Comprehensive Conservation Plan

Bowdoin National Wildlife Refuge Complex

Montana

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Summary

The U.S. Fish and Wildlife Service has prepared a comprehensive conservation plan for the Bowdoin National Wildlife Refuge Complex in Montana. The Regional Director of the Mountain–Prairie Region of the Service selected the following alternatives from the draft comprehensive conservation plan and environmental assessment as the preferred alternatives, which have been combined to compose the final CCP:

- *Alternative B*—overall refuge complex management
- *Salinity Alternative 4*—underground injection and flushing by Beaver Creek (addresses salinity)
- *Lake Thibadeau Refuge Alternative 2*—divest Lake Thibadeau National Wildlife Refuge

The refuge complex covers 84,724 acres in north-central Montana, 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

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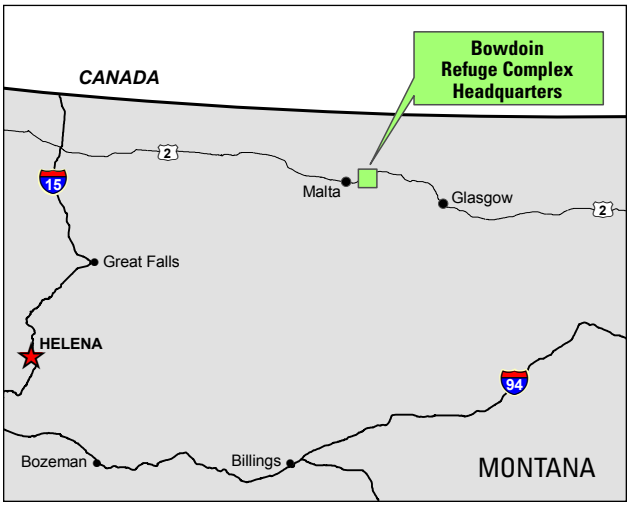
Chokecherry is a native shrub in the Bowdoin National Wildlife Refuge Complex.

The Refuge Complex

The Bowdoin National Wildlife Refuge Complex is 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.

The Bowdoin Refuge and waterfowl production areas in the Bowdoin District provide opportunities for the public to enjoy compatible wildlife-dependent public use activities such as hunting, fishing, wildlife observation, photography, environmental education, and interpretation.



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

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.

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Marbled godwit and long-billed curlew are shorebirds that nest in native prairie at the 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 Salinity and Blowing Salts

Develop a water management system on Bowdoin National Wildlife Refuge that protects the environment and mitigates current and future blowing salt concerns for neighboring properties, while providing quality water and wildlife habitat for migratory birds and other wetland-dependent wildlife.

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.

Management of the Refuge Complex

The comprehensive conservation plan directs the management of the Bowdoin Refuge Complex to meet the purposes of the refuge complex and address issues.

The plan is intended to be a broad umbrella of general concepts and specific objectives for wildlife, habitat, visitor services, and partnerships over the next 15 years. As the plan is implemented, the Service will develop stepdown plans with details for carrying out the actions needed to achieve objectives.

Habitat and Wildlife

The Service will conserve natural resources within the Bowdoin Refuge Complex by restoring, protecting, and enhancing native mixed-grass prairie and by maintaining quality wetland habitat for target migratory birds, such as northern pintail, and resident birds.

Uplands and Wetlands

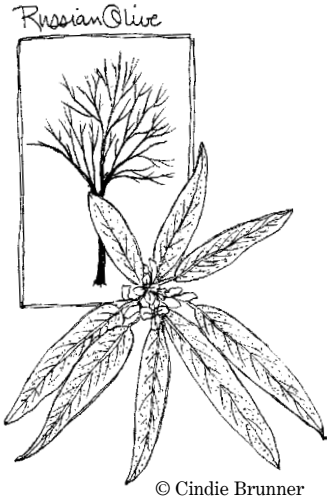
Native prairie areas and wetlands are the most productive habitