operations in Alternative B (Proposed Action) and Alternative C

Added funding would ensure enhancement and protection of refuge complex resources and facilities while improving safety and expanding opportunities for visitors to participate in wildlife-dependent activities and programs. The refuge complex facilities and infrastructure would be maintained and many of the backlogged maintenance projects would be completed.

A substantial increase in annual funding for staff, equipment, and supplies would be necessary for the full implementation of these alternatives.

Facilities in Alternative A (No Action)

Facilities would continue to be inadequate for staff office space, visitor services, seasonal housing, and storage of vehicles and heavy equipment. Currently, all heavy equipment and many vehicles are stored outside continually exposing them to the elements, which may cause them to deteriorate more rapidly. Vehicles, boats, and other equipment not stored in secure buildings would be susceptible to theft and vandalism.

Current office space would continue to be sufficient for current, permanent staff only but would not accommodate any seasonal staff or volunteers. The visitor contact area is small and would not allow for interpretive materials such as displays and educational materials, which would result in lost opportunities to educate and interact with visitors. Insufficient seasonal housing would continue to make it difficult to recruit additional seasonal staff and volunteers needed to conduct refuge complex programs.

Facilities in Alternative B (Proposed Action) and Alternative C

Additional staff would have proper office space with all the necessary technology and equipment to conduct their job and programs properly and meet the needs of the public. Visitors would feel more welcome in an expanded visitor contact area and have new opportunities to learn about the refuge complex's resources through interpretation.

Additional office and living space (for seasonal staff and volunteers) would accommodate the additional staff needed to properly manage and protect refuge complex resources while providing visitors quality, safe wildlife-dependent recreation and programs. Additional housing would also aid in attracting qualified seasonal employees to a semiremote station that has limited housing nearby. Equipment would be protected from environmental damage, reducing maintenance costs. The refuge complex would reduce its carbon footprint by using green technologies such as wind and solar power.

Signs and Boundary Designation in Alternative A (No Action)

Current signs and boundary posting on most Service lands are adequate and the visiting public, adjoining neighbors, and surrounding communities are aware of the locations and permitted activities for the refuges and waterfowl production areas. Hewitt Lake National Wildlife Refuge has been challenging to post and fence properly because the lake bottom is co-owned by a private landowner. This boundary line would require the fence to be constructed in a wetland basin, which would pose a significant flight hazard to waterfowl when the lake fills. A land exchange on Hewitt Lake Refuge would make the refuge easier to manage and post and make the land ownership less confusing to the public.

Signs and Boundary Designation in Alternative B (Proposed Action)

Same as alternative A, except that wildlife losses would be reduced and wildlife would be able to migrate more freely as fences were replaced with wildlife-friendly designs.

Signs and Boundary Designation in Alternative C

Same as alternative B, except a unique boundary sign for the limited-interest (privately owned) refuges would reduce confusion over land ownership and permitted uses.

Socioeconomics

The socioeconomic impacts are described by alternative.

Socioeconomics in Alternative A (No Action)

There would not be any significant change in the net economic contribution of Bowdoin National Wildlife Refuge Complex to the local economy through visitor spending and employee earnings. Current visitation levels are expected to remain the same,

contributing $594,000 to the local economy. Employment would remain at five full-time employees, which would contribute $316,000 in employee spending to the local economy. Combining visitation and employment effects, the total direct economic impact of alternative A on the study area would remain about $910,000 annually.

Socioeconomics in Alternative B (Proposed Action)

Increases in employment and visitation to the refuge complex would cause an increase in the economic activity the Service generated in the local area. Visitation would increase due to enhanced outreach efforts and increased wildlife production as a result of habitat improvements. Visitation is expected to increase to 28,750 visitor days, 25,875 of which would be from nonlocal visitors. Assuming nonlocal hunters spent an average of $55 per day and wildlife observers spent an average of $18 per day, visitation to the refuge complex would generate roughly $683,000 in annual local spending.

The addition of 7.5 employees would increase employment from 5 full-time equivalents to 12.5. The new employment would increase the salary of all refuge complex employees to about $866,500. Assuming 79 percent of employee earnings were spent locally, employee spending would contribute about $684,500 to the local economy, which represents an increase of $368,500. Combining visitation and employment effects, the total direct economic impact would be nearly $1,367,500 annually. This represents an increase of $457,500 over current levels.

Socioeconomics in Alternative C

Increases in visitation and employment would cause a slightly more significant increase in economic activity generated by the refuge complex compared with alternative B. Visitation would increase due to enhanced outreach efforts, programming, and other offerings at the refuge complex. Visitation is expected to increase to 30,000 visitor days per year under this alternative, where 27,000 are from nonlocal visitors. Assuming nonlocal hunters spent an average of $55 per day and wildlife observers spent an average of $18 per day, visitation to the refuge complex would generate roughly $713,000 in annual local spending.

The addition of seven and one-half, full-time-equivalent employees would match the increased employment in alternative B, also contributing about $684,500 to the local economy due to employee spending. Combining visitation and employment effects, the total direct economic impact would be nearly $1,397,500 annually. This represents an increase of $487,500 over current levels.

5.4 Cumulative Impacts

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

The Council on Environmental Quality regulations that implement the National Environmental Policy Act requires mitigation measures when the environmental analysis process detects possible significant impacts on habitat, wildlife, or the human environment.

None of the activities proposed for the CCP are expected or intended to produce significant levels of cumulative 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.
- All proposed activities would be regulated to lessen potential impacts to wildlife, fish, and plant species, especially during sensitive reproductive cycles.
- Monitoring protocols would be established to determine goal achievement levels and possible unforeseen impacts to resources and for application of adaptive resource management to ensure wildlife and habitat resources as well as the human environment are preserved.
- The Service could revise and amend the CCP after 5 years of implementation, for application of adaptive resources management to correct unforeseen impacts that occur during the first years of the plan.

CHAPTER 6—Analysis of Salinity

USFWS

Alkali salt blows off Dry Lake at Bowdoin Refuge, Phillips County, Montana (1988).

The U.S. Fish and Wildlife Service and the public have identified salinity and blowing salts at the Bowdoin National Wildlife Refuge as one of the most critical situations needing to be addressed in this CCP planning process. Because of the complexity of the salinity analysis, all aspects of NEPA evaluation are presented together in this chapter in the following sections:

- 6.1 Issues
- 6.2 Background
- 6.3 Salt and Water Management
- 6.4 Planning Process
- 6.5 Alternatives Analysis
- 6.6 Implementation of the Proposed Action

This chapter begins with a summary of the issues including extensive background to explain what caused the elevated salinity levels, what the effects are, and why it was important to address it in this planning effort. To develop this information and determine the best methods for resolving the issues, the Service assembled from various Federal and State agencies a team—hydrologists, biologists, engineers, managers, planners, and contaminant specialist—to develop and evaluate different options, known as alternatives. The team developed and analyzed four alternatives beyond current management; the evaluation included an analysis of the environmental and socioeconomic consequences and the cumulative impacts of implementing each of the following alternatives:

- *Salinity alternative 1*—current management (no action)
- *Salinity alternative 2*—evaporation ponds and removal of saline residue
- *Salinity alternative 3*—flushing by Beaver Creek
- *Salinity alternative 4*—underground injection well and flushing by Beaver Creek (proposed action)
- *Salinity alternative 5*—pumping to the Milk River

The Service has identified salinity alternative 4 as the best option, or proposed action, for addressing salinity and blowing salts based on the effectiveness of treatment, environmental and socioeconomic consequences, and cost. In addition, this alternative has been identified as the best option to achieve the long-term, desired future conditions described in this proposed goal statement:

> **Goal for Salinity and Blowing Salts**
> *Develop a water management system on Bowdoin National Wildlife Refuge that would protect the environment and mitigate current and future blowing salt concerns for neighboring properties, while providing quality water and wildlife habitat for migratory birds and other wetland dependent wildlife.*

Section 6.6 describes how the Service would carry out the proposed action, alternative 4, if the Regional Director for Region 6 (Mountain–Prairie Region) of the Service selected it as the preferred alternative for the final CCP.

6.1 Issues

Two issues are the focus of this separate analysis:

- Salinity for Lake Bowdoin and blowing salts
- Water quantity, delivery, and cost

Salinity for Lake Bowdoin and Blowing Salts

The salinity and blowing salts issue at Bowdoin Refuge is a direct result of the "salt balance," which is the relationship between the salt entering the refuge compared to the salt leaving the refuge. For many years, the amount of salt entering the refuge has been, and continues to be, far more than the amount of salt leaving the refuge. Thus, the overall concentration of salts in Lake Bowdoin and surrounding areas such as Dry Lake continues to rise.

Increasing salinity has the potential to shift Lake Bowdoin from one that supports a diverse plant and animal community that thrives in a brackish-type system to one that thrives in a saline-type system. Such a shift could negatively affect the ability of the lake and surrounding wetlands to fully support and meet the life cycle needs of migratory birds, including waterfowl.

The out-of-balance salt situation is due to a variety of reasons—many from modifications to the landscape, but others are natural. Understanding the relationship of the salt balance is fundamental to devising a solution that not only protects and sustains refuge habitats and resources for wildlife, but also protects the interests of local farmers, ranchers, and refuge visitors.

Water Quantity, Delivery, and Cost

Water quantity has a direct relationship to the effect of salts carried in the water—quantity, evaporation, inflow, and outflow all contribute to the salt balance. The principle sources of water for Bowdoin Refuge are precipitation, floodwater from Beaver Creek, ground water seepage, Milk river water rights, and irrigation return flows. Even with the current MOA with Reclamation for 3,500 acre-feet and with natural sources of water, the water quantity has been insufficient for supplying necessary water for wildlife habitat management and improving water quality.

6.2 Background

This section contains basic information about salts, quantification and classification of salinity, and principal salts at Bowdoin Refuge. Background about the salt balance covers the historical and current situations.

Salt Basics

The salt balance concept refers to the balance between the amount of salt entering a waterbody, in this case, Lake Bowdoin, and the amount of salt exiting. Over time, this salt inflow and outflow should be roughly equal to ensure the stability and resiliency of the lake system. A stable system increases the probability that plant and animal communities, which have adapted to this localized and sometimes highly variable system, remain within tolerable ranges and, thus, remain healthy and productive. If the system is not in balance, the concentration of salts is either increasing or decreasing depending on the direction of the imbalance. The magnitude of the salt imbalance is ultimately reflected in the diversity of (or lack of) plant and animal communities that are supported, as well as the number of viable management options to restore balance to the system.

Except for pure distilled water, all water has dissolved minerals or trace elements present in varying concentrations. These minerals (or salts) and trace

Mike Artmann / USFWS

Open water in the southern bay of Lake Bowdoin in spring (May 2007).

Mike Artmann / USFWS

The (same) southern bay of Lake Bowdoin in fall (October 2007). Concentrated salt crystallized on top of very shallow water and was susceptible to blowing.

elements are present within all landscapes in the underlying geology and soils as well as in precipitation that falls over an area. In many areas where precipitation does not exceed evaporation—which includes the arid climate of eastern Montana—the process of evaporation is a leading natural cause of concentrating salts in a system.

Evapoconcentration is the process of concentrating salts or trace elements (solids) in a liquid due to evaporation. When water evaporates during the hot, dry summer months, the solids remain in the water. As the volume of water is reduced by evaporation, the concentrations of these solids increase. In general, salinity concentrations are at their lowest during the spring after snowmelt and at their highest at summer's end. Salts that precipitate out of water during the evaporative process are often seen on the soil surface as white salt residues or crystals. When these salts fully dry and are exposed to strong winds, some particles become airborne and are transported out of the system by the wind. At Bowdoin Refuge, these conditions create the blowing salts events. The process of salts blowing out of a system is natural and is one way that a salt balance was maintained historically, especially during times of significant drought. Salts that do not blow away are re-dissolved when precipitation returns and water levels rise.

In wetland systems that are "closed basins"—which means there is no natural outflow due to topographic features or some other barrier—the evapoconcentration process greatly affects the overall water chemistry and resulting water quality. For example, the Great Salt Lake, located in an arid landscape in northern Utah, is the largest natural lake west of the Mississippi River and is a closed basin. It is naturally salty due to evapoconcentration. There is no outflow, thus salts are only removed from the system through wind or through artificial removal activities. As a result, salt concentrations are two to eight times greater than the world's oceans.

In comparison, a "flow-through system" is not closed—the water moves through the system before evaporation can accumulate the salts carried in the water to elevated concentrations. The Milk River, like all streams and rivers, is a flow-through system. Although salts do not accumulate like those in a closed system, salt concentrations vary depending on where the stream sits in relation to its overall watershed. Typically, salt concentrations are higher farther down in the watershed. In the case of the Milk River, concentrations are considerably higher where the Milk River empties into the Missouri River east of Nassau, Montana, compared with the headwaters area north of Browning, Montana. This is from the continual addition of salts and other minerals to the river as the water moves downstream in the watershed.

Donna Dewhurst / USFWS

Salinity can decrease the diversity of the wetland vegetation and the invertebrates that ducks like mallards rely on.

Quantification of Salinity

The concentration of salts present in the water and the underlying soils of Lake Bowdoin can be measured, quantified, and described. Typically, the concentration of salt in water is expressed as a measure of "total dissolved solids," which comprise inorganic salts—principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates—and small amounts of organic matter present in water. The measure of total dissolved solids, or TDS, is often reported as ppt (parts per thousand), percent, mg/L (milligrams per liter), or total mass in grams. One way to measure the TDS is to take a water sample, evaporate the water, and weigh the remaining solids. This is the most accurate method to obtain TDS, but it is very time-consuming, expensive, and requires laboratory-type equipment; thus, this method's utility for field testing and monitoring is limited.

Another way to measure TDS, which is quicker and less expensive and currently used by refuge staff, is to find out the electrical conductivity (or specific conductance) of water. The EC (electrical conductivity) is directly related to the concentration of dissolved ionized solids in the water. Ions from the dissolved solids enable water to conduct an electrical current, which can be measured with a conductivity meter. EC is reported in µS/cm (microSiemens per centimeter), mS (milliSiemens), or mmhos (millimhos). The relationship between EC and TDS is largely linear, thus conversion factors between EC and TDS are well understood. The following equation makes the conversion between EC and TDS (Tchobanoglous and Burton 1991):

$$\mu S/cm \times 0.64 \text{ of EC} = mg/L \text{ of TDS}$$

Salts in a waterbody are described by total weight, typically in tons. The total weight of salts is calculated by multiplying the concentration of salts in the water by the weight of the water. Weight of 1 acre-foot of water is approximately 1,360 tons.

$$(mg/L) \times (\text{weight of water})/1{,}000{,}000 = \text{tons of salts}$$

Therefore, the water delivered by the Malta Irrigation District to Bowdoin Refuge averages about 500 mg/L TDS. Subsequently, for every 1,000 acre-feet of water delivered at that concentration, approximately 680 tons of salts are added to Lake Bowdoin.

$$(500 \text{ mg/L} \times 1{,}360{,}000 \text{ tons})/1{,}000{,}000 = 680 \text{ tons of salts}$$

Describing the salts by weight is useful, because the concentration of salts can vary considerably since concentrations depend on both the total amount of salts and the total amount of water. The total amount of water can fluctuate widely in a single year due to evaporation and water deliveries, which causes the salt concentrations to fluctuate. By evaluating only the total weight of salts, the seasonal variations shown in concentrations are removed, and general trends such as the salt removal rate are easier to evaluate.

Throughout this chapter, mg/L is used in reference to TDS to represent the salinity concentration. However, for the modeling work conducted to analyze which alternative would be most effective at balancing salt, the total weight in tons was used as the measure to describe the amount of salts entering and exiting the refuge.

Classification of Salinity

Lake Bowdoin, like all of the wetlands on the refuge, can be described and classified in terms of its average salinity concentration. It is helpful to classify wetlands based on their salinity, because there has been considerable research describing the effect of varying salinity concentrations in terms of plant and animal communities and their tolerances to changing salinity. Entirely different plant and invertebrate communities thrive at varying salinity concentrations. In general, the higher the salinity concentration, the less diverse the communities tend to be (Gleason et al. 2009).

Refuge staff and others have been monitoring water quality in the wetlands since the late 1970s. A lot of information has been collected on salinity and how concentrations change with varying climatic conditions at the refuge. In 2009, Lake Bowdoin had an average salinity concentration of 10,500 mg/L. Following the salinity classification scheme displayed in table 9 (Stewart and Kantrud 1972), this concentration places the lake in the subsaline (second most concentrated) class.

Table 9. Salinity categories and the corresponding ranges of specific conductance values.

Salinity category	*Conductance*[1] *(µS/cm⁻¹)*	*Concentrations of dissolved solids—salts*[2] *(mg/L⁻¹)*	*(ppt)*
Fresh	0–500	0–320	0–0.3
Slightly brackish	500–2,000	320–1,280	0.3–1.3
Moderately brackish	2,000–5,000	1,280–3,200	1.3–3.2
Brackish	5,000–15,000	3,200–9,600	3.2–9.6
Subsaline	15,000–45,000	9,600–28,800	9.6–28.8
Saline	>45,000	>28,800	>28.8

Source: Stewart and Kantrud (1972).
[1] *µS/cm⁻¹=microSiemens per centimeter.*
[2] *mg/L⁻¹=milligrams per liter; ppt=parts per thousand.*

Interestingly, monitoring data shows that even within Lake Bowdoin, considerable variation in salinity concentrations exists. For example, the east side of the lake is typically more salty (1,000–2,000 mg/L more concentrated) than the west side. This is due almost entirely to the inflows of fresher water from the Black Coulee drainage and the Dodson South Canal on the west side of the lake.

Figure 29 shows the locations of the monitoring sites on and off the refuge, along with the infrastructure for water management in and between the refuge wetlands. Flow-through wetlands like Black Coulee Pond on the west side of the refuge and Lakeside and the Farm Ponds on the east side, rarely exceed 1,250 mg/L as water and salt pass through to Lake Bowdoin or Dry Lake, respectively. In addition, monitoring data shows that salinity concentrations tend to be lowest in the spring and highest in the late summer due to the evapoconcentration process.

Most of the refuge wetlands are less saline than Lake Bowdoin and fall into other salinity classes according to Stewart and Kantrud (1972), as follows:

- *Slightly Brackish*—Black Coulee Pond, Display Pond, Farm Ponds, and Lakeside
- *Moderately Brackish*—Goose Island Pond, Patrol Road Pond, Teal Pond Complex, and Strater Pond
- *Brackish*—Dry Lake Pond, Piping Plover Pond, and Drumbo Pond
- *Subsaline*—Lake Bowdoin

Principal Salts at Bowdoin Refuge

The principal salts at Bowdoin Refuge are sodium sulfate, sodium bicarbonate, calcium carbonate, calcium sulfate, and magnesium sulfate; minor amounts of chloride and fluoride salts are also present (Bauder et al. 2007, Gleason et al. 2009). These salts are largely derived from the soils and underlying geology that compose this area of Montana. Geologic history indicates that Lake Bowdoin is an old oxbow of the Missouri River channel that was pushed far to the south during the advancement of the last glaciers, about 15,000 years ago (Alden 1932).

The predominant soils on the refuge are clays and clay-loams. The most common clay-loam associations are Phillips-Elloam, Phillips-Kevin, Arvada-Bone, Scobey-Phillips, and Kevin-Sunburst. These soils range from mildly to strongly alkaline; soluble calcium and sodium salts are dispersed in much of the soil profile. The presence of these soluble salts contributes to the alkaline nature of refuge wetlands, in particular Lake Bowdoin. Delivered water from the Milk River via the Dodson South Canal also contains these primary salts. Although these salts occur in relatively low concentrations in the delivered water (typically less than 500 mg/L), the total volume of water is high; therefore, the total tons of salts is high. In addition, saline seeps occur as water moves through the soil profile and exits at the surface near and along the west and north shoreline of Lake Bowdoin.

Presettlement Salt Balance

To understand how the salt balance has been lost or altered over time, it is important to look at how it was maintained in the past. For the salt load to balance over time, incoming salts must be removed (or moved through the lake system) in roughly equal proportions, either by flushing or by the wind when water levels are low and salts precipitate out. There is little doubt that Lake Bowdoin functioned as a flow-through system during spring runoff and high-precipitation events. The flow-through nature of the system was essential to maintaining the lake's salt balance, as was the removal of salts by the wind during times of drought.

Historical evidence, in the form of a GLO (General Land Office) survey, helps shed light on how the system functioned in the past (figure 30). The GLO survey, which divided the landscape into 1-square-mile sections, was completed in 1892 and approved in 1893 for the area near Malta including the refuge. This survey included the Great Northern Railway, which was constructed just a couple years prior in 1887. In addition, the survey shows that Lake Bowdoin was originally called "Alkali Lake" (figure 30), undoubtedly in direct reference to the alkaline characteristics of the water and soils of the lake. Interestingly, there is no mention or depiction of marsh or lake habitat in the current locations of Dry Lake or Drumbo Pond.

The GLO survey shows a stream Alkali Lake (Lake Bowdoin) on the west side in the general location where the Black Coulee drainage enters today. It is drawn on the map as a dashed line, suggesting the stream was intermittent. This would make sense given the arid climate of the area (less than 12.5 inches in precipitation per year). The volume of water entering the lake through this stream is, of course, unknown. However, the drainage area does span to a low divide near the Milk River to the west and includes many smaller coulees coming from the hills to the south. It is likely that, during heavy rainstorms or deep snow years, this stream carried a considerable flow into the lake. Likewise, a stream is depicted exiting the lake in the southeast side near the present-day southeast arm of the lake. Based on local topography downstream of this outflow point, any outflow would have flowed into Beaver Creek following a relatively similar path as occurs today.

As mapped in 1892, the overall size of Lake Bowdoin was about 40 percent smaller than it is today; surface acres were approximately 2,885 acres. At a smaller surface area, and with a smaller volume, historically the lake would have exited at a lower elevation than it does today. In addition to spilling at a lower elevation, even small floods from Beaver Creek would have likely entered and exited the lake (from the east) and, in doing so, removed salts with it as a flood moved downstream. During very large flood events, like the one in 1986, water would have entered the lake from several directions and extensively flushed salts downstream. Following large floods, the lake may have remained in a fresher state longer than normal, because the large influx of fresh water would have removed large quantities of salts.

Historically, the inputs of water and salts would have come from precipitation, local runoff, Black Coulee drainage inflows, and Beaver Creek floods (likely the largest water inputs). The flow-through nature of Lake Bowdoin was critical to maintaining the salt balance. Wind also likely played an important role in removing salts when water levels were very low during droughts. Over time, this cyclical input and removal of water and salts from Lake Bowdoin maintained a brackish lake system, which supported a greater diversity of plant and animal communities than exists today.

Postsettlement Salt Balance

Why are salts "out-of-balance" at Lake Bowdoin? Simply put, significant development and changes in the last 100 years have altered the inputs and outputs of water and salts that maintain the lake's salt balance. Many of these changes occurred decades before the Milk River Project (described below) and subsequent establishment of Bowdoin National Wildlife Refuge in 1936. The combination of a modified landscape and reduced flooding continues to contribute to increased salinity levels. Below is a summary of the major changes that affected the processes controlling the salt balance in Lake Bowdoin:

- *Hydrologic Barriers*: The Great Northern Railway (1887) and early roads and dikes (1900) altered water flow into and out of the lakes.

- *Irrigation Inputs*: Starting in 1915, increased water from the Milk River Project (described below) west and south of the refuge added more water and salts to the lake. Without a consistent outflow mechanism, salts continue to increase.

- *Refuge Management*: Following refuge establishment, there was an emphasis on water conservation for wildlife during the 1930s. The Service built higher dikes, retained water longer to benefit wildlife, and developed new sources of water.

- *Beaver Creek Development*: Also during the 1930s, increased water development in the Beaver Creek watershed lowered the frequency

Figure 29. Map of wetlands, water management infrastructure, and monitoring sites on Bowdoin National Wildlife Refuge, Montana.

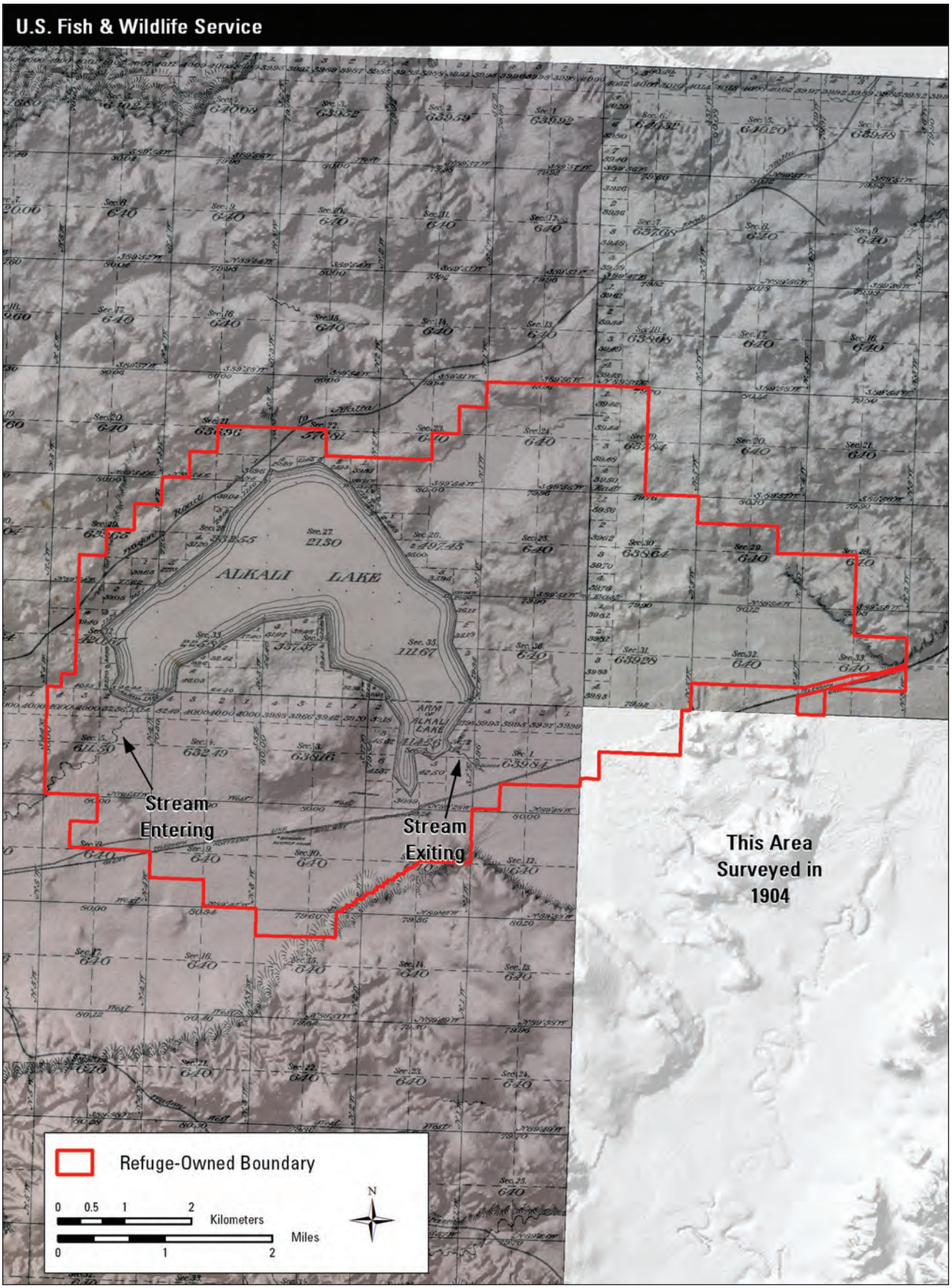

Figure 30. Map of a historical survey showing the location of Bowdoin Refuge on the topographic features of the landscape. *Source: General Land Office, 1892.*

of flooding, which greatly reduced the primary mechanism for removing salts.

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The Brady ditch and structure changed the flow-through lake system to increase the water storage for irrigation uses.

Railroad and Early Settlers

This area of northeastern Montana is commonly referred to as the "Hi-Line" of Montana, which includes the northern tier of counties. The Milk River watershed was largely unsettled by Europeans settlers before completion of the Great Northern Railway in the late 1880s and early 1890s. The railroad passed through Malta around 1887, reaching Havre in 1890 and its final destination, the west coast of the United States, in 1893. Regional industry and trade centers quickly grew around the railroad as goods, services, and people could now be moved quickly between locations. A post office was established in Malta in 1890. The 1892 GLO survey helped in the distribution of lands to homesteaders.

The railroad was a tremendously successful tool that propelled the area into full homesteading and economic development in the 1890s. However, the railroad effectively functioned as a hydrologic barrier to the natural movement of surface water between Lake Bowdoin and Beaver Creek. Instead of water flowing unimpeded during floods as it had previously, water now funneled through a series of railroad trestles, bridges, and culverts to flow in and out of the lake. It is very likely that smaller floods, which would have entered Lake Bowdoin unimpeded from the east, were deflected downstream by the railroad, thereby reducing the volume of water entering the lake.

In addition to the railroad, the Brady–Bateman–Switzer Company previously owned the lands within Bowdoin Refuge. The company was a partnership between three men from Helena and Great Falls, Montana, who started a cattle and hay ranch on Beaver Creek near the town of Ashfield. The company took up 19 desert and homestead entries along Beaver Creek and attempted to irrigate the land by diverting water from Beaver Creek and Lake Bowdoin. As early as 1900, the company constructed levees and ditches between Lake Bowdoin and Dry Lake and at the outflow of Dry Lake. These structures helped to increase water storage capacity and increase capabilities for water movement between Lake Bowdoin and Dry Lake (Anderson 1901). The Brady ditch and structure increased the storage capacity of Dry Lake and Lake Bowdoin by effectively halting the natural flow-through nature of the system; it could also capture floodwaters from Beaver Creek for later irrigation use. GLO surveys conducted in 1904 east of the refuge delineate extensive irrigation ditches and levees built to improve water distribution along Beaver Creek for pasture and grazing lands. It is clear that Lake Bowdoin and Dry Lake were part of an active irrigation system as early as 1900, more than a decade before construction of the main infrastructure associated with the Milk River Project.

Milk River Project

With the completion of the railroad, farmers and ranchers continued to arrive and settle throughout the Milk River watershed. Early settlers of the Milk River watershed soon realized that, in this arid climate, water was limited and often came in sporadic deluges that were not conducive to growing crops and raising livestock consistently. Dryland farming was the only means available in the absence of irrigation sources, which at the time were only available near streams and rivers. It soon became evident that a supplemental, stable supply of water was necessary if these settlers were to produce agricultural products and make a living on the landscape.

At the turn of the century, new Federal laws such as the Reclamation Act in 1902 committed the Federal Government to fund the construction and management of irrigation projects for arid lands of 20 States in the American West. To fund the construction and maintenance of irrigation projects, the act set aside money from the sale of semiarid public lands. In addition, the act established the U.S. Reclamation Service, the predecessor to the Bureau of Reclamation, to oversee the development of all irrigation projects in the West.

On March 4, 1903, the Secretary of the Interior conditionally authorized the Milk River Project, one of the first irrigation projects initiated under the Reclamation Act. The Milk River Project was one of many projects initiated during in the early 1900s to secure stable and reliable sources of water in Montana. The Milk River Project is a federally owned project that today supplies irrigation water to more

than 110,300 acres in eight irrigation districts and to approximately 200 irrigation pump contracts along the Milk River (figure 31). The authorized purpose for the Milk River Project is for irrigation; all other uses are secondary. Most of the Milk River flows used by irrigators and municipalities and for recreational and wildlife benefits comes from the Milk River Project.

Completion of the Milk River Project meant supplemental water from St. Mary River would be available to irrigators in the Milk River watershed, which otherwise would have flowed north into Canada, and ultimately into Hudson Bay. The idea behind the Milk River Project was relatively simple: move water east across a low divide separating the St. Mary River and the Milk River watersheds (USRS 1920). A 29-mile-long facility diverts water from the St. Mary River watershed near Glacier National Park into the North Fork of the Milk River. From there, the river flows into Canada for 216 miles before returning to the United States. After reentering the United States, the water flows into two primary reservoirs for storage until needed by downstream irrigators: (1) Fresno Reservoir is 104 miles west of Bowdoin Refuge; and (2) Nelson Reservoir is 4.5 miles northeast of the refuge. The St. Mary facilities are located on the Blackfeet Reservation in Glacier County; Reclamation owns and operates the diversion facilities.

Although authorized in 1903, it took another 40 years to complete the primary infrastructure of the Milk River Project. The construction of facilities began in earnest in July 1906 with the St. Mary Storage Unit along the St. Mary River. Because both the Milk River and the St. Mary River flow from the United States into Canada, a treaty was needed for water issues related to the Milk River Project. A treaty with Great Britain (for Canada) was signed in January 1909 and proclaimed in May 1910. It took several years to complete the canal and St. Mary Storage Unit, but in 1916 water from the St. Mary River was finally diverted into the North Fork of the Milk River; however, water for irrigation became available as early as 1911 in areas along the Milk River (USBR 1920). Other early infrastructure and facilities included the following:

- Dodson Diversion Dam (January 1910)
- Dodson North Canal (1914), built on the north side of the river
- Dodson South Canal (1915), supplied by the Dodson Diversion Dam, provided water to fill Nelson Reservoir and irrigate areas south of the river and east of Dodson
- Nelson dikes (1915), enlarged starting in 1921
- Swift Current dikes (1915)
- Vandalia Diversion Dam (1917)
- Bowdoin Canal (1917)
- Lake Sherburne Dam (1921)
- Fresno Dam (1939)

Nelson Reservoir's current storage capacity is approximately 79,200 acre-feet, and Fresno Reservoir's is approximately 103,000 acre-feet. While Reclamation manages the water storage facilities, eight irrigation districts manage distribution of the water to irrigators (farmers and ranchers); the Malta, Glasgow, and Dodson districts are closest to the refuge.

At one time during the early construction history of the Milk River Project, Reclamation considered Lake Bowdoin as a potential reservoir for downstream irrigation. An early project document (1902–11) by Reclamation states:

> *"The use of Bowdoin Lake as a reservoir site in connection with the Milk River project was considered by the employees of the Geological Survey before the Reclamation Act was passed. During the fall of 1902 a survey of the lake and adjacent territory was made and for several years thereafter the plans contemplated the construction of a reservoir that would utilize the lake for storage."*

Two items had to be considered before going forward with the reservoir plan for Lake Bowdoin: (1) moving the Great Northern Railway from south of Lake Bowdoin to north of the lake, from a point near Ashfield to a point near Strater; and (2) acquiring more than 5,000 acres of land "occupied and controlled by the Brady-Bateman-Switzer Company of Great Falls." The cost of these items made the development a reservoir prohibitive. Eventually, Reclamation acquired most of the lands and the lake, and plans for using the lake as a reservoir were abandoned. Instead, plans were considered to use Lake Bowdoin "as some plan for the control of the waters of Beaver Creek." Reclamation also abandoned this plan, and instead the lake was primarily used as a sump for irrigation return flows and excess runoff from the Milk River Project.

The Milk River Project was very successful in bringing additional water, and with it economic viability and stability to lands all along the Milk River. Additional structures have been constructed, en-

larged, and repaired over the last 80–90 years to improve the distribution of irrigation water and expand capabilities within the project.

In 1936, the Bowdoin National Wildlife Refuge was established as an overlay on lands owned and operated by Reclamation, with both agencies having jurisdiction. It was not until 1972 that the Service received primary jurisdiction over these lands. Bowdoin Refuge receives Milk River water through both the Dodson South Canal and the Bowdoin Canal. The Dodson South Canal provides water to lands immediately west of the refuge and is the feeder canal to Nelson Reservoir. This canal delivers water to Lake Bowdoin through the terms of a 1937 agreement between the Service and Reclamation. A sluice-type structure on the west side of the lake delivers the water; the structure was built more than two decades before the establishment of the refuge to divert irrigation return flows and excessive runoff in the canal into the lake. Unfortunately, construction of this canal intercepted the natural flow of surface water from the hills north of Lake Bowdoin. Additionally, seepage from the canal likely expanded saline seeps on the north and west shores of the lake.

The Black Coulee drainage, which drains into Lake Bowdoin, provides spring runoff and receives Milk River water as irrigation return flow supplied by the Dodson South Canal. Irrigation return flow comprises about 2,500 acre-feet annually to the refuge. The salt concentration of irrigation return flows is relatively fresh, about 500–700 mg/L. As such, the Black Coulee drainage is an important source of water for refuge habitats, especially wetlands on the west end of the refuge. However, the increased flow of water from increased irrigation capabilities brings in more salts than would likely have naturally occurred. Similarly, the Bowdoin Canal is an offshoot of the Dodson South Canal and provides irrigation water to lands south and east of the refuge, before emptying into Beaver Creek. The refuge can also receive water directly from the Bowdoin Canal into Drumbo and Goose Island Ponds. In addition, the refuge receives irrigation return flows from lands immediately adjacent to the refuge on the south side. These sources of irrigation return flow are important for the refuge. However, absent a flow-through system, they add more salts than otherwise would have been added to Lake Bowdoin, contributing to the salinity problem.

Refuge Establishment

The Bowdoin National Wildlife Refuge was established in 1936 to help restore declining waterfowl populations, which had been devastated by the loss of grassland and wetland habitats during the 1930s' Dust Bowl. It was one of many national wildlife refuges established throughout the northern Great Plains during the 1930s for migratory birds.

The Bureau of Biological Survey (a precursor to the U.S. Fish and Wildlife Service) correctly recognized the significance of Lake Bowdoin to protecting and restoring waterfowl populations in eastern Montana. The Bureau of Biological Survey began studying ways to increase the lake's water-holding capacity to provide valuable wetland habitat along with looking for ways to secure a more stable source of water for the newly formed refuge. To this end, the Secretary of the Interior (for Reclamation) and the Secretary of Agriculture (for the Bureau of Biological Survey) signed an MOA on March 9, 1937, to provide a refuge water supply from the Milk River of up to 3,500 acre-feet per year.

However, the 3,500 acre-feet was never enough water to manage Lake Bowdoin as a flow-through system. Based on the combination of the arid climate, the unpredictable water supply year to year, and the need to keep Lake Bowdoin from going dry, the Service needed to retain as much delivered water and floodwater as possible. This additional water needed to last through the summer and into the fall to provide wetland habitat for waterfowl and to prevent an outbreak of avian botulism. Except during flood years on the refuge, which allowed the flushing of salts from the lakes, Lake Bowdoin and Dry Lake were converted from a flow-through wetland system to a closed-wetland system.

During the 1930s and 1940s, the refuge received help from work crews employed through the Works Progress Administration, a Depression Era program that provided jobs on public works projects. These crews were instrumental in constructing refuge buildings and enhancing existing dikes, levees, roads, and water control structures to impound more water. The result was improved capabilities for water storage and management on Lake Bowdoin and Dry Lake.

While there is no question that changes to increase water storage capacity and manage water levels have provided tremendous benefits to waterfowl and wetland-dependent wildlife, these changes also have been some of the many factors contributing to salt accumulation in Lake Bowdoin.

Beaver Creek Watershed

Beaver Creek has its origin in the Little Rocky Mountains south of Malta, between Zortman and Lodgepole, Montana. The watershed is 195 miles long and has a drainage area of 2,060 square miles. Floods along Beaver Creek played a significant role in flushing salts from Lake Bowdoin and, over time, helped maintain the salt balance; however, water-

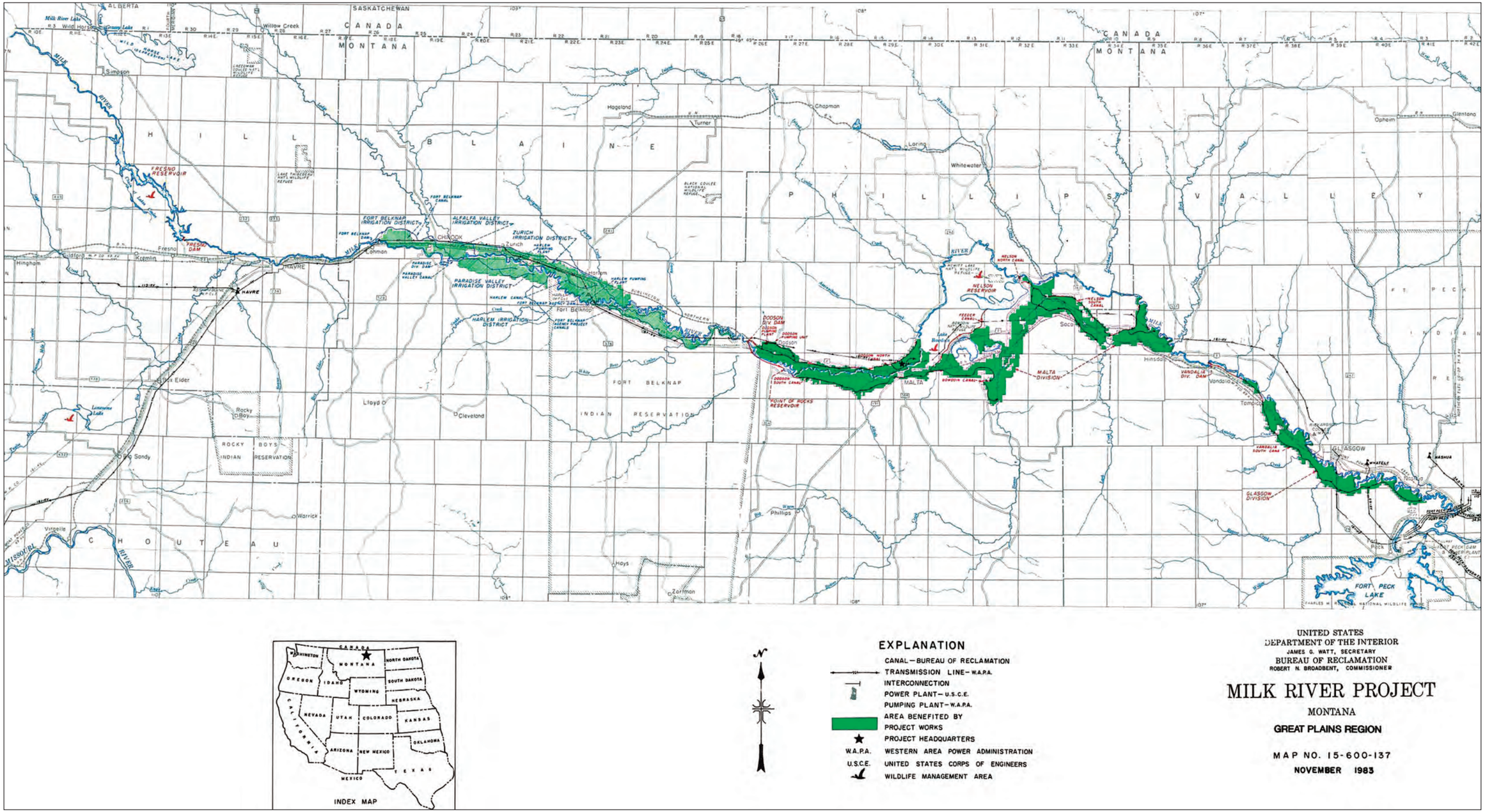

Figure 31. Map of the Milk River Project, Montana. *Source: Bureau of Reclamation, 1983.*

related developments in the watershed have significantly reduced the frequency of natural floods.

Refuge data, starting in 1937, indicates that the historical, average, flood frequency was once every 3–4 years. However, observations by refuge staff suggest that the frequency of floods since 1970 has decreased to once every 7–10 years. Only four floods have been recorded entering the refuge since 1970, the last being in 1996. It is likely that the establishment of numerous small impoundments and irrigation diversions in the Beaver Creek watershed has reduced the flood frequency on the refuge. The irrigation diversions and reservoir retention have reduced, by an estimated 45 percent, the average annual runoff in the Beaver Creek watershed upstream of Lake Bowdoin (Rodney and Mohrman 2006). Furthermore, the gradual but significant improvements in land management practices within the watershed might have contributed to the diminished magnitude and frequency of floods. Improved grazing, minimum-tillage farming, conversion of dry cropland to grass, and other innovations designed to retain rain and snowfall and use it more efficiently have reduced the runoff to Beaver Creek. The combined effect of these evolving land management practices is to reduce flood frequency, thereby inhibiting the primary mechanism for removing salts from the refuge.

Current Salt Balance

Inputs and outputs of salt affect and create the current salt balance.

Inputs of Salts

The sources of salts into Bowdoin Refuge are primarily from irrigation return flow, canal deliveries, ground water seepage, Beaver Creek floods, and rainfall. Figure 32 shows the sources of salts into the refuge and the average weight in tons per year; nearly half of the salts are from irrigation return flow. These input amounts have been developed from historical monitoring data as well as modeling to recreate the salt and water balance at the refuge.

Figure 33 shows the results from the model that estimated the total weight of salt on the refuge as a whole (Lake Bowdoin, Dry Lake, Dry Lake Pond, Drumbo Pond, and Lakeside) and Lake Bowdoin

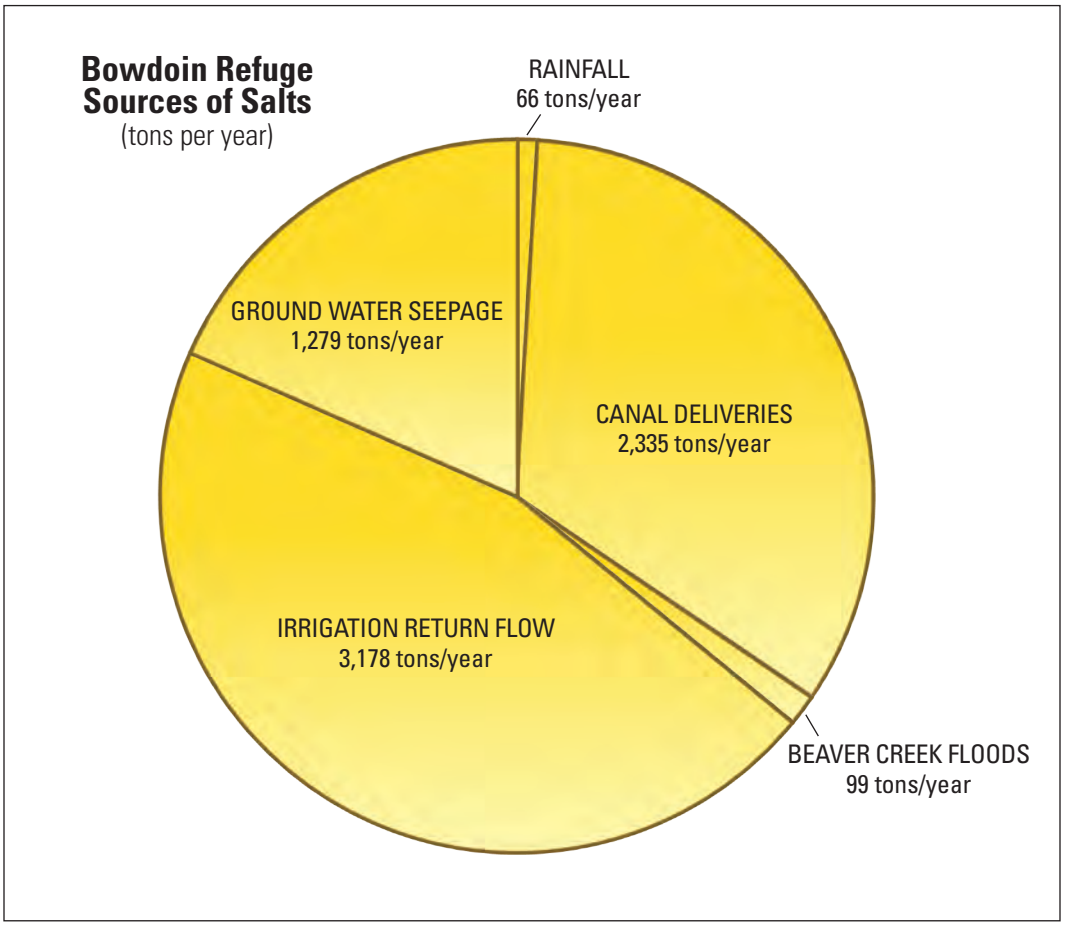

Figure 32. Chart of sources of salts into Bowdoin National Wildlife Refuge, Montana.

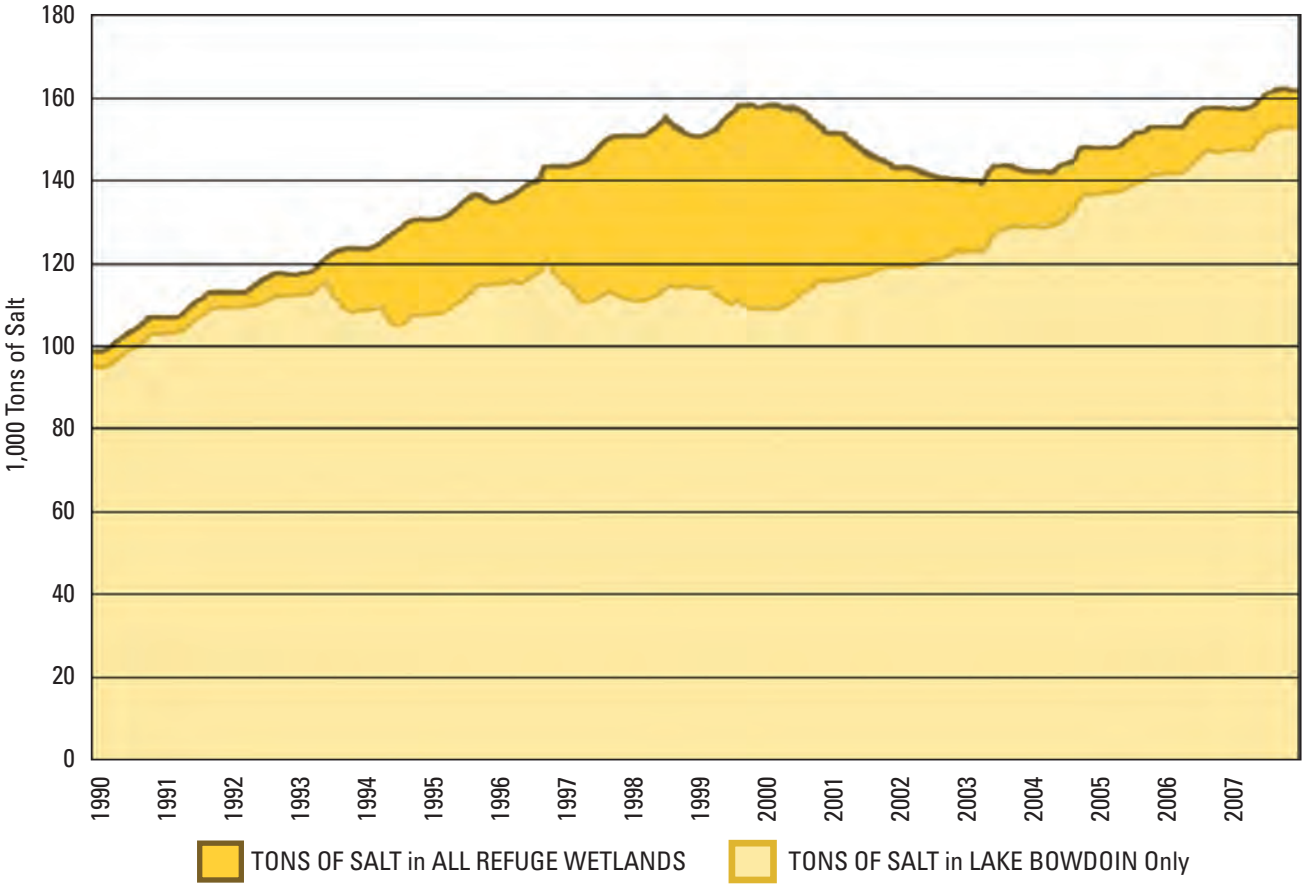

Figure 33. Graph of tons of salt in the lakes and wetlands at Bowdoin National Wildlife Refuge, Montana (1990–2007).

individually. There was a general increase of salts on the refuge, with Dry Lake seeing the most dramatic increase in salts. This was due to the 1990s' management practice of placing saline water on Dry Lake, which helped keep Lake Bowdoin in relative balance (figure 33). This management practice stopped in 1999, and Dry Lake has remained dry from 2000 to present except for spring runoff and rain events. Salts on the refuge decreased in the early 2000s due to the gradual loss of accumulated salts in Dry Lake from blowing away and from the onset of a drought that reduced the salt inputs. However, the salts began increasing once again since refuge managers no longer used this method to remove salts, with most concentrating in Lake Bowdoin. Under the current management plan of preventing releases into Dry Lake, the salts in Lake Bowdoin will continue to increase.

Outputs of Salts

Management actions as well as natural processes remove salts from the refuge.

Managed Removal of Salts. Past managers understood the salt imbalance and dealt with it in various ways. As shown in figure 34, various water sources add approximately 7,000 tons of salts to Lake Bowdoin in a typical year. Refuge managers have used two primary management methods to improve Lake Bowdoin's water quality and to reduce salinity concentrations:

- Discharge water into Beaver Creek (flow-through system)
- Manage Dry Lake as an evaporation basin for Lake Bowdoin (salts carried away by wind)

When water was plentiful and there were high spring flows in the Milk River and Beaver Creek drainages, past refuge managers occasionally managed Lake Bowdoin and Dry Lake as flow-through basins, flushing salts into Beaver Creek to improve water quality on the refuge. Managers made controlled releases to Beaver Creek in cooperation with downstream landowners. The releases, although rare, would generally occur before the start of the irrigation season to coincide with high stream flows in Beaver Creek during the spring. These high flows increased the dilution effect and discharges were

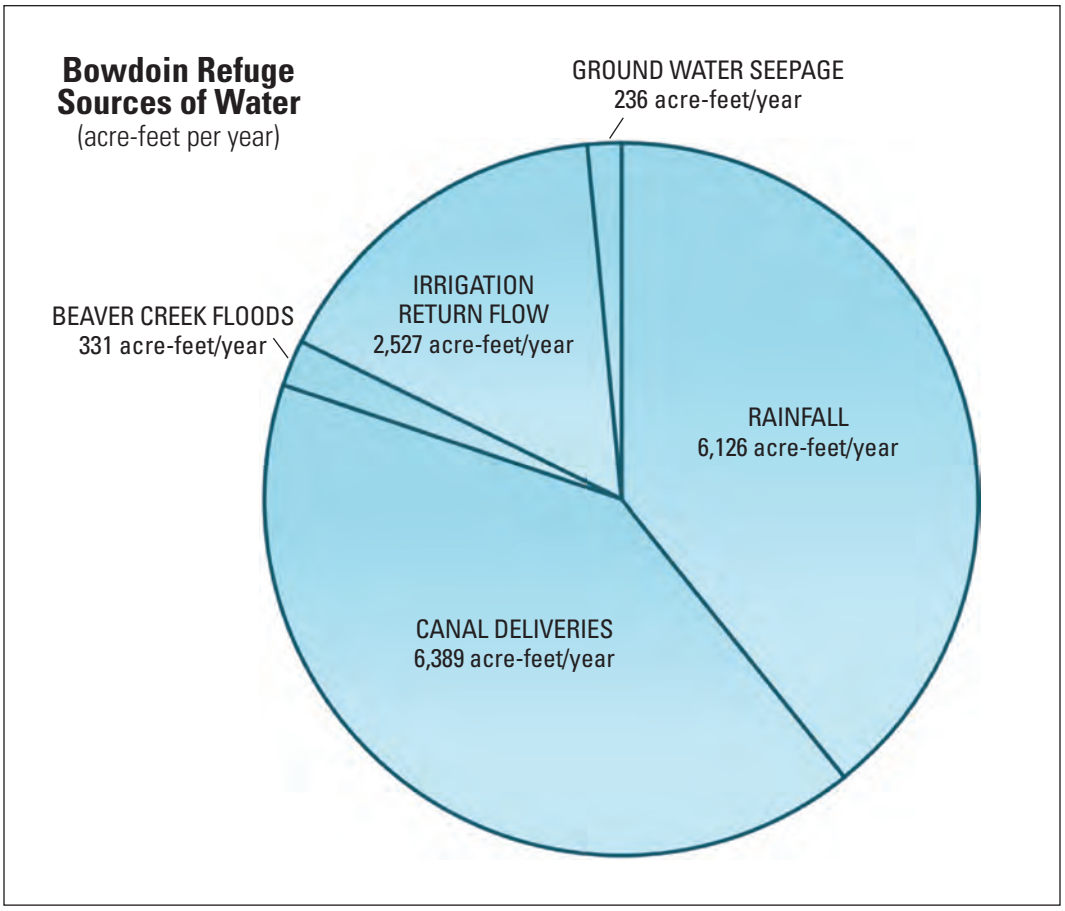

Figure 34. Chart of sources of water into Bowdoin National Wildlife Refuge, Montana.

within allowable limits, which minimized impacts to downstream irrigators.

However, in 1976, an accidental spill from the refuge into Beaver Creek due to failure of a water control structure occurred during the irrigation season. The Service settled the resulting lawsuit from downstream landowners claiming salts from the refuge impacted their lands. Consequently, this incident effectively stopped the Service from making future water releases into Beaver Creek; refuge staff has not intentionally released surface water from Lake Bowdoin into Beaver Creek since the late 1970s. As a result, managers needed to find another solution to deal with the increasing salinity concentrations on the refuge.

Droughts and floods in the 1980s provided a natural means of removing salts from the refuge. However, by the late 1980s and early 1990s, the Service needed to find other solutions. The solution at that time was to move salt-laden water from Lake Bowdoin to Dry Lake under the ice during the winter. This method was effective because, in the winter, the highly concentrated saltwater stays in solution (salt lowers the freezing point of water), while the fresher water separates and forms an ice layer on top. As water freezes, salts precipitate out into the water and the remaining ice contains very little salt. Refuge and State staffs recorded recent measurements of salt concentrations exceeding 30,000 mg/L under the ice. After transferring this salty water to Dry Lake, the water would remain throughout the spring and summer until it finally evaporated and left behind the salt residue. High winds transported the salt particles, which eventually settled downwind on the refuge uplands or the neighboring lands to the east and southeast of the refuge. During periods of high winds, the large salt "clouds" were very visible as the salts blew away from Dry Lake. Several factors created ideal conditions for the transport of salts from Dry Lake: (1) the lake's west–east geographic orientation; (2) the length of the lake; and (3) the surrounding topography (hilly on the east side) in relation to the prevailing westerly winds. The transfer of water into Dry Lake removed salts from Lake Bowdoin—approximately 5,000 tons of salt per year, or enough to roughly balance the annual salt inputs.

Although monitoring data clearly shows that this combination of moving water to Dry Lake and blowing salts was effective in maintaining relative

salt loads in Lake Bowdoin, Service managers no longer find it a viable option due to the effects on neighboring landowners and the effects on habitat in Dry Lake. Continually placing highly concentrated saltwater in Dry Lake for many years changed the value of the area's vegetation and habitat for wildlife. Where once sedges, rushes, and wetland grasses grew, today there are mostly weedy species such as kochia and large areas of bare soil. These effects occur across the 1,200-acre Dry Lake basin even though salty water has not been placed there since 1999.

However, it would be inaccurate to say Dry Lake currently has no wildlife value, because a variety of invertebrates and birds are adapted to saline environments. For example, when the Service managed Dry Lake as a wetland unit, or transported water to the lake, and food was available, large numbers of migrating and breeding waterfowl and shorebirds used Dry Lake. Even today, a variety of wetland-dependent birds and other wildlife use Dry Lake when there is water in the lake from runoff or precipitation. During years of abundant water supply, refuge staff manages Dry Lake as a separate wetland unit without the transfer of water from Lake Bowdoin. While water transfer may be a means to provide valuable wetland habitat, managers are not willing to accept the negative effects of transferring water to Dry Lake and the resulting blowing salts.

Mike Artmann / USFWS

Salt residue covers Dry Lake's northern bay, which supports salt-tolerant plants like bulrush and the low-growing saltgrass.

Natural Removal of Salts. The removal of salts due to natural climatic variables such as major drought and flooding still occurs on occasion, with the most recent in the mid-1980s. These natural events are important to keeping salinity concentrations from becoming even more extreme.

For example, a significant drought from 1983 through 1985 reduced Lake Bowdoin's water level nearly in half (figure 35). Salt concentrations in the lake eventually exceeded 30,000 mg/L, some of the highest concentrations ever recorded. Because of the smaller lake size, large areas of exposed shoreline were subject to drying and the forces of the wind; there was considerable wind removal of salts during the summers of 1984 and 1985. In fall 1985, the rains returned and Lake Bowdoin began to fill up again. This combination of concentrating the salts and transporting them away by wind, followed by an influx of water, created a dramatic decrease in salt concentrations from 30,000 mg/L to approximately 2,500 mg/L in spring 1986. This natural process continued into the next year starting in spring 1986, which saw above-normal precipitation, and having high water levels all summer. In late September, a massive, widespread rainstorm led to a 200-year flood episode in the Beaver Creek drainage, subsequently flooding the refuge and surrounding landscape (figure 35). This historic flood moved downstream a large amount of the salts stored in the lake and effectively lowered the salinity concentration for several years thereafter.

The natural processes of drought and flooding have a role in moving salt out of the system; however, their occurrences are unpredictable (in the case of major floods) and likely do not occur at frequencies to sustain the salt balance in the lake system.

Water Supply

The sources of water into the Bowdoin Refuge are primarily from irrigation return flow, canal deliveries, ground water seepage, Beaver Creek floods, and rainfall. As shown previously, figure 34 shows these sources and the average quantity in acre-feet by year. These input amounts have been developed from historical monitoring data as well as modeling to re-create the salt and water balance at the refuge.

Currently, the primary water right for the refuge is a right for "flood flows" from Beaver Creek. The Service can exercise this water right only during periods of high flows, which typically occur during spring runoff or after the irrigation season is over. In addition, the refuge is entitled to continue receiving all surface flows that originate in the Beaver Creek watershed and drain naturally into the ref-

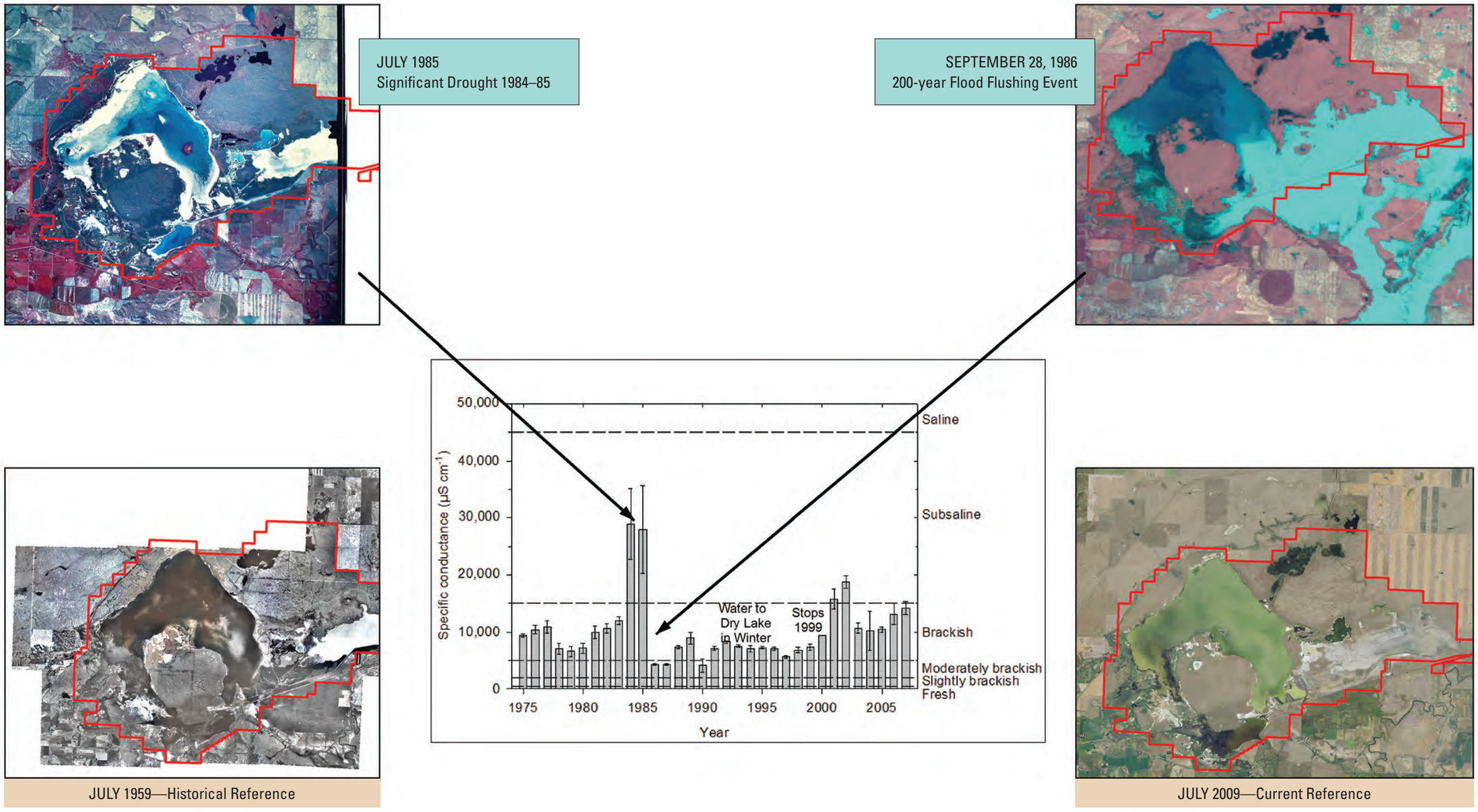

Figure 35. Map of water levels and salinity for Lake Bowdoin, Montana (1975–2007).

uge. However, these Beaver Creek water rights are ineffective in supplying adequate water to the refuge and in maintaining acceptable water quality because of the following: (1) senior water users downstream have priority over the refuge; and (2) there is increased development, primarily exempt stock ponds, in the upstream portion of the watershed. Consequently, the refuge is highly dependent on deliveries from the Milk River Project to meet its water needs for achieving the refuge purposes.

In addition to the Beaver Creek floodwater right, the Service's 1937 MOA with Reclamation provides for delivery of up to 3,500 acre-feet per year from the Milk River Project. In exchange for the water supply, the Service (then the Bureau of Biological Survey) agreed to contribute $40,000 toward the construction of Fresno Reservoir, which was completed in 1939. The MOA is still in effect and specifies that, during years of normal runoff, Reclamation would provide up to 3,500 acre-feet of water to the refuge each calendar year for improvement and maintenance of the refuge. If runoff is below normal, the refuge is to receive that portion of the 3,500 acre-feet that natural conditions and Federal reclamation laws permit, because the primary purpose of the Milk River Project is for irrigation. Therefore, the primary source of water for the refuge under normal conditions is Milk River water delivered to the refuge via the Dodson South Canal.

In the past, the refuge has obtained water in excess of 3,500 acre-feet through deliveries using the Malta Irrigation District facilities; the Service pays a fee to the irrigation district for all delivered water. Recorded deliveries have averaged 4,877 acre-feet of water. Figure 36 shows the historical deliveries of water supplied to the refuge—with the greatest quantities coming from canal deliveries and rainfall. Still, the current water supply does not meet resource needs at Bowdoin Refuge; consequently, the Service entered negotiations with the State of Montana for a reserved water rights compact.

Water Rights Compact

To address water supply issues at Bowdoin Refuge, the Service chose to negotiate a reserved water rights compact with the State of Montana. The following sections summarize the pertinent Montana water history and water rights issues, as they relate to the refuge, along with a description of the water rights compact for Bowdoin Refuge.

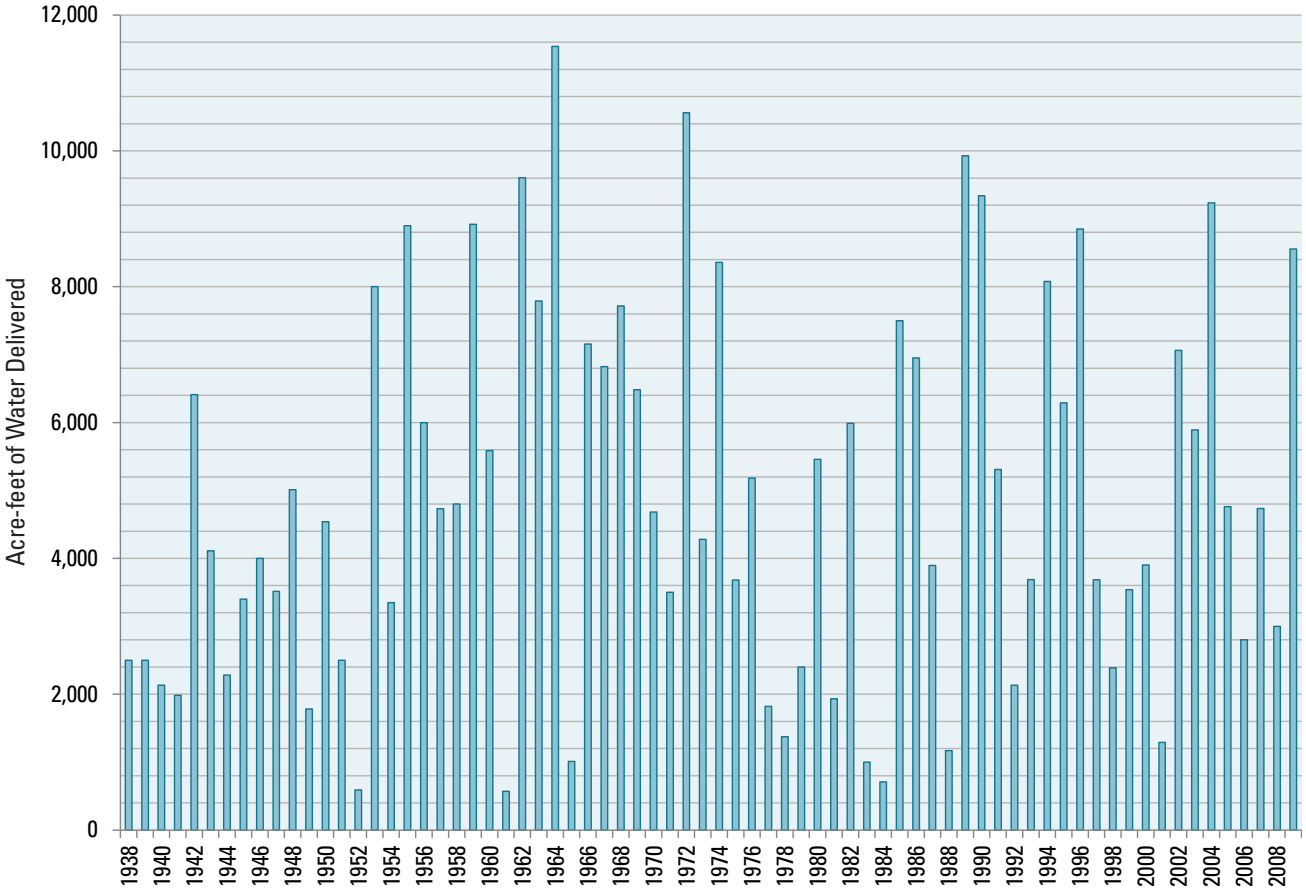

Figure 36. Graph of water deliveries to Bowdoin National Wildlife Refuge, Montana (1938–2008).

Montana Water History and Water Rights. The Montana Water Use Act of 1973 changed water rights administration in the State significantly. The act required that all water rights existing before July 1, 1973, be finalized through a statewide adjudication process in State courts. Furthermore, the act provided for the following: (1) the establishment of a permit system for all new water rights; (2) an authorization system for changing water rights; (3) a centralized records system; and (4) a system to reserve water for future consumptive uses and to maintain minimum instream flows for water quality, fish, and wildlife.

In 1979, the Montana legislature passed a bill amending the adjudication procedures for water rights. Rather than adjudicating water rights one watershed ("basin" in State terminology) at a time, all water rights existing before July 1, 1973, would be adjudicated statewide in all 85 basins. The State established the Compact Commission (Montana Reserved Water Rights Compact Commission) for negotiating compacts with Federal agencies and Indian tribes to quantify their reserved water rights. Thereafter, these compacts are included in adjudications.

The Montana Supreme Court issued an order requiring everyone who believed they had existing water rights to file statements of claim with DNRC (Montana Department of Natural Resources and Conservation) by January 1, 1982. DNRC provides technical assistance to the Montana Water Court by examining each claim for completeness, accuracy, and reasonableness. These examinations frequently result in the development of "issue remarks" if there are problems identified with the claim. A claimant must deal with these issue remarks before the court will develop a decree for the basin. Following resolution of the issue remarks and development of a report by DNRC, the Montana Water Court will issue temporary preliminary decrees or preliminary decrees. An objective period follows issuance of the decrees, during which parties can request up to two 90-day extensions. At the close of the objection period, anyone whose claims have objections must be notified, which triggers a 60-day counter-objection period. After all objections are resolved for a claim, the water judge issues a final decree. Subsequently, DNRC issues each water right holder a "certificate of water right" based on that decree.

The DNRC designated the Beaver Creek watershed as "basin 40M" and the Milk River watershed as "basin 40J." The water rights for Bowdoin Refuge consist of two major components: (1) water rights for water supplied within the Beaver Creek watershed; and (2) water from the Milk River watershed.

Water Rights Compact. Since 1995, the Service and the Compact Commission have been in negotiations about the Service's assertion of Federal reserved water rights in the Beaver Creek watershed for Bowdoin National Wildlife Refuge. The two parties reached a settlement in January 2007, and the Compact Commission's attorney developed a draft compact with input from the Solicitor's Office (Department of the Interior) and Service staff. This compact was presented to the Montana legislature twice and was passed in House bill 717, "Bill to Ratify Water Rights Compact between the State of Montana and the U.S. Fish and Wildlife Service for the Bowdoin National Wildlife Refuge."

The compact recognizes water rights from two sources: surface flows from the Beaver Creek watershed and ground water from existing wells within the refuge boundary. In addition, the Service has the right to develop up to 5,300 acre-feet of deep ground water. In negotiating the compact, the Service agreed to subordinate all of the water rights on Beaver Creek to valid, existing junior uses. In other words, the Service will not attempt to assert seniority in placing a "call" on any junior user after the date that the compact is finalized. A "call" is a request by an appropriator for water that a user is entitled to under its decree; such a call would force users with junior decrees to cease or diminish their diversions and pass the requested amount of water to the downstream senior making the call.

The Beaver Creek watershed is closed to all, large, future development as a result of the water right compact negotiated with the Fort Belknap Indian Reservation, which is in the same watershed as the refuge. Excluded from the closure are as follows: (1) exempt wells of 35 gpm (gallons per minute) that pump less than 10 acre-feet of water per year; and (2) stock ponds of 15 acre-feet or less that can fill and refill once each year. In return for agreeing to subordinate to existing valid junior uses, Bowdoin Refuge received a water right for 24,714 acre-feet per year from Beaver Creek and can continue to use 223 acre-feet of ground water from any source within the refuge boundary. The refuge can also develop 5,300 acre-feet of deep ground water from geologic formations dating at least back to the Jurassic Period.

The water rights compact is conditioned on the Service executing an MOU (memorandum of understanding) with the State (DNRC) within 5 years of passage of the previously mentioned House bill 717 that ensures the Service's use of these water rights will not continue or increase the issues associated with salinity and blowing salts. If the Service and DNRC cannot agree on an MOU, the water rights compact will be nullified; the Service would have to litigate its water rights in the Montana Water Court. The preferred alternative of the final CCP will be the basis for negotiating the MOU with the State.

6.3 Salt and Water Management

Management of salts at Bowdoin Refuge is tied to water management. An understanding of the salt balance and the water supply at the refuge would guide management actions in the short term and over time for a functioning lake system that benefits plant and animal communities and does not negatively affect nearby landowners and water users.

Salt Management

The long-term target for salt management is to have enough water, at an acceptable quality, to reestablish a flow-through system from Lake Bowdoin into Beaver Creek. This flow-through system would allow salts to pass through the refuge rather than accumulating in Lake Bowdoin. With the current salt concentrations, a flow-through system is not possible due to the potential environmental impacts to primarily downstream water users along Beaver Creek. If the refuge was able to maintain acceptable salt concentrations in Lake Bowdoin as defined by State regulations, a flow-through system could be restored if a sufficient water supply was secured.

The short-term target is to use management actions to remove sufficient salts so the Service can release water to Beaver Creek without significantly increasing the salinity of the creek water or negatively affecting downstream users. This management would also prevent the salts in Lake Bowdoin from becoming extremely concentrated, which would negatively affect wetland habitat and wildlife. The salt concentration objective for this type of management removal would average around 7,000 mg/L at a lake elevation of 2,209 feet (figure 37). However, the salt concentration of Lake Bowdoin would vary depending on water levels. With increased deliveries of water, it is estimated that at a lake elevation of 2,212 feet, salt concentration may decrease to approximately 5,000 mg/L. Conversely, if the water level were to drop to 2,207 feet, primarily as a result of drought, salt concentrations may again increase to over 25,000 mg/L.

The objective of maintaining a TDS concentration of 7,000 mg/L assumes the future input of water would match the historical delivery rates (1990–2007). The modeling effort to predict future salinity concentrations assumes that in some years there would be floods and in other years there would be droughts. In addition, modeling for the short-term target assumed that additional water supplies would not be received. As a result of maintaining a TDS concentration of 7,000 mg/L, approximately 80,000 tons of salt would remain on the refuge, primarily stored in the water in Lake Bowdoin.

Greg Thomson / USFWS

The marbled godwit is a target shorebird for management at the refuge complex.

The Service does not wish to completely remove all salts from refuge waters; in fact, these wetlands are naturally brackish. The 7,000 mg/L objective was selected based on the relatively high number of plant (both emergent and submergent) and invertebrate communities that can be supported (Gleason et al. 2009). These communities in turn support a wide range of migratory birds that visit the Bowdoin Refuge every year. However, the overriding target (long- and short-term) for any salt management program is to improve the water quality on the refuge over time so that releases of water to Beaver Creek or the Milk River would either: (1) not require an "authorization to degrade" permit from the State; or (2) if an "authorization to degrade" were required, the restrictions would be such that the approved release rate out of Bowdoin Refuge would provide a reliable method to maintain the salt balance.

Water Management

The desired long-term water management plan would be a flow-through system where the refuge receives a sufficient quantity of water that could eventually spill into Beaver Creek, carrying with it a quantity of salts equal to what has entered the refuge. By reestablishing a flow-through system, blowing salt events would be minimized and wildlife habitat would be improved.

To reach as quickly as possible the target salinity level needed for a flow-through system, there may need to be a reduced amount of water delivered to Lake Bowdoin. This would not only minimize the

amount of salts entering the refuge but concentrate the salts that are already in the water, allowing them to be more easily removed. Additionally, where practical, the inflow of salts could be reduced at the source by lining portions of irrigation canals and managing saline seeps and irrigation return flows.

Obstacles to Implementing a Flow-Through System

The Service would need to address several obstacles in developing an effective flow-through system: the lack of needed water supply, the potential need for State permits, and the removal of structures.

Additional Water Supply. Modeling efforts by Service hydrologists (using models developed in large part by State hydrologists), show the amount of water currently delivered to the refuge under the MOA with Reclamation—up to 3,500 acre-feet under normal water years—is not sufficient to implement a flow-through system for Lake Bowdoin even if water quality issues were resolved.

To address this shortfall, the Service has filed for an additional 8,000 acre-feet of water, based on the maximum delivery from the Milk River on record of 11,540 acre-feet. This historical use right is not part of the ongoing Federal water rights compact and will be litigated as part of the adjudication process for basin 40J (Milk River watershed). The Service understands this water right would likely be junior to most of the other water rights on the canal and would only be taken during periods when water is available.

Additional water would provide the following benefits to the refuge:

- Provide flushing opportunities after water quality issues are addressed.
- Help offset evaporation, which can exceed 3 feet per year.
- Provide the opportunity to manage Dry Lake and Drumbo Pond as a flow-through system.
- Allow all units to fill periodically (whereas many are dry now).
- Allow additional management options including more flexibility in filling Piping Plover Pond, developed to provide nesting habitat for the threatened piping plover.

Permits. Before discharging water into Beaver Creek or the Milk River, the discharge of refuge waters into State waterways must first meet the DEQ's water quality standards (DEQ–7). Currently, the Lake Bowdoin water does not meet these standards. The DEQ water quality standards program has two levels of protection: (1) protection of designated uses of water; and (2) prevention of significant degradation of high-quality waters.

Salinity standards have not been established for the Beaver Creek or the Milk River. The water discharged from Lake Bowdoin, when mixed with water from Beaver Creek or the Milk River, must not exceed the threshold determined by DEQ. As an example, in other rivers, a TDS concentration range from 960–1,600 mg/L during the irrigation season has been established (Bauder et al. 2007). To prevent impairment of aquatic life in Beaver Creek or the Milk River, the TDS concentration would have to be maintained below a threshold of 1,000 mg/L.

In addition to the salinity, elevated levels of sulfates, arsenic, and uranium are obstacles to releasing water. For example, to safely release water into Beaver Creek or the Milk River without harming aquatic life, a low calculated release rate (estimate of 200:1) from Lake Bowdoin would be permitted to avoid causing harm from sulfates. Therefore, if 200 cfs (cubic feet per second) were the rate of flow of the receiving water, only 1 cfs would be permitted from Lake Bowdoin. This mixing ratio could decrease under scenarios where sulfates are reduced.

The pollutants arsenic and uranium are both carcinogens, as defined in DEQ–7. Any release from Lake Bowdoin where the concentrations of either arsenic or uranium were greater than the receiving water concentration would require an "authorization to degrade" permit from the State. It is probable, with the addition of ground water inputs and the history of evapoconcentration, that an "authorization to degrade" permit would be necessary for any surface water release from Lake Bowdoin.

Current Structures and Dikes. To obtain the most effective flow-through system, the Service ideally would need to remove the stoplogs (logs or beams that prevent water flow) in the water control structures to allow water to flow between Lake Bowdoin and Beaver Creek during flood events. However, removing stoplogs would only be possible if salinity issues were resolved sufficiently or extreme flooding conditions were such that releases from Lake Bowdoin and Dry Lake were necessary to protect infrastructure. These flood water releases would be be conducted safely in coordination with downstream irrigators and in accordance with State guidance from DEQ. The quality of the discharged water would be monitored. Until that time, the refuge staff would maintain the stoplogs, dikes, and spillways primarily to prevent accidental releases. In addition, the refuge would manage water levels to reduce the chance of a breach in the dike.

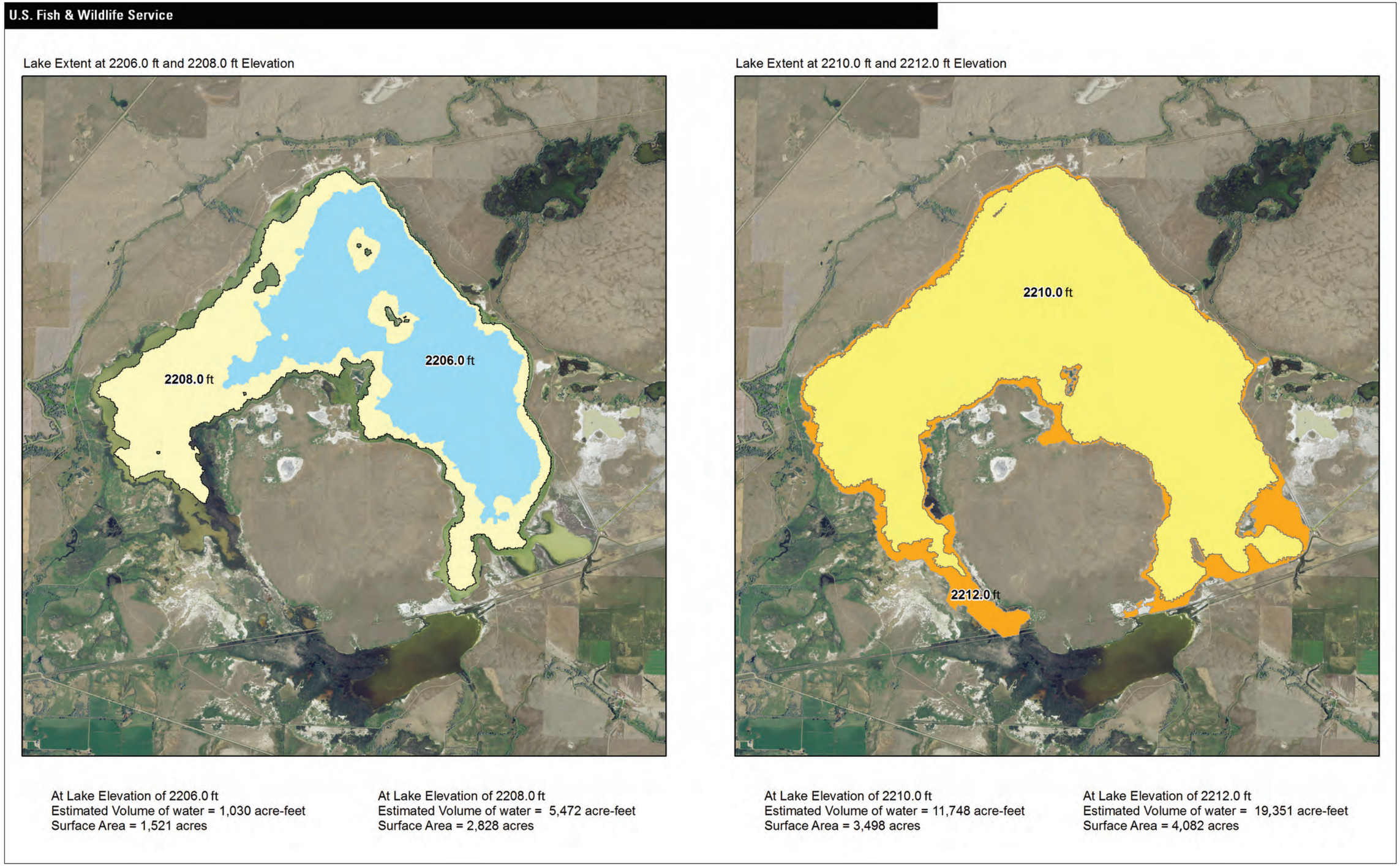

Figure 37. Map of the extent of Lake Bowdoin at various water elevations.

Salt and Water Objectives

The objectives for the salt and water management program follow:

- Achieve and maintain an average salt concentration of 7,000 mg/L at a lake elevation of 2,209 feet in Lake Bowdoin.
- Limit blowing salts.
- Obtain an additional 8,000 acre-feet of canal deliveries to allow for a flow-through system, while meeting all DEQ standards.
- Use the additional 8,000 acre-feet of canal deliveries for more management options.

6.4 Planning Process

When the Service started the preparation of a CCP in October 2006, the first step in the process was pre-planning. A planning team was established, internal issues and qualities of the area were identified, public involvement was planned including development of a mailing list, and available refuge data and relevant research were compiled. Public involvement was initiated on May 15, 2007, when the notice of intent to prepare the CCP was published in the Federal Register. More than 170 individuals and organizations were provided information on the planning process and invited to participate in a public meeting held in Malta, Montana, on May 22, 2007.

During pre-planning, it became very evident that the most pressing issue for the CCP and environmental analysis process would be the salinity and blowing salts on Bowdoin National Wildlife Refuge. The biological implications were evident. Furthermore, this was an environmental issue for the State and neighboring landowners, primarily because of past experiences and the future potential for blowing salts or a spill due to a flood, which could cause structure failure.

Refer to table 1 in chapter 1 for the detailed steps and timeline in the planning process for this CCP and environmental analysis. A summary follows of the process for developing alternatives, involving the public, and completing the CCP.

Development of Alternatives

On May 22, 2007, the Service formed a salinity team comprising hydrologists, biologists, toxicologists, and researchers from State and Federal agencies. This team discussed options for effectively managing the refuge's wetland resources while addressing the salinity issue. A smaller salinity group had staff from the refuge, the Compact Commission, DEQ, DNRC, U.S. Geological Survey, and Region 6's Division of Water Resources and Division of Refuge Planning. This group was tasked with developing alternatives to address the salinity situation.

The salinity group evaluated data and existing models. The group initially modeled and analyzed nine scenarios, including combinations of other scenarios, to determine their effectiveness in reducing salinity, improving water quality, and reducing blowing salts while still providing habitat for migratory birds. The group had five additional meetings while developing these models.

In addition to this effort, researchers from the U.S. Geological Survey's Northern Prairie Wildlife Research Center completed a separate analysis on the salinity ranges of water and soil for common plants and invertebrates found on Bowdoin Refuge. U.S. Geological Survey conducted a search of the literature on occurrences of plants and invertebrates in relation to salinity and pH of the water and soil. The resulting literature review was used to compile the latest information, develop databases, and write a report with the following:

- A general overview of salinity concepts
- Published tolerances and adaptations of plants, invertebrates, and animals to salinity
- Databases that the Service could use to summarize the range of reported salinity values associated with plants and invertebrates
- Database summaries of reported salinity ranges associated with plants and invertebrates at Bowdoin Refuge.

The resulting report was titled, "Literature Review and Database of Relations between Salinity and Aquatic Biota—Applications to Bowdoin National Wildlife Refuge, Montana" (Gleason et al. 2009).

Salinity Alternatives

On April 22, 2008, 17 individuals (biologists, hydrologists, managers, toxicologists, researchers, engineers, and planners), many from the original salinity team, assembled from five State and Federal agencies. The salinity group presented their findings and proposed alternatives. Two proposals early in the process were determined to be either ineffective or cost prohibitive; these are described below.

After meeting for 2 days, the team determined that four of the alternatives would be most effective and warranted further analysis, particularly of the cost, effectiveness, and environmental consequences.

The Service acquired the money to complete further analysis and entered into a contract with an engineering firm in Denver, Colorado—URS Group, Inc. The contract began in July 2008. URS provided information for three of the four alternatives that the Service decided to analyze:

- Evaporation ponds and removal of saline residue
- Flushing by Beaver Creek
- Underground injection of saline solution

Concurrently, the refuge staff and a team of biologists and hydrologists from the Service and the State conducted a separate analysis for the fourth alternative. This effort analyzed the cost, effectiveness, and consequences of pumping saline water to the Milk River through a pipeline.

Analysis of the four alternatives took more than a year to complete. Section 6.5 details the resulting evaluations of these four "action" alternatives along with an evaluation of the current situation, or "no-action" alternative.

Alternatives Considered but Eliminated

Two options that the Service did not find viable for addressing the salinity and blowing salts situation were eliminated from further analysis as described below.

Desalinization. The Service considered desalinization—for example, with reverse osmosis—but eliminated this option due not only to the costs (capital, operating, and maintenance costs) but also due to a lack of available disposal locations for the wastewater generated from this process. Desalinization would not remove salts from the site, because the salt would remain in the concentrated waste outflow. Subsequently, this waste outflow would need removal—placed on railcars, injected into the ground, or discharged into the Milk River.

Pumping Water into Dry Lake. Pumping saline water into Dry Lake and allowing the lake to serve as an evaporative basin to blow away salt residues was determined an unacceptable alternative and was dismissed from further consideration.

Public Involvement

Before completing the draft CCP and EA, the Service invited the public to a meeting on October 22, 2009, in Malta, Montana, for a review of the salinity alternatives and an opportunity to offer comment. A planning update was sent to each individual and group on the mailing list, and local media was contacted. More than 30 people attended this meeting including local landowners, media, private organizations, and other State and Federal agencies. Members of the salinity group presented the merits and challenges of each alternative and recorded the comments of meeting participants. Afterward, the CCP planning team evaluated the salinity comments from the public. The team incorporated the substantive comments into this final analysis and recommendation for a proposed action for the salinity and blowing salts on Bowdoin Refuge.

Plan Completion

Following public review of this draft CCP and EA, the planning team will give a briefing to the Regional Director (Region 6 of the Service) about the alternatives for the CCP for the Bowdoin National Wildlife Refuge Complex. This will include the salinity alternatives and proposed action (salinity alternative 4) described in this chapter. The Regional Director will make the decision on whether to accept this proposed action as the preferred alternative for salinity and blowing salts or to request further analysis or modifications.

Once approved, the preferred alternative for salinity and blowing salts, along with the preferred alternative for all the other management aspects of the refuge complex (refer to chapters 3 and 7), will become the final plan. The Service will publish a notice of availability in the Federal Register and send copies of the final CCP or CCP summary to individuals and groups on the mailing list.

Mike Artmann / USFWS

Three-square bulrush grows on the salt-covered shoreline along the southwestern edge of Lake Bowdoin.

6.5 Salinity Alternatives Analysis

This section describes the five salinity alternatives and the results of the analysis for each one.

- *Salinity alternative 1*—current management (no action)
- *Salinity alternative 2*—evaporation ponds and removal of saline residue
- *Salinity alternative 3*—flushing by Beaver Creek
- *Salinity alternative 4*—underground injection well and flushing by Beaver Creek (proposed action)
- *Salinity alternative 5*—pumping to the Milk River

There are several elements common to all alternatives. Following, a description of each alternative details the actions and expected consequences of carrying out those actions. At the end of this section, table 11 summarizes the actions and consequences.

Elements Common to All Alternatives

The elements described below apply to the five salinity alternatives, including the no-action alternative.

Salt and Water Inputs

For all modeling scenarios, it was assumed that historical conditions would continue into the future. Water inputs, water quality data, and climate data were taken for the period from 1990 through 2007, because data for this period is relatively complete.

In addition, modeling scenarios used the assumption that water would be supplied to each wetland unit similarly to previous management and water could flow between all units. From 1990 through 2007, approximately 80 percent of canal water was supplied to Lake Bowdoin, 17 percent to Lakeside, and 3 percent to Drumbo Pond.

Water Rights Compact

The Service would use the preferred salinity alternative, as selected by the Regional Director (Region 6), as the basis for negotiating the MOU with the State related to the water rights compact.

Sources of Salts

Regardless of which alternative the Regional Director selects, the Service would evaluate and take measures to reduce the delivery of salt to the refuge. Furthermore, the Service would encourage surrounding landowners to use the methods for reducing the size and contributions of salt from saline seeps near the refuge, as suggested by the Montana Salinity Control Association (Jane Holzer, agronomist, Montana Salinity Control Association, personal communication, October 2009):

- Establish a 5- to 10-year rotation from crops to perennial forage for haying and grazing in the recharge area. Most commonly use the deep-rooted crop, alfalfa, but also use other legumes and grasses, reducing the amount of water percolating through the root zone.
- Plant perennial vegetation in the recharge area through the Conservation Reserve Program to mimic the water use by alfalfa hay.
- Switch from the crop-fallow system to a flexible but more intensive annual cropping system. Follow the forage rotation, which can include cereal grain, with the flex-crop system.
- Line irrigation canals that leak water into the ground water.
- Encourage irrigation practices that use water more efficiently to minimize water table rise.

Baseline for Socioeconomic Analysis

The proposed salinity alternatives would have various effects on visitation to Bowdoin Refuge Complex for hunting and wildlife observation. Currently, there are 25,000 annual visitors to the refuge. Ninety percent, or 22,500 visitors, do not live close to the refuge and contribute a direct economic impact of $415,750 for visitation throughout the refuge complex.

Only nonresident visitor spending can be considered when calculating the socioeconomic impact of refuges on the local economy in the four-county region in north-central Montana. The money spent by local residents on visitation to the Bowdoin Refuge Complex would likely be spent on other local recreational activities if the refuge complex did not exist, so it cannot be considered a new expenditure in the local economy. Socioeconomic analyses of

visitor spending are compared for each alternative against this baseline data. The analysis assumes that nonresident hunters spend an average of $55 per day and wildlife observers spend an average of $18 per day. The economic impacts of salinity reduction are one-time construction spending, ongoing direct operational spending, and visitation-related effects.

Salinity Alternative 1–Current Management (No Action)

Salinity alternative 1 is the no-action alternative, meaning current management would continue. Under current management, water deliveries would remain near 3,500 acre-feet and no water would be released from Lake Bowdoin. There would not be any active removal of salts from Lake Bowdoin except by wind or during a flood event. Salts would continue to accumulate and the salinity situation would become increasingly difficult to manage.

The following describes the alternative's specific actions and expected environmental consequences if implemented.

Actions

These actions reflect the current management for addressing salinity and blowing salts.

Tons of Salt Removed. No salt would be removed unless there was a major flood event or the salts dried up and blew away when the level of Lake Bowdoin was dropped. The total weight of salt would increase to more than 250,000 tons in less than 20 years (figure 38).

Salinity Concentration. Lake Bowdoin would continue to receive about 7,000 tons of salt per year, causing salinity levels to increase steadily. The increase in salt and lack of outflow would cause salinity to reach extremely high levels during dry years—more than 30,000–40,000 mg/L. With elimination of the practice of allowing salt residue to concentrate in Dry Lake and be carried away by wind, the concentration of salts in Lake Bowdoin would reach even higher levels than what has been documented in the past.

Time to Achieve Salinity Objective. The objective of sustaining a brackish water quality level (7,000 mg/L) would never be reached without an accidental spill or major flood event. If one of these two events

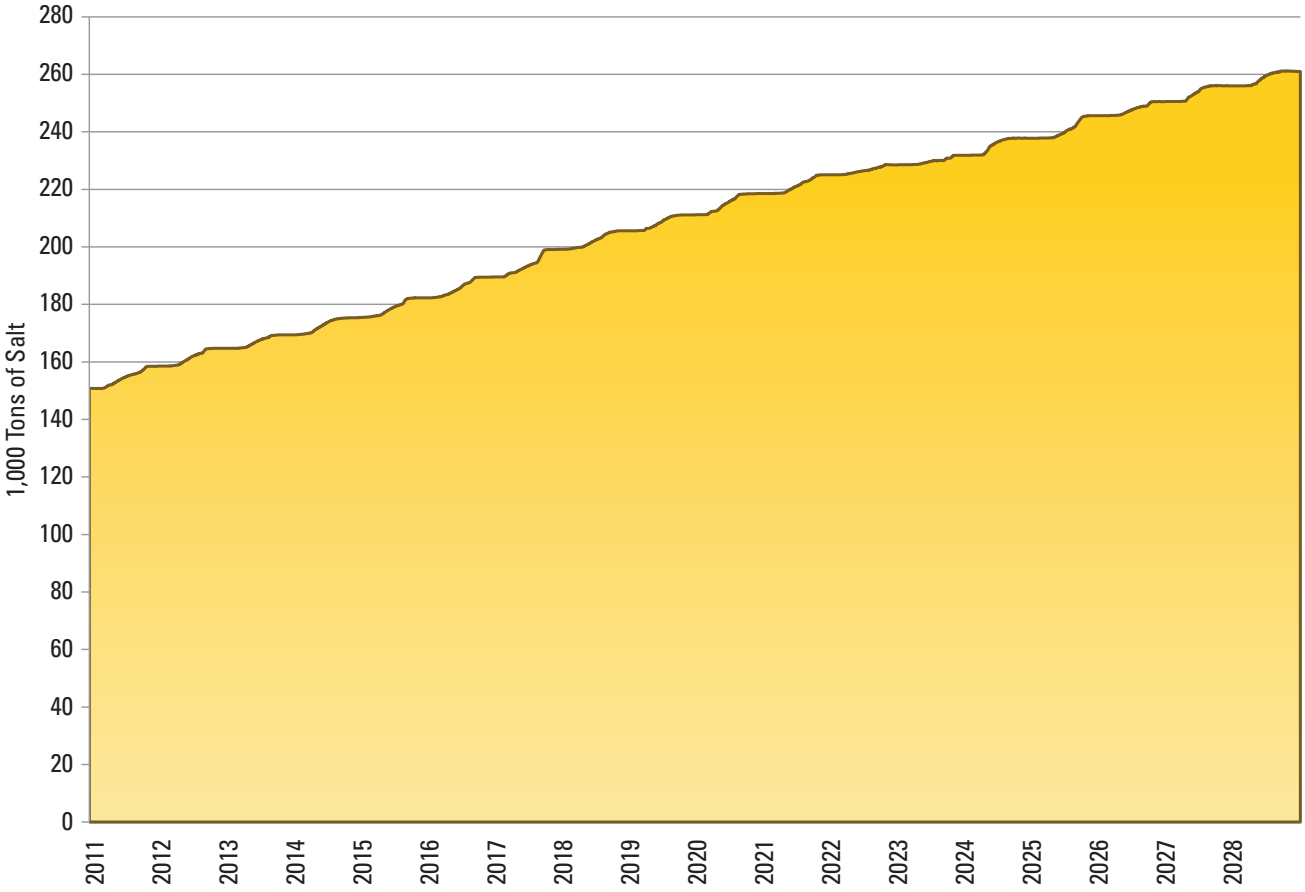

Figure 38. Graph of tons of salt in Lake Bowdoin with salinity alternative 1, no action.

occurred, the salinity objective would likely be met for a short period; however, the salinity level would not be sustained as salts continued to accumulate.

Elevation of Lake Bowdoin. There would be no management of the size of Lake Bowdoin. The lake's elevation would likely fluctuate between 2,208 feet and 2,211 feet throughout the year if water deliveries remained near 3,500 acre-feet. If the historical average of 4,900 acre-feet of canal water were delivered, Lake Bowdoin would fluctuate between 2,210 feet and 2,213 feet in elevation. Elevation of the lake would continue to depend on inflow and evaporation. Except under coordinated efforts with downstream users during floods, water would not be released even during wet years due to the high salinity and the threat of impacting downstream landowners, wildlife, vegetation, and invertebrates.

Amount of Water Removed. There would be no active removal of saline water from Lake Bowdoin under the current management.

Modifications and Facilities. There would be no changes or modifications to the current water management infrastructure. All water-level management structures would be maintained and stoplogs would remain in place to prevent accidental releases of water.

Capital Cost. There would be no capital cost associated with the current management practices. There could be indirect costs for tort claims related to an accidental spill of waters down Beaver Creek.

Monitoring and Research. The Service would continue to monitor water delivery, water quality, lake elevation level, wildlife disease outbreaks, migratory bird use, and sites for colonial-nesting birds.

Environmental and Socioeconomic Consequences

The actions of salinity alternative 1 would likely have the consequences described below.

Plant Diversity. Under the no-action alternative, plant species diversity in Lake Bowdoin would likely continue to decline as salinity concentrations increased to the upper ranges of the subsaline class (20,000–25,000 mg/L), with only a few of the most salt-tolerant species thriving (Gleason et al. 2009). Expansion of plant species requiring fresher sources of water for establishment, such as cattail and hardstem bulrush, would not occur. If the lake were kept at full-pool level, expansion of any emergent vegetation would likely not occur. Conversely, if the lake were kept lower for several years at a time, some expansion and colonization would be expected to occur. Submerged aquatic vegetation, which provides important food for waterfowl and habitat structure for invertebrates, would likely continue to decline. Plants such as sago pondweed and widgeongrass are important for migrating waterfowl and other waterbirds.

The strong west-to-east salinity gradient in Lake Bowdoin would remain. Wetland vegetation along the eastern and southeastern shorelines, where salinity concentrations are the highest, would remain dominated by salt-tolerant species such as alkaline bulrush, common three-square, and pickleweed, with little expansion into the lake over time. Emergent vegetation on the west side of the lake would likely remain dominated by cattail and hardstem bulrush.

Flow-through wetlands such as Patrol Road Pond, Black Coulee Pond, and Lakeside would remain in the slightly to moderately brackish wetland classes (less than 3,000 mg/L) as salts were passed into Lake Bowdoin and Dry Lake.

Mike Artmann / USFWS

With the fresher water it receives, Black Coulee Pond supports a greater amount of cattail than in more saline wetlands.

Invertebrates. Like plants, invertebrate diversity in Lake Bowdoin would decline with increased salinity. Fresh wetland systems contain diverse invertebrate communities, whereas wetland systems exceeding a brackish state (greater than 9,600 mg/L) tend to be dominated by relatively few groups of invertebrates (Gleason et al. 2009). Given the variable inflows of fresh water to Lake Bowdoin, such as the irrigation return flows in Black Coulee and the delivered water via the Dodson South Canal, there would likely be areas within the lake where a higher diversity of species still occurs. However, as the lake moved to a consistently salty state, these areas of invertebrate diversity would decline. Although diversity of invertebrates would likely decline, the total productivity of the lake may remain high because salt-tolerant species, which can be prolific, dominate.

Waterfowl and Other Waterbirds. Waterfowl use and productivity would likely further decline from

already low levels, as salt accumulations in Lake Bowdoin continued to increase. The salinity concentration for the lake in September 2009 averaged more than 10,500 mg/L. This concentration exceeds the level that affects the growth rates and survival of waterfowl broods, especially for ducklings less than 6 days old. At salinity concentrations higher than 15,000 mg/L, duckling mortality can exceed 90 percent (Mitcham and Wobeser 1988, Moorman et al. 1991). Furthermore, duckling growth rates are reduced when salinity concentrations are higher than 3,000 mg/L (Mitcham and Wobeser 1988).

At current salinity concentrations and with no available fresh water, Lake Bowdoin would be a "sink" to waterfowl populations—birds would be attracted to the lake for nesting, but conditions would not be conducive for young ducklings to survive. Fortunately, fresher sources of water are located within the lake near input channels and seeps and in nearby freshwater wetlands such as Patrol Road Pond, Drumbo Pond, Teal Ponds, Farm Ponds, Goose Island Pond, and the Lakeside units. These fresh sources would continue to be available even as the overall average salinity continued to rise in the lake.

Lake Bowdoin has a history of avian botulism outbreaks. Bird losses, mostly ducks, have averaged about 1,500 per year since 1979. Research has shown that, in general, the risk of botulism outbreaks declines when salinity concentrations increase (higher than 6,000 mg/L) (figure 39) and pH readings in the water exceed 8.5 (Rocke and Friend 1999, Rocke and Samuel 1999). Recent refuge data suggests this pattern may hold at Lake Bowdoin. Losses since 2003 averaged 190 birds while average salinity was higher than 10,000 mg/L. As salinity concentrations continued to rise, the risk of large outbreaks would likely remain low.

If Lake Bowdoin were kept at an elevation of 2,211 feet, an estimated 125 acres within the lake would be less than 3 inches deep; however, most of this is located in densely vegetated areas. Shorebird use would only increase during drought periods when the lake level lowered and expansive mudflats were available. This would be especially true if a drawdown occurred during the migration period (Fredrickson and Reid 1988b).

Colonial-nesting birds, such as American white pelicans, would likely not be greatly affected by steadily increasing salinity concentrations. Lake levels would likely remain consistent as in the past, and all nesting islands would remain surrounded by water.

Downstream Users. There potentially could be hazards to downstream water users if no action were taken. Increasing salinity would raise the potential severity if an accidental spill were to occur. However, this threat could be lessened substantially by keeping the lake at a lower operating level. But by operating the lake at a lower level with no mechanism to remove salts, the concentration would increase further. Furthermore, if salinity concentration reached critical levels, refuge managers may be forced to reconsider using the past practice of moving water from Lake Bowdoin to Dry Lake, which would allow the saline water to evaporate over the summer and be blown away by high winds.

Public Use. There would be no discharge of water, so the water level in most years, given historical deliveries of water, would provide access to existing boat ramps and the accessible pier on Lake Bowdoin. Since water quality would continue to decline, the production and diversity of food sources for wildlife would decline and, over time, there would be less wildlife for the enjoyment of the public.

Socioeconomics. Declining health of wetland habitats and a reduction in bird use of Bowdoin Refuge would decrease the opportunity for wildlife-dependent recreational opportunities including birdwatching and hunting visits. Visitation to the refuge is expected to decline by 4,850 visitors, decreasing the total to 12,650 (including hunters and wildlife observers). Based solely on nonresident visitation (11,380), the direct economic impacts would be $310,700 annually, a decrease of $105,050 from the baseline.

Cumulative Impacts. As salinity would continue to increase and likely reach critical levels, plant and invertebrate diversity and habitat quality would decline. This would be particularly true in dry years when lake levels dropped, salts were further concentrated, and there were no means other than by wind to remove the salt. Over time, this would result in reduced food resources and habitats for migratory birds and other wetland-dependent wildlife.

As the total amount of salt in the lake increased, the amount of salt available for removal by wind would also increase. If drought conditions were more frequent in the future or if the refuge was unable to acquire sufficient water from the Malta Irrigation District, lower lake levels would become more frequent. Increasing the potential opportunity for windblown salt could negatively affect public use opportunities if salt clouds were significant enough to reduce viewing or hunting opportunities. In addition, neighbors to the refuge and the local community would not view large salt clouds favorably, thus further stressing relationships between the refuge staff and community members. Failure to act on the salinity issues facing Lake Bowdoin would make it more difficult to establish long-term partnerships with State and local interests that have invested much time and effort in this planning process.

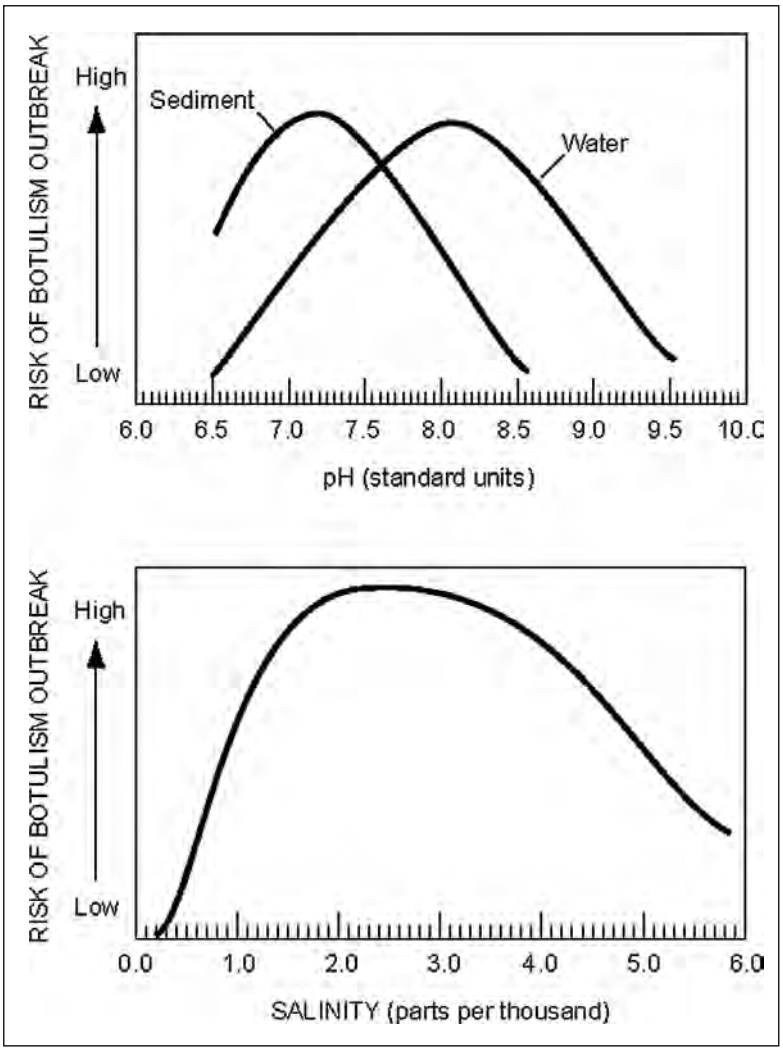

Figure 39. Graphs of the relationship of pH and salinity to avian botulism outbreaks (Rocke and Friend 1999).

If blowing salts contain high levels of particulate matter and exposure is sustained, human health can be affected. The EPA (U.S. Environmental Protection Agency) has established standards for 24-hour time periods and annual averaging timeframes (EPA 1997). Respiratory diseases such as asthma and chronic bronchitis can be aggravated by breathing air high in particulate matter. Bauder and others (2007) estimated that climatic conditions such as wind speed and precipitation near the refuge are conducive for windblown events to occur between two and eight times each year. While much of the windblown salt would likely settle back in the lake or within the refuge boundary, some may travel as far as 10–20 miles (Bauder et al. 2007). However, the configuration of Lake Bowdoin and Dry Lake differ considerably: Dry Lake is long and narrow and subjected to prevailing winds; Lake Bowdoin is relatively circular and somewhat protected by topographic features. Given the differences in topography, it is unlikely that the magnitude of salt blowing from Lake Bowdoin would equal past episodes of salt blowing from Dry Lake.

Salinity Alternative 2– Evaporation Ponds and Removal of Saline Residue

Salts would be removed from Lake Bowdoin during the winter by pumping highly concentrated saline water via underground pipelines to evaporation ponds located in Dry Lake. These evaporation ponds would cover approximately 300 acres. The water in these ponds would evaporate during the summer to the consistency of a concentrated sludge material. The material would then be moved to a drying building located near the railroad line. After further drying, the sludge material would be loaded onto railcars and properly disposed of in an approved landfill site.

The following describes the alternative's specific actions and expected environmental consequences if implemented.

Actions

These actions reflect the theme of this alternative for addressing salinity.

Tons of Salt Removed. Modeling showed that a water withdrawal rate of 800 acre-feet per year would be required to reach the salinity objective of 7,000 mg/L concentration, removing about 7,000 tons of salt per year. About 80,000 tons of salt would remain in the system. Figure 40 shows the initial decrease in salts, which eventually would level off at approximately 80,000 tons.

Salinity Concentration. Modeling by the Service calculated that a removal rate of 800 acre-feet—assuming historical water inputs—would be needed to reach the salinity objective of 7,000 mg/L.

Time to Achieve Salinity Objective. With a water withdrawal rate of 800 acre-feet and acceptance of all sources of water and salt to match historical management, the time to achieve the salinity objective of 7,000 mg/L would be 10–20 years. The exact time period would be dependent upon the quantity of salts received over this time.

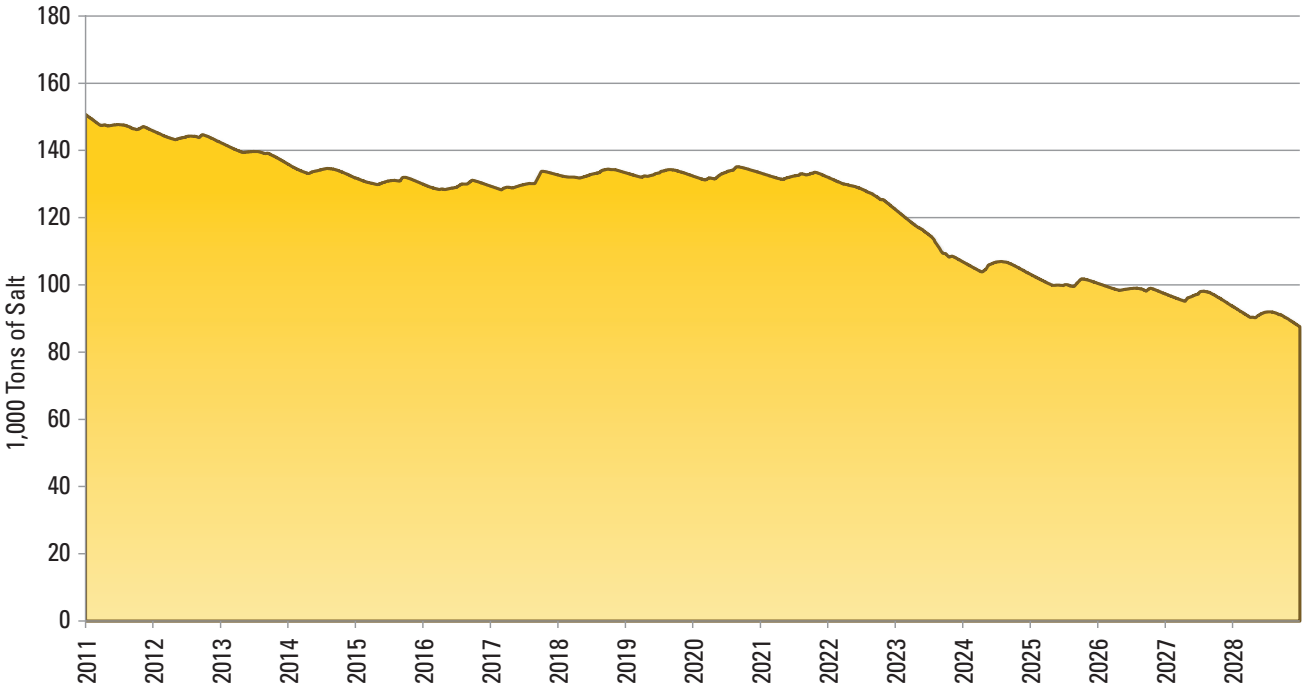

Figure 40. Graph of tons of salt in Lake Bowdoin with salinity alternative 2.

Elevation of Lake Bowdoin. The amount of lake water withdrawn and pumped to the evaporation ponds would have only a small effect on the lake's water level. Maintaining a lower lake elevation would concentrate the salts, allowing for more effective removal, and decreasing the time required to reach the salinity objective.

Amount of Water Removed. An average withdrawal of 800 acre-feet of water each winter would be required to maintain the salt balance, assuming all water and salt inputs remained consistent with past inputs.

Modifications and Facilities. The Service would develop 300 acres in evaporation ponds to concentrate salts for removal. A pump station, power source, and 5 miles of pipeline would be needed to pump water to the evaporation ponds. The concentrated salt sludge would be stored in a newly constructed salt storage building. After a drying period, the sludge would be loaded onto railcars and disposed of at a landfill or sent to a salt mill. This would require construction of a new railroad spur, which would be located near the old town site of Bowdoin and connected with the existing rail line. Heavy equipment and personnel would be acquired to load salts for transport.

Capital Cost. An initial cost estimate for the evaporation ponds design was $44 million, with an annual operating cost of $2 million. However, the Service has determined that more water needs removal to reach the salinity objective. Therefore, the capital and operating costs are expected to be higher than the initial estimate.

Monitoring and Research. Monitoring and research activities would be the same as described in salinity alternative 1, plus additional monitoring wells would be drilled in the Black Coulee drainage to monitor water quality and quantity coming into Bowdoin Refuge. Baseline information would be collected on current species of wetland vegetation, waterbirds, and invertebrates before construction activities and the changes would be monitored.

Environmental and Socioeconomic Consequences

The actions of salinity alternative 2 would likely have the consequences described below.

Plant Diversity. Over time, plant diversity and expansion of plant populations would increase as a result of a lower salt concentration in Lake Bowdoin and extended lower water levels. Emergent wetland plants such as cattail and hardstem bulrush on the west end of the lake would likely expand into the lake as lower water levels were consistently held due to winter removal of water. This expansion of plants in the west arm of the lake would be facilitated by the continued flow of relatively fresh irrigation return water from the Black Coulee drainage.

Reduced salinity on the western side of the lake would support reestablishment of submerged aquatic vegetation such as sago pondweed and wid-

geongrass. On the east side of the lake, however, extended periods of higher salt concentrations during the active salt removal process could lead to further reductions of these species. The footprint of the salt evaporation ponds would likely remain bare soil or sparsely vegetated due to high salt concentrations throughout much of the year. Heavy machinery work to clear the salt sludge would hinder plant establishment.

Increased disturbance to the soil from construction of the underground pipeline and the evaporation ponds in Dry Lake would increase the likelihood of infestations of invasive plant species such as Canada thistle.

Invertebrates. During the period of salt removal and lower water levels, elevated salinity concentrations throughout much of Lake Bowdoin would be expected and would cause some reduction in invertebrate diversity, especially on the eastern side. Salt-tolerant invertebrates such as the water boatman would become more abundant. A decrease in diversity would not necessarily equate to a decrease in the productivity and availability of resources for migratory birds. However, fewer species of migratory birds may be able to fully use these resources, depending on where they occurred in the lake. Even with a lower water level, there would remain areas of high invertebrate diversity especially near significant inputs of fresh water such as from the Black Coulee drainage and the Dodson South Canal. These areas would likely have a higher diversity of invertebrates and would serve as a source of invertebrate recolonization when salinity concentrations declined.

Waterfowl and Other Waterbirds. Waterfowl use would increase over time due to fresher conditions in Lake Bowdoin and the increased abundance of preferred invertebrates and plant resources. The shallower lake areas would provide optimal feeding opportunities to many species of waterfowl and shorebirds. The area of the evaporative ponds would be potentially available to migrating waterfowl during the spring and summer unless methods were used to exclude them (nets or disturbance guns). Bird use of these evaporative ponds would be closely monitored to determine if exclusion techniques were needed to prevent mortality.

Mark Wilson / USFWS

Piping plovers, which have nested near Piping Plover Pond, could be negatively affected by the operation of heavy equipment at the nearby evaporation ponds.

Concerns over direct mortality of waterfowl broods would be lessened with lower salinity concentrations. However, at the target objective for salinity of 7,000 mg/L, ducklings would have reduced growth rates if access to fresher water were not available. Extremely high salt concentrations in evaporation ponds might result in bird mortality if birds were unable to locate fresh sources of water, especially during fall migration (Windingstad et al. 1987).

Although not their preferred habitat, shorebirds and other waterbirds might use the evaporation ponds if they provided shallow-water habitat or mudflats and invertebrates during migration. Disturbance from removal of the salt sludge could be significant to birds using adjacent wetlands and upland; however, much of this disturbance would occur in late summer or fall after the nesting seasons. At the lower lake elevation of 2,208 feet, an estimated 240 acres of open water less than 5 inches deep would provide increased feeding opportunities for shorebirds. If lower water levels corresponded with spring or fall migration periods, increased use of the lake by shorebirds would be likely.

Colonial-nesting birds that traditionally use Woody Island, such as American white pelicans, cormorants, great blue herons, and Franklin's gulls, would be subject to a higher risk of predation if the lake were consistently held at a lower elevation. At 2,208 feet, Woody Island would cease to be an island, because its closeness to the mainland would allow easier access to mammalian predators. Some predation by coyotes presently occurs.

Downstream Users. Potentially, the hazards for downstream water users would be great if an accidental or flood-induced spill were to occur, given the highly concentrated sludge material that would be within the evaporation ponds. Because of the intended location of the evaporation ponds within Dry Lake, a large flood could pose a threat to the integrity of the ponds.

Public Use. There would be an increase in infrastructure on Bowdoin Refuge: pump station, power source (any power lines would be buried), evaporation ponds, underground pipeline, salt storage building, and rail spur. Operation of this system would lead to increased disturbance to not only wildlife but also to refuge visitors. To ensure visitor safety, part

of the refuge surrounding the evaporation ponds and pump would need closure during times of operation and salt removal. The increased noise and area closure could lead to a decrease in visitor satisfaction and might cause a decrease in public use.

Lower water levels would be anticipated as water is transported from Lake Bowdoin to Dry Lake, with the focus on a smaller lake size during active salt removal. The exposed mudflats and improved habitats would attract shorebirds and waterfowl, which would increase wildlife-viewing opportunities from the auto tour route.

With lower water levels, the area surrounding the western boat launch and accessible pier on Lake Bowdoin would be dry. Hunters could still use the north boat ramp, but the water would be shallow and may require hunters to push their boats further to access the lake. Larger, v-hull boats and motors would not be usable much of the time. The acreage accessible by waterfowl hunters on Lake Bowdoin would decline, and crowding might become an issue on other wetland units within the hunting area. Hunter satisfaction may decline.

In the long term, reduction in salinity concentrations and improvements to habitat on Lake Bowdoin, including increased plant diversity, would increase waterfowl numbers and diversity. These conditions would increase the opportunities for quality wildlife observation and waterfowl hunting.

Socioeconomics. Design and construction work necessary to build the infrastructure would provide an economic boost to the local community of Malta and to Phillips County. To construct the evaporation ponds and associated infrastructure, the capital cost could exceed $44 million, with an annual operating cost of $2 million. Money spent on lodging, food, and other necessities would increase dramatically during this phase. The annual budget provided to the refuge would be expanded for successful implementation. Hiring additional staff to help manage operations of the evaporation ponds would add permanent resources to the community as well.

Wildlife habitats would have increased wetland vegetation, invertebrates, and wetland-dependent migratory birds. Pumping water out of Lake Bowdoin would likely result in consistently lower water levels; however, the increased number and diversity of waterfowl would offset the effects on waterfowl hunters. Visitation to Bowdoin Refuge is expected have a net increase of 2,000 visitors, increasing the total to 19,500 (including hunters and wildlife observers). Based solely on nonresident visitation (17,580), the direct economic impacts would be $448,600 annually, an increase of $32,850 from the baseline.

Cumulative Impacts. As salinity concentrations decreased over time, plant diversity and wildlife use would increase. As the lake water level was lowered, up to two colonial-nesting islands would become peninsulas, which might lead to increased nest abandonment and increased risk of predation. There would be more disturbances to waterbirds due to the salt removal process.

The area and buffer designated for the evaporation ponds would be permanently affected by the salt removal operation and would become degraded habitat. Because the evaporation ponds would be located in Dry Lake, there would be a real threat of floods damaging the ponds. Given that floodwaters enter the refuge from the east through Dry Lake, the evaporation ponds could be affected and possibly breached even by small floods. This could result in an unacceptable discharge of saline waters down Beaver Creek.

The new railroad spur would increase fragmentation of existing habitats. Beyond the direct impact of the trains and noise, the new railroad spur would be an additional avenue for the spread of invasive plant species.

Salinity Alternative 3–Flushing by Beaver Creek

Flooding historically played a major role in removing salts from the lake system and maintaining the salt balance. Many factors have changed, however, which has altered the flood frequency of Beaver Creek. This alternative evaluated the effectiveness of flooding as the primary means to remove salts from Bowdoin Refuge. Six management options were evaluated for the effectiveness of flooding on removal of salts for modeled flood-return frequencies of 10, 25, 50, and 100 years:

- *Option 1*—Manage Lake Bowdoin similar to management in the 1990s with the outlet structures set at an elevation of 2,211.93 feet.
- *Option 2*—Manage Lake Bowdoin with the outlet structures completely blocked.
- *Option 3*—Manage Lake Bowdoin with the outlet structures completely open.
- *Option 4*—Remove all dikes, water control structures, and spillways that connect Lake Bowdoin to the outside ponding area.
- *Option 5*—Lower Bowdoin Road (county road).
- *Option 6*—Divert flood flows to Drumbo Pond, and then into Lake Bowdoin.

Mike Artmann / USFWS

This railroad trestle over a wetland south of Lake Bowdoin creates a constricted waterway.

The following describes the alternative's specific actions and expected environmental consequences if implemented.

Actions

These actions reflect the theme of this alternative for addressing salinity and blowing salts.

Tons of Salt Removed. Of the six options modeled, the most effective method of salt removal would be option 4—removing all dikes, water control structures, and spillways. It is estimated that 3,300 tons of salt would be flushed in a 10-year flood and 43,000 tons would be flushed in a 100-year flood.

The other option with significant salt-flushing capabilities would be option 3—managing Lake Bowdoin with the outlet structures completely open. With this option, no salt would be flushed in a 10-year flood; however, 22,200 tons of salt would be flushed in a 100-year flood.

The only other action where any salt flushing would occur is option 6—diverting water through Drumbo Pond. This would result in 28,000 tons of salt flushed in a 100-year flood, the minimal flood event where any substantial salt flushing could occur.

Salinity Concentration. For all options, there would be a temporary reduction in salinity due to water entering Lake Bowdoin during a flood. However, if no water were flushed out of the lake, the long-term salinity concentrations would increase once the water level returned to normal.

Time to Achieve Salinity Objective. The time to flush the salt for each of these options would likely be more than 100 years, because the quantity of salt flushed for the most effective option (4) in a 100-year flood would be 43,000 tons. However, floods are unpredictable and two 100-year flood events could occur in any timeframe.

Elevation of Lake Bowdoin. The water elevation of Lake Bowdoin would vary from 2,208 feet to 2,212 feet if the structures were blocked (option 2) and inputs of water remained similar to past deliveries. The elevation of the lake would decrease to the lower end of the range if the outlet structures were removed (option 4) or if the outlet structures were open (option 3).

Amount of Water Removed. There would be no active removal of water from Lake Bowdoin. However, there would be varying amounts of water removed depending on the flood event; some of this water might enter and leave.

Modifications and Facilities. To maximize salt removal, all water-level management structures would be removed including dikes, roads, and water control structures (option 4). The railroad bridge would need to be lengthened, expanding the constriction point, to allow larger volumes of water into the west arm of Lake Bowdoin via a conveyance channel. A large conveyance channel would be constructed from Drumbo Pond to Lake Bowdoin to facilitate increased water flow under option 6.

Capital Cost. The capital costs would be the same as salinity alternative 1 for the no-cost options of managing the structures at historical settings (option 1), completely blocking the outlet structures (option 2), or completely opening the outlet structures (option 3). Additionally, there would be substantial infrastructure costs for the following options: removing all dikes, water control structures, and spillways (option 4); lowering Bowdoin Road (option 5); and diverting water through Drumbo Pond (option 6).

Monitoring and Research. Monitoring and research activities would be the same as alternative 2.

Mike Artmann / USFWS

Refuge staff use this outflow dropboard structure to release water from Drumbo Pond to control the pond's water level.

Environmental and Socioeconomic Consequences

The actions of salinity alternative 3 would likely have the consequences described below.

Plant Diversity. Consequences to plant diversity would be the same as salinity alternative 1 except, if one of the modeled flood events occurred and the maximum amount of salt were flushed for a given scenario, there would be a short-term decrease in salinity concentrations following the flood. However, only the largest floods (100-year) would likely remove enough salt to freshen the system for several years following the event. Some improvement in plant diversity could occur if the reduced salinity concentrations were maintained for several years; however, absent another flood, salinity concentrations would return to unacceptable levels.

Invertebrates. Consequences to invertebrates would be the same as salinity alternative 1 until a flood occurred. In the case of a large flood, a short-term response by invertebrates to fresher conditions, which could last several years, would likely be beneficial in terms of abundance and diversity. However, diversity would continue to decline over the long term.

Waterfowl and Other Waterbirds. Consequences to waterfowl and other waterbirds would be the same as salinity alternative 1, except that a sudden drop in salinity and increase in water level during a flood event could increase the chance of a botulism outbreak during the year of the flood. Maintaining Lake Bowdoin at a lower water level would make access with any type of boat more difficult and could potentially affect disease monitoring, colonial-nesting surveys, and water quality monitoring throughout the lake.

Downstream Users. The potential hazards for downstream water users would depend on the salinity concentration of Lake Bowdoin and the time of year of flooding. If a flood occurred when Lake Bowdoin was highly saline, salt would be transported downstream. Depending on the magnitude of the flood event (the amount of water available for mixing), the negative effects on water quality and agricultural interests would range from negligible to severe. If lake levels were consistently low, smaller floods would likely enter the lake, but flooding volumes would be small enough that water would likely not exit the refuge.

Public Use. Consequences to public use would be the same as salinity alternative 2, except there would not be any added infrastructure; in fact, some would be removed under option 4. Removing or lowering the outlet structures would reduce the area available for waterfowl hunting on the lake and require hunters to drag their lightweight boats farther to access water.

Socioeconomics. An accidental spill or unintentional discharge to Beaver Creek during flood events could pose risks and burdens to private landowners downstream of Bowdoin Refuge. Large, windborne dust storms such as occurred in the past could cause salt accumulation on adjacent private lands, reducing productivity for hay and livestock operations.

In the short term, the removal of water control structures (option 4) would result in more shallow-water areas in Lake Bowdoin and fewer opportunities for hunting. Depending on what water control measures were implemented, the capital cost could be quite high. Contracting for construction services to remove the structures might bring some short-term economic benefits to the local community. Over the long term, the lowered salinity within the refuge would attract more waterbirds including waterfowl and shorebirds. This would provide additional opportunities for birdwatchers and hunters.

A 20-percent decrease in hunters would be expected due to a loss of access for hunting caused by low water levels. An equal or greater increase in wildlife observers would be expected due to an increase in species diversity. Since hunters spend an average of $55 per visit versus $18 per visit for wildlife observers, the overall direct impact would be $418,000 annually, a gain of only $2,250 over baseline impacts. Although visitation would be expected to increase by 950 visitors overall, the loss of hunters would result in this moderate increase.

Cumulative Impacts. Cumulative impacts would be the same as salinity alternative 1, except the infrastructure surrounding Lake Bowdoin would be modified to allow for enhanced flood flushing. Water quality and habitats for wetland-dependent wildlife would continue to degrade as salinity concentrations rose. Beaver Creek floods so infrequently that managing Lake Bowdoin while waiting for the next flood to occur would pose significant challenges to the refuge and downstream users. Some of these challenges would include correctly setting the stoplogs and maintaining the appropriate amount of water in the lake to optimize salt removal in the case of a large flood.

With the modified infrastructure, the Service would need to manage Lake Bowdoin at a sustained low level to have adequate safeguards between the lake elevation and the elevation at which water would move downstream under normal conditions. If the difference between the normal elevation and structure elevation were not great enough, frequent releases would be more likely. Because of possible extended lower lake levels, blown salts could became an issue. During a very large flood like that in 1986, a large amount of salts would likely be carried

downstream and sufficiently diluted by the volume of water, thereby removing the risk of direct losses to downstream users.

Salinity Alternative 4–Underground Injection Well and Flushing by Beaver Creek (Proposed Action)

An underground injection well would be used to force saline water deep into the ground. Once the salinity objective was met and water in Lake Bowdoin met all applicable water quality standards, modifications to the lake's infrastructure would be evaluated to determine the best way to re-create a flow-through system that maximized the effects of natural flooding. If natural flooding did not occur or more water to be supplied from the Milk River was not granted, the injection well could be used periodically to maintain salinity at an acceptable level.

Two different options for the injection well were analyzed: (1) use a holding pond; and (2) inject saline water directly from Lake Bowdoin, without a holding pond, into the ground.

For the holding pond option, water from Lake Bowdoin would be pumped to the holding pond only in the winter, when the water under the ice is most concentrated. Without a holding pond, water would be injected year-round directly from Lake Bowdoin. In both options, the water would be injected to a depth of 3,500–6,000 feet throughout the entire year.

The option of injecting directly from Lake Bowdoin into the ground was selected after considering the following consequences:

- The capital cost of construction with a holding pond would be about two times greater than construction of an injection well without a holding pond.
- A large footprint (area) would be required to construct a holding pond.
- There would be higher annual costs to pump water from Lake Bowdoin to a holding pond.
- A holding pond might be subject to flooding impacts from Beaver Creek.

The disadvantage of injecting into the ground directly from Lake Bowdoin is that the time to reach the salinity objective of 7,000 mg/L would be about twice as long. However, the short-term benefit would not justify the additional cost and impact to the landscape. The injection well might need periodic operation once the objective was met, as with a holding pond, if flooding did not naturally flush salts from the system or if more water was not granted.

Actions

The actions below relate only to the option of injecting directly from Lake Bowdoin without a holding pond.

Tons of Salt Removed. Lake Bowdoin would reach a steady state of 7,000 mg/L, at which point there would be 7,000 tons of salt per year removed, with a year-round injection rate of 500 gallons of water per minute directly from Lake Bowdoin and assuming historical water inputs. A total of 800 acre-feet of water per year would be removed, and 80,000 tons of salt would remain on the refuge. Figure 41 shows the decrease of salts in Lake Bowdoin, which eventually levels off at the 80,000 tons.

Salinity Concentration. Modeling by the Service calculated that a rate of 800 acre-feet (an injection rate of 500 gallons per minute), assuming historical water inputs, would be needed to reach and maintain the salinity objective of 7,000 mg/L.

Time to Achieve Salinity Objective. The time to reach the 7,000 mg/L salinity objective would be 10–20 years with a water withdrawal rate of 800 acre-feet and accepting all sources of water and salt to match historical management. The removal rate of 800 acre-feet would be continued if no other method to discharge salt were identified. Operating Lake Bowdoin in a more saline state would allow for faster disposal of salts.

Elevation of Lake Bowdoin. The amount of water withdrawn from the lake to the injection well would only have a small effect on Lake Bowdoin's water level. Maintaining a lower lake elevation would concentrate the salts, resulting in a more saline state. Because more salt would be injected, it would take less time to reach the salinity objective.

Amount of Water Removed. An average withdrawal of 800 acre-feet of water would be required to maintain the salt balance, assuming all water and salt inputs remained consistent with past inputs.

Modifications and Facilities. The Service would install an underground injection well (possibly more than 6,000 feet deep) along with the associated intake structures. A power source would need to be installed to operate the pump, and a small pump house would be constructed. Once the salinity objective was reached and maintained, Lake Bowdoin infrastructure (dikes, spillways, and water control structures) would be evaluated for removal or modification to facilitate more complete flushing by Beaver Creek during a flood event or with more water supplied from the Milk River.

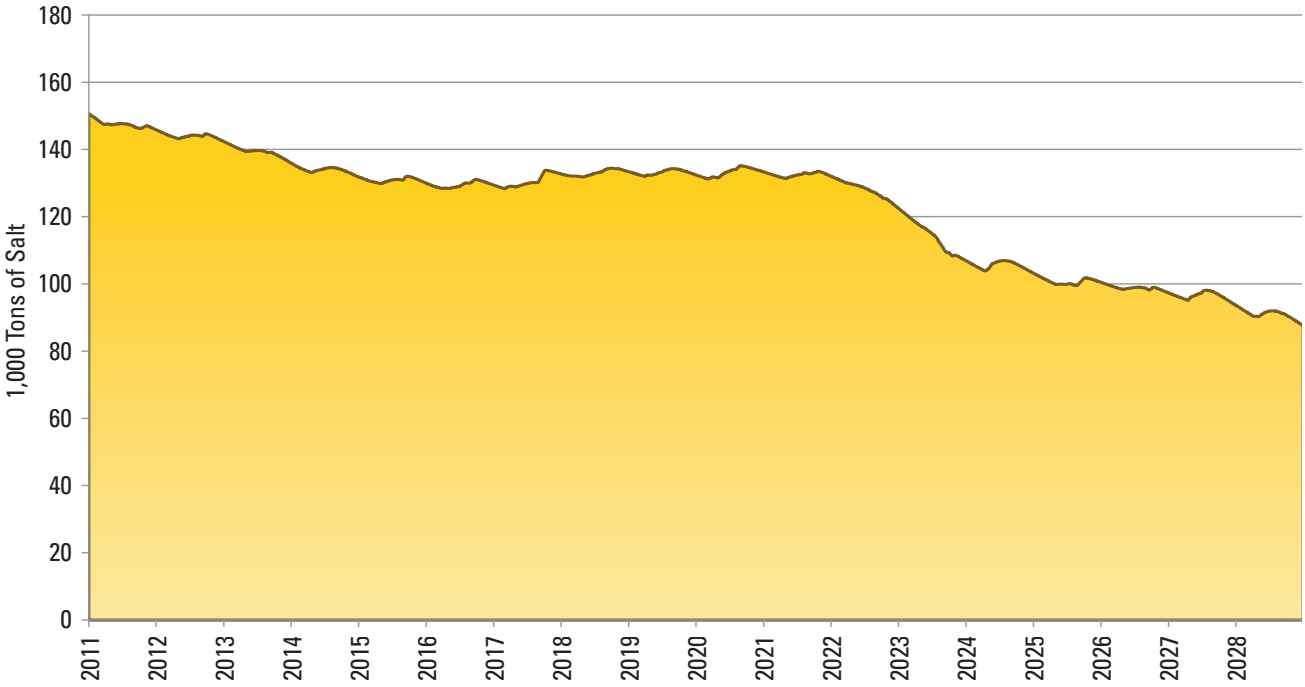

Figure 41. Graph of tons of salt in Lake Bowdoin with salinity alternative 3.

Capital Cost. An initial cost estimate for the injection well was $6.7 million, with an estimated annual operating cost of $100,000. However, the Service determined that more water must be removed to meet the salinity objective. Therefore, the capital and operating costs would likely be larger than the initial estimate.

The estimate for equipment-operating costs was $35,000 per year, primarily due to the electrical costs. Additionally, there would be a Service employee assigned to maintaining and operating the injection well and to working with the necessary contractors. The proposed maintenance position is shown in table 18 under section 7.9 in chapter 7.

Monitoring and Research. Monitoring and research activities would be the same as salinity alternative 2.

Environmental and Socioeconomic Consequences

The consequences below relate only to the option of injecting directly from Lake Bowdoin without a holding pond.

Plant Diversity. Consequences to plant diversity would be the same as salinity alternative 2 excluding the effects of the evaporation ponds. In general, plant species diversity would increase as salinity concentrations decreased; however, in the short term, there would be periods where low lake levels would increase salinity to levels detrimental to desirable plant diversity and abundance. In addition, a shift toward more salt-tolerant, less desirable plants would occur as salts were concentrated and removed. If Lake Bowdoin was held at a sustained low water level (less than 2,208 feet) during the active salt removal phase (all year), plants such as cattail and hardstem bulrush may spread from west to east on the western side of the lake to colonize newly exposed, bare shoreline.

Invertebrates. Consequences to invertebrates would be the same as salinity alternative 2 excluding the effects of the evaporation ponds. Some direct invertebrate losses from pumping activities would be expected, but these losses would be minimal.

Waterfowl and Other Waterbirds. Consequences to waterfowl and other waterbirds would be the same as salinity alternative 2 excluding the effects of the evaporation ponds. Some waterfowl would continue to use Lake Bowdoin for resting, feeding, loafing, and nesting. Intake pipes used for year-round injection could require frequent maintenance, subjecting birds to increased disturbance. Use by shorebirds would likely increase if the lake was consistently held lower during migration periods. More shallowly flooded habitat would be available to migrating birds and resident nesters during spring and fall.

For colonial-nesting birds such as American white pelicans, there could be higher rates of predation and nest abandonment if the lake was consistently lower during the salt-reduction phase. This is especially true for species using Woody Island, the largest and closest island to the mainland. The three other primary islands used for nesting are far enough from land, are surrounded by deeper waters,

and would remain as nesting islands. Lower lake levels would reduce the amount of flooded emergent vegetation for overwater-nesting birds such as Franklin's gulls.

Although the botulism bacterium is present in Lake Bowdoin, reducing the lake's water level and concentrating the salts during the active salt removal phase would likely decrease the risk of a large outbreak. An outbreak would be easier to detect along the discrete shorelines resulting from a lower water level. However, a low water level would make it harder to remove sick and dead birds due to more difficult boat access.

Downstream Users. The Service is required to adhere to EPA's rules and regulations for the installation, operation, and maintenance of a class 1 injection well. The EPA definition for a class 1 well is a well that injects hazardous and non-hazardous wastes into deep, isolated rock formations that are thousands of feet below the lowermost underground source of drinking water (EPA 2010). Strict adherence to these rules and regulations would reduce the threat to ground water users downstream from the refuge. An injection well would ideally be drilled into a geologic formation with a background concentration of TDS higher than 10,000 mg/L. If a suitable geologic formation was not found meeting this criteria, the Service could apply for a waiver if it were determined that (1) the receiving formation could not be used as an underground source of drinking water, and (2) there is no economic benefit of the formation.

Additionally, the risk to surface water users downstream would be lessened as the project eliminated salts from the refuge. Consistently keeping Lake Bowdoin at a lower level during the salt removal phase would significantly lessen the threat of accidental spills into Beaver Creek, minimizing any effects on downstream users. Exposed shorelines from the lower lake levels would increase the probability of windblown salts. However, Bauder et al. (2007) suggests that conditions conducive for windblown removal of salts occur on average 2–8 times per year.

Public Use. Consequences to public use are the same as salinity alternative 2 including the following. During the periods when Lake Bowdoin was operated at a lower water level to facilitate salt removal, there would be less open water available to waterfowl hunting. However, there would be opportunities to hunt waterfowl in Strater, Patrol Road, Drumbo, and Goose Island Ponds.

The area around the intake pipes in the lake and around the pump house would likely be closed to public access. There would be minimal disturbance to the visiting public once an injection well was placed and properly operating.

Socioeconomics. The design and construction costs to build the infrastructure—injection well, pump house, power source, and roads—would likely generate economic revenue for the local community. To construct the injection well and associated infrastructure, the estimated capital cost would be at least $6.7 million, and estimated annual operating costs would be $100,000. The relatively short-term nature of construction activities would likely result in temporary lodging or housing, with negligible economic impacts, as opposed to a permanent influx of people to the community. The hiring of more staff to help maintain, service, and operate the pump facility would translate into permanent revenue increases for the local community.

Although meeting the salinity objective would improve wildlife habitats, the water level would be much lower than with past management and might initially have a negative effect on waterfowl hunting. As habitat improved, however, the numbers and species of waterfowl attracted to Lake Bowdoin should increase, providing additional opportunities for hunting if access were available during low-water periods. Improvements in salinity concentrations from injecting water and from other water management activities might attract more birdwatchers and hunters in the fall as habitat conditions improved. Visitation to Bowdoin Refuge is expected have a net increase of 2,300 visitors, increasing the total to 19,800 (including hunters and wildlife observers). Based solely on nonresident visitation (17,830), the direct economic impacts would be $439,900 annually, an increase of $24,150 from the baseline.

A low lake level during the pumping phase may lead to salts blowing from the exposed flats. While much of this salt may be redeposited within the refuge, public perception may not be favorable at times especially with adjacent landowners. This could be alleviated if landowners were kept fully informed on the proposed plans to manage the water level.

Cumulative Impacts. Reduced salt load over time and lower salinity would be beneficial to plant and animal resources in Lake Bowdoin. Furthermore, the increased diversity of plants and invertebrates would benefit migratory birds and other wetland-dependent wildlife. The lower water level would increase foraging habitat for migrating waterfowl and shorebirds. Short-term, indirect effects on waterbirds would be expected during construction of the injection well and infrastructure if done during nonwinter months. This would likely be minimal, because birds would quickly find the surrounding wetlands. However, some birds might be disturbed to the point of leaving the refuge entirely in search of wetland habitats off-refuge. If primary construction activities (well drilling and infrastructure place-

ment) occurred during the winter, negative effects on migratory birds would be negligible.

The process to design, construct, and operate an injection well would follow all applicable EPA regulations as well as any permits required by the State of Montana. If the water in the receiving formation had salinity concentrations higher than 10,000 mg/L during construction of the injection well, it would not considered an underground source of drinking water and, thus, a waiver from EPA would not be required. If the water had salinity concentrations lower than 10,000 mg/L, the EPA could grant a waiver to the Service. Wells for drinking water are rarely 6,000 feet deep. A detailed analysis of existing wells and other uses of water in the area, such as Sleeping Buffalo Hot Springs, would be addressed during the permit process.

The footprint of the injection well would be relatively small (less than 0.25 acre), minimizing the risk of excessive disturbance to native vegetation and reducing the threat of invasive species. Effects on Dry Lake from an injection well would be nonexistent, and options to restore Dry Lake would be available. A flood entering the refuge from Beaver Creek would not affect the pump house because it would likely be built outside of the floodplain.

Salinity Alternative 5–Pumping to Milk River

A pipeline would carry saline water pumped from Lake Bowdoin to the Milk River. There are two locations for possible water discharge points, one west of Bowdoin Refuge and one east of the refuge. The distance to the Milk River at the western location would be considerably less than at the eastern location (4 miles compared with 14 miles); however, the western location would require easements across private property.

The quantity of water pumped to the Milk River would depend on the quantity of water flowing in the river. During high flows, more water could be pumped to the Milk River because there is more water to mix with the lake water. Similarly, during low flows, less water could be pumped to the Milk River to meet water quality guidelines.

To discharge into the Milk River, an "authorization to degrade" permit would be required due to water quality issues. While possible to request such a permit, the State has never granted one; moreover, the Service would not want to degrade any water system. Without this permit, the Service would not be able to carry out this alternative and could not achieve the salinity objective.

The following describes the alternative's specific actions and expected environmental consequences if implemented.

Actions

These actions reflect the theme of this alternative for addressing salinity and blowing salts.

Tons of Salt Removed. With varying water pumping rates (5–10 cfs), increased during high flows and lowered during low flows, it would be possible to remove 7,000 tons of salt per year and maintain Lake Bowdoin at a salinity concentration of 7,000 mg/L.

Salinity Concentration. A salinity concentration of 7,000 mg/L (salinity objective) in Lake Bowdoin could be maintained if regular discharges occurred. Lake Bowdoin could be operated in a less saline state and at a higher water level, with the assumption that discharge rates could be increased when the water had lower salinity concentrations. Discharge rates would be determined for variable flows in the Milk River and be approved by DEQ.

Time to Achieve Salinity Objective. The time to reach the salinity objective would vary depending on flow rates and water quality in the Milk River. A 10- to 20-year period could be expected.

Elevation of Lake Bowdoin. The amount of water withdrawn from the lake would result in only a small drop in the water level.

Amount of Water Removed. An average water withdrawal of 900 acre-feet could be expected if the releases were limited to 1/100th of the flow in the Milk River.

Modifications and Facilities. The Service would construct a pump station, intake structure, and pipeline from Lake Bowdoin to the Milk River. A power source would be installed to operate the pump. If the western discharge point were selected, a 4-mile pipeline would be constructed and would require at least six easements on private lands. If the eastern discharge point were selected, a 14-mile pipeline would be constructed across public land.

Capital Cost. The capital costs would vary depending on the location of the discharge point and resulting length and flow size of the pipeline (table 10). The direction chosen would affect the cost, particularly the western route, which would require easements across private lands. The eastern route would primarily cross public land, but would be considerably longer. The operating costs, mostly for electrical pump needs and for staff to operate the pump, are anticipated to be $100,000 per year.

Table 10. Pipeline size and cost estimates for western and eastern pipeline options for pumping to the Milk River.

Discharge rate	*Estimated cost ($ million)*	
	Western 4-mile pipeline	*Eastern 14-mile pipeline*
5 cubic feet per second	3	7.5
10 cubic feet per second	4	9

Monitoring and Research. Monitoring and research activities would be the same as salinity alternative 2.

Environmental and Socioeconomic Consequences

The actions of salinity alternative 5 would likely have the consequences described below.

Plant Diversity. Consequences to plant diversity in Lake Bowdoin would be the same as salinity alternative 2. Following State-approved dilution rates (mixing ratio) for releases to the Milk River, there would be little effect on aquatic plant vegetation within the Milk River based on the amounts of saline water to be discharged.

Invertebrates. Consequences to invertebrates would be the same as salinity alternative 2 except for the following. If approved mixing ratios were followed, increased salinity in the Milk River would not be expected to cause harm to aquatic species including fish and invertebrates. Tables of mixing ratios would be developed to show allowable discharge based on flow and concentration of TDS (salts). As an example, Bauder et al. (2007) found no effects on sensitive invertebrate species at a discharge rate of 5 cfs at a salinity concentration of 5,000 mg/L outside of the irrigation season.

Waterfowl and Other Waterbirds. The relatively high water level of Lake Bowdoin would help minimize effects on colonial-nesting birds. Over time, reduced salinity concentrations would result in greater waterfowl use of the lake as preferred invertebrates and plant species increased.

Downstream Users. Consequences to downstream water users would be the same as salinity alternative 4 except these users would see a small increase in salinity concentrations in the Milk River due to the pumping of salty refuge water into the river. However, State-approved mixing ratios would be followed, and effects from the extra salts added to the Milk River would be minimal. As the project reached the salinity objective, there would be reduced risks to downstream users in the case of an accidental spill.

Public Use. Consequences to public use would be the same as salinity alternative 4 except the acreage available to waterfowl hunters in most years would be the same as salinity alternative 1.

Socioeconomics. The projected reduction in salinity would produce a beneficial environment for wetland habitats and wetland-dependent migratory birds. This could increase visitation to Bowdoin Refuge for birdwatching and hunting opportunities. Visitation to the refuge is expected have a net increase of 2,500 visitors, increasing the total to 20,000 (including hunters and wildlife observers). Based solely on nonresident visitation (18,000), the direct economic impacts would be $449,750 annually, an increase of $34,000 from the baseline.

Building a pipeline to the Milk River following the shorter western route would require easements to cross private land. These easements would provide a short-term economic benefit to landowners who agreed to participate. The cost to construct the infrastructure including a pipeline capable of 10 cfs, a pump house, and electrical power sources would be an estimated $9 million. The annual operating costs would be $35,000 plus the cost of a full-time employee to oversee the maintenance and pumping.

Cumulative Impacts. State-approved discharge rates from Lake Bowdoin would be calculated for minimal effects from increased salt levels on sensitive species in the Milk River. If approved discharges were followed, no negative effects on sensitive species would be expected. However, based on recent water quality testing, refuge water shows the presence of certain trace heavy metals (for example, uranium) and other pollutants. Although these trace heavy metals occur naturally in the landscape, extensive discussions with DEQ staff indicate the Service would need to apply for an "authorization to degrade" permit to release refuge water into the Milk River (D. Yashan, wetland management section supervisor, DEQ, personal communication, July 2009). While it would be possible to request such a permit, the State has never granted one; moreover, the Service would not want to degrade any water system. Without this permit, the Service would not be able to carry out this alternative and could not achieve the salinity goal and objective.

Summary of Alternatives Actions and Consequences

Table 11 summarizes the actions for each alternative and the likely consequences of those actions. To compare the alternatives equally, it was assumed that historical deliveries of water and salt would continue. The results of the alternatives would be significantly different if the quantity and quality of the water entering the system were altered.

Table 11. Summary of alternatives and consequences considered to address the elevated salinity and blowing salts issue at Lake Bowdoin, Montana.

Alternative 1 (current management —no action)	*Alternative 2 (evaporation ponds and removal of salt residue)*	*Alternative 3 (flushing by Beaver Creek)*	*Alternative 4 (underground injection and flushing by Beaver Creek—proposed action)*	*Alternative 5 (pumping to Milk River)*
Tons of salt removed—actions				
Remove minimal salts incidentally from wind action, allowing 7,000 tons of salt per year to be added to the closed basin.	Remove the necessary 7,000 tons of salt per year using a withdrawal rate of 800 acre-feet of water per year.	Remove 3,300–43,000 tons of salt only incidentally through large floods.	Remove the necessary 7,000 tons of salt per year using a withdrawal rate of 800 acre-feet of water per year.	Possibly remove the necessary 7,000 tons of salt per year by varying the rate of pumped water.
Salinity level—actions				
Continue with no outflow, allowing salinity levels up to 40,000 mg/L in dry years.	Remove salts to allow salinity levels to eventually average the salinity objective of 7,000 mg/L.	Same as alternative 1, *except*: Allow salinity levels to increase except when salts could be flushed by a large flood.	Same as alternative 2.	Same as alternative 2, *except*: Varying the salinity levels in Lake Bowdoin during the removal process would not affect the time to reach the objective (lower salinities in Lake Bowdoin would not affect removal rate of salts).
Time to achieve salinity objective (7,000 mg/L)—actions				
Could never be achieved without an accidental spill or a flood.	10–20 years, depending on the water withdrawal rate, water supply, and lake elevation.	More than 100 years, with a 100-year flood to achieve the objective and reoccurring 100-year floods to maintain it.	Same as alternative 2.	10–20 years, depending on runoff.
Elevation of Lake Bowdoin—actions				
Maintain between 2,208 feet and 2,213 feet, depending on the amount of water received.	Same as alternative 1 in the long term. Lower elevations (2,208 feet) would reduce salt levels faster.	Same as alternative 1 if water inputs were not reduced, *plus*: Reduce water inputs to maintain average elevation at or below 2,209 feet.	Same as alternative 2.	Same as alternative 1 in the long term.

Table 11. Summary of alternatives and consequences considered to address the elevated salinity and blowing salts issue at Lake Bowdoin, Montana.

Alternative 1 (current management —no action)	*Alternative 2 (evaporation ponds and removal of salt residue)*	*Alternative 3 (flushing by Beaver Creek)*	*Alternative 4 (underground injection and flushing by Beaver Creek—proposed action)*	*Alternative 5 (pumping to Milk River)*
Amount of water removed—actions				
Withdraw no water.	Withdraw an average of 800 acre-feet of water each winter.	Same as alternative 1.	Withdraw an average of 800 acre-feet of water each winter.	Withdraw an average of 900 acre-feet of water each winter.
Modifications and facilities—actions				
Maintain all water-level management structures. Keep stoplogs in place year-round.	Construct at least 160 acres in evaporation ponds. Install a pump house and 5 miles of pipeline. Construct a building to dry and store salts. Install a railroad spur for transporting salts to an accepted disposal site. Acquire heavy equipment to load salts for transport.	Remove all water-level management structures including dikes, roads, and water control structures. Expand the railroad truss to allow water flows into the west arm of Lake Bowdoin via a conveyance channel constructed from Drumbo Pond.	Drill a well as deep as 6,000 feet into a formation that is not a source of drinking water. Install an underground injection well and intake structures. Install a power source to operate the pump and construct a pump house. Evaluate the need for removal or modification of water-level management structures to allow flood flushing by Beaver Creek.	Install a power source to operate the pump and construct a pump station and intake structure. If the western option were selected, construct 4 miles of pipeline, requiring numerous easements on private lands. If the eastern option were selected, construct 14 miles of pipeline across public land.
Capital cost—actions				
Continue to pay for delivery of water from the Milk River Project, averaging $21,500 per year for 3,500 acre-feet of water.	Same as alternative 1, *plus*: $44 million to construct the evaporation pond. $2 million annual operating costs.	Same as alternative 1 (options 1–3). Significant costs to remove water-level management structures (options 4–6).	Same as alternative 1, *except*: Additional costs to modify or remove water-level management structures. $6.7 million to build the injection well. Up to an additional $6.2 million if a holding pond is required. $35,000 annual operating costs.	Same as alternative 1, *plus*: $3–9 million depending on the pipeline length and easement costs. $35,000 annual operating costs.

Table 11. Summary of alternatives and consequences considered to address the elevated salinity and blowing salts issue at Lake Bowdoin, Montana.

Alternative 1 (current management —no action)	*Alternative 2 (evaporation ponds and removal of salt residue)*	*Alternative 3 (flushing by Beaver Creek)*	*Alternative 4 (underground injection and flushing by Beaver Creek—proposed action)*	*Alternative 5 (pumping to Milk River)*
Monitoring and research—actions				
Continue to monitor water quality, lake elevation, disease outbreaks, and sites for colonial-nesting birds.	Same as alternative 1, *plus*: Drill additional monitoring wells within the Black Coulee drainage to monitor water quality and quantity coming into the refuge. Collect baseline information on current species of wetland vegetation, waterbirds, and invertebrates, before construction activities and monitor changes.	Same as alternative 2.	Same as alternative 2.	Same as alternative 2.
Plant diversity—environmental consequences				
With only salt-tolerant species remaining, plant diversity would decrease as salinity increased.	Plant diversity would increase with the addition of brackish species. Emergent wetland plants would expand into areas that were previously open water. The evaporation ponds and canals would remain mostly devoid of vegetation.	Same as alternative 2, *excluding* the evaporation ponds and canals.	Same as alternative 3.	Same as alternative 3.
Invertebrates—environmental consequences				
Invertebrate diversity would decrease as salinity increased.	Invertebrate diversity would decrease, especially on the eastern side of the lake. The salt-tolerant water boatman and other insects could become more abundant. Brine shrimp could become established in evaporation ponds and conveyance channels and be available for waterfowl and shorebirds.	Same as alternative 1 *until* flooding, which could result in a short-term (several-year) increase in invertebrates.	Same as alternative 2, *excluding* the evaporation ponds, *plus*: There would be minimal losses of invertebrates due to pumping activities.	Same as alternative 2, *excluding* the evaporation ponds, *plus*: Increased salinity in Milk River would not harm invertebrates.

Table 11. Summary of alternatives and consequences considered to address the elevated salinity and blowing salts issue at Lake Bowdoin, Montana.

Alternative 1 (current management —no action)	*Alternative 2 (evaporation ponds and removal of salt residue)*	*Alternative 3 (flushing by Beaver Creek)*	*Alternative 4 (underground injection and flushing by Beaver Creek—proposed action)*	*Alternative 5 (pumping to Milk River)*
Waterfowl and Other Waterbirds—environmental consequences				
As salinity increased, use by waterfowl broods would decrease, broods could have impeded development, or brood mortality could occur. As salinity increased, the risk of botulism outbreaks might decrease.	Waterfowl use would increase due to more plant diversity and invertebrate diversity. Annual production and survival of waterfowl broods would improve. More shallow areas and mudflats would be exposed for use by dabbling ducks and shorebirds. Reaching the salinity objective might not increase the risk of a botulism outbreak. The evaporation ponds would attract waterfowl, which could become encrusted in salt.	Same as alternative 1, *except*: During a flood, sudden changes in salinity and water levels might increase the chance of a botulism outbreak.	Same as alternative 2, *excluding* the evaporation ponds.	Same as alternative 4.
Downstream users—environmental consequences				
There would continue to be the possibility of an accidental spill of highly saline water if a structure failed. If the lake level drops, there would be an increased salt concentration that might be carried by wind. Water quality would continue to worsen.	As the lake level decreased, water quality would improve over time. Initially there would be some blowing salts (most deposited on the refuge) until the salinity level was reduced.	Same as alternative 2, *except*: Water quality would improve during flooding.	Same as alternative 2.	Water quality would continue to worsen if pumping water to the Milk River were not permitted ("Authorization to Degrade") by the State because of heavy metals. If pumping water were permitted, the heavy metals would impact the Milk River.

Table 11. Summary of alternatives and consequences considered to address the elevated salinity and blowing salts issue at Lake Bowdoin, Montana.

Alternative 1 (current management —no action)	*Alternative 2 (evaporation ponds and removal of salt residue)*	*Alternative 3 (flushing by Beaver Creek)*	*Alternative 4 (underground injection and flushing by Beaver Creek—proposed action)*	*Alternative 5 (pumping to Milk River)*
Public use—environmental consequences				
Waterfowl hunters would continue to have access to hunting areas in most years, depending on available water. Visitors would be able to easily view waterbirds from the auto tour route.	The exposed mudflats and improved habitat would attract shorebirds and waterfowl, providing additional viewing opportunities. Some birds might move further from the shoreline as water receded. Hunters would need to carry their watercraft further to access the lake. The west boat launch would not be accessible to boats with motors. There would be fewer huntable acres for waterfowl hunters.	Same as alternative 2.	Same as alternative 2.	Same as alternative 2 if the Service received a permit to pump water to the Milk River; otherwise, same as alternative 1.
Socioeconomics—environmental consequences				
Declining wetlands and waterbird use would result in an annual reduction of 4,850 wildlife observers and hunters, causing a loss of $105,050 in visitor spending.	Design and construction work might provide an economic boost to local communities. Improved wetlands would attract more wildlife for viewing and hunting for an annual increase of 2,000 visitors, generating an additional $32,850 in visitor spending.	Removing some of the water-level management structures might result in some short-term economic benefits to the local community. Improved wetlands would attract more wildlife for viewing but lower water levels would reduce hunting access. More viewer expenditures, but a loss of hunter expenditures, would result in an overall increase of only $2,250 in visitor spending.	Same as alternative 2, *except*: The construction of evaporation ponds may not be necessary, eliminating that economic cost and benefit. Visitation would increase by 2,300 visitors, generating an additional $24,150 in visitor spending.	The quality of pumped water might cause impacts to downstream users. Where easements were required, there would an economic benefit to landowners willing to accept an easement across their lands. Improved wetlands would attract more wildlife for viewing and hunting for an annual increase of 2,500 visitors, generating an additional $34,000 in visitor spending.

Table 11. Summary of alternatives and consequences considered to address the elevated salinity and blowing salts issue at Lake Bowdoin, Montana.

Alternative 1 (current management —no action)	*Alternative 2 (evaporation ponds and removal of salt residue)*	*Alternative 3 (flushing by Beaver Creek)*	*Alternative 4 (underground injection and flushing by Beaver Creek—proposed action)*	*Alternative 5 (pumping to Milk River)*
Cumulative impacts				
As plant and invertebrate diversity decreased, wildlife use might decrease along with associated public use. The cost to deal with increasing salt loads would be greater over time. There might be increased probability of a more severe accidental spill.	As salinity levels decreased, plant diversity and wildlife use would increase along with associated public use. As lake levels were lowered, islands used by colonial-nesting birds would become peninsulas, which may cause the birds to abandon them. Disturbance to waterbirds would increase due to the salt removal process.	The ability to manage the lake at higher levels would be lost, resulting in fewer acres of wetland habitat. Salinity levels would continue to increase until a 100-year or greater flood.	Same as alternative 2, *except*: There would be minimal disturbance to wildlife while the injection well was constructed.	Same as alternative 4, *plus*: There would be monitoring of heavy metals and other pollutants before any water were pumped into the Milk River. Due to the presence of heavy metals and other pollutants, the State might not approve a permit for the Service to pump water, which would preclude meeting the salinity objective.

6.6 Implementation of the Proposed Action (Salinity Alternative 4)

The salinity and blowing salts issue at Lake Bowdoin is a result of a complex series of factors that have changed the fundamental flow of water into and out of the lake for more than a century. Montana water quality laws protect receiving waters from point and nonpoint sources of pollution. In this case, salts and trace heavy metals are the concern at Lake Bowdoin. As a result, the lake, which once was a flow-through system, must be managed today as a closed basin.

Random droughts and historical floods can and have functioned to remove salts from the lake system. However, relying on these periodic events is not a viable long-term solution. The Service's proposed action to address the salinity situation (salinity alternative 4) has the short-term solution of injecting the salts and heavy metals deeply and safely into the ground. However, in the long term, the Service's goal is to acquire enough water to institute a flow-through system.

Salinity Alternative 4– Underground Injection Well and Flushing by Beaver Creek

The Service is proposing salinity alternative 4 as the most effective and safest way to address salinity and blowing salts at Bowdoin National Wildlife Refuge. After the public's review and comment on this draft plan, the Regional Director will determine if this or another alternative is the preferred alternative for the final CCP.

Salinity alternative 4 would use a deep well to inject saline water into the ground. If this process could remove enough salt, the long-term goal for the refuge would be to operate the infrastructure to facilitate a flow-through lake system. The injection well would provide an effective method to remove salts from Lake Bowdoin, thereby reversing the upward trend of salt accumulation and, over time, reaching the salinity objective of 7,000 mg/L. To maximize the removal of salts, the Service would manage the lake at a lower level for certain periods. Once salinity concentrations were consistently at or below the objective level, the Service would evaluate lowering or removing the stoplogs at the

outlet to Beaver Creek to allow the largest quantity of water during floods to enter and exit Lake Bowdoin. Decisions by refuge managers to alter this infrastructure would be made in cooperation and coordination with State and local agencies, interested landowners, and members of the public.

The next section restates the goal for salinity and blowing salts, followed by the proposed action's specific objectives and strategies (and their rationale) that the Service would carry out to meet the goal.

Goal and Objectives for Salinity and Blowing Salts

Develop a water management system on Bowdoin National Wildlife Refuge that would protect the environment and mitigate current and future blowing salt concerns for neighboring properties, while providing quality water and wildlife habitat for migratory birds and other wetland dependent wildlife.

Objective for Interim Management of Lake Bowdoin

Before drilling the injection well, provide at least 2,000 acres of subsaline (more than 9,600 mg/L), permanent, wetland habitat for migratory birds and associated wetland-dependent wildlife on Lake Bowdoin.

Strategies

- Continue to receive water supplies and pursue available excess water from the Milk River Project to provide habitat for migratory birds.
- Continue to work with the State of Montana during the adjudication process for the Milk River watershed to claim an additional 8,000 acre-feet historical use right.
- Continue to monitor existing surface sites, ground water–monitoring wells, and the lake's water level elevation.
- In the spring, transport available water to Lake Bowdoin in early March and end by May 15 to reduce the chance of disease outbreaks and flooding of overwater nesters.
- In the fall, start transporting available water after September 1 to provide migratory bird habitat.
- Continue to monitor for avian disease outbreaks and the use of islands by colonial-nesting birds.

Rationale. Until the injection well project starts, the refuge would continue to manage for quality habitat under the current subsaline wetland conditions. In the absence of a large flood event, conditions in Lake Bowdoin would remain in the subsaline category, because there is no means to remove salts from the lake.

Wetland habitat is highly dependent on the available water delivered by the Malta Irrigation District; the lake has historically provided habitat for a variety of waterfowl and other waterbirds. Water deliveries in early spring would continue to provide wetland habitat throughout summer and fall. The refuge would continue monitoring salinity and wildlife use. In addition, collection of baseline data would be needed to effectively monitor the results of the injection well project.

Objective for Public Outreach and Education

While implementing the objectives to reduce salinity on Lake Bowdoin, provide valuable information on the process, benefits, and results of this salt reduction program to the public; local, State, and Federal governments; other agencies; and partners.

Donna Dewhurst / USFWS

The canvasback duck is one of many waterfowl species that uses Lake Bowdoin.

Strategies

- Inform people about the salinity situation and options with news releases to the media.
- Provide salinity information and monitoring results to the public in several ways including: presentations to community groups, distribution of brochures, and up-to-date Web pages.
- Conduct tours of the saline treatment site (injection well).

Rationale. It is likely that the injection well would not be operational for at least 5 years. During this time, the Service would continue to provide information on the progress for getting money and starting construction. This would be accomplished through news articles and presentations provided at Bowdoin Refuge and to community groups. When the Service started implementing the proposed action, the refuge staff would develop a fact sheet and other outreach methods to describe the installation and operation plan for the injection well, including where the injection well would be drilled. Once the project was fully implemented, the Service would provide updates on how the project was proceeding and meeting the objectives.

Objective for Salinity Concentration

Within 15 years after construction of the injection well, reduce salt concentrations in Lake Bowdoin to an average TDS (salts) of 7,000 mg/L at a lake elevation of 2209.0 feet while accepting all salt and water inputs, to provide the water quality needed to improve the diversity and quantity of wetland plants and invertebrates that can support healthy populations of waterbirds and other wetland-dependent species.

Strategies

- Develop a stepdown plan and required environmental analysis for the design, placement, installation, operation, and maintenance of the injection well in coordination with DEQ, DNRC, EPA, Reclamation, U.S. Geological Survey, irrigation districts, and other partners (table 12).
- Acquire project funding: (1) minimum of $6.7 million to design and construct the project; and (2) $100,000 to operate and maintain the system annually.
- Coordinate with local oil and gas companies and other consultants to determine the most cost-

Table 12. Partner agencies and expertise for the injection well project at Lake Bowdoin, Montana.

Agency	*Expertise and coordination*
Montana Department of Environmental Quality	Contaminants Water quality standards Regulatory standards
Montana Department of Natural Resources and Conservation	Hydrology and technical assistance Water quality monitoring Water rights
U.S. Environmental Protection Agency	Well permit Well operation Well monitoring
Bureau of Reclamation	Water delivery Negotiations with irrigation districts
U.S. Geological Survey	Wetland ecology Salinity and hydrological monitoring Geologic formations
Milk River Basin Joint Board of Control (irrigation districts)	Water quantity Water delivery
Oil and gas companies	Injection well drilling Geologic formations
Nongovernmental organizations	Grants Other funding sources

effective methods to drill and operate the injection well.

- Collect baseline information on plant and wildlife diversity and water quality as a basis for monitoring the effects of reducing salinity concentrations and the effectiveness of the method.

- Within 5 years, install the infrastructure necessary to achieve the objective including an injection well, intake pipes, power source, and pump house.

- Allow the water level of Lake Bowdoin to naturally recede to achieve maximum concentrations of salts for efficient injection. Limit fall water deliveries to maximize winter salt concentration levels.

- Until the salinity objective is achieved, operate the pump year-round to remove the maximum amount of salts annually. Use the pump to maintain the salinity objective as needed.

- Using additional maintenance staff and contractors, maintain or replace the pump and associated infrastructure as needed.

- Once the salinity objective is reached, determine the feasibility of modifying the wetland management structures to help maintain the objective's conditions by allowing Beaver Creek flooding to flush Lake Bowdoin. If additional water supply is granted, use this water to create a flow-through system.

Rationale. Salinity concentrations in Lake Bowdoin have steadily increased since 2000 due to drought conditions and a management decision not to place saline water into Dry Lake during the winter. Levels currently exceed 10,500 mg/L with higher average levels on the east side of the lake. Currently, there is no acceptable way to remove salts from the lake, thus this upward trend would continue in the future until a major flood or accidental spill occurred that would lower the salt load, at least temporarily.

Salinity concentrations are a function of water volume and salt loads. Nearly 7,000 tons of salt are added to the lake every year through various input sources (Kendy 1999; Stan Jones, personal communication, 2009). Extended droughts, which tend to occur on decadal patterns (that is, they reoccur every decade or once every few decades) in this area (Gleason et al. 2009), result in lower lake levels and elevated salt concentrations. It is estimated that, under relatively normal precipitation and an average water level of 2,210 feet in Lake Bowdoin, salinity would surpass 15,000 mg/L in the near future.

The salinity objective of 7,000 mg/L with normal water input is an aggressive target. This level was selected for the following reasons:

- It is well within the tolerances of several key invertebrate and plant communities including sago pondweed (Gleason et al. 2009).

- It is below levels considered harmful to waterfowl and other wetland-dependent birds.

- It provides managers with flexibility in operating the lake at higher water levels and reduced salinities.

Plant and invertebrate diversity is significantly lower in wetlands with high salinity concentrations (Euliss et al. 1999, Gleason et al. 2009, Swanson et al. 1984). Plant communities in highly saline wetlands favor a few species (Gleason et al. 2009). While salt-tolerant plants provide habitat for a suite of birds, a larger diversity of plant communities is more capable of providing for the needs of many species of wetland-dependent wildlife. Most invertebrates do not have the capacity to survive in water with salinity concentrations exceeding about 9,000 mg/L (Gleason et al. 2009). The importance of invertebrates is substantial for a variety of bird groups; invertebrates are critical for shorebirds (Helmers 1992, Skagen and Oman 1996), ducks (Krapu and Swanson 1975, Swanson et al. 1984), swans, cranes, grebes, and many others. Differences in how and where birds feed, as well as differing bill lengths and body size, allow birds to use invertebrates in different locations within a wetland, thereby reducing competition for resources. A lack of invertebrate diversity could result in food resources available for a narrower range of migratory birds that use the lake.

From 1990 to 2003, the refuge produced an average of 3,600 ducklings per year. Undoubtedly, many of these broods spent part of their development on Lake Bowdoin. Waterfowl broods, especially those less than 4 days old, are most at risk by elevated salinity concentrations. At salinity concentrations as low as 3,000 mg/L, reduced growth rates throughout development can occur (Mitcham and Wobeser 1988). If no fresh water is available, lethargy in ducklings can occur at 9,000 mg/L, 10-percent mortality at 12,000 mg/L, and near 100-percent mortality at levels higher than 18,000 mg/L (Moorman et al. 1991, Swanson et al. 1984). The influx of water into Lake Bowdoin—via the Black Coulee drainage and the Dodson South Canal—provides a source of fresher water for ducklings, thereby minimizing the threat of direct mortality.

Mike Artmann / USFWS

Salt residue accumulates at the southeastern outflow area of Lake Bowdoin.

At a water elevation of 2,208 feet, Lake Bowdoin is about 2,800 acres, contains nearly 5,500 acre-feet of water, and has an average depth of about 2 feet. In contrast, at an elevation of 2,210 feet, which is the average operating level, the lake is about 3,500 acres, contains 11,750 acre-feet of water, and has an average depth of 3.3 feet. If the salinity objective was met and maintained, the resulting salt concentrations of the lake with more water (higher lake level) would be considerably less.

This objective and the strategies for operation of the injection well would address the EPA regulations for a class 1 injection well, as summarized below:

- Inject below the lowermost geologic formation containing an underground source of drinking water.
- Identify and correct any penetrations within the surrounding area that would allow fluid to move out of the injection well.
- Obtain approval of the construction plan.
- Operate the well to ensure saline water is fully contained in the formation.
- Continuously monitor the injected water, movement of fluid in the formation, and mechanical operations.
- Plug and abandon the well correctly when complete.

Working with local groups, irrigation districts, partners, and congressional members would be essential to garner the support to develop, implement, and operate the injection well. The small staff at the refuge would require expertise and support from numerous partners to successfully carry out the project. The Service would seek expertise from public as well as private entities (oil and gas companies) to help guide the implementation of this proposed action.

Objective for Monitoring

Monitor, document, and evaluate the effects of fluctuating lake elevations and salinity concentrations on wetland plants, invertebrates, and associated wildlife to measure the effectiveness and impacts of the salt reduction project.

Strategies

- Before project construction, work with partners to collect baseline inventory information on current species of wetland plants, associated migratory birds and other wildlife, and invertebrates.
- Drill monitoring wells along Black Coulee drainage to monitor ground water flow and quality.
- Install a gauging station to monitor the rate of surface flow at Patrol Road Pond and Black Coulee culvert.
- Following requirements of the EPA relating to a class 1 injection well, monitor the containment of fluid in the injection zone.

- Continue to monitor salinity at the established monitoring sites across Lake Bowdoin to determine the changes in salinity from the injection well project. Add additional monitoring sites as needed.

- Design and implement a study to determine the effects of the injection well project on wetland plants, associated migratory birds and other wildlife, and invertebrates.

- Continue to monitor for disease outbreaks and for effects on colonial-nesting areas in response to changes in lake elevation and salinity.

- Monitor heavy metal concentrations during active salt removal and before releasing water into Beaver Creek.

Rationale. Refuge staff has collected a variety of water quality data, including salinity, for Lake Bowdoin and the surrounding wetlands for more than 30 years. This information has been critical in understanding the water and salt balance for the lake, and it is important to continue this data collection. The Black Coulee drainage is least understood in terms of water quality and water quantity. Additional monitoring wells are needed in this area to document the characteristics of source flows.

Additional biological information is needed to understand plant and animal responses to fluctuating salinity concentrations. To establish pre-injection well conditions, baseline information on plant and animal occurrences and their distribution throughout the lake would be needed.

Several islands in Lake Bowdoin provide colonial-nesting areas for several species of birds including American white pelican. An estimated 1,350 nests were present on two islands during 2009. Woody Island contained the largest number of nests and would be subject to the most disturbance if the lake level were consistently in the 2,208-foot range for extended periods during salt removal. Expanded surveys and monitoring would help document any effects on these birds. Additional coordination would be needed with individuals and groups conducting surveys if it was documented that local breeding populations had shifted their geographical locations.

Fluctuating water levels, both planned and unplanned, would be a part of managing salt levels in Lake Bowdoin. There would be times when the lake level would need to be low to facilitate more salt being removed from the system. Adaptive management would be used extensively throughout this process.

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An American white pelican on the Bowdoin Refuge Complex feeds its nestling.

Objective for Research

Pursue and develop research projects that would provide information on how to better manage and monitor the injection well project and improve the diversity and productivity of managed subsaline and brackish wetlands.

Strategies

- Work with partners to identify research and data needs.

- Develop partnerships with universities to provide opportunities for graduate study projects.

- Pursue partnerships with individuals and organizations with the required expertise to conduct this research.

- Evaluate the results of research projects to determine the need and feasibility of modifying the management direction.

Rationale. Implementing this project would provide opportunities for researchers to study the effects of not only drilling and operating the injection well but also the subsequent changes to habitat and wetland-associated wildlife.

The Service would develop partnerships with universities to provide potential projects for graduate students and would work with other agencies that have the expertise and interest in evaluating the effectiveness of the injection well. Studying the area before and after installing the injection well could provide valuable information for addressing salinity on other public lands and on private lands.

The results of these analyses would assist the refuge in determining how successful the project was in achieving the salinity objective and expected habitat improvement. These results would also help to determine if modifications were needed in the stepdown plan for installation and operation.

CHAPTER 7–Implementation of the Proposed Action, the Draft CCP

This chapter contains the specific objectives and strategies that would be used to carry out the Service's proposed action (alternative B), which reflects the draft comprehensive conservation plan for Bowdoin National Wildlife Refuge Complex in north-central Montana. The Service recommends this as the alternative that could best achieve the refuge complex's purposes, vision, and goals while helping to fulfill the Refuge System mission.

The proposed action (alternative B) would apply to all units of the refuge complex excepting Lake Thibadeau National Wildlife Refuge (refer to section 7.1). If the Regional Director selected alternative B as the preferred alternative, the objectives and strategies presented in this chapter would become the final plan to be carried out over the next 15 years. In addition, alternative B would be augmented by the objectives and strategies in salinity alternative 4, which are fully described in chapter 6 and are not included here (refer to section 7.2).

The stepdown management plans listed in table 19 (section 7.10) would provide implementation details for specific refuge programs.

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The American avocet is a target waterbird for the Bowdoin Refuge Complex.

7.1 Divestiture of Lake Thibadeau National Wildlife Refuge

The Service used the Mountain–Prairie Region's divestiture model as a tool to objectively determine the appropriateness of divestiture (refer to appendix E for the application of the model). Subsequently, the planning team prepared a separate environmental analysis for retention or divestiture of Lake Thibadeau National Wildlife Refuge, which is documented in section 3.1 in chapter 3). These combined analyses determined that the refuge cannot achieve its purposes nor does it meet any of the goals of the National Wildlife Refuge System.

Based on the analyses in chapter 3 and appendix E, the Service's proposed action is Lake Thibadeau alternative 2. The Service would divest its interest in Lake Thibadeau National Wildlife Refuge, removing it from the National Wildlife Refuge System. To

carry out this alternative, the Service would do the following:

- Prepare the final divestiture proposal, through coordination of the refuge staff with the Mountain–Prairie Region's Division of Realty, Division of Refuge Planning, and regional archaeologist.
- Voluntarily relinquish all refuge easements and return all rights to the landowner.
- Transfer to the landowner the dams, spillways, and water control structures, or remove them.
- Voluntarily relinquish the refuge water rights to the State of Montana.
- Complete the divestiture within 5 years of CCP approval.

The divestiture of Lake Thibadeau National Wildlife Refuge would require an act of Congress.

7.2 Salinity and Blowing Salts

Chapter 6 contains a separate environmental analysis that addresses the salinity and blowing salts problem at Bowdoin Refuge.

Lake Bowdoin is a subsaline waterbody with a rising salinity level. At certain salinity concentrations, desirable plants and animals cannot survive and are excluded from the ecosystem. Another problematic aspect is the dissolved salts in Dry Lake, which are carried by wind and deposited on private lands, with potentially negative effects on soils, crops, livestock, and human health.

To accomplish refuge objectives, the Service needs to reduce salinity levels and restore fresher conditions in Lake Bowdoin. Based on the analysis in chapter 6, the Service has identified salinity alternative 4 as the proposed action, comprising the following major actions:

- Develop an injection well to force saline water from Lake Bowdoin deep into the ground.

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Refuge staff record data about vegetation to measure conditions and response to management actions.

- Operate Lake Bowdoin to maximize the effects of natural flooding by allowing Beaver Creek floodwaters to flush the lake.

- Manage operations to meet the salinity objective of 7,000 mg/L of salts in Lake Bowdoin.

- Evaluate the lake's infrastructure to determine the best way to re-create a flow-through water system that would maximize the flushing effects of natural flooding.

7.3 Summary of the Draft CCP

The rest of this chapter contains the draft CCP—the objectives and strategies for the remaining resources and programs in the refuge complex as identified in alternative B, the proposed action (refer to section 3.3 in chapter 3).

The focus of the draft CCP, as described in alternative B, is to carry out science-based management of native mixed-grass prairie and associated wildlife along with complementary visitor services:

- The Service would use the best available science and research to determine the most effective methods for protecting, restoring, and enhancing native mixed-grass prairie to provide quality nesting habitat for targeted grassland-dependent birds. Invasive and nonnative plants, particularly Russian olive trees that fragment grassland habitat, would be controlled, reduced, or eliminated and areas restored to native plants. Enhanced wetlands would be managed to mimic natural conditions for target species of wetland-dependent migratory birds during spring and fall migrations and during the breeding and nesting season.

- The Service would provide more waterfowl sanctuary area on the eastern half of the refuge by closing a portion of the refuge to all foot traffic until migrating waterfowl depart, no sooner than December 1. This would not affect current waterfowl-hunting areas. The remaining wildlife-dependent public uses would be maintained or improved including the environmental education and interpretation programs. The Service would work with the State to determine the feasibility of offering a compatible, big game archery hunt on Bowdoin Refuge. The current visitor contact area would be expanded and a visitor services specialist would be added to the staff.

- All programs would provide visitors with information on the purposes of the refuge complex including the protection of migratory birds, the importance of protecting the remaining native mixed-grass prairie, and the mission of the National Wildlife Refuge System.

- Increased research and monitoring, staff, funding, infrastructure, and partnerships would be required to accomplish the goals, objectives, and strategies outlined in this chapter.

Sections 7.4–7.9 set out the objectives and strategies that serve as the steps needed to achieve the CCP goals for the remaining four refuges (not including Lake Thibadeau Refuge) and Bowdoin Wetland Management District. While a goal is a broad statement, an objective is a concise statement that indicates what is to be achieved, the extent of the achievement, who is responsible, and when and where the objective should be achieved—all to address the goal. The strategies are the actions needed to achieve each objective. Unless otherwise stated, the refuge complex staff would carry out the actions in the objectives and strategies. The rationale for each objective provides context such as background information, assumptions, and technical details.

Appendix D contains the required compatibility determinations (draft) for public and management uses associated with this draft CCP.

7.4 Goal for Upland Habitat and Associated Wildlife

Protect, enhance, and restore grassland habitat for breeding and migratory birds and other wildlife while maintaining the biological diversity and integrity of native prairie grasslands.

Native Grassland

Prairie ecosystems thrive on the intermittent disturbance brought by frequent fire and the irregular mosaic of vegetation carved out by insects and native grazers, especially the periodic passage of bison. These disturbances and subsequent renewal have shaped the life cycle of every native prairie organism. More than 150 years ago, bison were replaced with cattle, which grazed differently and did not migrate. Historically, continuous cattle grazing

was allowed on the refuge complex until the mid-1970s. This, combined with a lack of fire for at least 70 years, has resulted in a loss of plant structure and species diversity, both of which are necessary for a healthy and productive grassland ecosystem. The more palatable, tall, cool-season grasses such as green needlegrass and bluebunch wheatgrass have been replaced by increasers such as blue grama, fringed sagewort, and clubmoss. While these plants are an important part of native prairie, they should be components of a more diverse community (Lacey et al. 2005). The loss of variety in plant species and structure can be detrimental to grassland-dependent birds, which require a variety of habitats for nesting and foraging.

Today, cattle grazing can be a valuable tool in the absence of bison. If applied or used properly, grazing of native prairie by cattle can be used to stimulate vegetative and reproductive growth of plants. However, it is important that it be closely monitored and follow a prescription to achieve a habitat objective.

Grassland-nesting birds are one of the most rapidly declining groups of wildlife in North America, primarily due to habitat loss (Peterjohn et al. 1999). The Service has selected six target species of upland birds; these species depend on native prairie habitat and are listed as species of concern by Federal, State, and private entities (table 13). The upland habitat objectives, for both native and disturbed grasslands, focus on providing quality habitats (table 14) for these target species. The resulting habitats should benefit a much broader group of secondary bird species as well as a variety of other wildlife, both migratory and resident. This includes several of the target species of waterbirds (refer to section 7.5).

Native Grassland Objective 1

Over the next 50 years or more, manage for native grassland plant species composition that approximates the historical plant community consisting of (1) 80–90 percent grasses and grass-like plants including green needlegrass, bluebunch wheatgrass, and western wheatgrass, (2) 8–12 percent forbs such as American vetch, dotted gayfeather, purple prairie clover, and other native forbs, and (3) 4–6 percent shrubs such as winterfat, silver sagebrush, and rubber rabbitbrush.

Strategies

- Complete a baseline inventory of native grasslands in the refuge complex to determine abundance and overall health of grasses, forbs, and shrubs including whether remnants of the historical climax plant community exist and can serve as a seed source for restoration efforts.
- Determine if native ungulates are overbrowsing forbs and shrubs.
- Determine priority areas for restoration using the baseline inventory.

Table 13. Conservation status of target species of upland birds at Bowdoin National Wildlife Refuge Complex, Montana.

Species	*Montana species of concern*[1]	*U.S. Fish and Wildlife Service focal species*[2]	*Partners in Flight priority*[3]	*Bureau of Land Management*[4]	*National Audubon Watch List*[5]
Baird's sparrow	S2	√	1	Sensitive	Red
Sprague's pipit	S2	Candidate	1	Sensitive	Yellow
Chestnut-collared longspur	S3	√	2	Sensitive	Yellow
Greater sage-grouse	S3	Candidate	1	Sensitive	Yellow
Long-billed curlew	S2	√	2	Sensitive	Yellow
Marbled godwit	—	√	2	Sensitive	Yellow

[1] S2=*At risk because of very limited and potentially declining numbers, extent, or habitat, making it vulnerable to global extinction or extirpation in the State.* S3=*Potentially at risk because of limited and potentially declining numbers, extent, or habitat, even though it may be abundant in some areas. (Montana Fish, Wildlife & Parks; Montana Natural Heritage Program)*
[2] Candidate=*A species under consideration for official listing, for which there is sufficient information to support listing.*
[3] 1=*Needs conservation action.* 2=*Needs monitoring.*
[4] Sensitive=*Proven to be imperiled in at least part of its range and documented to occur on Bureau of Land Management lands.*
[5] Red=*Declining rapidly or having very small populations or limited ranges and facing major conservation threats; typically of global conservation concern.* Yellow=*Declining or rare; typically of national conservation concern.*

Table 14. Nesting habitat requirements for target species of upland birds at Bowdoin National Wildlife Refuge Complex, Montana.

Species	*Vegetation height (inches)*	*Litter depth*[1] *(inches)*	*Shrub cover (percent)*	*Area sensitive*[2]	*Use of nonnative vegetation*
Baird's sparrow	8.3–13.4	1.6–8.3	<25	Yes	Low
Sprague's pipit	10–12.5	0.8–4.3	5–20	Yes	Low
Chestnut-collared longspur	5.9–11.8	<2.5	<25	Yes	Low
Greater sage-grouse	>5.9	—	15–31	Yes	—
Long-billed curlew	2.5–11	—	0	Yes	Some
Marbled godwit	5.9–11.8	0.8–3.5	—	Yes	Low

[1] *(—)=No data found.*
[2] *Area sensitive=Species are more abundant or occur more frequently in larger patches of mixed-grass prairie; size of the area varies with the species.*
Sources: Davis (2004), Dechant et al. (2003), Dieni and Jones (2003), Green et al. (2002), Jones (2010), MSGWG (2005).

- Develop a grassland habitat management plan that incorporates tested methods for preserving and enhancing native grassland.

- Use a variety of management techniques such as prescribed burning, prescriptive grazing, and "interseeding." Use care with prescribed fire in this arid climate—to determine if and when an area should be burned, consider weather patterns (for example, annual rainfall since an area was last burned), vegetation, plant diversity, and current use by target bird species.

- Plant silver sagebrush on the Korsbeck and Beaver Creek WPAs to provide additional breeding, nesting, and feeding habitat for greater sage-grouse.

- To determine the effectiveness of management techniques, use a scientifically credible and conservative adaptive management monitoring scheme including evaluating the response of target upland bird species. Use this adaptive management approach to determine if the most effective methods and technologies are being used to achieve this objective.

- Collaborate with the Bureau of Land Management to monitor the prairie dog town on Hewitt Lake National Wildlife Refuge to ensure that it is maintained. Possibly pursue an agreement to close the entire prairie dog town to shooting year-round.

- Use habitat evaluations on Bowdoin Refuge to determine potential effects (and their degree) of native big game grazers such as white-tailed deer and pronghorn overbrowsing desirable native plant species, which would affect both species diversity and structure.

Rationale. Restoration of the historical plant community in the uplands would be a long-term project that goes well beyond the 15-year scope of the CCP. Ideally, upland habitats in the refuge complex would consist, over time, of grassland that provides a diversity of native vegetation and a mosaic of vegetative structure across a broad landscape. This mosaic of vegetation communities supports a greater diversity of grassland birds (Fuhlendorf et al. 2006, Madden et al. 2000) and other wildlife; however, whatever treatments are used for restoration must take into account the dry climate and the needs of the target bird species. The fact that many of the

Gary A. Monroe / USDA–NRCS PLANTS Database

Silver Sagebrush

target birds are present and nesting on uplands in the refuge complex indicates that these areas are already providing some habitat for these species. Using both monitoring and adaptive management would be important before choosing where, how, and when to enhance the vegetative and structural diversity of an area.

The Society for Ecological Restoration defines ecological restoration as "the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed" (Society for Ecological Restoration International 2004). As stated in their International Primer on Ecological Restoration, ecosystems may be altered "to the point at which the ecosystem cannot recover its predisturbance state or its historical developmental trajectory. Restoration attempts to return an ecosystem to its historic trajectory." It is not known how far the refuge complex would get along the restoration trajectory over the 15 years of the CCP; but once there was a baseline inventory, the Service could at least track that uplands were moving toward the ideal plant community and structure described in this objective.

A reference ecosystem that serves as a model is necessary to design restoration. Historical conditions are a good starting point for restoration design. The conditions described in this objective are based on the USDA (U.S. Department of Agriculture)–Natural Resource Conservation Service's ecological site description for the silty 10- to 14-inch precipitation zone (Lacey et al. 2005). Ecological site descriptions are based on "relic areas and other areas protected from excessive disturbance," illustrating the historical climax plant community as further described below (Natural Resources Conservation Service 2003):

> *The historic climax plant community for a site in North America is the plant community that existed at the time of European immigration and settlement. It is the plant community that was best adapted to the unique combination of environmental factors associated with the site […] Natural disturbances, such as drought, fire, grazing of native fauna, and insects, were inherent in the development and maintenance of these plant communities […] Plant communities that are subjected to abnormal disturbances and physical site deterioration or that are protected from natural influences, such as fire, for long periods, seldom typify the historic climax vegetation and may exist in a steady state that is different from the historic climax plant community. The historic climax plant community of an ecological site is not a precise assemblage of species for which the proportions are the same from place to place or from year to year.*

The ecological site description describes the grass, forb, and shrub species that compose the historical climax plant community and how the site may be affected by management actions such as lack of fire and overgrazing and environmental conditions such as prolonged drought. According to the ecological site description, most of the native uplands in the refuge complex are classified as "Plant Community C," which is characterized by a loss of tall bunchgrasses (green needlegrass, bluebunch wheatgrass, and porcupine grass) and an overabundance of clubmoss, blue grama, and prairie Junegrass.

Bowdoin Refuge may support as many as 300 white-tailed deer and pronghorn. Pronghorn graze some portions of the refuge year-round. While the full effect of this constant grazing is unknown, observations of sentinel forbs and shrub species on portions of the refuge show signs of severe overgrazing (Bob Skinner, wildlife biologist, U.S. Fish and Wildlife Service, Lewistown, Montana; personal communication, March 2007). Sentinel species are those species of desirable native plants that are often overbrowsed. These grazers, although native, can have detrimental effects on species diversity and structure due to their plant preferences. The Service would need to determine the severity of the grazing and, if necessary, determine how to better distribute and reduce herd sizes.

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Clubmoss

Native Grassland Objective 2

Within 3 years, use various treatment methods to determine the most effective technique for treating and restoring refuge uplands that have become unnaturally dominated (greater than 30-percent cover) by clubmoss.

Strategies

- Thoroughly research clubmoss effects and other studies dealing with clubmoss.
- Network with other agencies and universities that are dealing with clubmoss such as Natural Resources Conservation Service, The Nature Conservancy, and Montana State University.
- Recruit graduate students to carry out clubmoss studies on the refuge complex.
- Initially, establish small research plots of approximately 0.5 acre (=148 feet×148 feet) within a designated 5-acre, native-grassland study area that contains at least 30-percent clubmoss cover. Locate plots in areas with no nearby infestations of invasive plants.
- Investigate the effectiveness of using methods for treating and removing clubmoss: prescribed fire, grazing, "interseeding" of historical climax plant community species, fertilizing, herbicides, and other mechanical techniques.
- Map and monitor all treatment and control plots and document the clubmoss response.

Rationale. While clubmoss is a natural component of native uplands, overgrazing, drought, and lack of fire have allowed it to increase as herbaceous cover decreased. Clubmoss spreads slowly but tolerates drought better than most native grasses and forbs. According to the Natural Resources Conservation Service ecological site description, clubmoss cover in the historical plant community varied from none to trace amounts. Vegetation measurements taken in native prairie (four study plots, 445 acres total) on Bowdoin National Wildlife Refuge from 1998 to 2001 show clubmoss cover to average 21 percent with a standard deviation of 15 percent (Dieni and Jones 2003).

The role of clubmoss in plant communities is not well understood. It has been theorized that clubmoss outcompetes other vegetation by forming dense mats that intercept water and prevent seed germination (Heady 1952, Majorowicz 1963). Other studies have rejected this hypothesis and have suggested that (1) clubmoss does not affect water use by other plants (Colberg and Romo 2003) and (2) that seed germination is more affected by the species of seeds in the seedbanks (Romo and Bai 2004). Clubmoss may also reduce runoff, increase water infiltration in heavy rain events ,and prevent invasive plants from becoming established in native grasslands that have been stressed by past overgrazing or drought (Van Dyne and Vogel 1967).

D.M. Prellwitz / USFWS

Refuge staff apply bands to grassland-nesting birds such as Baird's sparrow to gather scientific information.

Furthermore, little is known about the value of clubmoss to wildlife. Dieni and Jones (2003) found that some grassland-nesting songbirds such as Baird's sparrows and western meadowlarks select nest patches (1.64 foot–radius plots around nests) with little or no clubmoss cover, while chestnut-collared longspurs favor sites with more cover. Sprague's pipits, did not indicate a preference.

While not seeking to eliminate clubmoss, reducing its abundance in some areas would help in the restoration of the uplands to the historical climax plant community. Small research plots and a combination of treatments would be used to simultaneously reduce clubmoss and reintroduce decreaser species such as green needlegrass and bluebunch wheatgrass. Successful methods would be used for future management of clubmoss to create a diversity of native vegetation and a mosaic of vegetative structure across uplands in the refuge complex.

Disturbed Grassland

Of the 4,477 acres of disturbed grasslands in the refuge complex, 4,008 acres are on the wetland management district and 469 acres on Bowdoin Refuge. These disturbed grasslands are areas where the soil has been disrupted either by Service activities or by former landowners for agricultural purposes. These lands have been seeded to DNC (dense nesting cover), a mixture of several tame wheatgrasses and legumes that is particularly attractive to nesting waterfowl. The predominant grass species in the DNC mix were intermediate wheatgrass, tall wheat-

grass, slender wheatgrass, pubescent wheatgrass, and western wheatgrass; the legumes were alfalfa and sweetclover.

Many of the DNC fields in the refuge complex are in poor condition with respect to plant diversity. These fields have only two to three of the originally planted species remaining and in many cases are dominated by exotic cool-season grasses (for example, crested wheatgrass and cheatgrass). Proper management of DNC is very intensive. A successful planting may provide quality habitat up to 8 years without disturbance; however, it is the periodic vegetation treatments such as burning and haying that capitalize on the relationship between young, vigorous stands of vegetation and higher wildlife production (Duebbert et al. 1981). With a rotational management plan that periodically rejuvenates the stand, the lifespan of a DNC seeding is about 15 years (Higgins and Barker 1982, Lokemoen 1984). Most of the refuge complex's DNC fields are well past this 15-year period.

Due to the intensive management requirements and the limited lifespan of DNC plantings—combined with recent studies indicating minimal benefits to grassland-nesting birds in DNC plantings in areas with an abundance of perennial cover (Arnold et al. 2007)—the refuge complex would gradually work to reseed the disturbed grasslands to native vegetation.

Disturbed Grassland Objective 1

Over the next 15 years, reseed at least 500 acres to native herbaceous mixtures on areas that have become decadent and overrun by nonnative, cool-season grasses to comprise more than 60-percent native grasses and forbs within 10 years after seeding.

Strategies

- Use the Natural Resources Conservation Service's ecological site descriptions, based on soil type, to determine characteristic vegetation composition for each site.
- Use locally collected seeds for planting to maintain the genetic strain of native plants found in the area, based on availability and cost.
- Use appropriate techniques for site preparation to ensure weed-free seedbeds.
- Use farming activities to prepare appropriate seedbeds.
- Manage habitat using tools such as prescribed fire and prescriptive grazing, haying, and resting.
- Use integrated pest management strategies to reduce invasive plants including noxious weeds.
- Use the best available science and updated techniques for restoration and monitoring response.
- Work with universities and other partners to pursue graduate student and research projects that would address specific management challenges for restoring and managing disturbed grasslands including controlling clubmoss and crested wheatgrass.
- Monitor the response of target species of upland birds before and after treatment to determine the success of management techniques, and use adaptive management to ensure the refuge complex is using the most effective methods and new technologies.
- In restored areas, continue to trap mammalian predators such as raccoons and skunks (1) to decrease predation on ground-nesting migratory birds and their nests and (2) to protect birds that have been live-trapped for banding or disease detection. Continue to use only live traps in these situations to ensure that only targeted predator species are removed from the area (use no leg hold traps).

Rationale. Using appropriate management techniques to emulate the natural disturbances under which native prairie plants evolved, the native plant seeding should persist in perpetuity. The native plantings would reduce habitat fragmentation and attract grassland birds that have adapted to the diverse structure of native prairie; whereas DNC would limit the structural diversity of the vegetation and likely attract those bird species that key into tall dense cover. Native grass, although more difficult to establish and usually more expensive, can be maintained in a vigorous condition longer without the need for constant rejuvenation.

Disturbed Grassland Objective 2

Over the next 15 years, continue to use and maintain DNC on disturbed grasslands for wildlife habitat; maintain DNC every 4–7 years to promote the optimal vigor of present plant species.

Strategies

- Use appropriate techniques for site preparation to ensure weed-free seedbeds.
- Use farming activities to prepare appropriate seedbeds.
- Seed DNC on highly erodible lands in Bowdoin Wetland Management District.
- Manage habitat using tools such as prescribed fire and prescriptive cattle grazing and haying to establish and maintain DNC.
- Use integrated pest management strategies to reduce noxious weeds and other invasive plants.

Rationale. Disturbed grasslands that have not been targeted for native plantings would be maintained in their current state of cover, and periodic treatment would remove accumulated duff and rejuvenate plants. Vegetative cover including DNC plantings older than 15 years would be managed to maintain their vigor, so these areas could continue to provide value to wildlife and increased soil stabilization for reduced sedimentation into wetlands.

Some areas might be reseeded to DNC if needed to maintain structure and productivity. Fields dominated by exotic cool-season grasses such as crested wheatgrass and cheatgrass might become source sites from which these exotic grasses could invade adjoining grasslands. In these situations, it might be more appropriate due to funding availability to plant DNC rather than a native grass mixture. In those seed mixes, viable grasses would be western wheatgrass, slender wheatgrass, and tall wheatgrass, and alfalfa would be a compatible legume. On highly erodible land that has lost its topsoil layer due to years of farming, planted DNC could reduce erosion and initiate the redevelopment of a topsoil layer for future native seed establishment.

7.5 Goal for Wetland Habitat and Associated Wildlife

Provide wetland habitat for breeding and migratory birds and other wildlife that maintains biological diversity and integrity of prairie pothole wetlands.

Wetlands in the Bowdoin National Wildlife Refuge Complex are a mixture of managed and natural wetlands of different types, sizes, and water quality. Managed wetlands are areas created or restored through water management, such as using water control structures to manually flood areas and to conduct water drawdowns. The focus for managed wetlands is to mimic natural wetland conditions whenever possible.

Temporary, seasonal, and semipermanent wetlands are by far the most important types of wetlands for most species of waterfowl that breed throughout the Prairie Pothole Region (Kantrud et al. 1989). Waterfowl, shorebirds, and other waterbirds depend on this complex of wetland types to fulfill various needs throughout their life history, particularly during the breeding season (Baldasarre and Bolen 2006). For example, during a radio-telemetry study of mallards nesting North Dakota, eight females used 7–22 different wetlands during the breeding period; the birds preferred temporary, seasonal, and, to a lesser extent, semipermanent wetlands (Dwyer et al. 1979).

By understanding how waterfowl and other waterbirds use resources, managers are able to attract and hold these species on managed wetlands. Manipulation of soil and water to produce essential habitat structure or foods may be necessary. The sharp increase in invertebrate populations when wetlands flood following a dry phase is an important reason for artificially flooding and draining wetlands to enhance waterfowl habitat (Cook and Powers 1958, Kadlec and Smith 1992), and it is the basis for the modern-day practice of moist-soil management (Fredrickson and Taylor 1982).

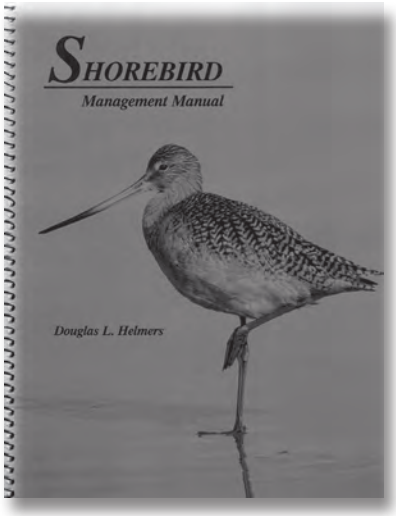
To promote seed-producing wetland plants for fall migrants like waterfowl, it is important to know the regional growing seasons. Managers can use this information to schedule gradual drawdowns of managed wetlands to achieve the most productive plant response. Plant promotion is also good structure for production and diversity of invertebrates. The

Dave Menke / USFWS

The sora is a small marsh bird that uses ponds in the Bowdoin Refuge Complex.

average length of the growing season in Phillips County, Montana, is 130 days (PhillCo Economic Growth Council, Inc. 2001). Where the growing season is shorter than 140 days, wetland drawdowns are described as early or late drawdowns. Early drawdowns are those that occur during the first 45 days of the growing season, whereas late drawdowns occur in the latter 90 days of the growing season (Fredrickson 1991). In areas characterized by summer droughts, early drawdowns often result in good germination and newly established plants have time to establish adequate root systems before dry summer weather predominates. For example, smartweed tends to respond best to early drawdowns, whereas sprangletop responds best to late drawdowns. Drawdowns can be natural or mechanical (by means of water control structures).

Drawdowns attract a diversity of foraging birds such as shorebirds and white-faced ibis to wetlands with abundant food resources, concentrated in smaller areas and at different water depths (Fredrickson 1991). Slow drawdowns (2–3 weeks) are usually more desirable for plant establishment and wildlife use. Slow release of water concentrates and traps invertebrates, making them readily available to foraging birds. Furthermore, drawdowns scheduled to match the spring migration are beneficial to migratory waterbirds.



Managed Wetlands

Lake Bowdoin attracts thousands of ducks, swans, and geese during the spring and fall migrations. The lake is a 5,459-acre natural, subsaline, permanent wetland that, during the early history of Bowdoin Refuge, was modified to create additional wetland habitat for migratory birds. Modifications to the lake included water control structures and a dike system for holding delivered water and capturing floodwaters and runoff.

Additionally, the Service manipulates water in several ponds in the refuge complex that attract a tremendous diversity of waterfowl and shorebirds, including the threatened piping plover. The deepwater impoundments have emergent vegetation such as bulrush and cattails and are important nesting, brood-rearing, and feeding sites for diving ducks such as the canvasback, as well as for the marsh wren, sora, and others.

Some of the managed semipermanent wetlands in the refuge complex lack full-management capabilities from off-refuge irrigation return flows, subirrigation, and seepage from Nelson Reservoir. Examples of these are Ducks Unlimited Pond, Patrol Road Pond, and Strater Pond.

Target Waterbird Species

The Service has selected a diverse group of target waterbird species, including ducks and shorebirds (table 15). Table 16 displays the habitat needs that the Service identified for these target species. Managing for the life history needs of these species would provide the natural wetland diversity and conditions needed not only for these targeted species but also for an even greater variety of wetland-associated wildlife. Monitoring would focus on these targeted species to determine their response to wetland management.

Shorebird Habitat Target Species

Nearly 40 species of shorebirds migrate through the interior region of North America and 13 species breed in this region (Helmers 1992). Shorebirds exploit upland habitats associated with wetlands by foraging in shallowly flooded pastures or irrigated agricultural fields with short, sparse, residual vegetation left from mowing, haying, grazing, or burning practices. Migratory shorebirds consume large numbers of invertebrates. Invertebrate availability in wetlands is a function of the hydrologic regime. Many shorebirds feed predominantly on chironomid larvae (blood worms), which occur in open shallow habitats with a silt substrate relatively free of vegetation.

Most shorebird use occurs where vegetation cover is less than 25 percent. Shorebirds prefer short vegetation, generally less than half the height of the bird. Nest sites for the target shorebirds range from sand or gravel substrate with no vegetation (piping plover) to midgrass prairie (marbled godwit, willet). Managing for a range of wetland habitat conditions, from sparsely vegetated mudflats to moderately vegetated open shallows, would provide shorebirds with required habitats throughout their migratory and breeding periods.

Eleven species of shorebirds have been documented breeding on the Bowdoin National Wildlife Refuge Complex: piping plover, killdeer, long-billed curlew, common snipe, upland sandpiper, marbled

Table 15. Conservation status of target species of waterbirds at Bowdoin National Wildlife Refuge Complex, Montana.

Species	*Montana species of concern*[1]	*U.S. Fish and Wildlife Service focal species*	*Partners in Flight priority*[2]	*Bureau of Land Management*[3]	*National Audubon Watch List*[4]
Northern pintail	—	√	—	—	—
Mallard	—	√	—	—	—
Redhead	—	—	—	—	—
Tundra swan	—	—	—	—	—
Piping plover	S2	Threatened	1	Special status	Red
White-faced ibis	S1	—	2	Sensitive	—
Willet	—	—	3	—	—
Franklin's gull	S3	—	2	Sensitive	—
Wilson's phalarope	—	√	3	Sensitive	Yellow

[1] S1=*At high risk because of extremely limited or rapidly declining numbers, range, or habitat, making it highly vulnerable to global extinction or extirpation in the State.* S2=*At risk because of very limited and potentially declining numbers, extent, or habitat, making it vulnerable to global extinction or extirpation in the State.* S3=*Potentially at risk because of limited and potentially declining numbers, extent, or habitat, even though it may be abundant in some areas. (Montana Fish, Wildlife & Parks; Montana Natural Heritage Program)*
[2] 1=*Needs conservation action.* 2=*Needs monitoring.* 3=*Local concern.*
[3] Special status or Sensitive=*Proven to be imperiled in at least part of its range and documented to occur on Bureau of Land Management lands.*
[4] Red=*Declining rapidly or having very small populations or limited ranges and facing major conservation threats; typically of global conservation concern.* Yellow=*Declining or rare.*

godwit, willet, spotted sandpiper, American avocet, Wilson's phalarope, and mountain plover. Shorebird habitat management in the refuge complex would emphasize provision of breeding habitat for three target species: piping plover, marbled godwit, and willet (table 17). These species represent different guilds (groups of species all members of which use similar resources in a similar way). Meeting the diverse habitat requirements for these species would likely provide quality habitat for all shorebirds.

Spring migration habitat should be available on the refuge complex by mid-April that provides foraging water depths of 0 (dry mud) to 0.6 feet (18 centimeters), which would meet the needs of these species, as specified below and in figure 42:

- *Piping plover*: 0–0.1 feet (0–3 centimeters)
- *Marbled godwit*: 0.1–0.5 feet (4–16 centimeters)
- *Willet*: 0–0.5 feet (0–16 centimeters)

Wetland Habitat Objectives

The following objectives address management of the temporary, seasonal, and semipermanent wetlands within the Bowdoin Refuge Complex.

Wetland Habitat Objective 1

Depending on the availability of delivered water and environmental conditions, fill at least 70 percent of the temporary wetlands to a maximum of 1.5 feet in spring (by April 15) for 3 out of every 5 years to provide breeding, nesting, feeding, and migration habitat for target waterbirds and feeding and breeding habitat for resident waterfowl and shorebirds.

Strategies

- Coordinate with Malta Irrigation District for timely water delivery to ensure water is available for peak migration periods for waterbirds.
- Develop new ground-water wells to supplement wetland management needs in the refuge complex.
- Develop water-pumping sites on Beaver Creek WPA and McNeil Slough WPA to create wetland habitat for migratory birds.
- Manipulate water levels with flooding and drawdowns (natural and physical releases).
- Monitor the response of target waterbirds to habitat management.

Table 16. Life history needs of target species of waterbirds at Bowdoin National Wildlife Refuge Complex, Montana.

Species	*Arrival date*	*Forage depth (feet)*	*Peak nesting month*	*Nesting site (distance above water line)*	*Departure date*
Northern pintail	Mid-March to early April	≤1.5	Mid-May	Shortgrass uplands	November
Mallard	Mid-March	≤1.5	May	Uplands, 2 feet	Freeze-up to November
Redhead	April[1]	3.3–9.8	Late May	Emergent vegetation (cattails and hardstem bulrush), 0.2–0.8 feet	Early October[1]
Tundra swan	Late March and late September	0–3.3	—	—	Early April and November
Marbled godwit	Late April[2]	0.2–0.4[3]	May	Midgrass uplands, <0.5 feet[4]	September
White-faced ibis	May[2]	0–1	May	Cattails and bulrushes, 3 feet	September
Franklin's gull	Mid-April	0–0.5[5]	May	Cattail or bulrush mats	Mid-October
Wilson's phalarope	Early May	0–0.25	June	Uplands and wet meadows	Mid-August to early September

[1]*Frank Belrose (1980).*
[2]*Ryan and Renken (1987).*
[3]*Melcher et al. (2006).*
[4]*Eldridge (1992).*
[5]*Refuge staff observations.*
Sources: Unless otherwise the noted, this information came from Birds of North America Online (Poole 2005) and Montana Field Guide (2010).

Table 17. Nest site and habitat characteristics of target, interior-nesting shorebirds at Bowdoin National Wildlife Refuge Complex, Montana.

Species	*Nest site*	*Substrate*	*Wetland type*	*Vegetation height*	*Vegetation density*	*Nesting behavior*
Piping plover	Beach or peninsula	Open, salt flats, or gravel	Alkaline or saline	None	Sparse	Semicolonial
Marbled godwit	Upland	Open or vegetated	Freshwater or saline	Medium	Moderate	Solitary
Willet	Upland prairie	Open or vegetated	Freshwater or saline	Medium	Moderate	Solitary

Source: Helmers (1992).

- Monitor the response of plants and invertebrates to the timing of flooding and drawdowns.
- Monitor for undesirable plants such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through flooding, prescribed burning, prescriptive grazing, or chemical use.
- Time flooding and drawdowns to mimic natural hydroperiods (wet cycles).
- Conduct all water manipulations slowly, so invertebrates can adjust to the changes in water level and temperature.
- Use mid- to late-summer water deliveries as part of managing large monocultures of cattails that reduce the availability of open-water habitat for waterbirds.

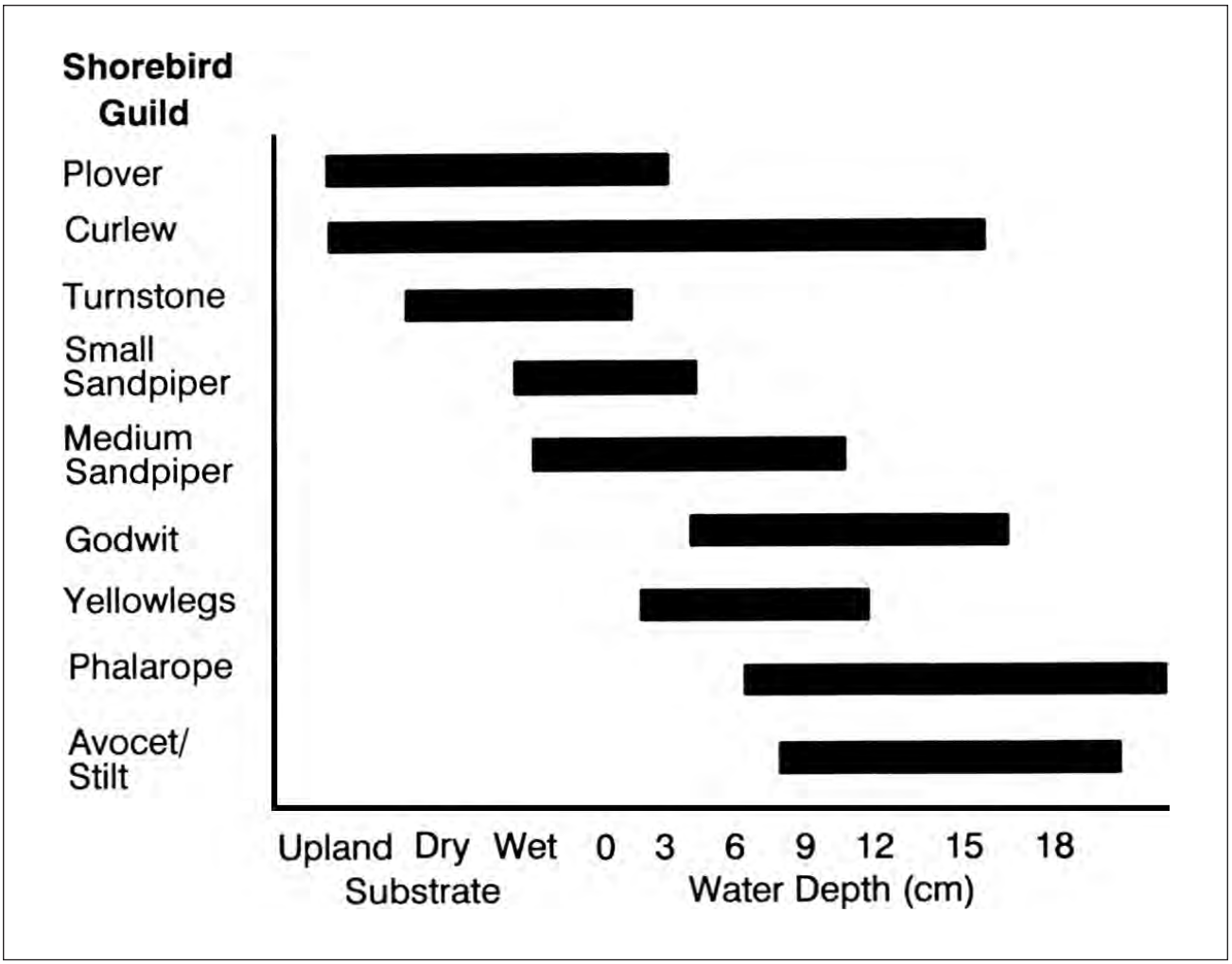


Figure 42. Graph of water depth and substrate preferences of shorebird foraging guilds (Helmers 1992).

- Allow wetlands to go dry by late spring or early summer through evaporation or water level management.
- Identify and map potential areas to create or enhance wetlands.

Rationale. Wetland vegetation is important to waterbirds such as waterfowl because they produce seeds, tubers, browse, and nesting sites and serve as litter or food for invertebrate populations. Temporary, seasonal, and semipermanent potholes are by far the most important wetland areas for breeding waterfowl (Kantrud and Stewart 1977, Stewart and Kantrud 1973). They provide migratory bird habitat for spring migration, feeding, and resting. In addition, potholes provide breeding habitat for the target species that depend on temporary wetlands. These wetlands are particularly important breeding habitat for early nesting species such as northern pintail and mallard and also serve as habitat for migrating waterfowl and shorebirds (Baldasarre and Bolen 2006). Temporary wetlands hold water for only a few weeks after snowmelt and occasionally for a few days following heavy rainstorms in late spring, summer, and fall. They are especially important, because they provide isolation and spacing for pairs of breeding waterfowl. Temporary wetlands are shallow basins; therefore, waters warm rapidly and are the first to become ice-free in late winter and early spring and provide the first sources of invertebrates (Baldasarre and Bolen 2006, Swanson et al. 1974).

Timing, speed, and duration of water deliveries and of wetland drawdowns all have important effects on the composition and production of wetland plants, invertebrate production and accessibility, and use by waterbirds. Fall flooding provides waterfowl and other waterbirds access to invertebrates and to seeds produced by wetland plants. Edges of wetlands with mudflats or shallow areas create feeding habitat for shorebirds and resting areas for other waterbirds. As the wetland deepens toward the center it creates different feeding depths for various species of waterbirds.

USFWS

White-faced ibis congregate in a wetland at Bowdoin Refuge Complex.

Wetland Habitat Objective 2

Depending on the availability of delivered water and environmental conditions, fill at least 70 percent of the seasonal wetlands to a maximum of 1.5 feet in the spring or fall, or both, for 4 out of every 5 years to provide feeding, breeding, nesting, brood-rearing, and migration habitat for target waterfowl, shorebirds, and other waterbirds.

Strategies

- Coordinate with Malta Irrigation District for timely water delivery to ensure water is available for peak migration periods for waterbirds.
- Acquire funding to buy additional delivered water from Malta Irrigation District (when available) for Lake Bowdoin during the spring or fall, or both.
- Manipulate water levels with flooding and drawdowns (natural and physical releases).
- Time flooding and drawdowns to mimic natural hydroperiods.
- Conduct all water manipulations slowly, so invertebrates can adjust to the changes in water level and temperature.
- Monitor the response of plants and invertebrates to the timing of flooding and drawdowns.
- Monitor for undesirable plants such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through flooding, prescribed burning, prescriptive grazing, or chemical use.
- Gradually fill temporary wetlands in late summer (September) over a 2- to 3-week period to provide feeding habitat for fall-migrating shorebirds. Continue filling to a maximum of 1.5 feet by October 30 for use by fall-migrating waterfowl and other waterbirds and in preparation for the following spring migration.
- Gradually begin filling wetlands by the beginning of April over a 2- to 3-week period for spring migrants. Continue filling to a maximum of 1.5 feet by April 15 for use by spring-migrating waterfowl and other waterbirds.
- Provide a 70:30 ratio of emergent vegetation to water over 7–8 years, with cattails not occupying more than 70 percent of a wetland. Remove 80–100 percent of cattails by using disking, burning, or chemical treatment when cattails exceed 70 percent of the wetland surface.
- Use chemicals approved by the Service for aerial spraying to kill undesirable plants in wetlands.

Rationale. Seasonal wetlands maintain water in spring and early summer but normally are dry by

late summer and early fall. They provide migrating, feeding, and resting habitat for migratory waterbirds. In addition, seasonal wetlands provide habitat for breeding and brood rearing for species such as northern pintail, mallard, and marbled godwit. These wetlands provide abundant invertebrate foods and other components of breeding habitat, including nesting cover for those species of ducks that nest over water (Baldasarre and Bolen 2006, Kantrud et al. 1989).

Waterfowl have various tolerances for the height and density of vegetation. Mallards and blue-winged teal readily use habitats with dense vegetation; northern pintails prefer shallow, open habitats where visibility is good and vegetation sparse. Shallow water is essential for dabbling ducks such as northern pintails and mallards whose optimum foraging depth is 0.2–0.8 feet. Wetland vegetation is important, because it provides seeds, tubers, browse, and nesting sites for waterfowl; this vegetation serves as litter or food for invertebrate populations.

Timing, speed, and duration of water deliveries and of wetland drawdowns all have important effects on the composition and production of wetland plants, invertebrate production and accessibility, and use by waterbirds. The key to managing habitat for migrating shorebirds is to encourage invertebrate production, and then make the invertebrates available to the birds. The proper regime of drawdown and flooding can stimulate plant growth and decomposition and create a detrital food source for invertebrates. When the water is drawn down slowly (0.8–1.6 inches per week) during the appropriate times of the year, shorebirds are attracted to the available invertebrates. Shorebirds feed primarily on midge larvae during migration. Several studies revealed that, irrespective of wetland type, midge larvae are often the most abundant invertebrate. Midges are often most abundant in areas of shallow, open water that is not shaded by submergent and emergent vegetation. Because many waterfowl hens and broods also consume midge larvae, management of habitat for shorebirds is also beneficial for waterfowl (Eldridge 1992). Fall flooding provides waterfowl and other waterbirds access to invertebrates and to any seeds produced by wetland plants and prepares the wetland for the following spring migrants.

Wetland Habitat Objective 3

Depending on the availability of delivered water and environmental conditions, fill at least 70 percent of the semipermanent wetlands to provide shallow areas of a maximum of 1.5 feet (for dabbling ducks such as northern pintail and mallard and for wading birds such as white-faced ibis and willet) and deep areas of 3–4 feet (for deep-water species such as lesser scaup). Allow emergent vegetation to establish as nesting habitat for overwater nesters, but allow no more vegetation than a ratio of 70:30 of emergent vegetation to open water.

Strategies

- Time the delivery of the Malta Irrigation District water to achieve this objective.
- Manipulate water levels with flooding and drawdowns (natural and physical releases).
- Time flooding and drawdowns to coincide with the migration periods.
- Conduct all water manipulations slowly, so invertebrates can adjust to the changes in water level and temperature.
- Monitor the response of target waterbirds to these manipulations.
- Monitor the response of plants and invertebrates to the timing of flooding and drawdowns.
- Monitor for undesirable plants such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through prescribed burning, prescriptive grazing, flooding, mechanical treatment, or chemical use.
- Flood the uplands surrounding the emergent vegetation zone in early spring to kill wet meadow plants, allowing midges to rapidly colonize the detritus. Maintain the high water level, and then slowly lower it to expose the decomposing vegetation during the peak shorebird migration.
- Through the nesting period, maintain 2–3 feet of water in areas with emergent vegetation for birds that nest over water.
- Fill 50 percent of the semipermanent wetlands to full capacity (at least 2–3 feet of water below the emergent vegetation) by May 15 to provide migration habitat for waterbirds, to serve as brood-rearing habitat for waterfowl, and to provide nesting habitat for overwater nesters such as white-faced ibis, Franklin's gull, and grebes. Annually rotate the wetlands that are flooded, allowing some to remain dry.

- Use drawdown structures or allow natural evaporation on these semipermanent wetlands to encourage nutrient recycling and increase production of invertebrates and desirable wetland plants and seeds. Determine the timing of these drawdowns depending on weather conditions (particularly increasing temperatures to aid evaporation) and management objectives.

- Use chemicals approved by the Service for aerial spraying to kill undesirable plants.

Rationale. Semipermanent wetlands ordinarily retain water through spring and summer and frequently into fall and winter. They are highly important to diving ducks and especially important for dabbling ducks in years when drought limits the availability of temporary and seasonal wetlands. During drought conditions in North Dakota, mallard broods occurred only on semipermanent wetlands (Baldasarre and Bolen 2006, Talent et al. 1982), and 58-percent more duck broods were recorded using semipermanent potholes in comparison with other types of wetlands in North Dakota and South Dakota (Baldasarre and Bolen 2006, Duebbert and Frank 1984). Semipermanent wetlands provide migration habitat for migratory waterbirds such as diving ducks (redhead and lesser scaup) both in the spring and fall (if they still have water) but, more significantly, habitat for brood rearing and overwater nesting for waterbirds such as white-faced ibis. These wetlands also provide escape cover.

The structure created by emergent vegetation is an essential feature of wetland habitats. Weller and Spatcher (1965) recorded maximum diversity and abundance of birds on marshes in Iowa where the ratio of emergent vegetation to water was 50:50 and referred to this form of wetland physiognomy as hemimarsh (Baldasarre and Bolen 2006). Bulrushes and especially cattails are among the most common plants in emergent communities. These plants are primarily important as cover, although alkali bulrushes are key food producers (Baldasarre and Bolen 2006). When conditions allow these plants to become a monoculture and overtake a wetland, animal and plant diversity declines. Wetland vegetation is important to waterbirds such as waterfowl because they produce seeds, tubers, browse, and nesting sites and serve as litter or food for invertebrate populations. Timing, speed, and duration of water deliveries and of wetland drawdowns all have important effects on the composition and production of wetland plants, invertebrate production and accessibility, and use by waterbirds. Filling wetlands in the fall would make seeds from wetland plants more readily available to migrating waterbirds.

R.H. Mohlenbrock / USDA–NRCS PLANTS Database

Alkali bulrush is a common emergent plant in the refuge complex.

Wetland Habitat Objective 4

On semipermanent wetlands having limited management capabilities, manage emergent vegetation as a hemimarsh to provide open water and cover for migratory birds.

Strategies

- Monitor for undesirable emergents such as cattail and bulrush. To maintain no more vegetation than a ratio of 70:30 for vegetation to open water, conduct management actions necessary to set back monocultures of these plants through the use of a glyphosate or, where possible, through flooding, prescribed burning, prescriptive grazing, mechanical treatment, or chemical use.

- Restore the natural vertical structure in riparian corridors using native species such as cottonwood, willows, and native shrubs to provide habitat for migratory birds and other native wildlife. Continue to fence riparian areas to protect them from trespass cattle grazing.

- Use chemicals approved by the Service for aerial spraying to kill undesirable plants.

- Monitor the response of waterbirds to management actions.

Rationale. Cattails are of little value as duck food but are more important as escape, loafing, and nesting cover for some species of waterfowl, other waterbirds, and red-winged and yellow-headed blackbirds. However, when unchecked, cattail stands often expand rapidly to the exclusion of other vegetation and open water; such conditions severely restrict

waterfowl and shorebird use (Baldasarre and Bolen 2006, Kaminski et al. 1985).

The desired optimal wetland condition that provides the greatest diversity and number of birds is hemimarsh. In hemimarsh conditions, wetland vegetation cover and water in a semipermanent wetland is at a 50:50 ratio (Weller and Spatcher 1965). Wetland birds that find hemimarsh conditions favorable include various waterfowl and shorebird species such as herons, gulls, terns, blackbirds, and grebes. All of the target species regularly use these particular semipermanent managed wetlands at various times of the year. In addition, they provide ideal nesting cover for birds that nest over water. It is important to avoid undesirable plants and monocultures of plants in hemimarsh wetlands. Undesirable plants are plants that quickly shift diverse floral systems toward monocultures, are difficult to reduce in abundance, have minimal values for wetland wildlife, or outcompete plants with greater value (Fredrickson and Reid 1988b).

Through limited water level management or chemical use, or both, the Service anticipates being able to achieve emergent vegetation to open water ratios close to the 50:50 ratio (such as 30:70 and 70:30 ratios) recommended by Weller and Spatcher (1965) in most years (approximately 11 out of 15). Because of the dynamics involved with these particular wetland conditions over time, the coverage of emergent vegetation may fall well outside the target range (30- to 70-percent coverage) in some years and, during years of extreme drought, cover of emergents such as cattail and bulrush may exceed the upper target of 70 percent.

The Drumbo, Goose Island, Patrol Road, Strater, and Black Coulee Ponds are considered semipermanent and the Service does not have complete management capabilities in these wetlands because of subirrigation and irrigation return flows entering the refuge. Consequently, cattails have overgrown these wetlands.

Avian Disease

The refuge complex staff completed a Disease Contingency Plan in 2006 for the Bowdoin National Wildlife Refuge Complex. The Bowdoin Refuge has a history of botulism outbreaks, which generally begin in July and last into September. The numbers of waterfowl affected has varied greatly from year to year, while the location of disease hotspots—areas with the highest mortalities—has changed little: the southwestern and southeastern bays of Lake Bowdoin, the northeast shore of Big Island in Lake Bowdoin, and the northwest portion of Drumbo Pond.

A sudden die-off of pelicans on Lake Bowdoin in 2003 was the result of West Nile virus, and the disease has been documented in the area every year since this time. Outbreaks begin as early as July and can last into fall.

While not documented at the refuge complex, new disease threats continue to emerge such as highly pathogenic avian influenza and Newcastle disease. The Service can no longer afford to rely on past informal protocols for avian diseases.

Avian Disease Objective

Manage wetlands to minimize or avoid outbreaks of avian botulism on the Bowdoin Refuge throughout the 15-year CCP. Continue to monitor for existing and new avian diseases throughout the refuge complex, particularly for those that might transfer to other wildlife and humans.

Strategies

- Follow the monitoring and response protocols outlined in the disease contingency plan.
- Annually review and update the disease contingency plan and continue to monitor for disease outbreaks within the refuge complex.
- Maintain a supply of personal protective equipment for emergency cleanup operations.
- Cooperate with partners who are responsible for detecting and monitoring existing and new wildlife diseases.
- Continue to submit tissue samples to the National Wildlife Health Center for disease diagnosis.
- Avoid fluctuating water levels in botulism hotspots between early July and early September when outbreaks are likely to occur; plan water deliveries during early spring (through May 15) and late summer (early September).
- As temperatures rise in the summer, monitor wetlands weekly for disease outbreaks. Send sample carcasses to the National Wildlife Health Center for analysis. Remove birds in areas with high visitor use.
- Continue to educate staff and visitors on how to avoid contact with wildlife diseases that have the potential to be transferred to humans.

- Continue to allow the U.S. Interagency Working Group to monitor the refuge complex for avian influenza outbreaks.

- When approved, implement the Mountain–Prairie Region policy for a mosquito control plan to address potential outbreaks of West Nile virus or avian influenza.

Rationale. America's global economy and the ability for individuals to easily travel around the world have escalated the transfer of new diseases, harmful to both animals and humans, to North America. Most recently, concerns have been raised over the potential migration to North America of highly pathogenic avian influenza. The Service's response to this outbreak could rapidly change management of Service lands. Unlike avian botulism, highly pathogenic avian influenza and West Nile virus pose serious human health risks (USFWS 1999a). Service employees and visitors are made aware of disease symptoms and avoiding the risks of contracting these diseases before going into the field. Unfortunately the symptoms of these diseases make it impossible to detect their presence and spread among wildlife until mortality occurs (Centers for Disease Control and Prevention 2010).

Avian botulism is a paralytic disease caused by ingestion of the *Clostridium botulinum* bacteria. The bacteria can exist as a dormant spore in soil for many years until a combination of warm temperatures, a protein source, and an anaerobic (no oxygen) environment allows the bacteria to become active and release its toxin. Decaying vegetation attracts a large number of aquatic invertebrates that pick up the toxin and are then ingested by waterfowl and shorebirds. A cycle develops when the affected birds die and the fly larvae that feed on the carcasses are, in turn, ingested by other birds. Sudden water drawdowns during this period could expand the spread of the botulism toxin by causing significant die-offs of aquatic invertebrates (Davis et al. 1971, USFWS 1999a). By avoiding the flooding of botulism hotspots during July through September, an outbreak would be avoided or at least reduced in severity.

Piping Plover

The northern Great Plains population of piping plover consists of about half of the world population of this plover. This population is expected to go extinct in 50–100 years unless significant conservation activities are started. Bowdoin National Wildlife Refuge has more than 1,300 acres of critical habitat designated for the piping plover. The Service has collaborated with Reclamation and Ducks Unlimited to restore and create habitat for this threatened species.

Piping Plover Objective 1

Over 15 years, annually monitor and protect piping plover nests found within the refuge complex and monitor the success of protected nests and hatched young. Strive for fledging rates of more than 1.36 fledglings per breeding pair of plovers (USFWS 2003).

Strategies

- Continue to participate in the International Piping Plover Census and annually monitor for the presence of piping plovers on Bowdoin and Hewitt Lake refuges.

- Survey wetlands for piping plovers by the most appropriate means (for example, by boat, walking the shoreline, or viewing from a vehicle with a spotting scope). Conduct surveys between late May and mid-June.

- Erect wire mesh cages with netted tops over piping plover nests that are in danger of being trampled or subjected to predation by birds.

- Move or elevate active nests that are in danger from rising water (Prellwitz et al. 1995).

- Monitor the success of protected nests by searching for "pip chips" (small pieces of egg shell left in the nest bowl during the hatching process) in or near the nest bowl or by timing nest visits based on known (or suspected) nest initiation date, laying rate, and average incubation period.

- Monitor hatched young to when they fledge.

Rationale. The northern Great Plains population of piping plovers is listed as threatened in the United States (USFWS 1985) due to a poorly understood decline in abundance. Mabee and Estelle (2000) suggested that nest predation is a major problem limiting the nest success of piping plovers throughout their range. However, according to Murphy et al. (2003), predators can successfully be deterred from depredating eggs of piping plovers by placing large (10-foot diameter) mesh exclosures (cages) over individual nests. Recruitment has improved with the use of these cages in the northern Great Plains (Murphy

USFWS

Piping Plover Chick

et al. 2003). Exclosures placed after one or more eggs have been laid in the nest bowl have resulted in less than 2-percent nest abandonment (Atkinson and Dood 2006).

Beginning in 1991, biologists throughout North America collaborated in a monumental effort known as the International Piping Plover Census (Haig and Plissner 1993). Breeding and wintering habitats are censused at 5-year intervals to (1) establish benchmark population levels for all known piping plover sites, (2) survey potential breeding and wintering sites, and (3) assess the current status of the species relative to past population estimates.

Piping Plover Objective 2

Over 15 years, improve and protect breeding, nesting, and feeding habitat on Piping Plover Pond at Bowdoin Refuge. Manage for gravel or alkaline beaches with no vegetation or vegetation that is short (less than 0.3 feet) and sparse (less than 10 percent cover), that are at least 65.6 feet wide, and that provide water for foraging throughout the breeding and brood-rearing season.

Strategies

- Monitor Piping Plover pond for encroachment of invasive plants, trees, and other tall vegetation. Maintain at least 90-percent bare gravel on nesting beaches.
- Apply herbicides, mechanical disturbance, or other means to remove upland vegetation before the breeding season or after plovers have left the area. Restrict control activities between May 15 and August 7 (Stewart 1975) or any time that piping plovers are present on the beaches.
- Acquire money to buy the water resources necessary to properly manage piping plover habitat at Bowdoin Refuge.
- Continue to work with Reclamation and other agencies to acquire additional knowledge and resources to improve and protect piping plover habitat on Piping Plover Pond at Bowdoin Refuge.
- Deliver water to Piping Plover Pond during the fall or spring, before the breeding season (refer to above Managed Wetlands section).

Rationale. In Montana, spring arrival of piping plovers usually occurs from late April through early May and departure is by late August (Lenard et al. 2003, Montana Piping Plover Recovery Committee 1997). Soon after spring arrival, male piping plovers begin establishing and defending territories that include a section of shoreline and an area of open ground (Whyte 1985).

Studies and observations of nesting habitat used by piping plovers indicate that the birds prefer a combination of suitable nesting substrate, lack of vegetative cover, existence of favorable water conditions, and availability of suitable forage habitat (Corn and Armbruster 1993, Licht 2001, Prindiville-Gaines and Ryan 1988, Root and Ryan 2004, Schwalbach 1988, Ziewitz et al. 1992). Sites with gravel substrate appear to provide the most suitable habitat and eggs there are more likely to hatch than those on alkali substrate (Prindiville-Gaines and Ryan 1988, Whyte 1985). Espie et al. (1996) found that, in Saskatchewan, depredated piping plover nests were generally closer to vegetation than successful nests. Prindiville-Gaines and Ryan (1988) found that breeding piping plovers chose territories with an average beach width of 82 feet, with optimal habitat characteristics of greater than 65.6 feet. Nesting sites studied by Schwalbach (1988) were found to be characteristically barren or with short (less than 0.3 feet) and sparse (less than 10-percent) vegetative cover.

7.6 Objectives that Support the Goals for Upland and Wetland Habitats

To meet the goals for both upland and wetland habitats, the Service would treat invasive and nonnative species, suppress wildfires, and carry out habitat protection and acquisition. All of these activities would directly affect the ability of the Bowdoin Refuge Complex to meet the goals for upland and wetland habitats.

Invasive and Nonnative Species

Invasive species, nonnative species, and noxious weeds are major threats to native upland and wetland ecosystems in the United States. Infestations of invasive species have a direct effect on the ability of the Bowdoin National Wildlife Refuge Complex to fulfill its wildlife conservation mission including species recovery, biological diversity, biological integrity, and natural functions.

Montana's noxious weed list contains 32 species and the Montana Department of Agriculture has categorized noxious weeds into four categories based on the invasion stage of each species:

- *Priority 1A*—weeds that are not yet found in Montana
- *Priority 1B*—weeds that have a limited presence in the State
- *Priority 2A*—weeds that are common in isolated areas of Montana
- *Priority 2B*—weeds that are abundant and widespread

The refuge complex does not have any priority 1A or 1B species. At Bowdoin Refuge, there is an infestation of perennial pepperweed, which is a priority 2A species. Most of the refuge complex's noxious weeds are in the priority 2B category: leafy spurge, spotted knapweed, Canada thistle, yellow toadflax, and saltcedar. In addition, the refuge complex has infestations of other nonnative, invasive species that, although they are not listed as noxious weeds by the State, may have negative effects on desirable refuge habitats: Russian olive, crested wheatgrass, reed canarygrass, Japanese brome, and *Phragmites*.

Some of the undesirable, nonnative species are within shelterbelts in the refuge complex. These shelterbelts were probably planted in the 1930s or 1940s for wildlife and around existing homesteads before the land was purchased by the Service; the shelterbelts consist mostly of Russian olive trees and caragana and cover about 8 acres.

Invasive and Nonnative Species Objective 1

Over 15 years, eradicate at least 25 acres of Russian olive trees and other nonnative trees and shrubs. Restore the sites to native herbaceous species that in 10 years postestablishment would comprise more than 60-percent native grasses and forbs throughout the refuge complex.

Strategies

- Map all treatment sites.
- Cut all standing trees and treat stumps with appropriate herbicide.
- As appropriate, use chemicals approved by the Service for aerial spraying to kill Russian olive trees.
- To remove woody material, use machinery to cut and shred the trees and bushes or pile and burn them.
- Remove vegetation that is impeding water delivery systems and boundary fences.
- Begin removing all shelterbelts to create more contiguous blocks of grassland habitat, and restore it to prevent invasive species from encroaching. Allow no additional shelterbelts.
- Monitor and diligently re-treat areas to prevent reinfestation.
- Restore bare areas resulting from the removal of Russian olive trees to native grass cover and monitor the results.
- Develop a program that provides information to the local community, partners, media, and other interested individuals or groups about the need to remove Russian olive trees to reduce the fragmentation of grassland habitat and to maintain the refuge canals used for managing wetlands.
- Collaborate with the Malta Irrigation District and Reclamation to treat Russian olive trees that occur along the Dodson South Canal, which is the major water delivery canal for Bowdoin Refuge.

Mike Artmann / USFWS

Nonnative Russian olive along Lakeside Canal in the Teal Pond area.

- Network with other agencies and refuges to stay current on effective treatment methods and to share equipment and resources.

- Map current infestations and actively monitor (at least every 3 years) these sites for new invasions. Immediately treat any new invasion to prevent expansion.

Rationale. Research indicates that native grassland birds need large, uninterrupted tracts of treeless grasslands (Bakker et al. 2002, Herkert 1994, Winter et al. 1999). Preventing the encroachment of woody vegetation into grassland systems contributes significantly to the recovery of grassland bird populations (Herkert 1994). The literature overwhelmingly indicates that planted and exotic trees in prairie landscapes often negatively affect a variety of birds (Bakker 2003). Specifically, trees on the prairie are correlated with negative consequences to ducks (Rumble and Flake 1983), other wetland birds (Naugle et al. 1999), prairie grouse (Hanowski et al. 2000, Niemuth 2000), grassland passerines (Grant et al. 2004, Winter et al. 2000), and ring-necked pheasants (Schmitz and Clark 1999, Snyder 1984). The effect of trees on the prairie landscape is greater than their "footprint," because they also affect the surrounding habitat. Many grassland birds avoid areas near trees, and bird abundance and nest success increases as distance to trees increases (Delisle and Savidge 1996, Gazda et al. 2002, Helzer 1996, Johnson and Temple 1990). For example, at one time there were nine active lek sites on Bowdoin Refuge. Today there are none. The Service speculates that this may be directly tied to the invasion of Russian olive trees and other nonnative woody vegetation into what was once contiguous grassland habitat. Research supports this theory, including numerous studies that determined sharp-tailed grouse leks were abandoned as tree cover increased, even as far away as 2 miles (Hanowski 2000). A study of active and inactive leks in Minnesota concluded that active sharp-tailed grouse leks had significantly lower proportions of upland forest and brush cover types and higher percentages of native grasses than inactive leks (Hanowski 2000). Gregg (1987) and Prose (1987) showed preferred lek sites by sharp-tailed grouse are characterized by low, sparse vegetation and that an excess of woody cover, within 2,625 feet of the lek site (well over half a mile), has a negative effect on the number of dancing males. Although Russian olive trees and other woody vegetation are often planted to benefit birds like grouse and pheasants, Kelsey et al. (2006) found that the detrimental effects of fragmenting grassland habitat, which reduces nesting success and increases predation, far outweighed any benefits to these species.

The Russian olive infestation on Bowdoin Refuge is so extensive that it can seem overwhelming (figure 43). After more than 30 years of unchecked growth and expansion, some areas such as the northwest corner of Big Island, Dry Lake Canal, and around Dry Lake Pond have become virtual Russian olive forests. The Russian olive stand on Big Island was chosen as the first target area because it is mostly native prairie, the infestation is relatively small (12 acres), and it is an "island" isolated from other areas making it unlikely to be reinvaded. A second target area is about 7 acres of trees around Piping Plover Pond. This wetland was enhanced to provide nesting habitat for piping plovers, and removing trees would benefit this threatened species. In addition to the two target areas, about 8 acres of shelterbelts in the refuge complex would be removed, and additional Russian olive removal would take place as needed.

By removing Russian olive trees, the positive effects on grassland-nesting birds in the native prairie can be substantial. For example, using a 328-foot (100-meter) buffer around groups of trees, the Service estimates that removing 12 acres of Russian olive trees on Big Island may actually improve at least 50 acres of prairie habitat for some grassland birds (figure 44). Improving nesting habitat for migratory birds through removal of Russian olive trees is necessary and required, by policy, to support and achieve the establishing purposes of the units within the refuge complex.

Combining treatments—such as mowing saplings, cutting trees, girdling, burning, grinding and chipping stands of small and possibly large trees, and chemical use—is the most effective means of controlling Russian olive because the effects are cumulative and would act on the plant at all life stages (Natural Resources Conservation Service 2002). Treatment would require funding, equipment, and staff for effective control and possible eradication of small infestations. Complete eradication of Russian olive is often impractical; however, it is practical for small isolated stands where the cost of control and time investment is small (Natural Resources Conservation Service 2002).

The proposed removal of 75 acres of Russian olive trees over 15 years may seem like a small amount given the timeframe. However, the refuge staff believes anything more would be unrealistic for the following reasons:

- Removal of Russian olive trees on this scale is time- and labor-intensive. In the past, the lack of funding and staff has meant that removal has been sporadic and slow.

- Current treatment methods and available herbicides are inefficient. For example, trees on Bowdoin Refuge that the Service has cut and treated often resprout from the roots, so the same areas must be re-treated for up to 5 years in some cases for good control. Plants are generally produced from stratified seed, but plants can grow from stump sprouts, stem cuttings, and root pieces (Natural Resources Conservation Service 2002). (Note: Because the embryos of many tree and shrub seeds are immature when the seeds fall, the embryos require time in a moist, cool environment to develop to the point where they can germinate—a process called stratification.)

- Cutting, grinding, and treating the trees is only the first step. If the Service is unable to use machinery to grind up the trees, the debris must be removed or gathered into piles and burned. This often involves heavy equipment that can disturb the surrounding grassland. To prevent invasive plant infestation, the entire area would have to be reseeded to native herbaceous vegetation. Revegetation should be done with the objective of providing plants that are well adapted and that can suppress the spread and growth of Russian olive (Natural Resources Conservation Service 2002). Continued monitoring and treatment of these areas would take many years.

- Russian olive trees on private land surround Bowdoin Refuge (figure 43). The Dodson South Canal (owned by Reclamation and maintained by the Malta Irrigation District), which delivers water to the refuge, is lined with Russian olive trees for miles. Even if every Russian olive tree on the refuge were removed, there would be a constant source of seeds from across the boundary fence and coming into the refuge with delivered water.

However, increased funding or staff, or improved treatment methods, could increase the amount of acres treated and restored over the life of the CCP. Russian olive is not listed as a noxious weed in Montana but is listed in several other western States; subsequently, the Federal, State, and local agencies in these States are becoming more active in controlling Russian olive. The Salt Cedar and Russian Olive Control Demonstration Act, passed in 2006, directed the Secretaries of the Interior, Agriculture, and Defense to establish a Federal program aimed at finding and carrying out the best means of controlling and eradicating Russian olive and saltcedar.

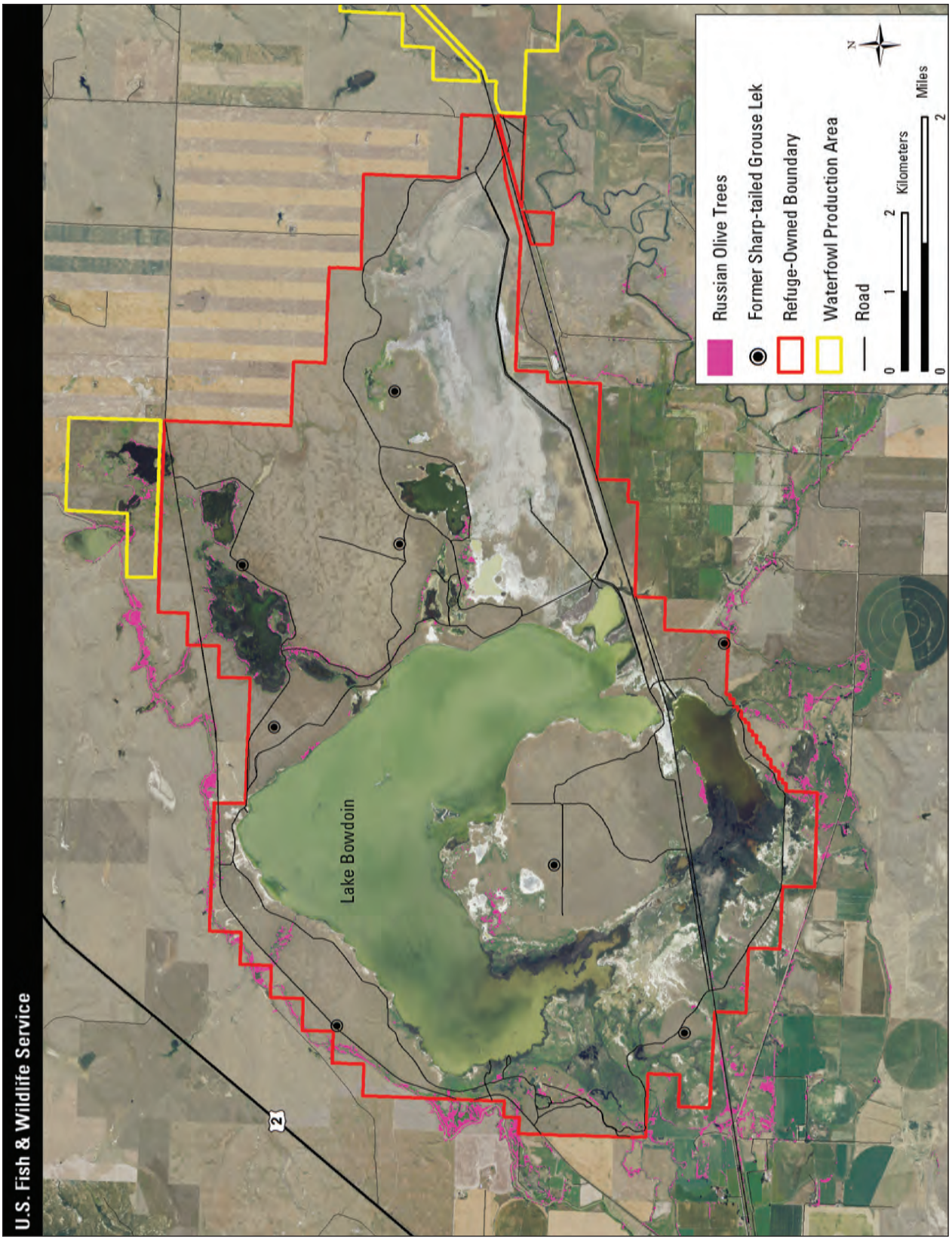


Figure 43. Map of Russian olive tree infestations in and around Bowdoin National Wildlife Refuge, Montana.

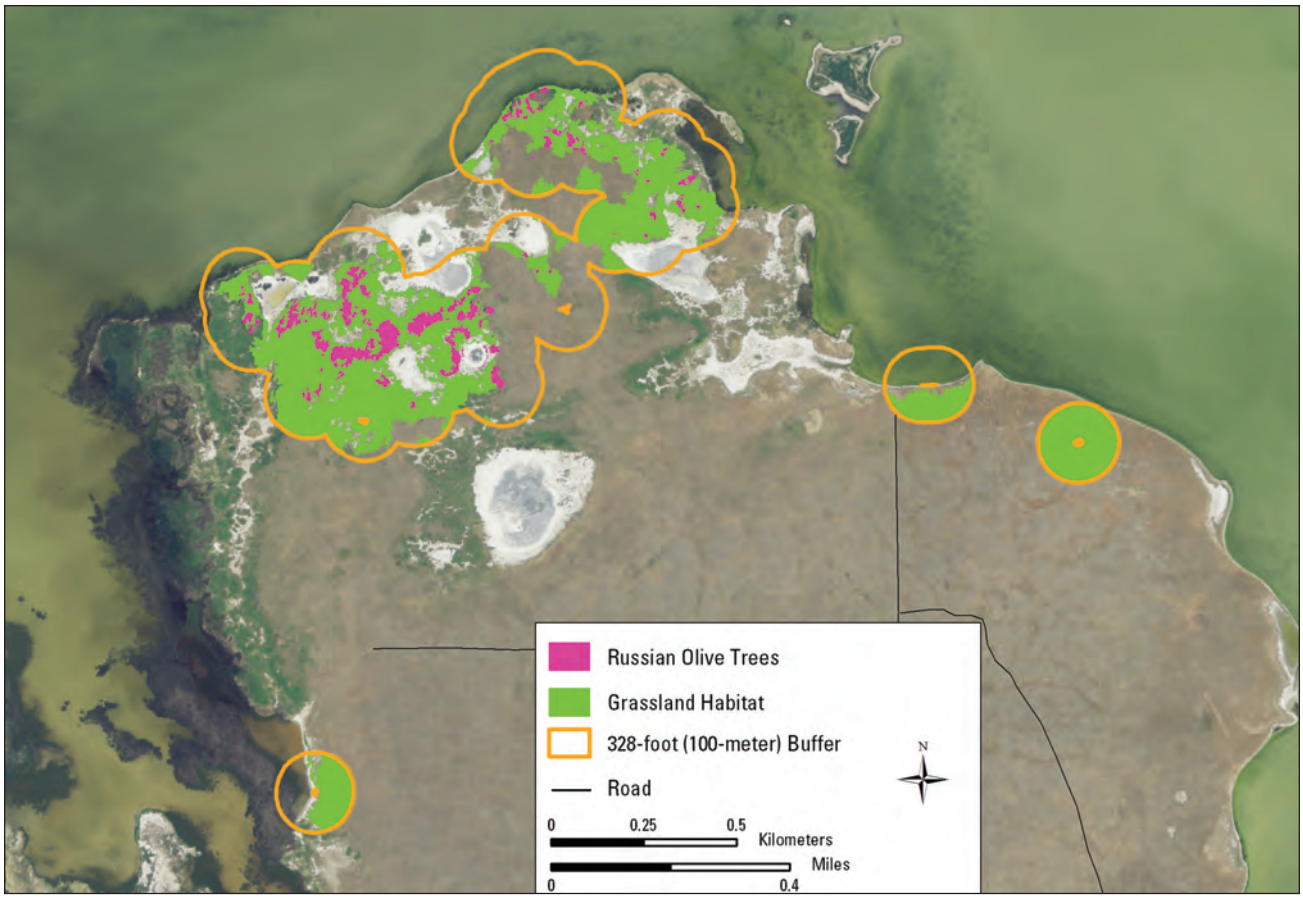


Figure 44. Map of Russian olive evaluation areas (Big Island) for grassland restoration at Bowdoin National Wildlife Refuge, Montana.

Invasive and Nonnative Species Objective 2

Within 2 years, establish a baseline inventory of all invasive plants including noxious weeds for Service lands. Eliminate small infestations of saltcedar, spotted knapweed, and yellow toadflax on Bowdoin National Wildlife Refuge Complex. Reduce leafy spurge, perennial pepperweed, reed canarygrass, Japanese brome, and *Phragmites* on the refuge complex by at least 50 percent (measured by canopy cover) over 15 years.

Strategies

- Write an integrated pest management plan within 2 years.
- Complete the baseline inventory with help from the Service's Invasive Species Strike Team.
- Using the Invasive Species Strike Team, Montana Conservation Corps, or refuge staff, repeat the inventory of all invasive plants including noxious weeds on Service lands every 5 years.
- Store all inventory data in the RLGIS (Refuge Lands Geographic Information System) database.
- Use integrated pest management to control invasive plants, and review literature for updated information on control techniques. Allow use of aerial applications of chemicals as outlined by the chemical label and Service policy for the use of aerial applicants.
- Coordinate the control of invasive plants by meeting and cooperating with county weed boards, irrigation districts, and other partners to share information and discuss control strategies.
- Map sites of invasive plant treatment each year in RLGIS.
- Monitor infestation rates and effectiveness of control efforts.
- Increase the Service's ability to control and monitor invasive plants by pursuing additional money through partnerships, grants, and invasive species' programs.

- Familiarize all staff with State-listed noxious weeds including staying current on potential new threats to Service lands.

- Map and store in RLGIS the invasive plant infestations noted by Service staff while conducting other work activities.

- Deploy early detection and rapid response strategies to attack newly found infestations before they become larger, causing harm and becoming more costly to treat.

Rationale. These problem plants can displace native vegetation over large areas, have the ability to form nearly monotypic stands in the absence of management, and, therefore, threaten native biodiversity (Bedunah 1992, Hutchison 1992, Svedarsky and Van Amburg 1996, Trammel and Butler 1995, Watson 1985). The control or elimination of invasive plants on Service lands would comply with State and Federal laws for invasive and noxious species.

Trying to manage an invasive plant infestation without any idea of the size, canopy cover, or rate of spread would jeopardize the efficiency of the control efforts and waste precious time and resources. An inventory would help prioritize the strategies for elimination of new and isolated infestations and containment or reduction of larger infestations.

Invasive and Nonnative Species Objective 3

Within 5 years, treat 20 acres of native grassland with varying degrees of crested wheatgrass infestation using a mix of treatments to determine effectiveness. Based on the results, add crested wheatgrass management to the integrated pest management plan.

Sheri Hagwood / Bureau of Land Management

Reed Canarygrass

Strategies

- Work with local universities to recruit graduate students to conduct research projects on controlling crested wheatgrass on the refuge complex.

- Within 2 years, ground-truth the vegetation map to verify the extent of the crested wheatgrass infestation on Bowdoin Refuge.

- Identify four 5-acre plots on Bowdoin Refuge that are in various stages of crested wheatgrass infestation, from initial invasion with individual plants making up less than 5 percent of the cover to where the cover is more than 50-percent crested wheatgrass. Using the best available science, apply to the plots and monitor effectiveness of a combination of treatments (such as wicking or spot spraying with herbicides, haying, prescriptive grazing, prescribed burning, and seeding of native grasses and forbs).

- Use the results of the plot treatments to develop a plan for management and reduction of crested wheatgrass across the entire refuge complex.

- Continue to work with other refuges, Grasslands National Park (Saskatchewan), University of Regina, and other agencies and organizations to apply adaptive management to control of crested wheatgrass as new data and treatment methods become available.

Rationale. Planted to stabilize soil on abandoned cropland during the drought of the 1920s and 1930s and as a hay and forage crop for cattle ever since, there are 15–26 million acres of crested wheatgrass on this continent today (Lesica and DeLuca 1996). Although it may be useful for agricultural purposes, rangeland dominated by crested wheatgrass has reduced value to wildlife, especially migratory birds, compared to native rangeland. Lloyd and Martin (2005) found that reproductive success of chestnut-collared longspurs was significantly lower in crested wheatgrass stands than in native prairie.

In addition to its negative effects on plant and wildlife diversity, crested wheatgrass can be detrimental to soil conditions by making it harder to get native seeds established, which can cause erosion and increase the chances of invasion by invasive plants (Ambrose and Wilson 2003, Jordan et al. 2008, McWilliams and Van Cleave 1960).

Researchers from the University of Regina and Grasslands National Park, both in Saskatchewan, Canada, have been conducting extensive research on crested wheatgrass infestations. They have also started studies of this species at Medicine Lake National Wildlife Refuge, east of Bowdoin Refuge Complex. Grasslands National Park is about 200 miles northeast of Bowdoin Refuge. The work of these Canadian researchers and that of other researchers suggests that a combination of treatments is necessary to control crested wheatgrass. Depending on whether the crested wheatgrass is invasive, planted, or a new infestation versus an old infestation, one site may need a different combination of treatments than another (Johnson 2004, Wilson 2000, Wilson and Gerry 1995, Wilson and Pärtel 2003). The Bowdoin Refuge staff has formed an informal working group with other refuges in Montana, Grasslands National Park, and the University of Regina to share resources and ideas for controlling crested wheatgrass.

Wildfire Management

The use of prescribed fire is a potential strategy for meeting several of the previous objectives for upland and wetland habitats. The following objective primarily addresses wildfire.

Wildfire Management Objective

Over the next 15 years, suppress all wildfires occurring within the refuge complex, maintaining an initial attack success rate of 95 percent or higher.

Strategies

- Conduct hazardous fuel treatments to reduce the threat of catastrophic wildfire to values at risk.
- Use BAER (Burned Area Emergency Response) or BAR (Burned Area Rehabilitation) monies as needed following wildfires.
- Within 1 year, complete the draft fire management plan and ensure it reflects the goals and objectives in the CCP.
- Have several refuge staff members maintain the necessary qualifications to conduct prescribed burns and to respond to wildfires.
- Require the fire management program for the refuge complex to continue following applicable laws, Department of the Interior and Service policies, and guidance established at national, regional, and local levels.

Rationale. The refuge complex is within the Service's Eastern Montana Fire Management District. Fire management staff and equipment may be used to respond to wildfire anywhere within the fire management district, using local refuge staff as well as other Federal and non-Federal partners to assist in wildfire suppression.

Treatment of hazardous fuel, thereby reducing the threat of catastrophic wildfire, is important to protect sensitive habitats and species, cultural resources, Federal and private infrastructure and facilities, and nearby local residences. Historically, wildfires had the ability to burn vast areas; with settlement, there is a high probability that wildfires on refuge complex lands would damage neighboring properties.

The community of Malta is identified as a "Community at Risk." Due to the small size of Service lands, the rapid rates of spread from grass fuel, and the potential for wildfire to cross onto adjacent lands, the Service has chosen to suppress all wildfires to reduce potential threats to neighboring private land.

Following a wildfire, BAER treatments are intended to protect public safety, to stabilize resources, and to prevent further degradation of natural and cultural resources. These treatments are considered emergencies and are done within 1 year of wildfire containment.

Mike Granger / USFWS

Prescribed fire can be an effective tool to manage grassland vegetation.

The BAR treatments are nonemergency efforts done within 3 years of wildfire containment. The treatments (1) would improve fire-damaged lands that are unlikely to recover to management-approved conditions and (2) would repair or replace minor facilities damaged by wildfire.

The use of BAER and BAR monies would follow national and regional policy and guidance. It is likely BAR money would be used the most within the refuge complex, including repairing or replacing fences damaged by wildfire and treating burned areas to prevent the spread of invasive plants.

Service policy requires that every Refuge System unit with burnable vegetation must have a fire management plan. The fire management plan is a stepdown plan from the CCP and provides specific guidance for how the fire management program will be carried out to meet national, regional, and refuge complex goals and objectives. An approved fire management plan allows the manager to consider a wide range of suppression alternatives and to conduct prescribed burns. Intended to be dynamic and reflect current policies and situations, the fire management plan is periodically reviewed or revised; required updates and revisions will follow national and regional policy and guidance.

To maintain the high initial attack success rate, it is important that refuge staff maintain and develop their qualifications to safely and effectively respond to wildfires and to use prescribed fire. In addition, local agreements between Federal and non-Federal partners would be maintained or pursued.

Appendix G further describes the fire management program for the refuge complex.

Habitat Protection and Acquisition

Habitat protection and acquisition would ensure the long-term protection of upland and wetland breeding habitat for waterfowl and other migratory birds. Conversion of grasslands to cropland has generated a need for upland habitat protection adjacent to wetlands. The Prairie Pothole Region probably once produced 15 million ducks each year but now produces about one-third that number, with drainage of wetlands the main reason for the difference (Belrose 1976). In addition, agriculture activities associated with annual crop production is the predominant factor affecting the landscape in the Prairie Pothole Region (Kantrud et al. 1989).

Native prairie grassland (upland) and wetland are the most productive habitat types in Montana, particularly in the Prairie Pothole Region. Although some laws protect these areas, which mostly occur on private lands, these vital habitats continue to be lost. The Service has committed to work with willing landowners in Montana to compensate them for protecting these habitats, primarily through perpetual grassland or wetland conservation easements. As of 2009, willing landowners have been compensated for protecting more than 50,000 acres of grassland and wetland habitat in the refuge complex.

Habitat protection needs evaluation through a priority system to identify critical areas and the most effective means of protection—through either fee title or easement. Conservation easements have several advantages over outright purchase of lands by the Service. First, easements are more cost-effective both in terms of initial purchase and in long-term management responsibilities. While easement contracts require attentive enforcement to ensure habitat protection, they do not carry the other burdens of ownership such as maintenance of facilities, fences, and signs; control of noxious weeds; and mowing of roadside ditches. Second, the landowner still owns and manages the land that has a conservation easement. The Service developed the conservation easement program to protect natural resources on the landscape while minimally affecting normal farm and ranch operations.

Upland Habitat

Livestock grazing is the primary land use in the Prairie Pothole Region of north-central Montana, where large tracts of contiguous grassland (more than 4,940 acres) remain, and where populations of nest predators such as red fox and raccoon are sparse and the coyote is the dominant predator (Ball 1995). The loss of upland-nesting cover and plant foods has reduced the value and productivity of associated wetlands for nesting waterfowl and their broods and other migratory birds and wildlife. This makes the Bowdoin National Wildlife Refuge Complex uniquely important for the continued conservation of habitat that remains intact and valuable for migrating and breeding waterfowl and other migratory birds.

Grassland conservation easements are perpetual and protect both existing and restored grasslands from being cultivated. Additional purposes of the grassland easement program are (1) to improve and protect the water quality of wetlands, (2) to maintain upland-nesting habitat for ground-nesting birds, (3) to protect highly erodible soils, and (4) to provide an alternative to the purchase of uplands in fee title by leaving land in private ownership. Grassland conservation easements are real property interests that the Service buys from willing landowners. These easements prohibit any alteration of permanent grassland cover including cropland conversion or

Mike Artmann / USFWS

The sharp-tailed grouse is a year-round resident on the Bowdoin Refuge.

development and haying or mowing until after July 15 (when most upland nesting by ducks is over). Provisions under grassland conservation easements do not prohibit or regulate livestock grazing.

Funding for grassland conservation easements comes from a variety of sources including Migratory Bird Hunting and Conservation Stamp Act (with Governor approval), North American Wetland Conservation Act grants, and Land and Water Conservation Funds. Thirty-three grassland easements have been purchased in the Bowdoin Refuge Complex, covering 39,767 acres. Through effective enforcement, these easement lands continue to provide important waterfowl breeding habitat in Montana.

In addition, the refuge complex administers four perpetual FmHA conservation easements. The Consolidated Farm and Rural Development Act of 1985 authorized the establishment of easements for conservation, recreation, and wildlife purposes on properties that were foreclosed on by the Federal Government ("inventories" properties), and the Service was designated manager of those easements worthy of inclusion into the National Wildlife Refuge System.

Wetland Habitat

Glacially created wetlands in the Prairie Pothole Region, in combination with the surrounding grasslands, provide breeding habitat that supports half of the continent's waterfowl production (Kantrud 1983). More than a million acres of potholes in the prairie States were drained between 1943 and 1961 (Briggs 1964). By the late 1950s, the loss of important waterfowl habitat was apparent. These two significant factors led to conservation movements by citizens and pressure from waterfowl hunting interests to reverse the loss of wetland habitat.

In response to this pressure, the Service sold Duck Stamps to fund a program of wetland acquisition and for purchase of wetland conservation easements (van der Valk 1989), waterfowl production areas, and national wildlife refuges. The Migratory Bird Hunting and Conservation Stamp Act, passed in 1934 and commonly known as the Duck Stamp Act, requires the purchase of a Federal hunting stamp by all waterfowl hunters ages 16 and over. Receipts from the sale of the stamps are used for the acquisition of migratory bird refuges under the provisions of the Migratory Bird Treaty Act. Waterfowl production areas and wetland conservation easements are purchased from willing sellers through the Small Wetlands Acquisition Program (authorized by Congress in 1958 by an amendment to the Migratory Bird Hunting and Conservation Stamp Act) to ensure long-term protection of breeding habitat for

migratory birds, primarily within the Prairie Pothole Region of the United States.

The Bowdoin Wetland Management District—comprised of waterfowl production areas and conservation easements—was established in 1973 under the authority of the Migratory Bird Hunting and Conservation Stamp Act to reduce waterfowl habitat loss in north-central Montana.

- The district's first waterfowl production area was purchased on April 19, 1977, in Blaine County. The Service manages these fee-title areas to provide breeding waterfowl with quality wetlands for courtship and brood rearing, as well as suitable grasslands for nesting. The Bowdoin Wetland Management District has nine waterfowl production areas totaling 9,504 acres.

- The first wetland conservation easement was purchased on April 14, 1977, in Phillips County. To date, 125 wetland easements have been purchased within the refuge complex, covering 10,635 wetland acres. Wetland conservation easements are perpetual and prohibit the filling, leveling, draining, or burning of wetlands under easement. These easements are real-property interests that the Service buys from willing landowners and are permanent fixtures to land titles. The land remains in private ownership and the landowner controls public access. Through effective enforcement of easement provisions, the lands under easement provide important waterfowl breeding habitat.

Habitat Protection and Acquisition Objective 1

Over the next 15 years, protect at least 900 acres of depressional wetlands and 16,000 acres of grasslands on private land within the refuge complex through the purchase of perpetual conservation easements or fee title from willing sellers.

Strategies

- Work with HAPET to develop a waterfowl-pair density map for the counties within the wetland management district.

- Implement the conceptual waterfowl habitat model developed by HAPET to identify and prioritize areas for protection with conservation easements.

- Focus the protection of wetlands with conservation easements in areas where the Service is also protecting priority grasslands.

Dave Menke / USFWS

The northern shoveler is one of the duck species that nests in upland habitats.

- Use mass mailings and public meetings to provide prospective sellers with information about the conservation easement program.

- Continue to piggyback on the Partners for Fish and Wildlife Program as a way to inform prospective sellers of the conservation easement program.

- Buy additional waterfowl production areas including "round-outs" and inholdings from willing sellers.

- Use the Service's strong partnership with Ducks Unlimited and other conservation organizations to generate other funding sources to buy easements or receive transferred lands.

- Use funding from the North American Wetland Conservation Act and other grants to buy easements.

Rationale. If the Service has a constant acquisition budget over the next 15 years, at least 16,000 acres of grassland and 900 acres of wetland can be protected through acquisition of conservation easements (Danielle Kepford, realty specialist, U.S. Fish and Wildlife Service, Lewistown, Montana; personal communication, 2008). The amount of additional acres protected in fee title would be negligible. Priorities for acquisitions would be set based on HAPET's conceptual waterfowl habitat model, as described below (USFWS 2007):

> *"The Service's Partners for Fish and Wildlife Program (PFW) in Montana completed a strategic planning process to identify con-*

servation focus areas in 2007 … The process identifies priority species and guilds for conservation and uses available data and models to focus conservation in the best habitat on the landscape. Waterfowl were identified as a priority group for the glaciated plains portion or prairie pothole region of Montana. A conceptual waterfowl habitat model was developed by the FWS Region 6 Habitat [Assessment] *and Population* [Evaluation] *Team office (HAPET) to identify and prioritize waterfowl habitat within the glaciated plains of Montana. Currently, an empirical model for waterfowl in the state does not exist. The conceptual model is based on the two primary components of waterfowl habitat, upland nesting cover, and wetlands.*

Extensive research has focused on how ducks settle on the breeding grounds. A correlation between the number of wetlands and number of breeding ducks at different scales is well known (Crissey 1969, Dzubin 1969, Stewart and Kantrud 1974, Johnson and Grier 1988, Batt et al. 1989, Cowardin and Blohm 1992). The PFW waterfowl habitat model used FWS National Wetland Inventory delineated wetlands and the public land section survey geographical information system (GIS) layers to identify areas with the highest wetland densities per square mile [figure 45]. *Wetland densities were categorized using levels identified by the HAPET office and allow the landscape to be divided into discrete groups for conservation prioritization. The categories include wetland densities of 1–3, 4–10, 11–25 and more than 25 per mi^2.*

Landscape characteristics surrounding wetland basins may also influence how breeding ducks use those basins. Krapu et al. (1997) found a negative effect of cropland on number of breeding pairs when temporary and seasonal pond area increased in 50.8 km^2 [12,553-acre] *plots. Reynolds et al. (2007) found that duck pairs selected wetlands differently when embedded in cropland, grazed land, and undisturbed grass cover. Reynolds et al. (2001) found that nest survival was positively related to grassland cover within a 10.4 km^2* [2,570-acre] *area site. The PFW conceptual waterfowl model used GIS modeling techniques with the statewide landcover layer developed by the Montana Gap Analysis Program to identify areas on the landscape with the highest density of undisturbed nesting cover (e.g., grassland). The upland nesting GIS layer consisted of 90m × 90m pixels and used a moving window analysis to identify areas on the landscape with the highest density of grassland* [figure 46]. *A moving window incorporating an area of 4 square miles was used to approximate the home range size of a breeding mallard hen. Grassland density categories include 0–10%, 10–40%, 40–80% and 80–100% grassland cover within the four square mile window. The final model combined the priority wetland density layer and the grassland density layer to identify areas on the landscape with high wetland and grassland densities* [figure 47]. *Future revision of the model will include updated landcover and wetland layers until an empirical model can be developed."*

Habitat Protection and Acquisition Objective 2

Over 15 years, use active monitoring and law enforcement to protect all refuge, flowage, FmHA, wetland, and grassland areas under Service easement, according to the provisions of the easement contracts and agreements.

Strategies

- Following the guidelines contained in the "Administrative and Enforcement Procedures for U.S. Fish and Wildlife Service Easements within the Prairie Pothole States" (known as the easement manual) and other enforcement procedures, conduct annual surveillance flights to detect potential conservation easement violations and promptly follow up with needed enforcement action.

- Send letters to new landowners informing them of existing conservation easements on their property and associated easement provisions.

- Review FmHA easements to ensure all wetland provisions are enforced.

Rationale. With an annual precipitation of less than 13 inches, the retention of water on the land to support the primary land use of grazing is more desirable to landowners than drainage. Counties within Bowdoin Wetland Management District have between 20 percent and 30 percent of the land base designated as cropland (cereal grains or hay) or prior cropland, for example, as part of the Conservation Reserve Program. Annual surveillance of wetland conservation easements is necessary not only in croplands where water is drained from fields

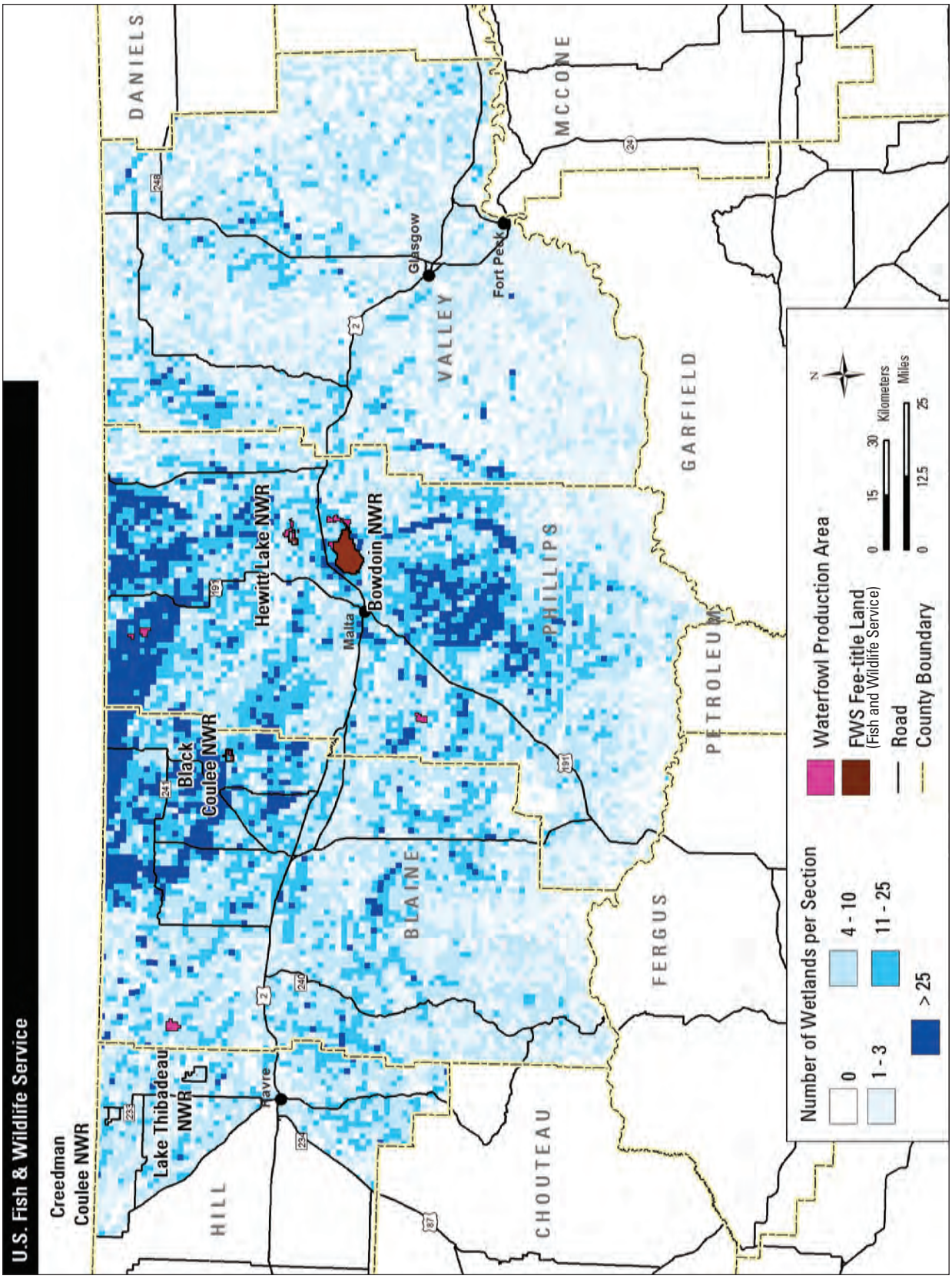


Figure 45. Map of wetland density per square mile in Bowdoin National Wildlife Refuge Complex, Montana.

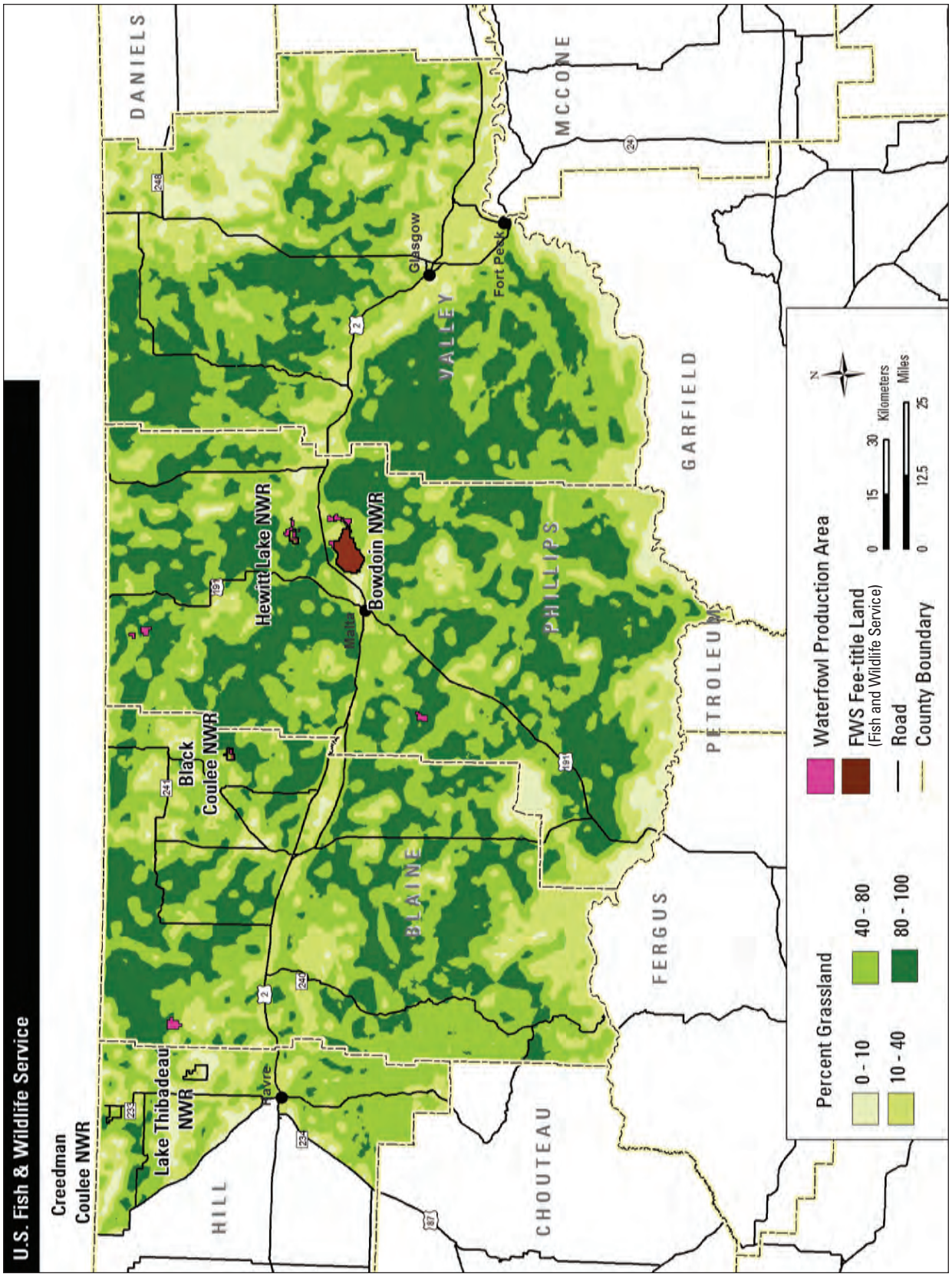


Figure 46. Map of grassland density in Bowdoin National Wildlife Refuge Complex, Montana.

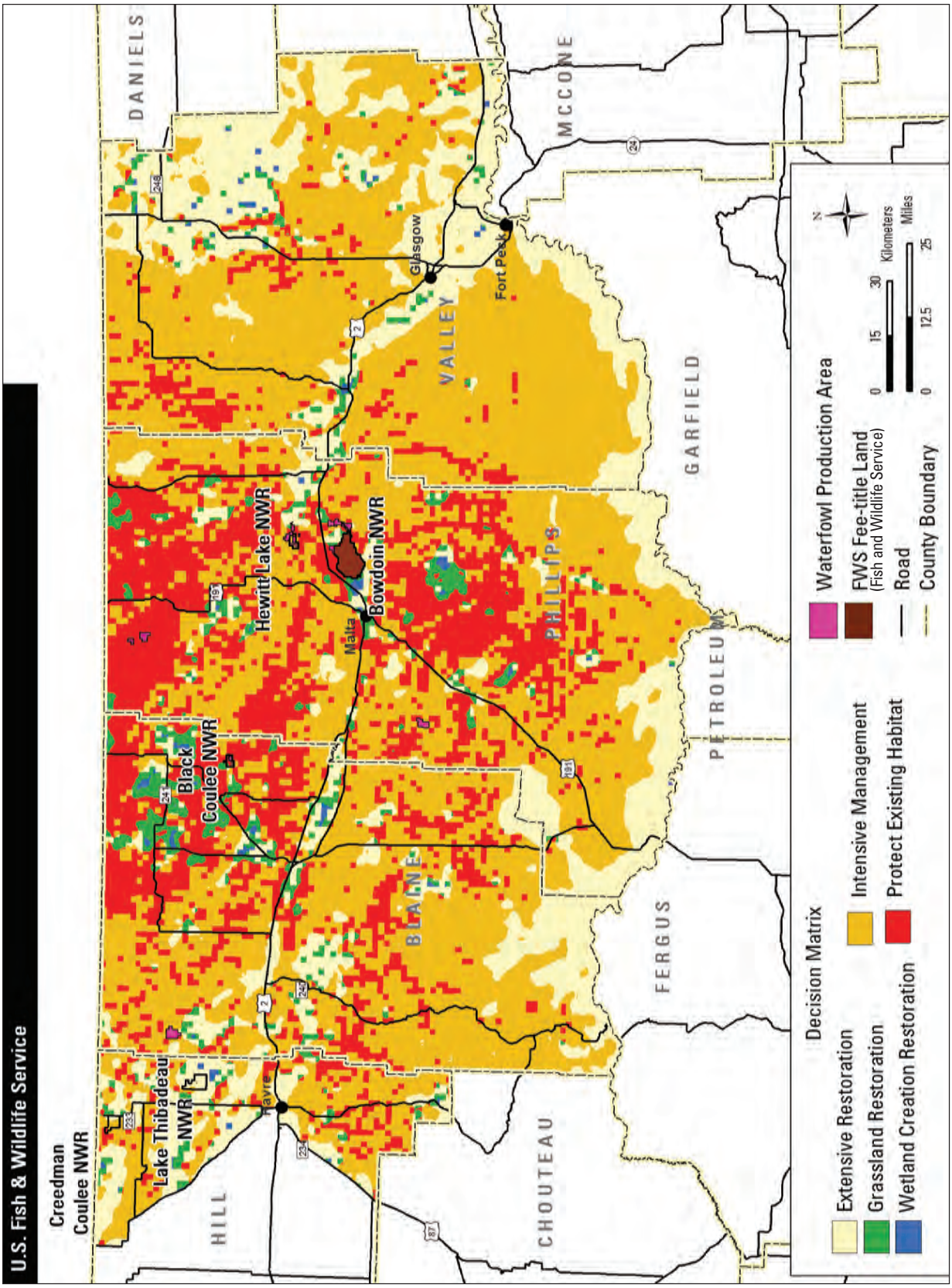


Figure 47. Map of areas with high densities of wetlands and grasslands for use as a decision matrix to determine protection priorities in Bowdoin National Wildlife Refuge Complex, Montana.

for greater crop production, but in rangelands where wetlands are drained to consolidate water into larger basins for livestock watering.

Since most of the grassland conservation easements protect native prairie, the major enforcement concern is conversion to cropland. While violations involving the conversion of native prairie to cropland are extremely rare, full restoration of native prairie in these situations is impossible. Nevertheless, landowners could plant grass in areas they had plowed, which would help them regain compliance with the easement provisions. Enforcement that ensures compliance would be essential to the protection of these habitats. Any haying, mowing, or harvesting seed before July 15 would be in violation of easement provisions and could cause direct losses to waterfowl and other grassland-nesting birds. While the cutting of hay on native prairie is not common, it is more likely to occur on grassland easements with tamegrass seeding such as those in the Conservation Reserve Program. Enforcement of haying restrictions would afford another opportunity to meet and visit with landowners and operators. These contacts may serve to remind landowners and operators of the easement provisions and hopefully prevent more serious violations in the future, which would achieve the goal of voluntary compliance.

7.7 Goal for Visitor Services and Cultural Resources

Provide visitors of all abilities with wildlife-dependent recreation, interpretation, and education opportunities that fosters an appreciation and understanding of the unique wildlife, plant communities, and cultural resources of the Montana Prairie Pothole Region.

Visitor Services

The Bowdoin National Wildlife Refuge Complex manages nearly 85,000 acres of lands and waters, some of which are open for wildlife-dependent and compatible public use (appendix D contains draft compatibility determinations for public uses associated with this draft CCP). Because the refuge complex is spread over four counties, it is impossible for Service staff to meet and interact with each visitor that comes to enjoy the habitats, fish, and wildlife found on the refuge complex. There are brochures, signage, and interpretive panels that visitors can use to independently explore and learn about the refuge complex; nevertheless, there are still visitors who are even unaware that they are on a national wildlife refuge.

Additional programs, staff, and funding would be needed for a broad-based program that reached the maximum number of visitors to achieve the proposed goal. Current staff might be able to provide some of the additional opportunities proposed in these objectives and strategies but not without sacrificing the ability to conduct other visitor, biological, or maintenance programs. Meeting the visitor services objectives would be contingent on hiring one permanent full-time visitor services specialist, one permanent full-time maintenance worker, and one permanent full-time law enforcement officer.

Hunting Objective

Continue to provide hunters with safe, reasonable harvest opportunities with uncrowded conditions, minimal conflicts with other users, and satisfaction with their overall experiences.

Strategies

- Continue to provide compatible hunting opportunities for waterfowl and upland game birds on 40 percent (western portion) of Bowdoin Refuge (figure 28 in chapter 4), according to State and Federal regulations.
- Continue to require hunters to use approved nontoxic shot for hunting of migratory and upland game birds on Service lands.
- Continue to permit compatible hunting opportunities for upland game birds in the waterfowl sanctuary portion of Bowdoin Refuge (figure 28 in chapter 4) as late-season hunting (no sooner than December 1), contingent on waterfowl migrating off the refuge when the wetlands freeze. Restrict the first 2 days of this hunt to hunting only by young people.
- Continue the hunter registry at Bowdoin National Wildlife Refuge and expand the form to include extra columns that would allow hunters to describe their hunting experience and satisfaction.
- Consider conducting limited-draw hunts to address overcrowding if hunter satisfaction decreases.
- Conduct random surveys on the wetland management district to determine hunter satisfaction.

- Evaluate future acquisitions for new hunting opportunities.
- Create a public use brochure for Bowdoin Wetland Management District.
- Continue to maintain the accessible boardwalk and hunting blind at the Pearce WPA for hunters with disabilities.
- Post changes in hunting regulations, seasons, and bag limits at the hunter kiosk and Bowdoin Refuge headquarters, on the refuge complex's Web site, and through news releases.
- Update the hunting regulation sections of the public use brochures as needed.
- Use the refuge signage and brochures to provide hunters with information on hunting regulations and where to hunt on the refuge complex to ensure compliance with public use regulations.
- Recruit one permanent, full-time, law enforcement officer.
- Continue to allow the public, including hunters, to park in designated parking areas on the north end and southeast boundaries of Bowdoin Refuge and to walk through the refuge to access Pearce WPA to the north and Beaver Creek WPA to the east (figure 28 in chapter 4).
- Improve public access to compatible, wildlife-dependent activities on Black Coulee National Wildlife Refuge by developing the entrance road and parking for the reservoir.
- Close the eastern portion of Bowdoin Refuge to all foot traffic from the beginning of the waterfowl hunting season through at least November 30, or until waterfowl have left the refuge, to provide continued sanctuary. Although the auto tour route would remain open through this portion of the refuge, require visitors to remain on the tour route outside of the hunting areas.
- Work with the State to determine the feasibility of providing a limited big game archery hunt on portions of Bowdoin Refuge that are currently open to public use. Address the compatibility of the hunt and the safety of hunters and other refuge visitors.

Rationale. Many people consider hunting to be a legitimate, traditional, recreational use of renewable natural resources. The National Wildlife Refuge System Act of 1966, other laws, and Fish and Wildlife Service policy permit hunting on a national wildlife refuge when it is compatible with the purposes for which the refuge was established and acquired. National wildlife refuges exist primarily to safeguard wildlife populations through habitat preservation. The word "refuge" includes the idea of providing a haven of safety for wildlife, and as such, hunting might seem an inconsistent use of the National Wildlife Refuge System. However, habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource.

As practiced on Bowdoin National Wildlife Refuge Complex, hunting does not pose a threat to the wildlife populations, and in some instances, is necessary for sound wildlife management. Harvesting wildlife on the refuge complex is carefully regulated to ensure equilibrium between population levels and wildlife habitat. All lands within the Bowdoin Wetland Management District are open to some form of hunting with the exception of Holm WPA. Closing the eastern half of Bowdoin Refuge to foot traffic during the waterfowl season would provide additional protection and rest for waterbirds and may actually improve hunting on other portions of the refuge. The western portion (40 percent of the refuge) is open to compatible hunting of waterfowl and upland game birds in accordance with State and Federal hunting regulations. The waterfowl sanctuary portion of the refuge (60 percent) is only open to late-season hunting (December 1–31) of upland game birds, contingent on when waterfowl migrate

Mike Artmann / USFWS

Black Coulee Pond is one of several ponds that are overgrown with cattail.

off the refuge due to the freezing of refuge wetlands. These hunting seasons are monitored and enforced to ensure regulations are followed and the provide hunters with a safe, quality experience.

The refuge complex currently has one wildlife refuge specialist with a minimum of 25 percent of their duties committed to collateral law enforcement patrols and enforcement. The wildlife refuge specialist's remaining responsibility is managing the wetland management district: 158 grassland and wetland conservation easements, 1 flowage easement, 4 FmHA easements, 9 waterfowl production areas, and 4 satellite refuges with 29 associated refuge and flowage easements. This individual is also responsible for conducting law enforcement activities across the refuge complex. Expansion of hunting and other visitor services programs would be contingent on the ability to recruit one, permanent, full-time law enforcement officer to protect refuge resources and provide the public with a safe experience.

Fishing Objective

Following State and Federal regulations, continue to allow compatible recreational fishing on Beaver Creek and McNeil Slough WPAs.

Strategies

- Continue to require visitors to follow State and Federal regulations for fishing on designated areas within the refuge complex.
- Include information on fishing locations and regulations in the new brochure for the waterfowl production areas.
- Continue to provide anglers information about other fishing opportunities on areas surrounding the refuge complex.

Rationale. Fishing is considered by many to be a legitimate, traditional, recreational use of renewable natural resources. The National Wildlife Refuge System Act of 1966, other laws, and Fish and Wildlife Service policy permit fishing when it is compatible with the purposes for which the refuge or district was established and acquired. Compatible recreational fishing opportunities are available at McNeil Slough WPA (primarily on the Milk River) and Beaver Creek WPA (primarily on Beaver Creek). The remainder of the wetlands within the district have minimal habitat or do not support harvestable game fisheries or populations.

Anglers have many exceptional fishing opportunities within 100 miles of Bowdoin Wetland Management District including fishing at the Nelson Reservoir, Cole Ponds, Milk River, Missouri River, Fort Peck Lake, and stocked ponds and reservoirs on public and private lands (Montana's Missouri River Country 2007).

Environmental Education and Interpretation Objective 1

Continue and expand environmental education programs and activities for adults and students on and off the refuge complex, focusing on the native prairie and wetland habitats and the natural, cultural, and historical resources of the Bowdoin National Wildlife Refuge Complex. Design these programs and activities to develop awareness of and promote advocacy for refuge resources and management activities for more than 500 visitors and students annually.

Strategies

- Recruit one permanent, full-time, visitor services specialist.
- Develop additional education kits specific to refuge programs and resources including field exploration kits (for example, backpacks with field equipment) and field activity pages.
- Develop a series of environmental outreach programs with specific themes (such as prairie and wetland conservation and grassland birds) that can be used for on- and off-refuge programs.
- Maintain and update a list of available environmental education kits and lending library materials for teachers.
- Every 5 years, facilitate a workshop for local teachers.
- Participate annually in at least two community events where the opportunity is available to educate the public about the refuge complex and its resources.
- Provide onsite programs for at least six school groups, or 300 students, on the refuge complex per year.
- Provide at least three onsite staff-led group programs on the refuge complex per year.
- Conduct at least 10 offsite visits to local schools within the wetland management district or with other groups or organizations to present infor-

mation on the history, purposes, and natural resources of the refuge complex.

- Host events for International Migratory Bird Day and National Wildlife Refuge Week.
- Pursue opportunities to expose middle school, high school, and college students to the field of natural resource management.
- Work with partners to develop programs to introduce young people to safe, effective, and ethical hunting techniques and methods.
- Develop programs for introducing young people to the enjoyment of the outdoors and instilling ethical, safe, and effective skills for observation, identification, and photography of wildlife.
- Work with schools and teachers within the wetland management district to develop programs that support their curriculum objectives.
- Pursue grants and other funding sources to support environmental education programs.

Rationale. Environmental education is a process designed to teach citizens and visitors, children and adults, the history and importance of conservation and scientific knowledge about the Nation's natural resources. Through this process, the Service can help develop a citizenry that has the awareness, knowledge, attitudes, skills, motivation, and commitment to work cooperatively toward the conservation of environmental resources. Environmental education within the Refuge System incorporates onsite, offsite, and distance-learning materials, activities, programs, and products that address the audience's course of study, refuge purposes, physical attributes, ecosystem dynamics, conservation strategies, and the Refuge System mission.

Highly structured programs do not have the same effect as allowing students to explore on their own. Programs must not be so rigid so that children cannot learn by using their own imaginations and senses and yet achieve a balance that ensures the student learns something new and exciting about the resources they encounter.

Environmental education is among the six compatible, wildlife-dependent recreational uses identified in the Improvement Act. Due to limited staff and resources, the Bowdoin National Wildlife Refuge Complex has been conducting minimal environmental education activities, typically only by invitation from local schoolteachers. Since today's children are tomorrow's land stewards, it is essential to help them become aware of the natural world around them and what they can do to help protect and restore it.

Environmental Education and Interpretation Objective 2

Provide additional interpretive opportunities for the public that focus on native prairie and wetland habitats, the refuge complex's purposes, and natural, cultural, and historical resources. Design these opportunities to promote awareness of and advocacy

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Lake Bowdoin in the distance.

for the National Wildlife Refuge System and the refuge complex's resources, management challenges, and programs.

Strategies

- Recruit one permanent, full-time, visitor services specialist.
- Design and install interpretive panels at the accessible wildlife observation stop (number 5) along the auto tour route.
- Work with the city of Malta to install an informational kiosk in town that provides refuge information and directional maps.
- Develop a display at the Phillips County museum highlighting the history of the refuge complex.
- Expand the visitor contact area at refuge headquarters into the conference room and add additional interpretive literature and activities.
- Develop a portable refuge-specific display that can be used for programs and events.
- Engage partners and challenge cost-share opportunities (such as the local film school) to develop a short refuge film for the refuge Web site and other outreach activities.
- Install interpretive panels describing the uses of prescribed fire, grazing, and haying.
- Install informational kiosks at the Beaver Creek and McNeil Slough WPAs to interpret wetland management in these areas.
- Expand the visitor contact area, providing access to visitors of all abilities. Use this additional space for improved interpretive displays and more materials.

Rationale. Interpretation is the identification and communication of important messages about natural and cultural resources to diverse audiences. Interpretation is designed to reveal relationships about the nature, origin, and purpose of a resource, landscape, or site in a way that forges connections between the interests of the audience and meanings inherent in the resource (National Association for Interpretation (no date). As a resource management tool, interpretation is designed to develop understanding—through understanding, appreciation—and through appreciation, protection (National Park Service 2009).

Interpretation is one of the six compatible, wildlife-dependent, recreational uses identified in the Improvement Act. Due to limited staff and resources, the Bowdoin National Wildlife Refuge Complex has been conducting minimal interpretation activities. It is essential to help the public become aware of the natural world around them and what they can do to help protect and restore it.

Wildlife Observation and Photography Objective

Provide increased opportunities for wildlife observation and photography that enhance the visitor experience and encourages an appreciation and connection to the northern prairie.

Strategies

- Recruit one permanent, full-time, visitor services specialist.
- Maintain year-round opportunities for wildlife observation and photography along the existing auto tour route on Bowdoin Refuge including the accessible nature trails. Develop an accessible wildlife observation site with spotting scopes and an expanded parking area at stop number 5 along the auto tour route (figure 28 in chapter 4).
- Maintain the refuge complex's two accessible photography blinds at Bowdoin Refuge and Pearce WPA.
- Install a remote camera for observing grouse lek activities.
- Provide regularly scheduled wildlife observation tours.
- Update the Bowdoin Refuge brochures for known mammal, reptile, and amphibian species.
- Notify the local media of opportunities to view migrating birds, particularly unique species.
- Close the east end of Bowdoin Refuge to all foot traffic at the start of the waterfowl-hunting season (at least through November 30) or until waterfowl depart the refuge, to provide sanctuary areas for migratory waterfowl and shorebirds (figure 28 in chapter 4). Keep the auto tour route open but require visitors to remain on the auto tour route in designated sanctuary areas.
- Encourage visitors to provide their observations and experiences at the end of a visit through

contacts in the visitor contact area and during random field encounters, requesting they provide feedback in the brochures and through the refuge complex's Web site.

Rationale. Most visitors that come to the Bowdoin National Wildlife Refuge Complex are here to view and photograph wildlife and scenery—more than 25,000 visitors each year. Wildlife observation and photography are among the six, wildlife-dependent, recreational uses that have been found compatible on the refuge complex. Wildlife observation often serves as the foundation for an individual's environmental ethics. This happens when people begin to appreciate and care about the wildlife they are able to enjoy and experience firsthand; they take this appreciation and awareness back to their own communities and backyards.

The proposed enhancements to the photography and wildlife-viewing areas within the refuge complex would not only enhance the visitor's experience and opportunity to view and photograph wildlife but also provide a connection to the area's unique habitat and wildlife. This connection may result in a greater understanding and appreciation of the refuge complex and the important grassland and wetland habitat protected within its boundaries.

These uses have the potential to negatively affect resources, particularly use by visitors who are permitted to explore the refuge complex on foot. Studies have shown that individuals or groups walking disturb wildlife, particularly waterfowl, even more than vehicles. To minimize some of these effects at the most popular area for wildlife viewing—Bowdoin Refuge—the east end of the refuge would be closed to foot traffic during the waterfowl-hunting season. This would provide an undisturbed resting area for waterfowl and other waterbirds until hunting season ends around November 30. Visitors could still view these birds from the auto tour route but would need to remain in their vehicles in designated sanctuary areas.

Cultural Resources

The refuge complex has some historical structures, including a few dams and spillways. In addition, there are remnants of prehistoric use—tipi rings have been found throughout the refuge complex.

Cultural Resources Objective 1

Through partnerships, continue to develop a comprehensive cultural resource inventory of the refuge complex and preserve and protect all known cultural resources while ensuring future activities comply with section 106 of the National Historic Preservation Act.

Carmen Luna / USFWS

Petroglyph

Strategies

- Work with the Service's zone archaeologist and contractors, local tribes, and universities to continue developing the cultural resources inventory.
- Document all cultural resource sites found during refuge activities.
- Work with archaeological staffs of the Service and the State Historic Preservation Office to ensure refuge complex activities comply with section 106 of the National Historic Preservation Act.

Rationale

Ideally, a comprehensive inventory would help ensure the protection of cultural resources. Throughout the life of this 15-year plan, the refuge complex staff would work with partners and the regional archaeologist and staff to begin documenting cultural sites.

Federal laws and policies mandate the identification and protection of cultural resources on Federal lands. Section 106 of the National Historic Preservation Act requires Federal agencies to consider the effects on cultural resources before conducting any Federal action. Without a complete inventory, the refuge complex's identification of all cultural resources is likely incomplete. Nevertheless, the law requires all Federal activities that have the potential to impact cultural resources be evaluated. Until the inventory is completed, the staff would continue to work with the regional archaeologist to evaluate projects with the potential to have impacts, on a case-by-case basis.

Cultural Resources Objective 2

Improve public awareness and appreciation for the cultural resources and history of the refuge complex and the northern prairies while creating a greater understanding of this history's connection to the natural resources of the area.

Strategies

- Work with the city of Malta to install an informational kiosk in the community that provides information on the cultural resources of the area and the history of the refuge complex.
- Include cultural resource interpretation in the expanded visitor contact area.

Rationale. Cultural resources interpretation communicates important messages about the area's history, context, and resources to diverse audiences. Refuge complex lands have a rich history of Native American and Euro-American presence. Historical structures include the stone pillars at the entrance into Bowdoin Refuge, which were built by workers in the Works Progress Administration.

As a resource management tool, interpretation is designed to develop understanding; through understanding, appreciation; and through appreciation, protection (National Park Service 2009). Working with the city of Malta to interpret these resources and create a display in the city would generate additional interest and understanding of these resources while encouraging people to visit the refuge to learn more.

7.8 Goal for Partnerships

Maintain and expand partnerships that preserve, restore, and enhance healthy and productive prairie/wetland complexes on Bowdoin National Wildlife Refuge and the wetland management district.

Public, Government, and Industry Partners

Partnerships are vital to achieving the Service's mission. Present and future conservation activities conducted on Service lands and conservation easements have the potential to positively influence adjoining landowners and surrounding communities.

Partnership Objective 1

Continue to participate in and expand partnerships that contribute to the understanding and conservation, restoration, and enhancement of diverse, healthy, productive grassland and wetland systems and the goals of the National Wildlife Refuge System.

Strategies

- Develop a Friends group to support the refuge complex's goals and programs.
- Continue to support the Partners for Fish and Wildlife Program work on private lands.
- Continue working with Montana Fish, Wildlife & Parks to conduct habitat improvement projects in areas open to hunting.
- Work with other Federal land managers to determine if their infrastructure and management actions could be used to enhance the refuge complex's wetland system.
- Cooperate with the weed boards within the four counties covering the refuge complex.
- Continue to cooperate with neighboring communities, counties, landowners, and nongovernmental organizations to accomplish projects of mutual interest.
- Coordinate with universities to develop an ongoing program of graduate projects that could be used to research and resolve refuge management issues.
- Continue expanding partnerships with the counties to improve roads that provide public access to the refuge complex.

Rationale. Regular communication with partners, various groups, communities, and individuals through meetings, local events, and activities would not only help garner support for refuge management activities and the National Wildlife Refuge System, but also allow managers to hear and understand their concerns. This open dialog and involvement with partners would help build and maintain support for the refuge complex's programs. Furthermore, many of the Bowdoin National Wildlife Refuge Complex's wildlife, habitat, and public use programs and habitat projects could not continue without the funding and support from partners.

Partnership Objective 2

Following current and future Service policy, work with energy developers—who are exploring and extracting reserved and excepted mineral rights on conservation easements and fee-title lands—to reduce impacts by ensuring that disturbance and physical occupancy is kept at the minimum space compatible with efficient mineral operations.

Strategies

- Work with energy developers who hold mineral leases below Service lands to encourage on- and offsite habitat improvements in exchange for disturbances caused by their exploration and development activities.
- Evaluate future land acquisitions to determine the status of reserved and excepted oil, gas, and mineral rights to evaluate the potential impacts of energy development on wetland habitat.
- Use time, place, and manner stipulations to minimize impacts to habitats and associated wildlife (FWS Oil and Gas handbook and 50 CFR 29.32).
- Ensure compliance of permitted mineral exploration and extraction activities with section 106 of the National Historic Protection Act of 1966, as amended.
- According to the Endangered Species Act, complete a section 7 evaluation for permitted mineral and extraction activities on lands that have the potential to support threatened and endangered species.
- Where appropriate, use 43 CFR 3101.5 (Issuance of Leases, National Wildlife Refuge System Lands) to manage Federal minerals below Service-owned land. Work with Bureau of Land Management resource specialists to include stipulations on Federal permits to protect wildlife and habitat.

Rationale. Energy exploration and development on Service lands can occur when the minerals rights have been either severed from the surface title or retained by the United States Government. In the case of severed minerals on Service land, a prior owner of both surface and mineral rights, sold or granted by deed the mineral rights underlying his or her property. The landowner may have reserved or retained all or a portion of the mineral rights as part of the sale of the property to the Service. One of the rights included in the mineral estate is the implied right of the mineral estate owner (Alspach 1989) to use as much of the surface as reasonably necessary to explore for and produce minerals (*Placid Oil Co.* v. *Lee*, 243 S.W.2d 860; Tex. App. 1951). These activities are deemed reasonable if consistent with current practices of the industry. Without this right,

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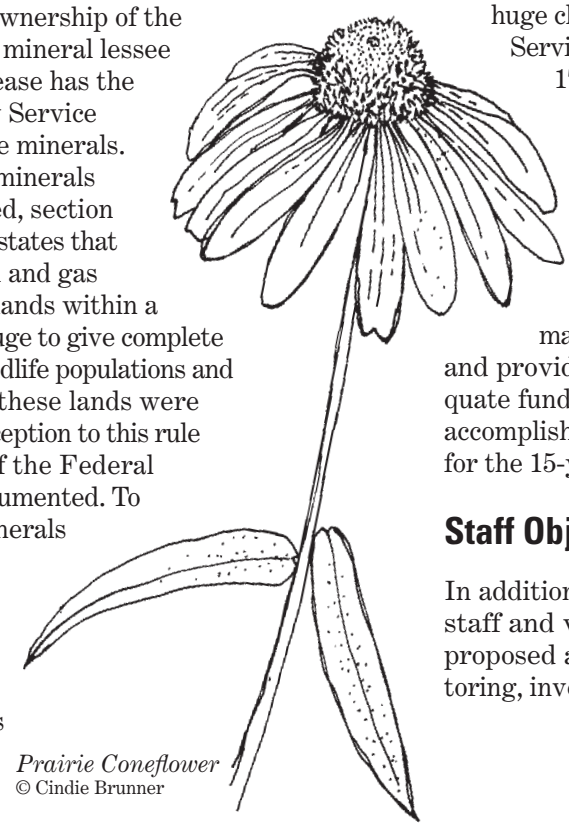
Glasswort plants are scattered on the salt-covered edge of southeastern Lake Bowdoin.

the reservation of minerals would be worthless to the grantee or reserver.

State laws overseeing the activities of exploration and production of minerals give some protection to the surface owner, because both parties must agree on compensation for surface damages (State of Montana 2009). Federal law for mineral rights reserved and excepted on Service land requires persons holding mineral rights to the greatest extent practicable conduct operations in such a manner as to prevent damage, erosion, pollution or contamination to the lands, water, facilities and vegetation of the area (50 CFR 29.32). In addition, physical occupancy of the area must be kept to the minimum space compatible with the conduct of efficient mineral operations. The Mineral Leasing Act of 1920 is the Federal law that authorizes the leasing of mineral rights owned by the United States Government. These Federal minerals are leased under the authority of the Bureau of Land Management. Regulations pertaining to the leasing and extraction of Federal minerals are found in 43 CFR.

Conservation easement contracts and waterfowl production areas are purchased subject to all valid existing mineral rights. In these situations, mineral rights are the dominant estate, and the rights of the surface owner or easement contract are the servient estate. There are several instances in the refuge complex where the Service owns surface title over Federal minerals. In most of these cases, the Federal minerals were leased before the Service obtaining ownership of the surface estate. The mineral lessee as afforded in the lease has the authority to occupy Service land and extract the minerals. When the Federal minerals have not been leased, section 3101.5–1 of 43 CFR states that there shall be no oil and gas mineral leasing on lands within a national wildlife refuge to give complete protection to the wildlife populations and habitats for which these lands were established. The exception to this rule is when drainage of the Federal minerals can be documented. To protect Federal minerals from drainage the Bureau of Land Management requests leasing recommendations from the Service. As a rule, the Service recommends a stipulation of no surface occupancy be added to the lease. This protects the Service's surface rights but allows for the Federal mineral extraction from surfaces outside the boundaries of a refuge or waterfowl production area.



Prairie Coneflower
© Cindie Brunner

Regardless of the circumstances, the Service would work closely with the mineral producer and Bureau of Land Management specialists to impose reasonable restrictions or conditions required to minimize adverse effects to wildlife and habitat resources (42 CFR 3101.1–2). Stipulations used to protect the resource would address time, place, and manner of activities. Guidance for handling mineral exploration and development is found in the Mountain–Prairie Region's "Fish and Wildlife Service Handbook on Management of Oil and Gas Activities on Fish and Wildlife Service Lands" (U.S. Fish and Wildlife Service 2009a).

7.9 Goal for Operations

Prioritize for wildlife first and emphasize the protection of trust resources in the utilization of staff, funding, partnerships, and volunteer programs.

Staff

The staff of the Bowdoin Refuge Complex has a huge challenge in managing almost 85,000 acres of Service lands scattered throughout a four-county, 17,183-square-mile area. Current staff at the refuge consists of five permanent full-time employees. Table 18 shows the current staff and proposed additional staff required to fully implement the CCP. If all positions were funded, refuge staff would be able to carry out all aspects of this CCP, which would provide maximum benefit to wildlife, improve facilities, and provide for public use. Projects that have adequate funding and staffing would receive priority for accomplishment. Staffing and funding are requested for the 15-year life of this CCP.

Staff Objective

In addition to current employees, recruit additional staff and volunteers needed to fully carry out the proposed actions in this draft CCP including monitoring, inventory, and research.

Table 18. Current and proposed staff for Bowdoin National Wildlife Refuge Complex, Montana.

Program	*Current positions*	*Proposed changes*
Management	GS–485–12 refuge manager GS–485–09 wildlife refuge specialist	GS–485–13 refuge manager[1] GS–485–12 supervisory wildlife refuge specialist[2]
Biology	GS–486–11 wildlife biologist	GS–486–12 wildlife biologist[3] GS–404–8 biological science technician[1]
Administration	GS–303–07 administrative support assistant	GS–341–9 administrative officer[3] GS–326–5 office automation clerk[1]
Maintenance	WG–4749–08 maintenance worker	WG–4749–8 maintenance worker[1] WG–3502–5 laborer[1] (career seasonal)
Visitor services	None	GS–025–9 visitor service specialist[1] GS–025–9 law enforcement officer[1]

[1] *Added position.*
[2] *Reclassification of current GS–12 refuge manager position.*
[3] *Position upgrade.*

Strategies

- Retain the current refuge complex positions (permanent, full time): one GS–486–11 wildlife biologist, one GS–485–9 wildlife refuge specialist (wetland district manager and collateral law enforcement officer), and one WG–4749–08 maintenance worker.
- Recruit a permanent, full-time, GS–485–13 wildlife refuge manager to oversee implementation of the CCP and direct the actions of the proposed expanded staff.
- Convert the current GS–485–12 refuge manager position to a supervisory wildlife refuge specialist to function as the deputy refuge manager.
- Upgrade the current administrative support assistant to a GS–341–9 administrative officer.
- Recruit a permanent, full-time, GS–326–5 office automation clerk.
- Recruit a permanent, full-time, GS–025–9 visitor services specialist to design and carry out the proposed expanded public use programs.
- Upgrade the current GS–486–11 wildlife biologist position to a GS–486–12.
- Recruit a permanent, full-time, GS–404–8 biological science technician.
- Recruit a permanent, full-time, GS–025–9 law enforcement officer.
- Recruit an additional permanent, full-time WG–4749–8 maintenance worker.
- Recruit a permanent, seasonal, WG–3502–5 maintenance laborer to maintain and rehabilitate current and future refuge facilities and equipment.
- Increase outreach to recruit additional volunteers needed to carry out the proposed actions for the public use, maintenance, and biological programs.
- Recruit at least four temporary biological technicians annually.
- Retain at the refuge complex a biologist assigned to the Partners for Fish and Wildlife Program.
- Reinstate the Youth Conservation Corps program by hiring four youths and one GS–186–5 social services aid (temporary seasonal) to lead the program.
- Work with Montana universities to develop a volunteer program by providing college credits in exchange for volunteer work experience.

Rationale. The current staff of five, permanent, full-time employees lacks the time and expertise needed to fully implement the proposed habitat management and monitoring projects, facilities maintenance, and expanded public use programs. In addition, the current staffing level remains well below that prescribed by the minimum staffing model developed by the Service for all refuges (USFWS 2008c). The model recommends adding the

equivalent of 6.5 full-time positions—a maintenance worker, wildlife biologist, deputy refuge manager, visitor services specialist, law enforcement officer, wildlife refuge specialist, and a seasonal biological science technician.

Facilities and Equipment

The refuge complex staff is responsible for maintaining a vast system of lands, roads, trails, fences, signs, buildings, equipment, and other infrastructure necessary to manage habitat and public use programs.

The success of management operations throughout the refuge complex is dependent on having adequate facilities including offices, housing, and storage buildings. Additionally, the staff needs vehicles and various heavy equipment machines to conduct the work specified in the objectives and strategies.

Facilities and Equipment Objective 1

Maintain, expand, or enhance facilities, equipment, and supplies to support all biological, visitor services, and maintenance programs including accommodation of additional staff and volunteers and protection and storage of all needed equipment and vehicles.

Strategies

- Maintain equipment for operations and replace as money becomes available.
- Maintain the current buildings and refuge housing as needed, as well as other refuge complex facilities and infrastructure to achieve management objectives.
- Acquire five additional field vehicles and necessary field equipment for proposed staff.
- Replace outdated heavy equipment such as the road grader, scraper, farm tractor, and front-end loader.
- Acquire attachments for the farm tractor (for example, a farm disc, grapple fork, and mowers) for habitat management.
- Expand or enhance the refuge office facilities to accommodate the proposed additional staff.
- Construct a 10-bay parking storage facility for existing and future vehicles.
- Construct a four-bay cold-storage building to house additional heavy equipment.
- Expand the visitor contact area, making areas accessible to visitors with disabilities, and improve the interpretive displays and materials.
- Expand the bunkhouse to accommodate up to 8 individuals.
- Develop one campsite with a concrete pad, septic system, water, and electricity for a volunteer with a recreational vehicle.
- Maintain a separate ground water well for the two refuge complex residences.
- Convert the office, apartment, two houses, and shop buildings to a solar energy system.
- Acquire a mower and marsh master to manage vegetation in wet areas for control of undesirable plant species and to create open-water habitat.

Rationale. The current storage facilities are insufficient to store existing vehicles; most remain outside exposed to the harsh climates of this area. The refuge headquarters is sufficient for existing staff including seasonal employees but would need to be expanded when additional permanent staff was added. Although recently remodeled, the bunkhouse would still not be adequate to provide housing for all seasonal and volunteer staff. Availability of this housing would be critical to recruitment of seasonal staff, because rental housing is very limited in the surrounding rural communities.

Facilities and Equipment Objective 2

Identify the boundaries of all refuge complex units and fence the boundaries, as needed, using wildlife-friendly fence designs to prevent trespass cattle grazing. Adequately sign unit boundaries to identify Service lands and permissible public use and to better orient visitors.

Strategies

- Evaluate fences to determine the need to replace, remove, add, or repair the fences needed to prevent cattle trespass and provide wildlife friendly fencing.
- Work with the State to determine the important migratory paths for pronghorn through Bowdoin Refuge. Evaluate the need for fences in these areas and remove, modify, or replace them using

fencing standards that allow for wildlife passage while supporting the refuge's prescriptive grazing program.

- Acquire funding to replace dilapidated boundary fence, gates, and parking areas.
- Continue to work with the landowner on Hewitt Lake National Wildlife Refuge to exchange the fee-title lands needed to create a more manageable and enforceable boundary and bring awareness of the refuge boundary.
- Continue to maintain entrance signs on refuges with more than 40 percent of land within their boundaries in fee title.
- Continue to maintain entrance signs on all waterfowl production areas.
- Continue to work with the regional Division of Realty to acquire or exchange lands with willing sellers that would resolve issues related to trespass, boundary "round-outs," and boundaries that are difficult to post and maintain due to their odd shape or location.
- Appropriately identify waterfowl production areas within refuge boundaries.

Rationale. Most of Montana is considered open range, so according to State law the Service and other landowners must build a fence to keep cattle from grazing their lands. The existing fences are in good condition but need to be replaced with wildlife-friendly designs, including replacement of the bottom strand with smooth wire at least 18 inches off the ground. This would take considerable staff and resources to accomplish but is important to ensure refuge complex fences do not impede or harm migrating wildlife, particularly on Bowdoin Refuge, which is part of a migratory corridor for pronghorn. The refuge would work with the State to identify these corridors and evaluate the existing fences to determine whether they are needed for the prescriptive grazing program and how best to modify or replace them, as appropriate.

Overall, the refuge complex boundaries are well signed and visitors are oriented. Maintaining and replacing these signs is time-consuming but critical for protecting refuge habitats and preventing trespass. Bowdoin Refuge and Hewitt Lake Refuge have irregular boundaries that are difficult to sign or boundaries that are located across bodies of water. The refuge complex staff would continue to work with the regional Division of Realty and willing landowners to address these issues.

7.10 Stepdown Management Plans

The CCP is a broad umbrella plan that provides general concepts and specific objectives for habitat, wildlife, public use, cultural resources, partnerships, and operations over the next 15 years. The purpose of the stepdown management plans is to provide details to Service staff for carrying out specific actions and strategies authorized by the CCP. Table 19 lists the stepdown plans needed for the refuge complex, status, and next revision date.

Table 19. Stepdown management plans for Bowdoin National Wildlife Refuge Complex, Montana.

Plan	*Completed (year approved)*	*New or revision (completion year)*
Disease management	2006	2013
Fire management	2002	2012
Habitat management	—	2018
Hazard communication	2007	2012
Integrated pest management	2003	2014
Occupant emergency	2008	Annual
Refuge safety	2007	Annual
Sign	1984	—
Spill prevention	2007	2012
Upland management	1992	2018
Visitor services	2008	2018
Wetland management	—	2018
Wildlife management	—	2018

7.11 Research, Monitoring, and Evaluation

Appendix D contains the draft compatibility determination for research and monitoring. Furthermore, the Service proposes to most efficiently deal with the uncertainty surrounding habitat management with adaptive resource management (figure 48) (Holling 1978, Kendall 2001, Lancia et al. 1996, Walters and Holling 1990). This approach provides a framework within which objective decisions can be made and the uncertainty surrounding those decisions reduced. The key components of an adaptive resource management plan, such as this draft CCP and proposed stepdown plans, follow:

- Clearly defined management goals and objectives
- A set of management actions with associated uncertainty as to their outcomes
- A suite of models representing various alternative working hypotheses describing the response of species or communities of interest
- Monitoring and assessment of the response of target organisms
- Use of monitoring and assessment information to direct future decisionmaking through the selection of a best model

The first three components—goals, actions, and models—are largely defined before initiation of an adaptive resource management plan. The latter two components, monitoring and directed decisionmaking, compose a repetitive process whereby, each year, the predictive ability of models are tested against what was observed during monitoring. This may result in a new best model, greater support for the existing best model, or new models constructed from emerging hypotheses. In this way, management can evolve as more information about the refuge complex is gained and uncertainty is reduced.

Development of adaptive resource management plans for habitat management would allow the refuge complex staff to "learn by doing," while focusing on management objectives. Knowledge gained from assessing management actions is as integral to the process as the management actions themselves. This emphasis on gaining knowledge about the refuge complex creates a situation whereby the staff can refine its habitat management with feedback between management and assessment.

7.12 Plan Amendment and Revision

The Service will annually review the final CCP to determine the need for revision. A revision would occur if and when significant information became available such as a change in ecological conditions. Revisions to the CCP and the stepdown management plans would be subject to public review and compliance with the National Environmental Policy Act. At a minimum, the Service would evaluate the plan every 5 years and revise it after 15 years.

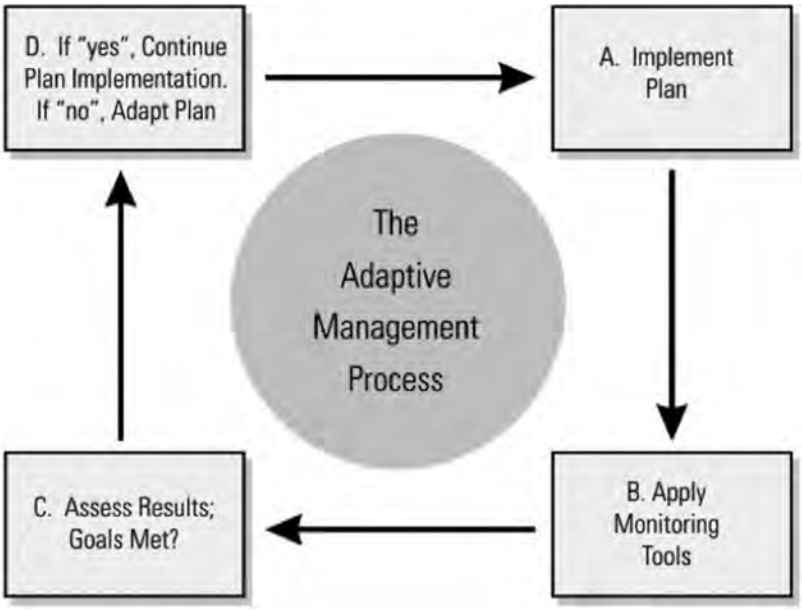


Figure 48. Adaptive management process.

Glossary

ac—Acre.

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

A.D.—Anno Domini, "in the year of the Lord."

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

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

amphibian—Class of cold-blooded vertebrates that includes frogs, toads, and salamanders.

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

BAER—Burned Area Emergency Response.

BAR—Burned Area Rehabilitation.

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

biological control—Organisms or viruses used to control invasive plants or other pests.

biological diversity, biodiversity—Variety of life and its processes including the variety of living organisms, the genetic differences among them, and the communities and ecosystems in which they occur ("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.

breeding habitat—Environment used by migratory birds or other animals during the breeding season.

canopy—Layer of foliage, generally the uppermost layer, in a vegetative stand; midlevel or understory vegetation in multilayered stands. Canopy closure (also canopy cover) is an estimate of the amount of overhead vegetative cover.

CCP—See comprehensive conservation plan.

CFR—See Code of Federal Regulations.

cfs—Cubic feet per second.

cm—Centimeter.

CO_2—Carbon dioxide.

Code of Federal Regulations (CFR)—Codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. Each volume of the CFR is updated once each calendar year.

Compact—Montana House Bill Number 717–Bill to Ratify Water Rights Compact.

Compact Commission—Montana Reserved Water Rights Compact Commission.

compatibility determination—See compatible use.

compatible use—Wildlife-dependent recreational use or any other use of a refuge or district that, in the sound professional judgment of the Director of the U.S. Fish and Wildlife Service, will not materially interfere with or detract from the fulfillment of the mission of the Refuge System or the purposes of the refuge or district ("Draft Fish and Wildlife Service Manual" 603 FW 3.6). A compatibility determination supports the selection of compatible uses and identified stipulations or limits necessary to ensure compatibility.

comprehensive conservation plan (CCP)—Document that describes the desired future conditions of the refuge or district and provides long-range guidance and management direction for the refuge manager to accomplish the purposes of the refuge or district, contribute to the mission of the Refuge System, and meet other relevant mandates ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

concern—See issue.

cool-season grass—Grass that begins growth earlier in the season and often becomes dormant in summer; grasses that germinate at lower tem-

peratures. Examples of cool-season grasses in the refuge complex are western wheatgrass, needle and thread, and green needlegrass.

conservation—Management of natural resources to prevent loss or waste; actions may include preservation, restoration, and enhancement.

conservation easement—Perpetual agreement entered into by a landowner and the Service by which a landowner gives up or sells one or more of the rights on their property for conservation purposes, with terms set by the Service. In return for a single lump-sum payment, the landowner agrees not to drain, burn, level, or fill habitats covered by the easement. Conservation easements generally prohibit the cultivation of grassland and wetland habitats while still permitting the landowner traditional grazing uses. A single-habitat conservation easement is often referred to as either a wetland easement or a grassland easement.

coordination area—Wildlife management area made available to a State by a "cooperative agreement between the United States Fish and Wildlife Service and the State fish and game agency pursuant to section 4 of the Fish and Wildlife Coordination Act (16 U.S.C. 664); or (B) by long-term leases or agreements pursuant to the Bankhead–Jones Farm Tenant Act (50 Stat. 525; 7 U.S.C. 1010 et seq.)." States manage coordination areas, but they are part of the Refuge System. CCPs are not required for coordination areas.

cover, cover type, canopy cover—Present vegetation of an area; also see canopy.

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

dense nesting cover (DNC)—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.

DEQ—Montana Department of Environmental Quality.

district—See wetland management district

district purpose—See purpose of the refuge.

disturbance—Significant alteration of habitat structure or composition from natural causes such as wildfire or human-caused activities and development such as timber harvest and road building.

DNC—See dense nesting cover.

DNRC—Montana Department of Natural Resources and Conservation.

drawdown—Manipulating the water level in an impoundment to allow for the natural drying-out cycle of a wetland.

duck, dabbling—Duck that mainly feeds on vegetable matter by upending on the water surface or by grazing and only rarely dives.

duck, diving—Duck that mainly feeds by diving through the water.

EA—See environmental assessment.

easement, flowage—Easement signed by the landowner granting the Service the right to maintain and operate an artificial lake or raise the water of a natural lake or stream—by means of dams, dikes, fills, ditches, spillways, and other structures—for water conservation, drought relief, migratory birds, and other wildlife conservation purposes.

easement, refuge—Easement signed by the landowner granting the Service the right to control hunting and trapping, to maintain a wildlife conservation demonstration unit, and to maintain a closed refuge and reservation for migratory birds and other wildlife.

EC—Electrical conductivity.

ecosystem—Dynamic and interrelating complex of plant and animal communities and their associated nonliving environment; a biological community, together with its environment, functioning as a unit. For administrative purposes, the U.S. Fish and Wildlife 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.

ecotype—Subspecies or race that is especially adapted to a particular set of environmental conditions.

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

endangered species, Federal—Plant or animal species listed under the Endangered Species Act of 1973, as amended, that is in danger of extinction throughout all or a significant portion of its range.

endangered species, State—Plant or animal species in danger of becoming extinct or extirpated in a particular State within the near future if factors contributing to its decline continue; species with a population at a critically low level or having habitat that has been degraded or depleted to a significant degree.

environmental assessment (EA)—Concise public document, prepared in compliance with the National Environmental Policy Act, that briefly discusses the purpose and need for an action and alternatives to such action and that 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—U.S. Environmental Protection Agency.

evapoconcentration—Concentration of chemical constituents in a liquid due to evaporative processes.

extinction—Complete disappearance of a species from the earth; no longer existing.

extirpation—Extinction of a population; eradication of a species within a specified area.

˚F—Temperature in degrees Fahrenheit.

fauna—Vertebrate and invertebrate animals in an area.

Federal trust resource—Resource 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 of America 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—Species where the Federal Government has primary jurisdiction including federally endangered or threatened species, migratory birds, anadromous fish, and certain marine mammals.

fee title—Acquisition of most or all of the rights to a tract of land.

Federal land—Public land owned by the Federal Government including lands such as national wildlife refuges, national forests, and national parks.

flora—Plant species in an area.

FmHA—Farmers Home Administration.

forb—Broad-leaved herbaceous plant; seed-producing annual, biennial, or perennial plant that does not develop persistent woody tissue but dies down at the end of the growing season.

fragmentation—Alteration of a large block of habitat that creates isolated patches of the original habitat interspersed with a variety of other habitat types; process of reducing the size and connectivity of habitat patches, making movement of individuals or genetic information between parcels difficult or impossible.

ft—Feet, length measure.

full-time equivalent—One or more job positions with tours of duty that, when combined, equate to one person employed for the standard Government work-year.

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

Geographic Information System (GIS)—Computer system capable of storing and manipulating spatial data; 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.

GLO—General Land Office.

glyphosate—Glyphosate N–(phosphonomethyl) glycine; broad-spectrum systemic herbicide used to kill invasive plants, especially perennials. Glyphosate inhibits an enzyme involved in the synthesis of the amino acids tyrosine, tryptophan, and phenylalanine; absorbed through foliage and translocated to growing points, it is only effective on actively growing plants and is not effective as a pre-emergence herbicide.

goal—Descriptive, open-ended, and often broad statement of desired future conditions that conveys a purpose but does not define measurable units ("Draft Fish and Wildlife Service Manual" 620 FW 1.5).

gpm—Gallons per minute, water flow.

grassland tract—Contiguous area of grassland that is unfragmented.

GPS—Global Positioning System.

GS—General schedule pay rate schedule for certain Federal positions.

habitat—Suite of existing environmental conditions required by an organism for survival and reproduction; place where an organism typically lives and grows.

habitat type, vegetation type, cover type—Land classification system based on the concept of distinct plant associations.

HAPET—Habitat Assessment and Population Evaluation Team.

hemimarsh—Emergent phase of a seasonal or semipermanent wetland where the ratio of open-water area to emergent vegetation cover is about 50:50 and vegetation and open-water areas are highly interspersed.

hydroperiod—Period of time during which soils, waterbodies, and sites are wet.

impoundment—Body of water created by collection and confinement within a series of levees or dikes, creating separate management units although not always independent of one another.

Improvement Act—National Wildlife Refuge System Improvement Act of 1997.

in—Inch.

indigenous—Originating or occurring naturally in a particular place.

integrated pest management—Methods of managing undesirable species such as invasive plants; education, prevention, physical or mechanical methods of control, biological control, responsible chemical use, and cultural methods.

"interseed"—Mechanical seeding of one or several plant species into existing stands of established vegetation.

introduced species—Species present in an area due to intentional or unintentional escape, release, dissemination, or placement into an ecosystem as a result of human activity.

invasive species—Species that is nonnative to the ecosystem under consideration and whose intro-

duction causes, or is likely to cause, economic or environmental harm or harm to human health.

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

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 ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

issue remark—An industry term in the State of Montana denoting official documentation of a problem with a water rights claim, such as an incorrect identification of the place of water diversion or use, an incorrect priority date, or a claim in excess of the amount of water historically put to beneficial use.

lek—An elevated patch of grassland used by male grouse to display and challenge one another to attract females; the elevation not only provides a clear view to interested female grouse, but it also enables the males to spot predators at a distance.

management alternative—See alternative.

management plan—Plan that guides future land management practices on a tract of land.

MBOGC—Montana Board of Oil and Gas Conservation.

mg/L—Milligrams per liter; measure of weight per volume, in this case, salts in water.

migration—Regular extensive, seasonal movements of animals between their breeding regions and wintering regions; to pass periodically from one region or climate to another for feeding or breeding.

migratory bird—Bird species that follows a seasonal movement from its breeding grounds to its wintering grounds; includes waterfowl, shorebirds, raptors, and songbirds.

mission—Succinct statement of purpose or reason for being.

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

mixed-grass prairie—Transition zone between tallgrass prairie and shortgrass prairie dominated by grasses of medium height that are about 2–4 feet tall; soils are not as rich as in the tallgrass prairie and moisture levels are less.

mmhos/cm—Millimhos per centimeter; measure of a solution's ability to conduct electricity, in this case, for salinity.

MOA—Memorandum of agreement.

monitoring—Collecting information to track changes of selected parameters over time.

MOU—Memorandum of understanding.

mS—MilliSiemens.

MSGWG—Montana Sage Grouse Working Group.

national wildlife refuge (NWR)—Designated area of land, water, or an interest in land or water within the National Wildlife Refuge System but does not include coordination areas; 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)—Set administrative policy for all refuges and units in the National Wildlife Refuge System; defined a unifying mission for the Refuge System; established the legitimacy and appropriateness of the six priority public uses (hunting, fishing, wildlife observation, photography, environmental education, and interpretation); established a formal process for determining appropriateness and compatibility; established the responsibilities of the Secretary of the Interior for managing and protecting the Refuge System; required a comprehensive conservation plan for each unit by the year 2012; amended portions of the Refuge Recreation Act and National Wildlife Refuge System Administration Act of 1966.

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

neotropical migrant, migratory bird—Bird species that breeds north of the United States and Mexican border and winters primarily south of this border.

NEPA—National Environmental Policy Act.

nest success—Chance that a nest will hatch at least one egg.

nongovernmental organization—Group that is not comprised of Federal, State, tribal, county, city, town, local, or other governmental entities.

North American Waterfowl Management Plan—Recognized that the recovery and perpetuation of waterfowl populations depends on restoring wetlands and associated ecosystems throughout the United States and Canada; established cooperative international efforts and joint ventures comprised of individuals, corporations, conserva-

tion organizations, and local, State, Provincial, and Federal agencies drawn together by common conservation objectives.

noxious weed—Plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture, irrigation, navigation, natural resources of the United States, public health, or the environment.

NRCS—Natural Resources Conservation Service.

NWR—See national wildlife refuge.

objective—Concise target statement of what will be achieved, how much will be achieved, when and where it will be achieved, and who is responsible for the work; derived from goals and provides the basis for determining management strategies; should be attainable, time-specific, and stated quantitatively to the extent possible (if cannot be stated quantitatively, may be stated qualitatively) ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

palustrine—Relating to a system of inland, nontidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water but grows above the surface); palustrine wetlands range from permanently saturated or flooded land to land that is wet only seasonally.

Partners in Flight program—Western Hemisphere program designed to conserve neotropical migratory birds and officially endorsed by numerous Federal and State agencies and nongovernmental organizations; also known as the Neotropical Migratory Bird Conservation Program.

partnership—Contract or agreement entered into by two or more individuals, groups of individuals, organizations, or agencies in which each agrees to furnish a part of the capital or some in-kind service such as labor for a mutually beneficial enterprise.

patch—Area distinct from that around it; distinguished from its surroundings by environmental conditions.

perennial—Lasting or active through the year or through many years; waterbody that retains water year-round; plant species that has a lifespan of more than 2 years.

planning team—Group of individuals that prepares the comprehensive conservation plan; interdisciplinary in membership and function; generally consists of a team leader, refuge manager, biologist, staff specialists or other representatives of Service programs, ecosystems or regional offices, and State or tribal partners' wildlife agencies as appropriate.

planning team leader—Professional planner or natural resource specialist knowledgeable of the requirements of National Environmental Policy Act and who has planning experience; manages the refuge planning process and ensures compliance with applicable regulatory and policy requirements.

planning unit—National wildlife refuge or wetland management district, or an ecologically or administratively related refuge complex, or a distinct unit of a refuge; may include lands outside refuge or district boundaries.

plant community—Assemblage of plant species unique in its composition that occurs in particular locations under particular influences; 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.

ppt—Parts per thousand.

preferred alternative—Alternative selected to becomes the final plan; it can be the proposed action, the no action alternative, another alternative, or a combination of actions and alternatives described in the draft CCP and environmental analysis document.

prescribed fire—Skillful application of fire to natural fuels under specified conditions such as weather, fuel moisture, and soil moisture that allows 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.

pristine—Typical of original conditions.

private land—Land owned by a private individual, a group of individuals, or a nongovernmental organization.

private landowner—Individual, group of individuals, or nongovernmental organization that owns land.

private organization—Nongovernmental organization.

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 or district's purposes; hunting, fishing, wildlife observation, photography, environmental education, and interpretation; also see wildlife-dependent recreational use.

proposed action—Alternative proposed to best achieve the purpose, vision, and goals of a refuge or district (contributes to the Refuge System mission, addresses the significant issues, and is consistent with principles of sound fish and wildlife management).

public—Individuals, organizations, and groups; officials of Federal, State, and local government agencies; Indian tribes; and foreign nations (may include anyone outside the core planning team); anyone 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 domain, reserved from—See reserved from public domain.

public involvement—Process that offers affected and interested individuals and organizations an opportunity to become informed about and to express their opinions on Service actions and policies; in the process, these views are studied thoroughly and thoughtful consideration is given to public views when shaping decisions for refuge and district management.

purpose of the refuge, district—Reason for establishment and management of a national wildlife refuge or wetland management district that is specified in or derived from the law, proclamation, Executive order, agreement, public land order, donation document, or administrative memorandum establishing authorization or expansion of a refuge, refuge unit, refuge subunit, or district ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

raptor—Carnivorous bird such as a hawk, falcon, or vulture that feeds wholly or chiefly on meat taken by hunting or on carrion (dead carcasses).

Reclamation—Bureau of Reclamation.

refuge—See national wildlife refuge.

Refuge Operations Needs System—National database that contains the unfunded operational needs of each refuge and district; projects included are those required to implement approved plans and meet goals, objectives, and legal mandates.

refuge purpose—See purpose of the refuge.

Refuge System—See National Wildlife Refuge System.

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

reserved from public domain—Public land placed into permanent reserved status, such as a national wildlife refuge, that is not held in private ownership.

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

rest—Free from biological, mechanical, or chemical manipulation in reference to Service lands.

restoration—Management emphasis designed to move ecosystems to desired conditions and processes such as healthy upland habitats and aquatic systems.

riparian area, habitat, corridor—Area that transitions from a terrestrial to aquatic ecosystem including streams, lakes, wet areas, and adjacent plant communities and their associated soils that have free water at or near the surface; land and its vegetation immediately adjoining and directly influenced by a stream.

RLGIS—Refuge Lands Geographic Information System.

"round-outs"—Odd shapes and holes of non-Federal land within the boundary of Refuge System units that are straightened, or made whole, by the purchase of land tracts.

runoff—Water from rain, melted snow, or agricultural or landscape irrigation that flows over the land surface into a waterbody.

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

sediment—Material deposited by water, wind, and glaciers.

senior water rights—Rights to water that were legally filed earlier than junior (more recent) water rights, having precedence.

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

Service Asset Maintenance Management System—National database that contains the unfunded maintenance needs of each refuge and district; projects include those required to maintain existing equipment and buildings and to correct safety deficiencies for the implementation of approved plans and to 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—Suborder of birds (Charadrii) such as a plover or snipe that frequents the seashore or mudflat areas.

spatial—Relating to, occupying, or having the character of space.

special use permit—Special authorization from the refuge manager for any service, facility, privilege, or product of the soil provided at the Service's 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—Species, while not falling under the definition of special status species, that is of management interest by virtue of being Federal trust species such as migratory birds, important game species, or significant keystone species; species that has a documented or apparent population decline, a small or restricted population, or dependence on restricted or vulnerable habitats.

stand—Homogenous area of vegetation with more or less uniform soils, landform, and vegetation.

stepdown management plan—Specific plan that provides the details necessary to carry out management strategies identified in the comprehensive conservation plan ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

strategy—Specific action, tool, or technique or combination of actions, tools, and techniques used to meet unit objectives ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

submergent—Vascular or nonvascular plant adapted to grow in water, either rooted or nonrooted, that lies entirely beneath the water surface except for flowering parts in some species.

TDS—Total dissolved solids (salts).

threatened species, Federal—Species listed under the Endangered Species Act of 1973, as amended, that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

threatened species, State—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.

trust resource—See Federal trust resource.

trust species—See Federal trust species.

µmhos/cm—Micromhos per centimeter; measure of a solution's ability to conduct electricity, in this case, for salinity.

µmhos/cm—Micromhos per centimeter; measure of a solution's ability to conduct electricity, in this case, for salinity.

ungulate—Hoofed mammal.

U.S.—United States.

µS/cm—MicroSiemens per centimeter; measure of a solution's ability to conduct electricity, in this case, for salinity.

U.S.C.—United States Code.

USDA—United States Department of Agriculture.

U.S. Fish and Wildlife Service (Service, FWS)—Part of U.S. Department of the Interior; 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 National Wildlife Refuge System comprised of national wildlife refuges and waterfowl production areas. The Service operates national fish hatcheries and ecological service field stations, 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, oversees the Federal aid program that distributes millions of dollars in excise taxes on fishing and hunting equipment to State wildlife agencies, and helps foreign Governments with their conservation efforts.

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

U.S. Geological Survey—Federal agency in the U.S. Department of the Interior whose mission is to provide reliable scientific information to describe and understand the earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.

ungulate—Hoofed mammal.

vision statement—Concise statement of the desired future condition of a planning unit, based primarily on the Refuge System mission, specific refuge or district purposes, and other relevant mandates ("Draft Fish and Wildlife Service Manual" 602 FW 1.5).

wading birds—Birds having long legs that enable them to wade in shallow water such as egret, great blue heron, black-crowned night-heron, and bittern.

waterbird—Birds dependent on aquatic habitats to complete portions of their life cycles.

waterfowl—Category of birds that groups ducks, geese, and swans.

watershed—Geographic area within which water drains into a particular river, stream, or waterbody.

wetland—Land transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

wetland management district—Land that the Refuge System acquires with Federal Duck Stamp money 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.

wildfire—Free-burning fire requiring a suppression response; all fire other than prescribed fire that occurs on wildlands.

wildland fire—Wildfire or prescribed fire that occurs in undeveloped land.

wildlife-dependent recreational use—Use of a refuge or district involving hunting, fishing, wildlife observation, photography, environmental education, or interpretation; also see priority public use.

wildlife management—Practice of manipulating wildlife populations either directly through regulating the numbers, ages, and sex ratios harvested or indirectly by providing favorable habitat conditions and alleviating limiting factors.

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

WPA—Waterfowl production area.

Appendix A

Key Legislation and Policy

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

A.1 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

- To fulfill our statutory duty to achieve refuge purpose(s) and further the Refuge System mission.
- Conserve, restore where appropriate, and enhance all species of fish, wildlife, and plants that are endangered or threatened with becoming endangered.
- Perpetuate migratory bird, interjurisdictional fish, and marine mammal populations.
- Conserve a diversity of fish, wildlife, and plants.
- Conserve and restore, where appropriate, representative ecosystems of the United States including the ecological processes characteristic of those ecosystems.
- To foster understanding and instill appreciation of fish, wildlife, and plants and their conservation, by providing the public with safe, quality, and compatible wildlife-dependent public use. Such use includes hunting, fishing, wildlife observation and photography, and environmental education and interpretation.

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 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.

A.2 Legal and Policy Guidance

Management actions on national wildlife refuges and wetland management districts are circumscribed by many mandates including laws and Executive orders. Regulations that affect refuge and district management the most are listed below.

American Indian Religious Freedom Act (1978)—Directed 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)—Prohibited discrimination in public accommodations and services.

Antiquities Act (1906)—Authorized 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)—Directed the preservation of historic and archaeological data in Federal construction projects.

Archaeological Resources Protection Act (1979), as amended—Protected 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)—Required federally owned, leased, or funded buildings and facilities to be accessible to persons with disabilities.

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

Dingell–Johnson Act (1950)—Authorized the Secretary of the Interior to provide financial assistance for State fish restoration and management plans and projects. Financed by excise taxes paid by manufacturers of rods, reels, and other fishing tackle. Known as the Federal Aid in Sport Fish Restoration Act.

Emergency Wetlands Resources Act (1986)—Promoted wetland conservation for the public benefit to help fulfill international obligations in various migratory bird treaties and conventions. Authorized the purchase of wetlands with Land and Water Conservation Fund monies.

Endangered Species Act (1973), as amended—Required all Federal agencies to carry out programs for the conservation of threatened and endangered species.

Environmental Education Act of 1990—Established the Office of Environmental Education within the Environmental Protection Agency to develop and administer a Federal environmental education program. Responsibilities of the office include developing and supporting programs to improve understanding of the natural and developed environment and the relationships between humans and their environment, supporting the dissemination of educational materials, developing and supporting training programs and environmental education seminars, managing a Federal grant program, and administering an environmental internship and fellowship program. Required the office to develop and support environmental programs in consultation with other Federal natural resource management agencies including the Service.

Executive Order 7295 (1936)—Established Bowdoin National Wildlife Refuge "as a refuge and breeding ground for migratory birds and other wildlife."

Executive Order 7713 (1937)—Established Lake Thibadeau National Wildlife Refuge "as a refuge and breeding ground for migratory birds and other wildlife."

Executive Order 7801 (1938)—Established Black Coulee National Wildlife Refuge "as a refuge and breeding ground for migratory birds and other wildlife."

Executive Order 7833 (1938)—Established Hewitt Lake National Wildlife Refuge "as a refuge and breeding ground for migratory birds and other wildlife."

Executive Order 8924 (1941)—Established Creedman Coulee National Wildlife Refuge "as a refuge and breeding ground for migratory birds and other wildlife."

Executive Order 11644, Use of Off-road Vehicles on Public Lands (1972)—Provided policy and procedures for regulating off-road vehicles.

Executive Order 11988, Floodplain Management (1977)—Required 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. Prevented Federal agencies from contributing to the "adverse impacts associated with occupancy and modification of floodplains" and the "direct or indirect support of floodplain development." In the course of fulfilling their respective authorities, Federal agencies "shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains."

Executive Order 11990, Protection of Wetlands (1977)—Directed Federal agencies to (1) minimize destruction, loss, or degradation of wetlands, and (2) preserve and enhance the natural and beneficial values of wetlands when a practical alternative exists.

Executive Order 12996, Management and General Public Use of the National Wildlife Refuge System (1996)—Defined the mission, purpose, and priority public uses of the Refuge System; presented four principles to guide management of the Refuge System.

Executive Order 13007, Indian Sacred Sites (1996)—Directed 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.

Executive Order 13443, Facilitation of Hunting Heritage and Wildlife Conservation (2007)—Directed Federal agencies that have programs and activities that have a measurable effect on public land management, outdoor recreation, and wildlife management, including the Department of the Interior and the Department of Agriculture, to facilitate the expansion and enhancement of hunting opportunities and the management of game species and their habitat.

Federal Noxious Weed Act (1990)—Required 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)—Required the preservation of evidence of the Government's organization, functions, policies, decisions, operations, and activities, as well as basic historical and other information.

Federal Water Pollution Control Act of 1972—Required any applicant for a Federal license or permit to conduct any activity that may result in a discharge into navigable waters to obtain a certification from the State in which the discharge originates or will originate, or, if appropriate, from the interstate water pollution control agency having jurisdiction over navigable waters at the point where the discharge originates or will originate, that the discharge will comply with applicable effluent limitations and water quality standards. Required that a certification obtained for construction of any facility must also pertain to subsequent operation of the facility.

Section 404: Authorized the Secretary of the Army, acting through the Chief of Engineers, to issue permits, after notice and opportunity for public hearing, for discharge of dredged or fill material into navigable waters of the United States, including wetlands, at specified disposal sites. Required selection of disposal sites be in accordance with guidelines developed by the Administrator of the Environmental Protection Agency in conjunction with the Secretary of the Army. Stated that the Administrator can prohibit or restrict use of any defined area as a disposal site whenever she or he determines, after notice and opportunity for public hearings, that discharge of such materials into such areas will have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, wildlife, or recreational areas.

Fish and Wildlife Act (1956)—Directed the Secretary of the Interior to develop the policies and procedures necessary for carrying out fish and wildlife laws and to research and report on fish and wildlife matters. Established the U.S. Fish and Wildlife Service within the Department of the Interior, as well as the positions of Assistant Secretary for Fish and Wildlife and Director of the Service.

Fish and Wildlife Coordination Act (1958)—Allowed the U.S. Fish and Wildlife Service to enter into agreements with private landowners for wildlife management purposes.

Fish and Wildlife Improvement Act of 1978—Improved the administration of fish and wildlife programs and amends several earlier laws including the Refuge Recreation Act, the National Wildlife Refuge System Administration Act, and the Fish and Wildlife Act of 1956. Authorized the Secretary to accept gifts and bequests of real and personal property on behalf of the United States. Authorized the use of volunteers for Service projects and appropriations to carry out volunteer programs.

Historic Sites, Buildings and Antiquities Act (1935), known as the Historic Sites Act, as amended (1965)—Declared a national policy to preserve historic sites and objects of national significance, including those located at refuges and districts. Provided procedures for designation, acquisition, administration, and protection of such sites and for designation of national historic and natural landmarks.

Land and Water Conservation Fund Act of 1965—Provided money from leasing bonuses, production royalties, and rental revenues for offshore oil, gas, and sulphur extraction to the Bureau of Land Management, the USDA Forest Service, the U.S. Fish and Wildlife Service, and State and local agencies for purchase of lands for parks, open space, and outdoor recreation.

Migratory Bird Conservation Act (1929)—Established 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)—Authorized the opening of part of a refuge to waterfowl hunting.

Migratory Bird Treaty Act (1918)—Designated the protection of migratory birds as a Federal responsibility and enabled the setting of seasons and other regulations including the closing of areas, Federal or non-Federal, to the hunting of migratory birds.

Mineral Leasing Act (1920), as amended—Authorized and governed leasing of public lands for development of deposits of coal, oil, gas and other hydrocarbons, sulphur, phosphate, potassium and sodium. Section 185 provided for granting of rights-of-way over Federal lands for pipelines.

National Environmental Policy Act (1969)—Required 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. Required Federal agencies to integrate this act with other planning requirements and prepare appropriate documents to facilitate better environmental decisionmaking (40 CFR 1500).

National Historic Preservation Act (1966), as amended—Established 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)—Defined the National Wildlife Refuge System and authorized 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—Set the mission and administrative policy for all refuges in the National Wildlife Refuge System. Mandated comprehensive conservation planning for all units of the Refuge System.

National Wildlife Refuge System Volunteer and Community Partnership Enhancement Act of 1998—Encouraged the use of volunteers to help the Service in the management of refuges within the Refuge System. Facilitated partnerships between the Refuge System and non-Federal entities to promote public awareness of the resources of the Refuge System and public participation in the conservation of those resources. Encouraged donations and other contributions by persons and organizations to the Refuge System.

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

North American Wetlands Conservation Act (1989)—Provided for the conservation of North American wetland ecosystems, waterfowl and other migratory birds, fish, and wildlife that depend on such habitats.

Pittman–Robertson Act (1937)—Taxed the purchase of ammunition and firearms and earmarks the proceeds to be distributed to the States for wildlife restoration. Known as the Federal Aid in Wildlife Restoration Act or P–R Act.

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

Refuge Revenue Sharing Act, *section 401* (1935)—Provided for payments to counties in lieu of taxes using revenues derived from the sale of products from refuges.

Refuge Trespass Act of June 28, 1906—Provided the first Federal protection for wildlife at national wildlife refuges. Made it unlawful to hunt, trap, capture, willfully disturb, or kill any bird or wild animal, or take or destroy the eggs of any such birds, on any lands of the United States set apart or reserved as refuges or breeding grounds for such birds or animals by any law, proclamation, or Executive order, except under rules and regulations of the Secretary. Protected Government property on such lands.

Rehabilitation Act (1973)—Required 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.

Salt Cedar and Russian Olive Control Demonstration Act (2006)—Furthered the purposes of the Reclamation Projects Authorization and Adjustment Act of 1992 by directing the Secretary of the Interior, acting through the Commissioner of Reclamation, to carry out an assessment and demonstration program to control saltcedar and Russian olive, and for other purposes.

Transfer of Certain Real Property for Wildlife Conservation Purposes Act of 1948—Provided that, on determination by the Administrator of the General Services Administration, real property no longer needed by a Federal agency can be transferred without reimbursement to the Secretary of the Interior if the land has particular value for migratory birds or to a State agency for other wildlife conservation purposes.

U.S. Department of the Interior Order Number 3226 (2001)—Directed bureaus and offices of the Department to analyze the potential effects on climate change when undertaking long-range planning, setting priorities for scientific research, and making major decisions about use of resources.

Volunteer and Community Partnership Enhancement Act (1998)—Encouraged the use of volunteers to help in the management of refuges within the Refuge System. Facilitated partnerships between the Refuge System and non-Federal entities to promote public awareness of the resources of the Refuge System and public participation in the conservation of the resources and encouraged donations and other contributions.

Wilderness Act of 1964—Directed the Secretary of the Interior, within 10 years, to review every roadless area of 5,000 or more acres and every roadless island (regardless of size) within the Refuge System and National Park Service for inclusion in the National Wilderness Preservation System.

Appendix B

List of Preparers, Consultation, and Coordination

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

Team member	*Position*	*Work unit*
Mike Artmann	Wildlife biologist and GIS specialist	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Division of Refuge Planning, Lakewood, Colorado
Mike Dailey	Hydrologist, planner	Montana Department of Natural Resources and Conservation, Glasgow, Montana
Paula Gouse	Wildlife refuge specialist	Charles M. Russell National Wildlife Refuge Complex, Fort Peck, Montana
James Graham	*Former* wetland district manager (*Current* supervisory wildlife refuge specialist)	Bowdoin National Wildlife Refuge Complex, Malta, Montana (Agassiz National Wildlife Refuge, Middle River, Minnesota)
Stan Jones	Hydrologist	Montana Department of Natural Resources and Conservation, Helena, Montana
Laura King	Planning team leader	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Division of Refuge Planning, Moiese, Montana
Carmen Luna	Refuge manager	Bowdoin National Wildlife Refuge Complex, Malta, Montana
Jana Mohrman	Hydrologist	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Division of Water Resources, Lakewood, Colorado
Deb Parker	Writer-editor	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Division of Refuge Planning, Lakewood, Colorado
John Simpson	Hydrologist	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Division of Water Resources, Lakewood, Colorado
Kathy Tribby	*Former* refuge operations specialist (*Current* outdoor recreation planner)	Bowdoin National Wildlife Refuge Complex, Malta, Montana (Bureau of Land Management, Malta, Montana)
Dean Yashan	Watershed management section supervisor	Montana Department of Environmental Quality, Helena, Montana

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

Team member	*Position*	*Work unit*
Bruce Barbour	*Former* private lands biologist	U.S. Fish and Wildlife Service, Malta, Montana
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Jack Cunningham	Hydraulic engineer	Bureau of Reclamation, Denver, Colorado
John Esperance	*Former* branch chief of Comprehensive and Land Protection Planning	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Lakewood, Colorado
Ned Euliss	Research biologist	U.S. Geological Survey, Jamestown, North Dakota
Sheri Fetherman	Chief, Division of Education and Visitor Services	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Lakewood, Colorado
Vanessa Fields	Wildlife biologist	Benton Lake National Wildlife Refuge, Great Falls, Montana
Robert Gleason	Director	U.S. Geological Survey, Jamestown, North Dakota
Bill Greiman	Agricultural engineer	Montana Department of Natural Resources and Conservation, Helena, Montana
Ann Harrie	Fish standards specialist	Montana Department of Environmental Quality, Helena, Montana
Shannon Heath	Outdoor recreation planner	U.S. Fish and Wildlife Service, Helena, Montana
Jeff King	Project leader	National Bison Range, Moiese, Montana
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Rachel Laubhan	Wildlife biologist	U.S. Fish and Wildlife Service, Stafford, Kansas
Brant Loflin	Zone archaeologist	U.S. Fish and Wildlife Service, Spearfish, South Dakota
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Dean Rundle	Refuge supervisor	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Lakewood, Colorado
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Bob Skinner	Wildlife biologist	Charles M. Russell National Wildlife Refuge, Lewistown, Montana
Michael Spratt	*Former* chief, Division of Refuge Planning	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Lakewood, Colorado

Team member	*Position*	*Work unit*
Mark Sullivan	Wildlife management biologist	Montana Fish, Wildlife & Parks, Glasgow, Montana
Brian Tangen	Research biologist	U.S. Geological Survey, Jamestown, North Dakota
Kate Thompson	*Former* biological science technician (wildlife)	Bowdoin National Wildlife Refuge Complex, Malta, Montana
Meg Van Ness	Regional archaeologist	U.S. Fish and Wildlife Service, Mountain–Prairie Region, Lakewood, Colorado
Matthew Walker	Area biologist	Natural Resources Conservation Service, Great Falls, Montana
Jay Weiner	Legal counsel	Montana Reserved Water Rights Compact Commission, Helena, Montana
Harold Wentland	Wildlife biologist	Montana Fish, Wildlife & Parks; Glasgow, Montana

Appendix C

Public Involvement

A notice of intent to prepare the draft comprehensive conservation plan and environmental assessment was published in the Federal Register on May 14, 2007. The Service compiled a mailing list of more than 170 names during pre-planning. The list includes private citizens; local, regional, and State government representatives and legislators; other Federal agencies; and interested organizations. Public scoping began immediately after publication of the notice of intent and was announced through news releases and issuance of the first planning update to the mailing list. Information was provided on the history of the refuge complex and the CCP process, along with an invitation to a public scoping meeting. Each planning update included a comment form to give the public an opportunity to provide written comments. Emails were also accepted at the refuge complex's email address: bowdoin@fws.gov.

One public scoping meeting was held in Malta, Montana, on May 22, 2007. There were more than 25 attendees, primarily local citizens and surrounding ranchers. Following a presentation about the refuge complex and an overview of the CCP and the National Environmental Policy Act processes, attendees were encouraged to ask questions and offer comments. Verbal comments were recorded and each attendee was given a comment form to submit additional thoughts or questions in writing.

All written comments were due June 30, 2007; 15 emails and letters were received in addition to the verbal comments recorded at the public scoping meeting. All comments were shared with the planning team and considered throughout the planning process.

As part of the CCP process, the planning team set up a salinity team to address the most critical issue to both the refuge complex and the public—increased salinity and blowing salts on Bowdoin National Wildlife Refuge. The salinity team worked for almost 2 years on the issue, which included a yearlong study by a contractor to develop alternatives for addressing this problem. On October 22, 2009, the planning team held a public meeting to provide information about the results of this effort and resulting alternatives. The public had an opportunity to ask questions and offer suggestions about the various aspects of the alternatives. To notify the public about this meeting, more than 170 meeting announcements were mailed out to the planning mailing list on September 24, 2009. Media outlets were sent a news release, and staff provided interviews to statewide newspapers. Several people helped prepare for the meeting and were there to answer questions: (1) Service staff from the Bowdoin Refuge, the regional Division of Refuge Planning, and the regional Division of Water Resources; and (2) the Montana Department of Natural Resources and Conservation and Department of Environmental Quality, including members of the Montana Reserved Water Rights Compact Commission. Thirty individuals attended this meeting and provided comments, which were recorded. These comments were considered by the planning team in the preparation of this draft CCP and EA, particularly chapter 6, which addresses the salinity and blowing salts problem.

C.1 Federal Officials

U.S. Representative Dennis Rehberg, Washington, DC
U.S. Senator John Tester, Washington, DC
U.S. Senator Max Baucus, Washington, DC

C.2 Federal Agencies

Bureau of Land Management, Malta, Montana
Bureau of Reclamation, Billings, Montana
National Park Service, Omaha, Nebraska
Natural Resource Conservation Service, Malta, Montana
U.S. Geological Service, Fort Collins Science Center, Fort Collins, Colorado
U.S. Geological Service, Jamestown, North Dakota

C.3 Tribal Officials

Blackfeet Nation, Browning, Montana
Chippewa Cree Tribe, Box Elder, Montana
Crow Tribe of Indians, Crow Agency, Montana
Fort Belknap Tribal Council, Harlem, Montana
Fort Peck Tribal Council, Poplar, Montana

C.4 State Officials

Attorney General's Office, Helena, Montana
Governor Brian Schweitzer, Helena, Montana
Representative Tony Belcourt, Box Elder, Montana
Representative Kristin Hansen, Havre, Montana
Representative John Musgrove, Havre, Montana
Representative Wayne Stahl, Saco, Montana
Representative Wendy Warburton, Havre, Montana
Senator John Brenden, Scobey, Montana
Senator Rowlie Hutton, Havre, Montana
Senator Jonathan Windy Boy, Box Elder, Montana

C.5 State Agencies

Farm Services Agency, Malta, Montana
Montana Department of Environmental Quality, Helena, Montana
Montana Department of Natural Resources and Conservation, Glasgow, Montana
Montana Department of Natural Resources and Conservation, Great Falls, Montana
Montana Department of Natural Resources and Conservation, Havre, Montana
Montana Department of Natural Resources and Conservation, Helena, Montana
Montana Department of Tourism, Helena, Montana
Montana Fish, Wildlife & Parks Commissioner, District 4, Scobey, Montana
Montana Fish, Wildlife & Parks Director, Helena, Montana
Montana Fish, Wildlife & Parks, Glasgow, Montana
Montana Fish, Wildlife & Parks, Malta, Montana
Montana Historical Society and Preservation Office, Helena, Montana

C.6 Local Government

Blaine County Commissioners, Chinook, Montana
Glasgow Irrigation District, Glasgow, Montana
Hill County Commissioners, Havre, Montana
Malta Irrigation District, Malta, Montana
Mayor of Malta, Malta, Montana
Phillips County Commissioners, Malta, Montana
Valley County Commissioners, Glasgow, Montana

C.7 Organizations

American Bird Conservancy, The Plains, Virginia
American Prairie Foundation, Malta, Montana
American Rivers, Washington, DC
American Wildlands, Bozeman, Montana
Audubon Society, Helena, Montana
Audubon Society, New York, New York
Audubon Society, Washington, DC
Beyond Pesticides, Washington, DC
Blue Goose Alliance, Tallahassee, Florida
Burlington Northern Railway, Havre, Montana
CARE Group, Washington, DC
Defenders of Wildlife, Washington, DC
Ducks Unlimited, Clancy, Lewistown, Montana
Ducks Unlimited, Memphis, Tennessee
Fund for Animals, New York, New York
Gallatin Valley Pheasants Forever, Bozeman, Montana
The Humane Society, Washington, DC
Isaac Walton League, Gaithersburg, Maryland
Malta Area Chamber of Commerce, Malta, Montana
Montana Department of Tourism, Helena, Montana
Montana Natural Heritage Program, Helena, Montana
Montana National Wildlife Federation, Helena, Montana
Montana Salinity Control Association, Conrad, Montana
National Trappers Association, New Martinsville, West Virginia
National Wildlife Federation, Reston, Virginia
National Wildlife Refuge Association, Washington, DC
The Nature Conservancy, Boulder, Colorado
The Nature Conservancy, Helena, Montana
North American Nature Photography Association, Wheat Ridge, Colorado
Phillips County Historical Society, Malta, Montana
St. Mary Rehabilitation Working Group, Glasgow, Montana
Sierra Club, San Francisco, California
The Wilderness Society, Washington, DC
Wildlife Management Institute, Bend, Oregon
Wildlife Management Institute, Fort Collins, Colorado
Wildlife Management Institute, Washington, DC
The Wildlife Society, Townsend, Montana
World Wildlife Fund, Bozeman, Montana

C.8 Universities and Schools

Colorado State University Libraries, Fort Collins, Colorado
Malta Elementary School, Malta, Montana
Malta High School, Malta, Montana
Northwestern University, Evanston, Illinois

C.9 Media

Billings Gazette Online, Billings, Montana
The Billings Outpost, Billings, Montana
Fort Belknap News, Harlem, Montana
The Glasgow Courier, Glasgow, Montana
Great Falls Tribune, Great Falls, Montana
Havre Daily News, Havre, Montana
KLAN Radio, Glasgow, Montana
KLTZ Radio, Glasgow, Montana
KMMR Radio, Malta, Montana
Montana Public Radio, Missoula, Montana
News Media Broadcasters, Havre, Montana
Phillips County News, Malta, Montana
Yellowstone Public Radio, Billings, Montana

C.10 Individuals

81 private individuals

Appendix D

Draft Compatibility Determinations

D.1 Refuge Complex Name

Bowdoin National Wildlife Refuge Complex:

- Bowdoin National Wildlife Refuge
- Black Coulee National Wildlife Refuge
- Creedman Coulee National Wildlife Refuge
- Hewitt Lake National Wildlife Refuge
- Lake Thibadeau National Wildlife Refuge
- Bowdoin Wetland Management District

D.2 Dates Established

February 14, 1936
August 1, 1958
January 28, 1938
October 25, 1941
March 7, 1938
September 23, 1937

D.3 Establishing and Acquisition Authorities

7 U.S.C. § 1000, 1006, 1010–13, July 22, 1937 (Bankhead–Jones Farm Act)
16 U.S.C. § 715(d), Migratory Bird Conservation Act
16 U.S.C. § 718(c), Migratory Bird Hunting and Conservation Stamp
Executive Order 7295, February 14, 1936
Executive Order 7713, September 23, 1937
Executive Order 7801, January 28, 1938
Executive Order 7833, March 7, 1938
Executive Order 8592, November 12, 1940
Executive Order 8924, October 25, 1941
Public Law 85–585, August 1, 1958
Secretarial Order 2843, November 17, 1959

D.4 Refuge Complex Purposes

The establishing and acquisition authorities set out the purposes for each unit of the refuge complex, as described below.

Bowdoin National Wildlife Refuge

- "As a refuge and breeding ground for migratory birds and other wildlife; "[…] and that such part of said lands as the Secretary of Agriculture may deem proper be reserved for use as a shooting area to be operated under a cooperative agreement or lease with the Montana State Game Commission or such other operating agency as may be approved. The reservation of these lands as a migratory waterfowl refuge is subject to the use thereof by [the Department of the Interior] for irrigation and other incidental purposes."*Executive Order 7295, February 14, 1936*

- As "a refuge and breeding ground for migratory birds and other wildlife […] subject to their use pursuant to the reclamation laws, and for the purpose of oil and gas development […] and for purposes incidental thereto." *Executive Order 8592, November 12, 1940*

- For "any other management purpose, for migratory birds." *Migratory Bird Conservation Act*

Black Coulee National Wildlife Refuge

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." *Three refuge and flowage easements, 1937–38*

- As "a refuge and breeding ground for migratory birds and other wildlife." *Executive Order 7801, January 28, 1938*

Creedman Coulee National Wildlife Refuge

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." *Eight refuge and flowage easements, 1937–39*

- As "a refuge and breeding ground for migratory birds and other wildlife." *Executive Order 8924, October 25, 1941*

Hewitt Lake National Wildlife Refuge

- For "water conservation, drought relief, flood control, stock water, migratory waterfowl and wildlife conservation purposes […] and operate and maintain a closed refuge for migratory birds and other wildlife." *Section 16 land; revocable easement signed August 30, 1938*

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes *[…]* wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." *Two refuge and flowage easements, 1937–38*

- As "a refuge and breeding ground for migratory birds and other wildlife […] nothing herein shall affect the disposition of the oil and gas deposits therein." *Executive Order 7833. March 7, 1938*

- For "purposes of a land conservation and land utilization program." *Bankhead–Jones Farm Tenant Act*

- For "use and administration under applicable laws as refuges for migratory birds and other wildlife." *Secretarial Order 2843, November 17, 1959*

Lake Thibadeau National Wildlife refuge

- For "water conservation, drought relief, and for migratory bird and wildlife conservation purposes […] wildlife conservation demonstration unit and closed refuge and reservation for migratory birds and other wildlife." *Thirteen refuge and flowage easements, 1937–38*

- As "a refuge and breeding ground for migratory birds and other wildlife." *Executive Order 7713, September 23, 1937*

Bowdoin Wetland Management District

- As "Waterfowl Production Areas subject to […] all of the provisions of such Act [*Migratory Bird Conservation Act*] […] except the inviolate sanctuary provisions." *Migratory Bird Hunting and Conservation Stamp*

- For "any other management purpose, for migratory birds." *Migratory Bird Conservation Act*

D.6 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.

D.7 Description of Uses

The following uses are evaluated for compatibility within the Bowdoin National Wildlife Refuge Complex:

- Recreational hunting
- Recreational fishing
- Wildlife observation and noncommercial photography
- Environmental education and interpretation

- Cooperative farming, haying, and grazing
- Commercial filming, audio recording, and still photography
- Research and monitoring

Recreational Hunting

Recreational hunting is identified as a wildlife-dependent recreational use under the Improvement Act. In addition to the site-specific regulations mentioned below, the State hunting regulations would apply to all Service-owned lands in the refuge complex. Hunters may only possess and use Service-approved, nontoxic shot loads on Service-owned lands, and vehicle travel and parking is restricted to public roads, pullouts, and parking areas. The refuge complex Web site and public use brochures would provide guidance on site-specific regulations. The general hunting regulations are available from Montana Fish, Wildlife & Parks.

The CCP proposes to continue the hunting uses described for each unit below. In addition, the Service would add the following to improve recreational hunting opportunities within the refuge complex:

- The eastern portion of Bowdoin National Wildlife Refuge would be closed to all foot traffic from the beginning of the waterfowl hunting season through November 30 to provide continued sanctuary for waterfowl and shorebirds. Although the auto tour route would remain open through this portion of the refuge, visitors would have to remain inside their vehicles outside of the hunting areas.

- On Black Coulee National Wildlife Refuge, the Service would improve public access to compatible wildlife-dependent activities, including hunting, by developing the entrance road and parking for the reservoir.

Bowdoin National Wildlife Refuge. Public hunting of migratory birds (ducks, geese, coot, swan, sandhill crane, and mourning dove) and upland game birds (ring-necked pheasant, sharp-tailed grouse, greater sage-grouse, and gray partridge) would be permitted on the western portion (approximately 40 percent) of Bowdoin National Wildlife Refuge excluding the railroad right-of-way and around the residences, shop, and maintenance areas, or where otherwise posted. Upland game bird hunters must wear at least one item of blaze orange clothing above the waist.

Limited hunting of fox and coyote would be permitted through issuance of a special use permit from the refuge manager on Bowdoin Refuge. Only centerfire rifles, rimfire rifles, or shotguns with Service-approved nontoxic shot would be permitted.

Big game hunting would not be permitted on Bowdoin National Wildlife Refuge. Bowdoin Refuge may not be used to access adjoining land for big game hunting except the Pearce and Beaver Creek WPAs. Using the refuge to access adjoining land to retrieve a big game animal would not be allowed unless approved and the hunter was accompanied by a refuge employee or State game warden.

Shooting from roads would be prohibited. If a hunter must retrieve a dead or injured game bird from a closed area, they may not carry their firearm with them.

An accessible boat dock, a pier, and a parking area would be available at the west boat launch on Lake Bowdoin. Hunters on Bowdoin National Wildlife Refuge would be required to sign in and out at the hunter registration kiosk. Brochures with current public use regulations would be available at the registration kiosk and from the refuge's Web site.

Since 2002, the portion of the refuge normally closed to hunting (along the eastern boundary) has been opened to upland game bird hunting throughout the month of December with the first 2 days of the special opening being limited to youth hunters only. Since waterfowl generally remain at Bowdoin Refuge until the wetlands freeze up, the opening of the late-season, upland game bird hunt would be contingent on waterfowl being gone by November 30 to avoid further disturbance to these migratory birds.

Black Coulee National Wildlife Refuge. A portion of the land within the refuge boundary is private land and hunters wishing to gain access to this inholding must get permission from the landowner. The refuge would be otherwise open to hunting of migratory birds (duck, goose, coot, swan, sandhill crane, and mourning dove), upland game (ring-necked pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, red fox, and coyote), and big game according to State regulations.

Creedman Coulee National Wildlife Refuge. Most of the land within the refuge boundary is private land encumbered by a refuge or flowage easement. Hunters wishing to gain access must get permission from the landowner. The refuge would be otherwise open to hunting of migratory birds (duck, goose, coot, swan, sandhill crane, and mourning dove), upland game (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, red fox, and coyote), and big game according to State regulations.

Hewitt Lake National Wildlife Refuge. A portion of the land within the refuge boundary is private land encumbered by refuge and flowage easement. Hunters wishing to gain access to these areas must get permission from the landowner. The refuge would be

otherwise open to hunting of migratory birds (duck, goose, coot, swan, sandhill crane, and mourning dove), upland game (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, red fox, and coyote), and big game according to State regulations.

Lake Thibadeau National Wildlife Refuge. Most of the land within the refuge boundary is private land encumbered by refuge and flowage easements. Hunters wishing to gain access must get permission from the landowner. The refuge would be otherwise open to hunting of migratory birds (duck, goose, coot, swan, sandhill crane, and mourning dove), upland game (ring-necked pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge, red fox, and coyote), and big game according to State regulations.

Bowdoin Wetland Management District. Except for the Holm WPA, all waterfowl production areas within the Bowdoin Wetland Management District would be open to hunting of migratory birds, upland game, furbearers, and big game. Big game hunting at the McNeil Slough WPA would be restricted to archery, muzzleloader, and shotgun only. An accessible hunting and photography blind and parking area would be provided at the Pearce WPA. Unless otherwise noted, all Service lands open to hunting would be subject to State hunting regulations and seasons.

Availability of Resources

Existing programs such as current refuge directional signs and brochures could be updated with available resources. Maintenance of access roads, parking, hunting and information kiosks, and public use signs is closely tied to Service Asset Maintenance Management System funding. The refuge complex's base funding would fund the update and printing of existing and new brochures.

Additional law enforcement staff and resources would be required (1) to manage significant changes to the hunting program to minimize disturbance to wildlife and habitat, and (2) to monitor compliance with public use and hunting regulations.

Anticipated Impacts of Use

The hunting program on Service lands in the refuge complex would continue to provide hunters ample quality hunting opportunities without materially detracting from the mission of the Refuge System and goals or establishing purposes of the refuge complex lands. Public use brochures and the refuge Web site would be kept up-to-date and made readily available to hunters. Hunter success and satisfaction would continue to be monitored using the hunter registration kiosk sign-in sheet along with random contacts with hunters in the field and in the refuge complex office.

Hunting is considered by many to be a legitimate, traditional, recreational use of renewable natural resources. The National Wildlife Refuge System Act of 1966, other laws, and the Fish and Wildlife Service's policy permit hunting on a national wildlife refuge when it is compatible with the purposes for which the refuge was established and acquired. National wildlife refuges exist primarily to safeguard wildlife populations through habitat preservation. The word "refuge" includes the idea of providing a haven of safety for wildlife, and as such, hunting might seem an inconsistent use of the National Wildlife Refuge System. However, habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource. As practiced on Bowdoin National Wildlife Refuge Complex, hunting does not pose a threat to the wildlife populations and, in some instances, is actually necessary for sound wildlife management. By its very nature, hunting creates a disturbance to wildlife and directly impacts the individual animals being hunted. However, it is well recognized that this activity has given many people a deeper appreciation of wildlife and a better understanding of the importance of conserving their habitat, which has ultimately contributed to the Refuge System mission. Furthermore, despite the potential impacts of hunting, a goal of the refuge complex is to provide opportunities for quality wildlife-dependent recreation. Hunting would be designed and monitored to offer a safe and quality program and to keep adverse effects within acceptable limits.

Although hunting directly impacts the hunted species and may indirectly disturb other species, limits on harvest and access for recreational hunting would ensure that populations do not fall to unsustainable levels. Closed areas on the refuge complex provide sanctuary to migratory birds during the hunting season. In some cases, hunting can be used as a management tool to control elevated populations that are having a negative effect on wildlife habitat.

Additional impacts from hunting activity include conflicts with individuals participating in wildlife-dependent, priority public uses such as wildlife observation and photography. Closing the eastern portion of Bowdoin Refuge to foot traffic during the migratory bird hunting season could lead to more crowding and conflicts between hunters and nonhunters. This could decrease the visitors' satisfaction during the hunting season if different users are restricted to the same portions of the refuge. Additional staff time and resources would be required to manage this program.

Determination

Recreational hunting would be a compatible use on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in recreational hunting would follow the Service's public use regulations, including site-specific regulations, and the State's hunting regulations.
- Hunters would continue to use approved non-toxic shot for migratory and upland game bird hunting on Service-owned lands.
- Vehicles would be restricted to county and public roads and parking areas in the refuge complex.
- Signage and brochures would be used to provide hunters information on where and how to hunt on the refuge complex to ensure compliance with public use regulations.

Justification

One of the secondary goals of the National Wildlife Refuge System is to provide opportunities, when found compatible, for the public to develop an understanding and appreciation for wildlife. Hunting is identified as a priority public use in the National Wildlife Refuge System Improvement Act of 1997 and would help meet the above secondary goal with only minimal conflicts. Recreational hunting can instill, in citizens of all ages, a greater appreciation for wildlife and its habitat. This appreciation may extend to the Refuge System and other conservation agencies.

Based on anticipated biological impacts described above and in the environmental assessment, the Service has determined that recreational hunting within the refuge complex would not interfere with the Service's habitat goals and objectives or purposes for which the refuges and district were established. Limiting access and monitoring the use could help limit any adverse effects. Except for the Holm WPA, all lands and waters within the wetland management district would be open to hunting in accordance with the Migratory Bird Hunting and Conservation Stamp Act, under which they were acquired.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

Recreational Fishing

Recreational fishing is defined as a wildlife-dependent recreational use under the Improvement Act. The Service does not actively manage sport fisheries within the Bowdoin National Wildlife Refuge Complex, but recreational fishing opportunities would be available at the McNeil Slough WPA (primarily in the Milk River) and the Beaver Creek WPA (primarily in Beaver Creek). The remaining wetlands within Bowdoin Wetland Management District have only minimal habitat or high salinity levels, or both, and do not support a game fishery. The Bowdoin, Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges would be closed to all fishing to provide refuge for migratory birds. Regardless, wetlands on these refuges do not support game fish due to high salinity levels or minimal or no permanent deepwater habitat.

Anglers have plenty of fishing opportunities within 10–100 miles of the refuge complex including the nearby Nelson Reservoir, Cole Ponds, Milk River, Missouri River, Fort Peck Lake, and stocked ponds on public and private lands.

The draft CCP does not call for the implementation of any new fishing programs.

Availability of Resources

The fishing program could be administered using current resources.

Anticipated Impacts of Use

Fishing and other human activities cause disturbance to wildlife and trampling of vegetation along the bank of rivers and streams. Littering can also become a problem.

Determination

Recreational fishing would not be a compatible use at the Bowdoin, Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges.

Recreational fishing would be a compatible use at waterfowl production areas throughout the Bowdoin Wetland Management District in accordance with State regulations.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in recreational fishing would follow the Service's public use regulations and State fishing regulations and limits.

- Vehicles would be restricted to county and public roads and parking areas on the waterfowl production areas.
- Use of motorized boats would be prohibited.
- Boats, fishing equipment, and all other personal property must be removed at the end of each day.

Justification

Fishing is listed as a priority public use in the Improvement Act. Based on the biological effects addressed above and in the environmental assessment, the Service has determined that recreational fishing would not interfere with the habitat goals and objectives or purposes for establishment of the waterfowl production areas within the refuge complex.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

Wildlife Observation and Noncommercial Photography

Wildlife observation and photography are both defined as wildlife-dependent recreational uses under the Improvement Act. All lands within the Bowdoin National Wildlife Refuge Complex would be open to these activities although portions of the Black Coulee, Creedman Coulee, Hewitt Lake, and Thibadeau National Wildlife Refuges are private land, and visitors must get permission from the landowners to access those areas. Bowdoin National Wildlife Refuge would continue to provide a 15-mile auto tour route with accompanying interpretive brochure and observation pullouts as well as an accessible photo blind and observation deck on the Display Pond Trail. Pearce WPA would continue to provide an accessible blind with parking and a boardwalk. The refuge complex would continue to provide interpretive brochures and panels, which allow self-guided access to the Bowdoin National Wildlife Refuge, and a bird list that could be used throughout the refuge complex. Public roads, trails, and photography blinds would be maintained as needed. Walk-in access would be allowed anywhere on Bowdoin National Wildlife Refuge and the wetland management district except on the railroad right-of-way and around the residences, shop, and maintenance areas, or where otherwise posted.

Access to the privately owned portions of the Lake Thibadeau, Creedman Coulee, Black Coulee and Hewitt Lake National Wildlife Refuges is by landowner permission only.

The CCP proposes to continue the above wildlife observation and noncommercial photography uses and add the following to improve opportunities for these uses:

- An accessible wildlife observation site and expanded parking area would be added at stop number 5 along the auto tour route. Two permanent spotting scopes and interpretive panels would also be added. At least one spotting scope would be set at a level accessible to visitors in wheelchairs and small children. The panel would describe the natural history of the birds and the area.
- The Service would close the east end of Bowdoin National Wildlife Refuge to all foot traffic at the start of the waterfowl-hunting season at least through November 30, or until waterfowl depart the refuge, to provide sanctuary areas for primarily migratory waterfowl and shorebirds. The auto tour route would remain open but visitors would remain on the auto tour route in designated sanctuary areas.

Availability of Resources

Implementing new facilities outlined in the CCP is closely tied to funding requests submitted as visitor facility enhancement projects through the Service Asset Maintenance Management System. Existing programs such as current directional signs and brochures could be updated with available resources.

Additional staff and resources would be required to manage the increased use to minimize disturbance to wildlife and habitat and to educate photographers and wildlife observers about the local resources and proper wildlife-viewing and photography etiquette.

Anticipated Impacts of the Use

Guided tours of the refuge complex could potentially increase wildlife disturbance, but the presence of Service employees would keep this impact to a minimum, and the opportunity could be used to educate all attendees on proper wildlife-viewing and photography etiquette. Increased visitation could also lead to other short-term impacts such as increased litter and trampled vegetation.

The additional wildlife observation area along the auto tour would provide more opportunities to see birds and other wildlife but from longer distances, causing minimal disturbance. A small concrete pad and spotting scope would be added to an expanded

pulloff to accommodate additional vehicles. The expansion and additions would be minimal and should not cause any impacts.

Sanctuary would be provided for migrating waterfowl and other waterbirds during the waterfowl-hunting season at Bowdoin National Wildlife Refuge. Conflicts between hunters and nonhunters may increase during the hunting season due to closure of the eastern portion of the refuge to foot traffic. Nonhunter satisfaction may decrease due to a reduction in access opportunities. Hunter satisfaction may decrease due to an increase in wildlife disturbance within the hunting zone.

Determination

Wildlife observation and noncommercial photography would be compatible uses on the Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in wildlife observation and photography would follow all public use regulations. Guided tours would be held where minimal impact to habitat and wildlife would occur.
- Non-Service vehicles would be restricted to county and public access roads in the refuge complex.
- Viewing areas would be designed to minimize disturbance impacts to wildlife and all refuge resources while providing a good opportunity to view wildlife in their natural environments. Visitors using permanent or portable observation and photography blinds would be provided with information on proper use and etiquette of these structures to minimize disturbance to wildlife and their natural environments and other refuge complex visitors.

Justification

One of the secondary goals of the National Wildlife Refuge System is to provide opportunities, when found compatible, for the public to develop an understanding and appreciation for wildlife. Wildlife observation and photography are identified as priority public uses in the National Wildlife Refuge System Improvement Act of 1997 and would help meet the above secondary goal with only minimal conflicts. Wildlife observation and photography can instill, in citizens of all ages, a greater appreciation for wildlife and its habitat. This appreciation may extend to the Refuge System and other conservation agencies.

Based on anticipated biological impacts described above and in the environmental assessment, the Service has determined that wildlife observation and noncommercial photography within the refuge complex would not interfere with the Service's habitat goals and objectives or purposes for which the refuges and district were established. Limiting access and monitoring the uses could help limit any adverse effects.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

Environmental Education and Interpretation

Environmental education and interpretation are both identified as wildlife-dependent recreational uses under the Improvement Act. All lands within the Bowdoin National Wildlife Refuge Complex would remain open to these activities. These programs have been opportunistic as time and staff allow. Interpretive panels and brochures would be maintained and updated to reflect changes in information or policy and to meet the Service's graphic standards. Portions of the Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges are private land, and visitors must get permission from the landowners to access these areas.

The CCP proposes to continue environmental education and interpretation and add the following to improve these programs:

- The Service would expand the opportunities for environmental education and interpretation to foster appreciation and understanding of the National Wildlife Refuge System and the resources of the Bowdoin National Wildlife Refuge Complex. Additional interpretive panels would be developed for the refuge complex and an accessible observation site with spotting scopes would be developed along the auto tour route at Bowdoin National Wildlife Refuge. The mammal, reptile and amphibian lists would be updated for the refuge complex and a brochure would be developed.
- The Service would develop a Friends group and work with the Malta Chamber of Commerce and Phillips County Historical Society to develop informational kiosks and interpretive displays for the refuge complex that would be placed in the town of Malta.

- Many of the proposed actions would be contingent on recruiting a visitor services specialist to develop and carry out these additional programs.

Availability of Resources

Funding for environmental education and interpretation activities, directional signs, and brochures would be mainly supported by annual operation and maintenance money. Funding from other sources such as grants, regional project proposals, challenge cost-share agreements, and other temporary funding sources would also be sought and used as they became available.

Funding requests for new facilities would be submitted as visitor facility enhancement projects through the Service Asset Maintenance Management System.

Anticipated Impacts of the Use

The use of the refuge complex for onsite activities by groups of teachers and students for environmental education or interpretation may impose a short-term, low-level impact on the immediate and surrounding area. Impacts may include trampling of vegetation and temporary disturbance to nearby wildlife species during the activities.

Refuge complex brochures, interpretive panels, and other educational materials would continue to be updated as needed to meet Service requirements. Features such as the auto tour route and accessible observation sites would continue to provide access to the many sights and sounds of the refuge complex.

The Service would continue to promote a greater public understanding and appreciation of the refuge complex resources, programs, and issues through interpretive, outreach, and environmental educational programs. Working with the Friends group and other local groups, the Service would continue to provide environmental education and interpretation both on and off Service lands. Presentations, both on and off Service lands, would be provided to refuge visitors, school groups, and organizations, allowing the Service to reach a broader audience. Onsite presentations would be managed to minimize disturbance to wildlife, habitat, and cultural resources.

Determination

Environmental education and interpretation would be compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in environmental education and interpretation programs would follow all Service regulations. Onsite activities would be held where minimal impact to wildlife and habitats would occur.

- The Service would review new environmental education and interpretation activities to ensure these activities meet program objectives and are compatible.

Justification

One of the secondary goals of the National Wildlife Refuge System is to provide opportunities, when found compatible, for the public to develop an understanding and appreciation for wildlife. Environmental education and interpretation are identified as priority public uses in the National Wildlife Refuge System Improvement Act of 1997 and would help meet the above secondary goal with only minimal conflicts. Environmental education and interpretation would be used to encourage an understanding in citizens of all ages to act responsibly in protecting wildlife and its habitat. These are tools used in building a land ethic, developing support of the refuge complex, and decreasing wildlife violations.

Environmental education is an important tool for the refuge complex to provide visitors with an awareness of its purposes, values, and specific issues such as wetland ecology, water quality, impacts of nonnative species, and migratory bird management. This tool would also provide visitors and students a greater understanding of the mission and importance of the National Wildlife Refuge System to the American people.

Based on anticipated biological impacts described above and in the environmental assessment, the Service has determined that environmental education and interpretation on the refuge complex would not interfere with the Service's habitat goals and objectives or purposes for which the refuges and district were established. Limiting access and monitoring the uses could help limit any adverse effects.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

Cooperative Farming, Haying, and Grazing

The Service would continue to use cooperative farming, haying, and prescriptive livestock grazing as management tools throughout the refuge complex. These tools would be used to meet habitat objectives, control vegetative litter, promote native plant production and diversity, control the spread of invasive plant species, and help convert disturbed grasslands back to native plant species.

Farming and Haying. The Bowdoin Refuge and Bowdoin District currently use cooperative farming and haying as tools to manage upland habitats, including control of invasive plant species and cattails. The Service would enter into an agreement with a local landowner to (1) help restore cropland and poor quality habitat to quality grassland habitat for wildlife, or (2) cut and remove DNC to rejuvenate vegetation growth. A farming cooperator would be issued a cooperative farming agreement or special use permit by the refuge manager and allowed to till seed, harvest small grain, control invasive plants, or harvest hay on Service-owned lands. The agreement generally would be issued for a 2- to 4-year management prescription.

Cooperative farming of Service lands is usually done on a share basis where the Service and the cooperator each receive a share of the crop. The Service would retain its share as standing cover for wildlife forage or in exchange for additional work from the cooperator such as invasive plant control, grass seeding, or provision of supplies such as herbicides and fence materials for habitat protection and improvement on the management unit. Any fees or cash income received by the Service would be deposited in the Refuge Revenue Sharing Account.

The draft CCP proposes to continue using cooperative farming and haying to manage habitats. Furthermore, the draft CCP establishes goals and objectives for specific habitat types where cooperative farming and haying may be used. In addition, the Service has identified target wildlife species (for example, northern pintail and Sprague's pipit) and their habitat requirements. This has resulted in objectives that would guide management to achieve the habitat needs of these target species. The refuge complex would improve the monitoring and research programs for vegetation and wildlife to assess habitat and wildlife population responses to cooperative farming and haying.

Grazing. The refuge complex currently uses prescriptive livestock grazing as a tool to manage a variety of uplands and seasonal wetlands. Grazing by livestock has been a preferred management tool because the effect on habitat is controllable and measurable. Livestock grazing has been used in a variety of ways including high intensity–short duration, rest rotation, and complete rest. Grazing may occur throughout the year as management needs dictate. Where applicable, a rotation schedule using multiple grazing units is used to manage grazing intensity.

Fencing and controlling livestock is the responsibility of the cooperating rancher. The Service provides instruction and guidance within the special use permit for placement of fences, water tanks, and livestock supplements to ensure that sensitive habitats or refuge complex assets are protected. A temporary electric fence is used where there isn't an existing fence. Current forage conditions, habitat objectives, and available water would determine stocking rates in each grazing unit. Two stock water wells exist on the eastern portion of Bowdoin Refuge but are in need of rehabilitation before they can be used again by livestock.

The draft CCP proposes to continue using prescriptive livestock grazing to meet habitat objectives. Furthermore, the draft CCP establishes goals and objectives for specific habitat types where prescriptive livestock grazing may be used. In addition, the Service has identified target wildlife species (for example, northern pintail and Sprague's pipit) and their habitat requirements, which has resulted in objectives that would guide the prescriptive grazing program to achieve the habitat needs of these target species. The refuge complex would improve the monitoring and research programs for vegetation and wildlife to assess habitat and wildlife population responses to prescriptive livestock grazing. Different grazing rates and management strategies would be investigated to determine the best methods for meeting the habitat goals and objectives.

Availability of Resources

Existing resources would be sufficient to administer the farming, haying, and grazing programs at current levels. These programs would continue to be conducted through special use permits or cooperative farming agreements, which minimize the need for staff time and Service assets to complete work. A refuge complex biologist would be needed to plan and oversee monitoring and research of to assess the impacts and effectiveness of these management programs. One temporary biological technician would be necessary to carry out the on-the-ground monitoring.

Rehabilitation of existing stock water wells and drilling of additional wells in strategic locations would increase the effectiveness of the grazing pro-

gram and reduce the impacts caused by livestock watering in wetlands and canals and by cooperators hauling water to grazing cells on a daily basis.

Anticipated Impacts of the Use

The cooperative farming and haying program and prescriptive livestock-grazing program would be used to meet habitat- and species-specific goals and objectives identified in the draft CCP. These programs are intended to maintain and enhance habitat conditions for the benefit of a wide variety of migratory birds and other wildlife that use the refuge complex. Minimal negative effects are expected through the use of these tools. Control of invasive plant species through these programs would be a long-term benefit.

Some wildlife disturbance would occur during operation of noisy farming equipment and some animals may be temporarily displaced. Wildlife would receive the short-term benefit of standing crops or stubble for food and shelter and the long-term benefit of having cropland or other poor-quality habitat converted to native grasses or DNC. In addition, restoration of cropland to grassland cover would prevent soil erosion, improve water quality, and the need for chemical use.

Some trampling of areas by livestock may occur around watering areas or mineral licks. If fences are not maintained, it may be difficult to meet habitat objectives. It is anticipated that grazing would be in a mosaic pattern with some areas more intensively grazed than others in certain years. Grazing, as well as fire, is known to increase the nutrient cycling of nitrogen and phosphorous (Hauer and Spencer 1998, McEachern et al. 2000, Burke et al. 2005). Hoof action may break up mats of clubmoss and allow native plant seeds to become established. However, cattle grazing would also increase the risk of invasive plants getting established. Grazing in the spring could have adverse effects to grassland-bird nests due to trampling and loss of vegetation. In addition, the presence of livestock would be disturbing to some wildlife species and some public users. The long-term benefits of this habitat management tool should outweigh the short-term negative effects.

Determination

Cooperative farming, haying, and grazing as a habitat management tools would be compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- To ensure consistency with management objectives, the Service would require general and specific conditions for each farming, haying, or grazing permit.

- Only areas that have a prior crop history, an invasive plant problem, or decadent DNC would be included in the farming and haying program. To minimize impacts to nesting birds and other wildlife, the refuge manager would determine and incorporate any needed timing constraints on the permitted activity into the cooperative farming agreement or special use permit. For example, haying would not permitted on Service lands until after August 1 to avoid destroying bird nests on the management unit unless the refuge manager deems it necessary to hay earlier to control invasive plants or restore grasslands.

- The cooperative farming agreement or special use permit would specify the type of crop to be planted. Farming permittees would be required to use Service-approved chemicals that are less detrimental to wildlife and the environment.

- Control and confinement of livestock are the responsibility of the permittee, but the Service would determine where fences, water tanks, and livestock supplements would be placed within the management unit. Temporary electric fence would be used to retain livestock within grazing cells as well as to protect sensitive habitat areas and refuge complex assets such as water control structures or water quality-monitoring wells. Cooperators would be required to remove fences at the end of the grazing season.

- Grazing fees would be based on the current-year USDA Statistics Board publication for Grazing Fee Rates for Cattle by Selected States and Regions, as provided annually by the regional office. Standard deductions for labor associated with the grazing permit would be included on the special use permit.

- The refuge complex would carry out a vegetation-monitoring program to assess if habitat requirements of target species are being met. A minimum of one temporary biological technician would be necessary to monitor and document these activities. A biologist would be necessary to plan and oversee the monitoring program and assess the impacts and effectiveness of these management programs.

Justification

Some habitat management needs to occur to maintain and enhance habitat for migratory birds and other wildlife. When properly managed and monitored, prescriptive farming and haying are options that can be used to improve wildlife cover and restore disturbed habitats to desirable grassland cover. Prescriptive livestock grazing can rejuvenate native grasses and help control the spread of some invasive plant species. Each of these tools can be controlled and the results would be monitored (for example, vegetation monitoring) so that adjustments in the programs can be made to meet habitat goals and objectives.

Using local cooperators to accomplish the work is a cost-effective method to accomplish the habitat objectives. The long-term benefits of habitat restoration and management far outweigh the short-term impacts caused by cooperative farming, haying, and grazing.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

Commercial Filming, Audio Recording, and Still Photography

Commercial filming is the digital or film recording of a visual image or sound (audio) recording, and commercial still photography is the capture of a still image on film or in a digital format—by a person, business, or other entity for a market audience such as for a documentary, television, feature film, advertisement, or similar project. It does not include news coverage or visitor use.

Bowdoin National Wildlife Refuge Complex provides tremendous opportunities for commercial filming and still photography of migratory birds and other wildlife. Each year, the refuge complex staff receives one to three requests to conduct commercial filming or photography on Service lands. The staff would continue to evaluate each request on an individual basis, and if the use were allowed, the requesting individual or group would be issued a special use permit. The permit would designate what areas may be accessed and what activities are and are not allowed, to minimize the possibility of damage to cultural or natural resources or interference with other visitors (refer to "Stipulations Necessary to Ensure Compatibility").

Permittees would be able to access all areas of the refuge complex that are open to the public and must abide by all public use regulations. In rare cases and through the special use permit process, the Service may permit access to areas closed to the public.

Availability of Resources

The commercial filming, audio recording, and still photography uses could be administered with current resources. Administrative costs for review of applications, issuance of special use permits, and staff time to conduct compliance checks may be offset by a fee system designated in a proposed rule that would modify the commercial filming and still photography policy for the agencies within the Department of the Interior. This proposed rule is currently in the public review process (Federal Register, Volume 72, Number 160, August 20, 2007).

Anticipated Impacts of Use

Wildlife filmmakers and photographers tend to create the greatest disturbance of all wildlife observers (Dobb 1998, Klein 1993, Morton 1995). While observers frequently stop to view wildlife, photographers are more likely to approach the animals (Klein 1993). Even a slow approach by photographers tends to have behavioral consequences to wildlife (Klein 1993). Photographers often remain close to wildlife for extended periods in an attempt to habituate the subject to their presence (Dobb 1998). Furthermore, photographers with low-power lenses tend to get much closer to their subjects (Morton 1995). This usually results in increased disturbance to wildlife as well as habitat including the trampling of plants. Handling of animals and disturbing vegetation (such as cutting plants and removing flowers) or cultural artifacts is prohibited on Service lands.

Issuance of special use permits with strict guidelines and followup by refuge complex staff for compliance could help minimize or avoid these impacts. Permittees who do not follow the stipulations of their special use permits could have their permits revoked, and further applications for filming or photographing on refuge complex lands would be denied.

Determination

Commercial filming, audio recording, and still photography would be compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Commercial filming or still photography must (1) demonstrate a means to extend public appreciation and understanding of wildlife or natural habitats, (2) enhance education, appreciation, and understanding of the National Wildlife Refuge System, or (3) facilitate outreach and education goals of the refuge complex. Failure to demonstrate any of these criteria would result in a special use permit being denied.

- All commercial filming would require a special use permit that would (1) identify conditions that protect the refuge complex's values, purposes, resources, and public health and safety, and (2) prevent unreasonable disruption of the public's use and enjoyment of the refuge complex. Such conditions may be, but are not limited to, specifying road conditions when access would not be allowed, establishing time limitations, and identifying routes of access. These conditions would be identified to prevent excessive disturbance to wildlife, damage to habitat or refuge complex infrastructure, or conflicts with other visitor services or management activities.

- The special use permit would stipulate that imagery produced on refuge complex lands would be made available for use in environmental education and interpretation, outreach, internal documents, or other suitable uses. In addition, any commercial products must include appropriate credits to the Bowdoin National Wildlife Refuge Complex, the Refuge System, and the Service.

- Still photography requires a special use permit (with specific conditions as outlined above) if one or more of the following would occur:

  - It takes place at locations where or when members of the public are not allowed.

  - It uses models, sets, or prop that are not part of the location's natural or cultural resources or administrative facilities.

  - The Service would incur additional administrative costs to monitor the activity.

  - The Service would need to provide management and oversight to avoid impairment of the resources and values of the site, limit resource damage, or minimize health and safety risks to the visiting public.

- To minimize the impact on Service lands and resources, the refuge complex staff would ensure that all commercial filmmakers and commercial still photographers (regardless of whether a special use permit is issued) comply with policies, rules, and regulations. The staff would monitor and assess the activities of all filmmakers, audio recorders, and still photographers.

Justification

Commercial filming, audio recording, and still photography are economic uses that must contribute to the achievement of the refuge complex purposes, mission of the Refuge System, or the mission of the Service. Providing opportunities for these uses should result in an increased public awareness of the refuge complex's ecological importance as well as advancing the public's knowledge and support for the Refuge System and the Service. The stipulations outlined above and conditions imposed in the special use permits issued to commercial filmmakers, audio recorders, and still photographers would ensure that these wildlife-dependent activities occur with minimal adverse effects to resources or visitors.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

Research and Monitoring

The Bowdoin National Wildlife Refuge Complex receives one to three requests each year to conduct scientific research or monitoring on Service lands. Priority is given to studies that contribute to the enhancement, protection, preservation, and management of the refuge complex's native plant, fish, and wildlife populations and their habitats. Non-Service applicants must submit a proposal that outlines the following:

- Objectives of the study

- Justification for the study

- Detailed methodology and schedule

- Potential impacts on wildlife and habitat including disturbance (short- and long-term), injury, or mortality

- Description of measures the researcher would take to reduce disturbances or impacts

- Staff required and their qualifications and experience
- Status of necessary permits such as scientific collection permits and endangered species permits
- Costs to the Service including staff time requested, if any
- Anticipated progress reports and end products such as reports or publications
- Refuge complex staff or others, as appropriate, would review research proposals case-by-case and issue special use permits if approved. Criteria for evaluation would include, but not be limited to, the following:
- Research that would contribute to specific refuge complex management issues would be given higher priority over other requests.
- Research that would conflict with other ongoing research, monitoring, or management programs would not be approved.
- Research that would cause undue disturbance or would be intrusive would likely not be approved. The degree and type of disturbance would be carefully weighed when evaluating a research request.
- Proposals would be evaluated to determine if any effort was made to minimize disturbance through study design including adjusting location, timing, number of permittees, study methods, and number of study sites.
- The length of the project would be considered and agreed on before approval.

Availability of Resources

Current resources would be adequate to administer the research and monitoring on a very limited basis. A refuge complex biologist would be necessary to administer large and long-term projects, which generally require more indepth evaluation of applications, management of permits, and oversight of research projects. The biologist would identify research and monitoring needs and work with other Service staff, universities, and scientists to develop studies that would benefit the refuge complex and address the goals and objectives in the draft CCP.

Anticipated Impacts of Use

Some degree of disturbance would be expected with all research activities, since researchers may use Service roads or enter areas that are closed to the public; in addition, some research may require collection of samples or handling of wildlife. However, minimal impact on wildlife and habitats would be expected with research studies, because special use permits would include conditions to ensure that impact to wildlife and habitats are kept to a minimum.

Determination

Research and monitoring would be compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Extremely sensitive wildlife habitats and species would be sufficiently protected from disturbance by limiting research activities in these areas. All refuge complex rules and regulations would be followed unless otherwise exempted by refuge complex management. Projects would be reviewed annually.
- Refuge complex staff would use the above criteria for evaluating and determining whether to approve a proposed study. If research methods were determined to have potential impacts on habitat or wildlife, it must be demonstrated that the research was necessary for conservation management of resources on the refuge complex. Measures to minimize potential impacts would need to be developed and included as part of the study design; these measures would be conditions on the special use permit.
- Refuge complex staff would monitor research activities for compliance with conditions of the special use permit. At any time, refuge complex staff may accompany the researchers to determine potential impacts. Staff may determine that previously approved research and special use permits be terminated due to observed impacts. The refuge manager would also have the ability to cancel a special use permit if the researcher was out of compliance or to ensure wildlife and habitat protection.

Justification

Potential impacts of research activities on refuge complex resources would be minimized through re-

strictions included as part of the study design, and research activities would be monitored by the refuge complex staff. Results of research projects would contribute to the understanding, enhancement, protection, preservation, and management of the refuge complex's wildlife populations and their habitats.

Mandatory 15-year Reevaluation Date

(Based on date of final plan)

D.8 Signatures

Submitted by:

Carmen Luna, Project Leader — Date
Bowdoin National Wildlife Refuge Complex
Malta, Montana

Approved by:

Richard A. Coleman, Ph.D. — Date
Assistant Regional Director
U.S. Fish and Wildlife Service
Mountain–Prairie Region
National Wildlife Refuge System
Lakewood, Colorado

Reviewed by:

Dean Rundle, Refuge Supervisor — Date
U.S. Fish and Wildlife Service
Mountain–Prairie Region
National Wildlife Refuge System
Lakewood, Colorado

Appendix E

Divestiture Model Results for Lake Thibadeau National Wildlife Refuge

During the CCP process, the Service identified Lake Thibadeau National Wildlife Refuge as a candidate for removal from the National Wildlife Refuge System through divestiture (the selling or release of Service interests). The refuge was evaluated by the planning team, regional office, and the refuge manager to determine whether it warranted continued status as a national wildlife refuge. Based on the analysis, the Service is recommending that Lake Thibadeau National Wildlife Refuge be considered for divestiture.

This 3,840-acre limited-interest refuge is primarily private land encumbered by flowage and refuge easements acquired by the Government in the 1930s. The Service has the right to impound water, control uses that occur on that water, and control hunting and trapping. The Service does not have rights to control uses of the uplands or natural wetland basins; these rights would require additional easements or purchase of the land from a willing seller. The 19.4-acre fee-title area is land reserved from public domain by the Bureau of Land Management.

The analysis of Lake Thibadeau Refuge used the Service's Mountain–Prairie Region evaluation model to determine whether to recommend the refuge for divestiture. The divestiture model is a set of criteria for measuring the value of a refuge based primarily on its purposes and the goals of the Refuge System. Designed as a pre-planning tool, the model allows planners and refuge managers to determine whether a refuge or easement refuge should be considered for divestiture. Since use of the model indicated that Lake Thibadeau Refuge should be considered for divestiture, the process and consequences of divestiture were analyzed further during the CCP process and documented under section 3.1 in chapter 3 of the draft CCP.

E.1 The Divestiture Model

Mountain–Prairie Region staff developed the divestiture model during a 2-day workshop held December 14–15, 2004, at the regional office in Lakewood, Colorado. The model standardizes policy in the Mountain–Prairie Region for identifying which refuges to consider for divestiture.

The divestiture model comprises primary criteria (five questions), secondary criteria (three questions), additional considerations, and five rules (to organize answers to criteria questions for determination of whether to consider divestiture). For each criteria question, the answer related to Lake Thibadeau National Wildlife Refuge is stated and followed by a justification.

Primary Criteria

The following five questions compose the primary criteria for evaluating a national wildlife refuge for divestiture.

1. Does the refuge achieve one or more of the goals of the National Wildlife Refuge System?

Answer: No. According to the rules of this model, if the refuge does not achieve one or more goals of the National Wildlife Refuge System, it should automatically be recommended for divestiture.

Justification: Lake Thibadeau National Wildlife Refuge does not meet the goals of the Refuge System as set by Service policy—National Wildlife Refuge System Mission and Goals and Refuge Purposes (June 20, 2006):

A. Conserve a diversity of fish, wildlife, and plants and their habitats, including species that are endangered or threatened with becoming endangered.
B. 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.
C. 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.
D. Provide and enhance opportunities to participate in compatible wildlife-dependent recreation

(hunting, fishing, wildlife observation and photography, and environmental education and interpretation).

E. Foster understanding and instill appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

The refuge is a reservoir created by a dam in the middle of an arid landscape. It provides little migratory bird habitat, because the watersheds up stream of the reservoir have been heavily developed since its establishment, capturing most of the water. With the absence of permanent vegetative cover around the wetlands, erosion occurs and sediment continues to be added to the wetland basins.

The refuge's ability to function as a water source and habitat for migrating waterbirds is almost gone. In the last 10 years, there has only been one occasion when there was sufficient water collected in the spring to provide habitat; this event provided about 30 acres of water for about 3 months. The historical lakebeds of the refuge would provide this seasonal habitat any time moisture is made available and would function in this capacity even if the area was not a refuge. In addition, the lakebeds are natural sumps, being the lowest points for the surrounding area. Runoff from surrounding farm land finds its way to these locations. Draining or removing this water from these locations is highly unlikely.

The impoundment Lake Thibadeau Refuge is functioning as any other livestock pond in the area (figure 49). Within 10 miles of the refuge are more than 6,500 acres of wetlands including more than 3,000 acres of seasonal or temporarily flooded wetlands in more than 1,300 basins. The impoundment on the refuge does provide some loafing areas for waterfowl, but not of any quality. The mere presence of seasonal water does not make it a refuge.

Conservation implies action, and the Service has no authority to do anything other than impound water when it is available. Hunting is allowed by landowner permission. There are no other opportunities to provide wildlife-dependent recreation or to foster an understanding or appreciation of the diversity and interconnectedness of fish, wildlife, and plants and their habitats.

2. Does the refuge meet its purpose (fulfill the refuge's intent and statutory purpose)?

Answer: No.

Justification: The refuge was established in 1937 "as a refuge and breeding ground for migratory birds and other wildlife" (Executive Order 7713). The lands and waters of this area cannot provide the habitat necessary to provide a refuge and breeding ground as found on other Refuge System lands. As described previously, there is a lack of water due to upstream development. The uplands, over which the Service has no authority to manage, are used for agriculture. Only about 8 percent of the upland habitat (about 340 acres) is unbroken ground with the potential to retain some native prairie species. However, 95 percent of this area is in one block and is heavily grazed. The Service has no authority or ability within the easement to control the uses and management of this upland habitat. The remaining uplands of the refuge are intensively farmed.

3. Does the refuge provide substantial support for migratory bird species, important sheltering habitat for threatened and endangered species, or support for species identified in authorizing legislation?

Answer: No.

Justification: The past 30 years of wildlife observations show there has never been substantial use of this refuge by migratory birds.

4a. Does the refuge have biological integrity; if it does not, is it feasible to restore the biological integrity of the converted or degraded habitat?

Answer: No.

Justification: Due to alteration of the natural hydrologic processes in the watershed and the conversion of native grasslands to cropland, the refuge has lost most of the historical biotic composition, structure, and function that define its biological integrity, diversity, and environmental health. Certainly, migratory birds will make use of open-water habitat, and the refuge will at times provide a remnant amount of what historically was present, but this amount of use alone will not bring the biological diversity of the refuge to a level that would meet the purpose of a migratory bird refuge.

Since the refuge has no authority over the uplands, it is unrealistic to expect that this area would be restored to grassland cover by the current landowners. Further, acquisition of this land in either fee title or conservation easement is unlikely given the limited money for these activities and the fact that this location is not a high priority for either type of acquisition.

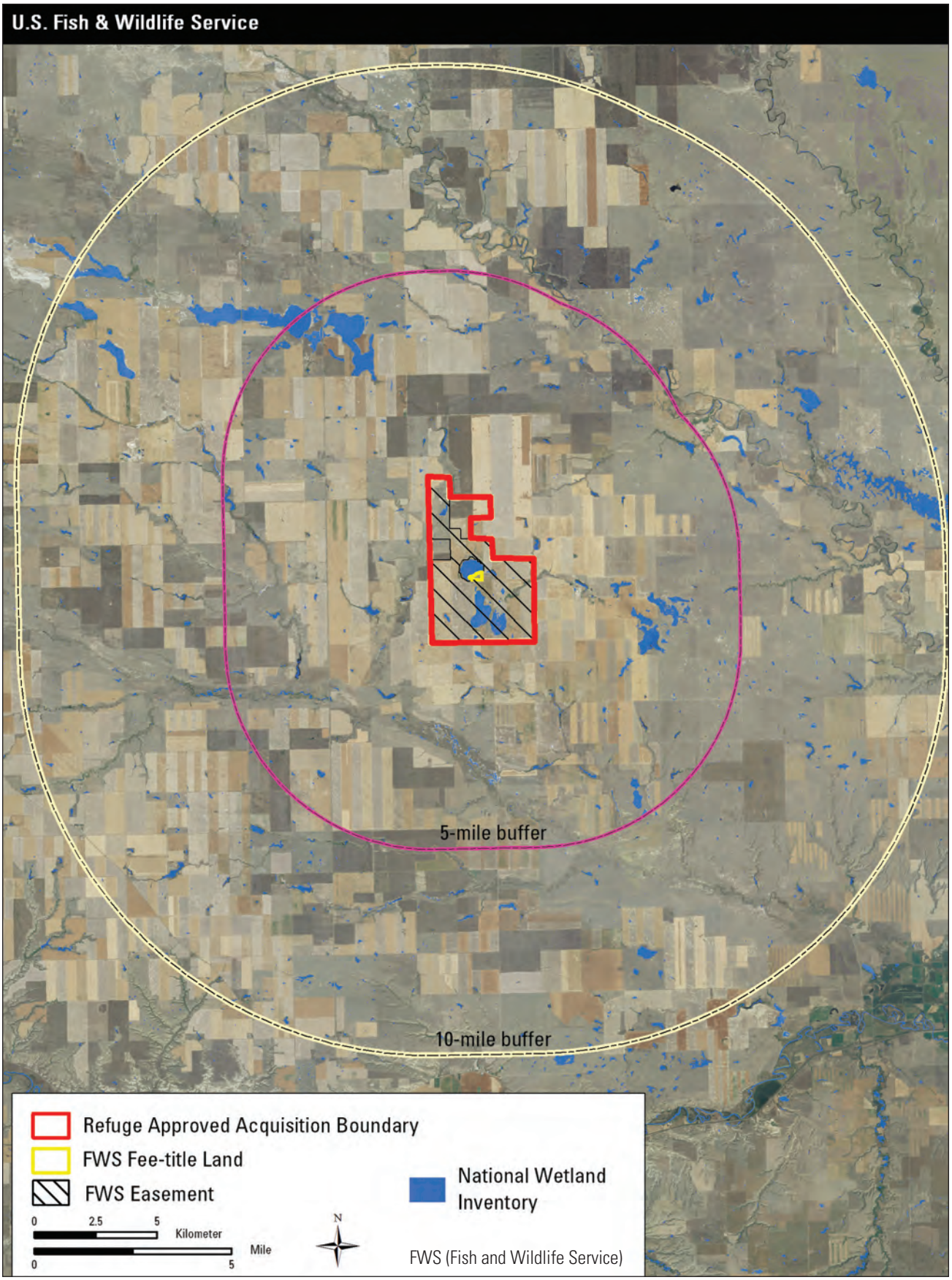

Figure 49. Map of wetlands within 10 miles of Lake Thibadeau National Wildlife Refuge, Montana.

4b. Does the Service have or can it reasonably acquire the right to restore the habitat?

Answer: No.

Justification: The upland habitat is more than 90-percent cropland. Acquiring this land for restoration would not only be expensive, but biological restoration of native prairie in a mixed-grass prairie ecosystem is very difficult. The moisture regime that defines the prairie is arid, so establishing a full complement of prairie species is not likely. Native vegetation exists, but the value has been reduced due to the introduction of invasive plants and the loss of ecological functions.

The Service's water right for the refuge may be enough to provide open-water habitat for migratory birds, given several consecutive good water years. The process to exercise these rights would require an evaluation to determine the extent of retained Service water by dams or diversions in the upstream watersheds. Water rights in north-central Montana are not only very valuable but a necessity for the ranching lifestyle. If the Service were to spend the time and resources trying to pursue this water right, the results would not be worth the effort and would most likely create a legal water rights debate with the upstream landowners. Moreover, restoration of the wetland habitat alone will not raise the level of the biological diversity to achieve the purpose of this refuge.

Expenditure of money to restore biological diversity of critical migratory bird habitat would not be a priority in this location of the refuge complex. There are other areas of higher priority that still have some elements of biological diversity.

5. Does the refuge contribute to landscape conservation, provide a stepping stone for migratory birds, or serve as a unique habitat patch important to the conservation of a trust species?

Answer: No.

Justification: Lake Thibadeau National Wildlife Refuge is not the only water source in the area (see figure 14 in chapter 2). It does not contribute to landscape conservation and is not important for trust species, because it is identical to the surrounding landscape. If the refuge did not exist, migratory birds would not be affected. Creedman Coulee National Wildlife Refuge and other wetlands and stock ponds in the vicinity provide for migrating birds.

Secondary Criteria

These last three questions, although secondary criteria, are also part of the divestiture evaluation.

6. Politics/Community—Is there such significant community interest in and support for the refuge that divestiture would result in unacceptable long-term public relations?

Answer: No.

Justification: All of the landowners holding title to land within the refuge boundary are active ranchers or farmers. It is unlikely that they would be willing to sell the land to the Service as they rely on it to make their living.

7. Jurisdiction—Does the Service have or can it acquire the jurisdiction to meet the refuge's purpose and Refuge System mission and goals and also prevent incompatible uses?

Answer: No.

Justification: Refer to the above justifications for answers to 4a and 4b.

8. Other Land Manager—Could some other party achieve most or all of the purposes of the refuge without the Service having to incur costs?

Answer: No.

Justification: Refer to the above justifications for answers to 4a and 4b.

Additional Considerations

Justification: The dam and water control devises were last inspected in 2007. The diversion dam, which has been designated as a low-hazard dam, received a good evaluation with minor deficiencies. The remaining dams and water control structures would require extensive repair and replacement to bring the system to a functioning level. This repair would be costly to the Service for minimal benefit.

Rules

Five rules organize the answers to the criteria questions and are for determining whether to consider a national wildlife refuge for divestiture.

Rule 1: IF the refuge cannot meet one or more Refuge System goals, the refuge should be considered for divestiture.

This is the rule that applies to Lake Thibadeau National Wildlife Refuge.

Since rule 1 is definitive for Lake Thibadeau Refuge, there is no need to apply the other four rules. If rule 1 did not apply, a refuge would be further evaluated using rules 2–5, which address how well a refuge meets the Refuge System goals and refuge purposes, how well a refuge supports trust species, if a refuge possesses biological integrity and connectivity, and if the Service has jurisdiction.

E.2 Justification

Based on the Service's evaluation using the Mountain–Prairie Region's divestiture model, Lake Thibadeau National Wildlife Refuge should be considered for divestiture. Specifically, under rule 1, the refuge did not meet one or more of the Refuge System goals and, therefore, should be considered for divestiture. The refuge does not meet or minimally meets the refuge purpose. Furthermore, the refuge does not substantially support trust species and does not possess biological integrity.

Appendix F

Species Lists

This appendix contains the common and scientific names of animals and plants of the Bowdoin National Wildlife Refuge Complex. The amphibians, reptiles, and mammals have ranges that encompass the refuge complex. The bird and plant lists are from actual sightings and surveys at the Bowdoin National Wildlife Refuge. Species of concern were determined from global, Federal, and State of Montana listings (Montana Natural Heritage Program 2009a, 2009b).

F.1 List of Amphibian and Reptile Species

The following amphibian and reptile list is based on refuge complex files and listings on the Montana Natural Heritage Program Web site for Phillips, Blaine, and Hill counties. The taxonomic order follows Werner et al. (2004).

Common Name	*Scientific Name*	*Designation*
SALAMANDERS		
Tiger salamander	*Ambystoma tigrinum*	—
FROGS and TOADS		
Plains spadefoot toad	*Spea bombifrons*	Species of concern
Great Plains toad	*Bufo cognatus*	Species of concern
Woodhouse's toad	*Bufo woodhousii*	—
Boreal chorus frog	*Pseudacris maculata*	—
Northern leopard frog	*Rana pipiens*	Species of concern
TURTLES		
Painted turtle	*Chrysemys picta*	—
Spiny softshell	*Apalone spinifera*	Species of concern
LIZARDS		
Greater short-horned lizard	*Phrynosoma hernandesi*	Species of concern
Common sagebrush lizard	*Sceloporus graciosus*	Species of concern
SNAKES		
Eastern racer	*Coluber constrictor*	—
Western hognose snake	*Heterodon nasicus*	Species of concern
Milk snake	*Lampropeltis triangulum*	Species of concern
Gopher snake *or* bullsnake	*Pituophis catenifer*	—
Terrestrial garter snake	*Thamnophis elegans*	—
Plains garter snake	*Thamnophis radix*	—
Common garter snake	*Thamnophis sirtalis*	—
Western rattlesnake	*Crotalus viridis*	—

F.2 List of Fish Species

The following fish list is based on surveys of Beaver Creek and the Bowdoin National Wildlife Refuge intake canal (2000–2003) and staff observations.

Common	*Scientific*	*Designation*
Goldeye	*Hiodon alosoides*	—
Brassy minnow	*Hybognathus hankinsoni*	Potential species of concern
Common carp	*Cyprinus carpio*	Exotic species (not native to Montana)
Spottail shiner	*Notropis hudsonius*	Exotic species (not native to Montana)
Fathead minnow	*Pimephales promelas*	—
River carpsucker	*Carpiodes carpio*	—
White sucker	*Catostomus commersoni*	—
Black bullhead	*Ameiurus melas*	Exotic species (not native to Montana)
Brook stickleback	*Culaea inconstans*	Potential species of concern
Black crappie	*Pomoxis nigromaculatus*	Exotic species (not native to Montana)
Iowa darter	*Etheostoma exile*	Potential species of concern
Yellow perch	*Perca flavescens*	Exotic species (not native to Montana)
Bigmouth buffalo	*Ictiobus cyprinellus*	—
Pumpkinseed	*Lepomis gibbosus*	Exotic species (not native to Montana)
Smallmouth bass	*Micropterus dolomieu*	Exotic species (not native to Montana)
Northern pike	*Esox lucius*	—

F.3 List of Bird Species

The following bird list is based on the Bowdoin National Wildlife Refuge bird list (July 2008); all species have been observed on the refuge. Species names are in accordance with the Montana Natural Heritage Program Web site (Montana Natural Heritage Program 2009a, 2009b). A "B" indicates local breeders, and focal bird species were determined from the focal species strategy of the 2005 U.S. Fish and Wildlife Service Migratory Bird Program.

Common Name	*Scientific Name*	*Designation*
LOONS		
Common loon	*Gavia immer*	Species of concern
GREBES		
Pied-billed grebe	*Podylimbus podiceps*	B
Horned grebe	*Podiceps auritus*	Species of concern, B
Red-necked grebe	*Podiceps grisegena*	—
Eared grebe	*Podiceps nigricollis*	B
Western grebe	*Aechmophorus occidentalis*	B
Clark's grebe	*Aechmophorus clarkii*	Species of concern, B
PELICANS		
American white pelican	*Pelecanus erythrorhynchos*	Species of concern, B
CORMORANTS		
Double-crested cormorant	*Phalacrocorax auritus*	Focal species, B
HERONS		
American bittern	*Botaurus lentiginosus*	Species of concern, B
Great blue heron	*Ardea herodias*	Species of concern, B
Great egret	*Ardea alba*	—
Snowy egret	*Egretta thula*	—
Cattle egret	*Bubulcus ibis*	—
Black-crowned night-heron	*Nycticorax nycticorax*	Species of concern, B
IBIS		
White-faced ibis	*Plegadis chihi*	Species of concern, B
GEESE		
Greater white-fronted goose	*Anser albifrons*	—
Snow goose	*Chen caerulescens*	—
Ross' goose	*Chen rossii*	—
Canada goose	*Branta canadensis*	B
SWANS		
Tundra swan	*Cygnus columbianus*	—
DUCKS		
Wood duck	*Aix sponsa*	Focal species, B
Gadwall	*Anas strepera*	B
Eurasian wigeon	*Anas penelope*	—
American wigeon	*Anas americana*	Focal species, B
Mallard	*Anas platyrhynchos*	Focal species, B

Common Name	Scientific Name	Designation
Blue-winged teal	*Anas discors*	B
Cinnamon teal	*Anas cyanoptera*	B
Northern shoveler	*Anas clypeata*	B
Northern pintail	*Anas acuta*	Focal species, B
Green-winged teal	*Anas crecca*	B
Canvasback	*Aythya valisineria*	B
Redhead	*Aythya americana*	B
Ring-necked duck	*Aythya collaris*	—
Greater scaup	*Aythya marila*	Focal species
Lesser scaup	*Aythya affinis*	Focal species, B
White-winged scoter	*Melanitta fusca*	Focal species
Long-tailed duck	*Clangula hyemalis*	—
Bufflehead	*Bucephala albeola*	B
Common goldeneye	*Bucephala clangula*	B
Barrow's goldeneye	*Bucephala islandica*	Potential species of concern
Hooded merganser	*Lophodytes cucullatus*	Potential species of concern
Common merganser	*Mergus merganser*	—
Red-breasted merganser	*Mergus serrator*	—
Ruddy duck	*Oxyura jamaicensis*	B
NEW WORLD VULTURES		
Turkey vulture	*Cathartes aura*	—
HAWKS and EAGLES		
Osprey	*Pandion haliaetus*	—
Bald eagle	*Haliaeetus leucocephalus*	Species of concern
Northern harrier	*Circus cyaneus*	B
Sharp-shinned hawk	*Accipiter striatus*	—
Cooper's hawk	*Accipiter cooperii*	—
Northern goshawk	*Accipiter gentilis*	Species of concern
Broad-winged hawk	*Buteo platypterus*	—
Swainson's hawk	*Buteo swainsoni*	Species of concern, B
Red-tailed hawk	*Buteo jamaicensis*	B
Ferruginous hawk	*Buteo regalis*	Species of concern, focal species, B
Rough-legged hawk	*Buteo lagopus*	—
Golden eagle	*Aquila chrysaetos*	Species of concern
FALCONS		
American kestrel	*Falco sparverius*	B
Merlin	*Falco columbarius*	—
Peregrine falcon	*Falco peregrinus*	Species of concern, focal species
Prairie falcon	*Falco mexicanus*	—
GALLINACEOUS BIRDS		
Gray partridge	*Perdix perdix*	Exotic (not native to Montana, introduced) species, B
Ring-necked pheasant	*Phasianus colchicus*	Exotic (not native to Montana, introduced) species, B

Common Name	Scientific Name	Designation
Greater sage-grouse	*Centrocercus urophasianus*	Species of concern, B
Sharp-tailed grouse	*Tympanuchus phasianellus*	Species of concern, B
Wild turkey	*Meleagris gallopavo*	Exotic (not native to Montana) species
RAILS		
Yellow rail	*Coturnicops noveboracensis*	Species of concern, focal species
Virginia rail	*Rallus limicola*	B
Sora	*Porzana carolina*	B
American coot	*Fulica americana*	B
CRANES		
Sandhill crane	*Grus canadensis*	B
PLOVERS		
Black-bellied plover	*Pluvialis squatarola*	—
American golden-plover	*Pluvialis dominica*	—
Snowy plover	*Charadrius alexandrinus*	Focal species
Semipalmated plover	*Charadrius semipalmatus*	—
Piping plover	*Charadrius melodus*	Threatened species, species of concern, focal species, B
Killdeer	*Charadrius vociferous*	B
Mountain plover	*Charadrius montanus*	Species of concern. focal species
STILTS and AVOCETS		
Black-necked stilt	*Himantopus mexicanus*	Species of concern, B
American avocet	*Recurvirostra americana*	B
SANDPIPERS		
Greater yellowlegs	*Tringa melanoleuca*	—
Lesser yellowlegs	*Tringa flavipes*	—
Solitary sandpiper	*Tringa solitaria*	—
Willet	*Tringa semipalmatus*	B
Spotted sandpiper	*Actitis macularia*	B
Upland sandpiper	*Bartamia longicauda*	Focal species, B
Whimbrel	*Numenius phaeopus*	—
Long-billed curlew	*Numenius americanus*	Species of concern. focal species, B
Hudsonian godwit	*Limosa haemastica*	Focal species
Marbled godwit	*Limosa fedoa*	Focal species, B
Ruddy turnstone	*Arenaria interpres*	—
Red knot	*Calidris canutus*	—
Sanderling	*Calidris alba*	—
Semipalmated sandpiper	*Calidris pusilla*	—
Western sandpiper	*Calidris mauri*	—
Least sandpiper	*Calidris minutilla*	—
White-rumped sandpiper	*Calidris fuscicollis*	—
Baird's sandpiper	*Calidris bairdii*	—
Pectoral sandpiper	*Calidris melanotos*	—
Stilt sandpiper	*Calidris himantopus*	—

Common Name	Scientific Name	Designation
Short-billed dowitcher	*Limnodromus griseus*	—
Long-billed dowitcher	*Limnodromus scolopaceus*	—
Wilson's snipe	*Gallinago delicata*	B
PHALAROPES		
Wilson's phalarope	*Phalaropus tricolor*	Focal species, B
Red-necked phalarope	*Phalaropus lobatus*	—
GULLS		
Franklin's gull	*Leucophaeus pipixcan*	Species of concern, B
Bonaparte's gull	*Chroicocephalus philadelphia*	—
Ring-billed gull	*Larus delawarensis*	B
California gull	*Larus californicus*	B
Herring gull	*Larus argentatus*	—
TERNS		
Caspian tern	*Hydroprogne caspia*	Species of concern. focal species, B
Common tern	*Sterna hirundo*	Species of concern, focal species, B
Arctic tern	*Sterna paradisaea*	Focal species, B
Forster's tern	*Sterna forsteri*	Species of concern
Black tern	*Chlidonias niger*	Species of concern. focal species, B
DOVES		
Rock pigeon	*Columba livia*	Exotic (not native to Montana, introduced) species
Eurasian collared-dove	*Streptopelia decaocto*	Exotic (not native to Montana, introduced) species, B
Mourning dove	*Zenaida macroura*	Focal species, B
CUCKOOS		
Black-billed cuckoo	*Coccyzus erythropthalmus*	Species of concern, focal species, B
Yellow-billed cuckoo	*Coccyzus americanus*	Species of concern, focal species
OWLS		
Eastern screech-owl	*Megascops asio*	Species of concern, B
Great horned owl	*Bubo virginianus*	B
Snowy owl	*Bubo scandiaca*	—
Burrowing owl	*Athene cunicularia*	Species of concern. focal species, B
Long-eared owl	*Asio otus*	B
Short-eared owl	*Asio flammeus*	Potential species of concern, focal species, B
Northern saw-whet owl	*Aegolius acadicus*	Focal species
NIGHTJARS		
Common nighthawk	*Chordeiles minor*	B
HUMMINGBIRDS		
Ruby-throated hummingbird	*Archilochus colubris*	B
KINGFISHERS		
Belted kingfisher	*Megaceryle alcyon*	—

Common Name	Scientific Name	Designation
WOODPECKERS		
Red-headed woodpecker	*Melanerpes erythrocephalus*	Species of concern, focal species, B
Yellow-bellied sapsucker	*Sphyrapicus varius*	Focal species
Downy woodpecker	*Picoides pubescens*	B
Hairy woodpecker	*Picoides villosus*	B
Northern flicker (yellow-shafted)	*Colaptes auratus auratus*	B
Northern flicker (red-shafted)	*Colaptes auratus cafer*	B
FLYCATCHERS		
Western wood-pewee	*Contopus sordidulus*	B
Willow flycatcher	*Empidonax traillii*	B
Least flycatcher	*Empidonax minimus*	B
Say's phoebe	*Saynoris saya*	B
Western kingbird	*Tyrannus verticalis*	B
Eastern kingbird	*Tyrannus tyrannus*	B
SHRIKES		
Loggerhead shrike	*Lanius ludovicianus*	Species of concern. focal species, B
Northern shrike	*Lanius excubitor*	—
VIREOS		
Warbling vireo	*Vireo gilvus*	—
Red-eyed vireo	*Vireo olivaceus*	—
JAYS, MAGPIES, and CROWS		
Blue jay	*Cyanocitta cristata*	—
Black-billed magpie	*Pica hudsonia*	B
American crow	*Corvus brachyrhynchos*	—
Common raven	*Corvus corax*	—
LARKS		
Horned lark	*Eremophila alpestris*	B
SWALLOWS		
Tree swallow	*Tachycineta bicolor*	B
Northern rough-winged swallow	*Stelgidopteryx serripennis*	B
Bank swallow	*Riparia riparia*	B
Cliff swallow	*Petrochelidon pyrrhonota*	B
Barn swallow	*Hirundo rustica*	B
CHICKADEES		
Black-capped chickadee	*Poecile atricapillus*	B
Mountain chickadee	*Poecile gambeli*	—
NUTHATCHES		
Red-breasted nuthatch	*Sitta canadensis*	—

Common Name	Scientific Name	Designation
CREEPERS		
Brown creeper	*Certhia americana*	Species of concern
WRENS		
Rock wren	*Salpinctes obsoletus*	—
House wren	*Troglodytes aedon*	B
Winter wren	*Troglodytes troglodytes*	Species of concern
Marsh wren	*Cistothorus palustris*	B
KINGLETS		
Golden-crowned kinglet	*Regulus satrapa*	—
Ruby-crowned kinglet	*Regulus calendula*	—
THRUSHES		
Mountain bluebird	*Sialia currucoides*	—
Townsend's solitaire	*Myadestes townsendi*	—
Veery	*Catharus fuscescens*	Species of concern
Swainson's thrush	*Catharus ustulatus*	—
Hermit thrush	*Catharus guttatus*	—
American robin	*Turdus migratorius*	B
Varied thrush	*Ixoreus naevius*	—
THRASHERS		
Gray catbird	*Dumetella carolinensis*	—
Brown thrasher	*Toxostoma rufum*	B
Northern mockingbird	*Mimus carolinensis*	—
STARLINGS		
European starling	*Sturnus vulgaris*	Exotic (not native to Montana) species, B
PIPITS		
American (water) pipit	*Anthus rubescens*	—
Sprague's pipit	*Anthus spragueii*	Species of concern. focal species, B
WAXWINGS		
Bohemian waxwing	*Bombycilla garrulous*	—
Cedar waxwing	*Bombycilla cedrorum*	B
WARBLERS		
Tennessee warbler	*Vermivora peregrina*	Potential species of concern
Orange-crowned warbler	*Vermivora celata*	—
Yellow warbler	*Dendroica petechia*	B
Yellow-rumped warbler	*Dendroica coronata*	—
Townsend's warbler	*Dendroica townsendi*	—
Blackpoll warbler	*Dendroica striata*	—
American redstart	*Setophaga ruticilla*	—
Ovenbird	*Seiurus aurocapilla*	Species of concern
Northern waterthrush	*Seiurus noveboracensis*	—
Mourning warbler	*Oporornis philadelphia*	—
MacGillivray's warbler	*Oporornis tolmiei*	—

Common Name	Scientific Name	Designation
Common yellowthroat	*Geothlypis trichas*	B
Wilson's warbler	*Wilsonia pusilla*	—
Yellow-breasted chat	*Icteria virens*	—
TANAGERS		
Scarlet tanager	*Piranga olivacea*	—
Western tanager	*Piranga ludoviciana*	—
SPARROWS		
Spotted towhee	*Pipilo maculates*	B
American tree sparrow	*Spizella arborea*	—
Chipping sparrow	*Spizella passerina*	B
Clay-colored sparrow	*Spizella pallida*	B
Brewer's sparrow	*Spizella breweri*	Species of concern, B
Vesper sparrow	*Pooecetes gramineus*	B
Lark sparrow	*Chondestes grammacus*	B
Lark bunting	*Calamospiza melanocorys*	B
Savannah sparrow	*Passerculus sandwichensis*	B
Grasshopper sparrow	*Ammodramus savannarum*	Species of concern. focal species, B
Baird's sparrow	*Ammodramus bairdii*	Species of concern. focal species, B
Le Conte's sparrow	*Ammodramus leconteii*	Species of concern. focal species
Fox sparrow	*Passerelia iliaca*	—
Song sparrow	*Melospiza melodia*	B
Lincoln's sparrow	*Melospiza lincolnii*	—
White-throated sparrow	*Zonotrichia albicollis*	—
Harris' sparrow	*Zonotrichia querula*	—
White-crowned sparrow	*Zonotrichia leucophrys*	—
Golden-crowned sparrow	*Zonotrichia atricapilla*	—
Dark-eyed junco	*Junco hyemalis* subspp.	—
McCown's longspur	*Calcarius mccownii*	Species of concern, B
Lapland longspur	*Calcarius lapponicus*	—
Chestnut-collared longspur	*Calcarius ornatus*	Species of concern. focal species, B
Snow bunting	*Plectrophenax nivalis*	—
GROSBEAKS and BUNTINGS		
Rose-breasted grosbeak	*Pheucticus ludovicianus*	—
Black-headed grosbeak	*Pheucticus melanocephalus*	—
Lazuli bunting	*Passerina amoena*	—
BLACKBIRDS and ORIOLES		
Bobolink	*Dolichonyx oryzivorus*	Species of concern. focal species
Red-winged blackbird	*Agelaius phoeniceus*	B
Western meadowlark	*Sturnella neglecta*	B
Yellow-headed blackbird	*Xanthocephalus xanthocephalus*	B
Rusty blackbird	*Euphagus carolinus*	Focal species
Brewer's blackbird	*Euphagus cyanocephalus*	B
Common grackle	*Quiscalus quiscula*	B

Common Name	*Scientific Name*	*Designation*
Brown-headed cowbird	*Molothrus ater*	B
Baltimore oriole	*Icterus galbula*	B
Bullock's oriole	*Icterus bullockii*	B
FINCHES		
Pine grosbeak	*Pinicola enucleator*	—
Cassin's finch	*Carpodacus cassinii*	Species of concern
House finch	*Carpodacus mexicanus*	B
Common redpoll	*Acanthis flammea*	—
Hoary redpoll	*Acanthis hornemanni*	—
Pine siskin	*Spinus pinus*	—
American goldfinch	*Spinus tristis*	B
Evening grosbeak	*Coccothraustes vespertinus*	—
OLD WORLD SPARROWS		
House sparrow	*Passer domesticus*	Exotic (not native to Montana) species, B

F.4 List of Mammal Species

Common Name	Scientific Name	Designation
SHREWS		
Masked shrew	*Sorex cinereus*	—
Merriam's shrew	*Sorex merriami*	Species of concern
Preble's shrew	*Sorex preblei*	Species of concern
BATS		
Little brown myotis	*Myotis lucifugus*	—
Silver-haired bat	*Lasionycteris noctivagans*	Potential species of concern
Big brown bat	*Eptesicus fuscus*	—
Townsend's big-eared bat	*Corynorhinus townsendii*	Species of concern
Hoary bat	*Lasiurus cinereus*	Species of concern
Western small-footed myotis	*Myotis ciliolabrum*	—
Western long-eared myotis	*Myotis evotis*	—
Spotted bat	*Euderma maculatum*	Species of concern
Eastern red bat	*Lasiurus borealis*	Species of concern
Fringed myotis	*Myotis thysanodes*	Species of concern
Long-legged myotis	*Myotis volans*	—
Yuma myotis	*Myotis yumanensis*	Potential species of concern
HARES and RABBITS		
Mountain cottontail	*Sylvilagus nuttallii*	—
White-tailed jackrabbit	*Lepus townsendii*	—
Snowshoe hare	*Lepus americanus*	—
SQUIRRELS		
Richardson's ground squirrel	*Spermophilus richardsonii*	—
POCKET GOPHERS		
Northern pocket gopher	*Thomomys talpoides*	—
BEAVERS		
Beaver	*Castor canadensis*	—
MICE, RATS, and VOLES		
Western harvest mouse	*Reithrodontomys megalotis*	—
White-footed mouse	*Peromyscus leucopus*	—
Deer mouse	*Peromyscus maniculatus*	—
House mouse	*Mus musculus*	Exotic species (not native to Montana)
Meadow vole	*Microtus pennsylvanicus*	—
Prairie vole	*Microtus ochrogaster*	—
Western jumping mouse	*Zapus princeps*	—
Meadow jumping mouse	*Zapus hudsonius*	Species of concern
Bushytail woodrat	*Neotoma cinerea*	—
Muskrat	*Ondatra zibethicus*	—

Common Name	Scientific Name	Designation
NEW WORLD PORCUPINES		
Porcupine	*Erethizon dorsatum*	—
CANIDS		
Coyote	*Canis latrans*	—
Red fox	*Vulpes vulpes*	—
Swift fox	*Vulpes velox*	Species of concern
FELIDS		
Bobcat	*Lynx rufus*	—
Mountain lion	*Felis concolor*	—
PROCYONIDS		
Raccoon	*Procyon lotor*	—
MUSTELIDS		
Long-tailed weasel	*Mustela frenata*	—
Least weasel	*Mustela nivalis*	—
Mink	*Mustela vison*	—
Badger	*Taxidea taxus*	—
MEPHITIDS		
Striped skunk	*Mephitis mephitis*	—
CERVIDS		
Mule deer	*Odocoileus hemionus*	—
White-tailed deer	*Odocoileus virginianus*	—
Elk	*Cervus canadensis*	—
Moose	*Alces alces*	—
PRONGHORN		
Pronghorn	*Antilocapra americana*	—

F.5 List of Plant Species

Common Name	Scientific Name
Alfalfa	*Medicago sativa*
Alkali bulrush	*Scirpus maritimus*
Alkali sacaton	*Sporobolus airoides*
American sloughgrass	*Beckmania syzigachne*
American vetch	*Vicia americana*
Arum-leaved arrowhead	*Sagittaria cuneata*
Balkan catchfly	*Silene csereii*
Barnyard grass	*Echinochloa crusgalli*
Beaked sedge	*Carex rostrata*
Bigbract verbena	*Verbena bracteata*
Birch	*Betula papyrifera*
Black bindweed	*Polygonum convovulus*
Black medick	*Medicago lupulina*
Bluebunch wheatgrass	*Pseudoroegneria spicata*
Blue grama	*Bouteloua gracilis*
Blue lettuce	*Lactuca pulchella*
Bottlebrush grass	*Elymus hystrix*
Boxelder	*Acer negundo*
Box knotweed	*Polygonum buxiforme*
Broad-leaf arrowhead	*Sagittaria latifolia*
broom snakeweed	*Gutierrezia serothrae*
Buffaloberry	*Shepherdia argentea*
Buffalograss	*Buchloe dactyloides*
Bull thistle	*Cirsium vulgare*
Bushy knotweed	*Polygonum ramosissimum*
Butter and eggs	*Linaria vulgaris*
Canadian waterweed	*Elodea canadensis*
Canada thistle	*Cirsium arvense*
Canada wild rye	*Elymus canadensis*
Cheatgrass	*Bromus tectorum*
Chokecherry	*Prunus virginiana*
Clasping pepperweed	*Lepidium perfoliatum*
Common bladderwort	*Utricularia vulgaris*
Common cattail	*Typha latifolia*
Common mallow	*Malva neglecta*
Common plantain	*Plantago major*
Common ragweed	*Ambrosia artemisiifolia*
Coontail	*Ceratophyllum demersum*
Crested wheatgrass	*Agropyron cristatum*
Curlycup gumweed	*Grindelia squarrosa*
Cutleaf goldenweed	*Haplopappus spinulosus*

Common Name	Scientific Name
Dandelion	*Taraxacum officianale*
Dewey sedge	*Carex deweyana*
Dotted blazingstar	*Liatris punctata*
Eaton's aster	*Symphyotrichum eatonii*
English plantain	*Plantago lanceolata*
European bur-reed	*Sparganium emersum*
Field bindweed	*Convolvulus arvensis*
Field chickweed	*Cerastium arvense*
Field horsetail	*Equisetum arvense*
Field pennycress	*Thlaspi arvense*
Fireweed	*Chamerion angustifolium*
Flatspine stickseed	*Lappula occidentalis*
Foothill arnica	*Arnica fulgens*
Foxtail barley	*Hordeum jubatum*
Fries' pondweed	*Potamogeton friesii*
Fringed loosestrife	*Lysimachia ciliata*
Fringed sagewort	*Artemisia frigida*
Giant goldenrod	*Solidago gigantea*
Giant red Indian paint-brush	*Castilleja miniata*
Golden currant	*Ribes odoratum*
Golden dock	*Rumex maritimus*
Goosefoot	*Chenopodium* spp.
Greasewood	*Sarcobatus vermiculatus*
Green ash	*Fraxinus pennsylvanica*
Green foxtail	*Setaria viridis*
Green needlegrass	*Stipa viridula*
Green sagewort	*Artemesia dracunculus*
Hairy evening-primrose	*Oenothera strigosa*
Hairy golden-aster	*Chrysopsis villosa*
Hardstem bulrush	*Scirpus acutus*
Heliotrope	*Heliotropium curassavicum*
Horsemint	*Monarda stricta*
Horsetail	*Equisetum fluviatile*
Inland saltgrass	*Distichlis spicata*
Jacob's ladder	*Polemonium pulcherrimum*
Japanese brome	*Bromus japonicus*
Juniper	*Juniperus communis*
Kentucky bluegrass	*Poa pratensis*
Kochia	*Kochia scoparia*
Lambstongue ragwort	*Senecio integerrimus*

Common Name	Scientific Name
Leafy spurge	*Euphorbia esula*
Lupine	*Lupinus flexuosus*
Macoun's buttercup	*Ranunculus macounii*
Many-flowered aster	*Symphyotrichum ericoides*
Maximilian sunflower	*Helianthus maximilianii*
Missouri goldenrod	*Solidago missouriensis*
Musk mallow	*Malva moschata*
Narrow-leaf water plantain	*Alisma gramineum*
Narrow-leaved collomia	*Collomia linearis*
Narrow-leaved milkvetch	*Astragalus pectinatus*
Needle and thread	*Stipa comata*
Needle spikerush	*Eleocharis acicularis*
Nodding brome	*Bromus anomalus*
Nodding chickweed	*Cerastium nutans*
Nodding smartweed	*Polygonum lapathifolium*
Northern bedstraw	*Galium boreale*
Orchardgrass	*Dactylis glomerata*
Pale spikerush	*Eleocharis macrostachya*
Pasqueflower	*Pulsatilla patens*
Perennial sowthistle	*Sonchus arvensis*
Pigweed	*Amaranthus retroflexus*
Plains cottonwood	*Populus deltoides*
Ponderosa pine	*Pinus ponderosa*
Povertyweed	*Iva axillaris*
Prairie coneflower	*Ratibida columnifera*
Prairie Junegrass	*Koeleria macrantha*
Prairie rose	*Rosa arkansana*
Prickly pear	*Opuntia polycantha*
Prickly lettuce	*Lactuca serriola*
Proso millet	*Panicum miliaceum*
Prostrate knotweed	*Polygonum aviculare*
Purple prairie clover	*Dalea purpurea*
Purplestem aster	*Symphyotrichum puniceum*
Quackgrass	*Agropyron repens*
Redtop	*Agrostis stolonifera*
Reed canarygrass	*Phalaris arundinacea*
Richardson's pondweed	*Potamogeton richardsonii*
Ridgeseed spurge	*Chamaesyce glyptosperma*
Rocky Mountain beeplant	*Cleome serrulata*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Rush skeletonweed	*Lygodesmia juncea*
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola iberica*
Sago pondweed	*Potamogeton pectinatus*

Common Name	Scientific Name
Sandbar willow	*Salix interior*
Sandberg bluegrass	*Poa secunda*
Scarlet gaura	*Gaura coccinea*
Scarlet globemallow	*Sphaeralcea coccinea*
Scratchgrass	*Muhlenbergia asperifolia*
Seaside arrowgrass	*Triglochin maritima*
Shortbeak sedge	*Carex brevior*
Showy milkweed	*Asclepias speciosa*
Silver sage	*Artemisia cana*
Silverweed cinquefoil	*Argentina anserina*
Silver cinquefoil	*Potentilla argentea*
Slender lip fern	*Cheilanthes feei*
Slender pondweed	*Potamogeton filiformis*
Silverleaf scurfpea	*Psoralea argophylla*
Small pondweed	*Potamogeton pusilus*
Smartweed	*Polygonum persicaria*
Smooth brome	*Bromus inermis*
Spotted knapweed	*Centaurea stoebe*
Spreading dogbane	*Apocynum androsaemifolium*
Stiff goldenrod	*Oligoneuron rigidum*
Stiff sunflower	*Helianthus pauciflorus*
Stinkgrass	*Eragrostis cilianensis*
Threadleaf crowfoot	*Ranunculus trichophyllus*
Three-square bulrush	*Schoenoplectus pungens*
Timothy	*Phleum pretense*
Tufted phlox	*Phlox caespitosa*
Tumblemustard	*Sisymbrium altissimum*
Watermilfoil	*Myriophyllum exalbescena*
Water plantain	*Alisma plantago-aquatica*
Water starwort	*Collitriche hermadroditica*
Wavyleaf thistle	*Cirsium undulatum*
Western clamy weed	*Polanisia trachysperma*
Western snowberry	*Symphoricarpos occidentalis*
Western waterweed	*Anacharis occidentalis*
Western wheatgrass	*Agropyron smithii*
Western white clematis	*Clematis ligusticifolia*
Western wild rose	*Rosa woodsii*
Western wild-rye	*Elymus glavcus*
Western yarrow	*Achillea millefolium*
White cinquefoil	*Potentilla arguta*
White prairie aster	*Aster ericoides*
White sage	*Artemesia ludoviciana*
Whitetop	*Cardaria draba*

Common Name	Scientific Name
Widgeongrass	*Ruppia maitima*
Wild asparagus	*Asparagus officianalis*
Wild buckwheat	*Polygonum convolvulus*
Wild daisy, fleabane	*Erigeron glabellus*
Wild licorice	*Glyzerhiza lepidata*
Wild mint	*Nemtha arvensis*
Wild mustard	*Brassica kaber*
Wild oats	*Averia fatua*
Wild onion	*Allium textile*
Willow	*Salix* spp.
Wire rush	*Juncus balticus*
Wolf berry	*Symphoricarpos orbiculatus*
Woolly plantain	*Plantago patagonica*
Yellow sweetclover	*Melilotus officinalis*
Yellow umbrella plant	*Eriogonum flavum*

Appendix G

Fire Management Program

The Service has administrative responsibility for fire management at Bowdoin National Wildlife Refuge and Bowdoin Wetland Management District, which covers 24,915 acres. Additional fire responsibilities cover the satellite refuges—Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges—which total 1,458 fee-title acres.

G.1 The Role of Fire

In ecosystems of the Great Plains, vegetation has evolved under periodic disturbance and defoliation from grazing, fire, drought, and floods. This periodic disturbance is what kept the ecosystem diverse and healthy while maintaining significant biodiversity for thousands of years.

Historically, natural fire and fires started by Native Americans have played an important disturbance role in many ecosystems by removing fuel accumulations, decreasing the impact of insects and diseases, stimulating regeneration, recycling nutrients, and providing a diversity of habitats for plants and wildlife.

When fire or grazing is excluded from prairie landscapes, the fuel load increases due to the buildup of thatch and expansion of woody vegetation. This increase in fuel loading leads to an increase in a fire's resistance to control, which threatens firefighter and public safety as well as Federal and private lands and facilities. However, fire when properly used can do the following:

- Reduce hazardous fuel buildup in both wildland-urban interface and non–wildland-urban interface areas
- Improve wildlife habitats by reducing the density of vegetation or changing the plant species composition, or both
- Sustain or increase biological diversity
- Improve woodland and shrubland by reducing plant density
- Reduce susceptibility of plants to insect and disease outbreaks
- Improve the quality and quantity of livestock forage
- Increase the quantity of water available for municipalities and activities dependent on water supplies from wildlands

G.2 Wildland Fire Management Policy and Guidance

Based on Federal interagency policy (Fire Executive Council 2009), wildland fire is defined as any nonstructure fire that occurs in the wildland including wildfire and prescribed fire. Response to wildland fire is based on consideration of a full range of fire management actions—allowing the fire to benefit the resource where possible or taking suppression action when those benefits are not attainable or there is a likely risk to important resources or adjacent lands.

Considerations, guidance, and direction for wildland fire management should be addressed in the land use resource plans (for example, this CCP). Fire management plans are stepdown processes from the land use plans and habitat plans and provide details about fire suppression, fire use, and fire management activities.

The 1995 Federal Fire Policy Wildland Fire Management Policy was updated in 2001. This revised 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. The following guiding principles and policy statements are excerpted from this document titled Review and Update of the 1995 Federal Wildland Fire Management Policy; these are the foundational principles for Federal wildland fire management policy.

Guiding Principles

1. Firefighter and public safety is the first priority in every fire management activity.

2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the planning process.
   Federal agency land and resource management plans set the objectives for the use and desired future condition of the various public lands.

3. Fire management plans, programs, and activities support land and resource management plans and their implementation.

4. Sound risk management is a foundation for all fire management activities.
   Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity. Net gain in public benefit will be an important component of decisions.

5. Fire management programs and activities are economically viable, based on values to be protected, costs, and land and resource management objectives.
   Federal agency administrators are adjusting and reorganizing programs to reduce costs and increase efficiencies. As part of this process, investments in fire management activities must be evaluated against other agency programs to effectively accomplish the overall mission, set short- and long-term priorities, and clarify management accountability.

6. Fire management plans and activities are based on the best available science.
   Knowledge and experience are developed among all Federal wildland fire management agencies. An active fire research program combined with interagency collaboration provides the means to make these tools available to all fire managers.

7. Fire management plans and activities incorporate public health and environmental quality considerations.

8. Federal, State, tribal, local, interagency, and international coordination and cooperation are essential.
   Increasing costs and smaller workforces require that public agencies pool their human resources to successfully deal with the ever-increasing and more complex tasks of fire management. Full collaboration among Federal wildland-fire management agencies and between these agencies and international, State, tribal, and local governments and private entities results in a mobile fire management workforce available for the full range of public needs.

9. Standardization of policies and procedures among Federal wildland-fire management agencies is an ongoing objective.
   Consistency of plans and operations provides the fundamental platform on which these agencies can cooperate, integrate fire activities across agency boundaries, and provide leadership for cooperation with State, tribal, and local fire management organizations.

G.3 Management Direction

The Bowdoin National Wildlife Refuge Complex and the Eastern Montana Fire District will protect life, property, and other resources by safely suppressing all wildfires.

Prescribed fire, as well as manual and mechanical fuel treatments, would be used in an ecosystem context to protect both Federal and private property and for habitat management purposes. Fuel reduction activities would be applied in collaboration with Federal, State, private, and nongovernmental partners. In addition, the Service would set priorities for fuel treatment based on guidance for prioritization established in the goals and strategies outlined in the following documents: (1) "U.S. Fish and Wildlife Service National Wildlife Refuge System Wildland Fire Management Program Strategic Plan 2003–2010"; and (2) "Region 6 Refuges Regional Priorities FY07–11." For wildland-urban interface treatments, areas with community wildfire protection plans and designated "communities at risk" would be the primary focus. The only community at risk near the refuge complex, as identified in the Federal Register, is the town of Malta. The development of the community wildfire-protection plan for Malta is a current, ongoing process.

All aspects of the fire management program would be conducted consistent with applicable laws, policies, and regulations. Bowdoin National Wildlife Refuge Complex would maintain a fire management plan to accomplish the fire management goals described below. Prescribed fire and manual and

mechanical fuel treatments would be applied in a scientific way under selected weather and environmental conditions.

Fire Management Goals

Fire management goals are set at national, regional, and local levels.

National Fire Management Goals

The goals and strategies of the "U.S. Fish and Wildlife Service National Wildlife Refuge System Wildland Fire Management Program Strategic Plan" are consistent with the following guidance:

- Policies of the Department of the Interior and the Service
- National Fire Plan direction
- The President's Healthy Forest Initiative
- The 10-Year Comprehensive Strategy and Implementation Plan
- National Wildfire Coordinating Group Guidelines
- Initiatives of the Wildland Fire Leadership Council
- Interagency Standards for Fire and Aviation Operations

Regional Fire Management Goals

The "Region 6 Refuges Regional Priorities FY07–11" are consistent with the refuges' vision statement for the Mountain–Prairie Region, "to maintain and improve the biological integrity of the region, ensure the ecological condition of the region's public and private lands are better understood, and endorse sustainable use of habitats that support native wildlife and people's livelihoods."

Refuge Complex Fire Management Goals

The fire management goal for the Bowdoin National Wildlife Refuge Complex is to use prescribed fire and manual and mechanical treatments to (1) reduce the threat to life and property through hazardous-fuel reduction treatments, and (2) meet the habitat goals and objectives identified in this CCP.

Fire Management Objective

Fire is an important natural component in the maintenance and restoration of native prairie and wetland ecosystems, as well as tamegrasses planted for wildlife, such as dense nesting cover. The primary objective of the prescribed fire management program is to reduce fuel loads while restoring and maintaining native prairie and wetland habitats. Prescribed fire would be used to recycle nutrients, reduce or eliminate invasive plants, increase the growth and production of native plants, improve wildlife habitat and nesting cover for migratory birds, and reduce the risk of wildfire.

Achieving this objective would require burning between 500 and 2,000 acres of upland and wetland habitats annually, until every acre has been burned at least once. However, according to the literature, fire must be used cautiously in this arid climate. It is uncertain how often this area historically burned, particularly since the arid climate makes it slow to recover. To determine the need and frequency of using prescribed fire, the Service would review the historical weather patterns; the quality, diversity, and species of vegetation; the presence of invasive species; the habitat needs of target species; and the results of monitoring prior-treatment sites. It is possible that other habitat manipulations would be more appropriate to achieve desired objectives.

Strategies

Strategies and tactics that consider public and firefighter safety, as well as resource values at risk, would be used. Wildfire suppression, prescribed fire methods, manual and mechanical means, timing, and monitoring would be described in detail within the stepdown fire management plans for the refuge complex.

All fire management actions would use prescribed fire and manual or mechanical means to reduce hazardous fuels, restore and maintain desired habitat conditions, control nonnative vegetation, and control the spread of woody vegetation within the diverse ecosystem habitats. The fuel treatment program would be site specific and follow the most recent interagency template for burn plans.

A prescribed fire would temporarily decrease air quality by reducing visibility and releasing components through combustion. The refuge complex would meet the Clean Air Act emission standards by adhering to the Montana requirements during all prescribed fire activities.

G.4 Fire Management Organization, Contacts, and Cooperation

Using the fire management district approach, the Mountain–Prairie Region of the Service would establish qualified technical oversight of fire management for the refuge complex. Under this approach, the level of fire management staffing would be determined by established modeling systems and be based on the fire management workload of a group of refuges and possibly that of interagency partners. Workload is based on historical wildfire suppression activities as well as historical and planned fuel treatments.

Depending on budgets, fire management staff and support equipment may be located at the headquarters of the refuge complex or at other refuges within the district and shared between all units. Fire management activities would be conducted in a coordinated and collaborative manner with Federal and non-Federal partners.

On approval of this CCP, one or more fire management plans would be developed for the refuge complex. The fire management plans may be prepared as (1) plans that cover each individual refuge and wetland management district, (2) a plan that covers the area identified within this CCP, (3) a plan that covers the fire management district, or (4) an interagency fire management plan.

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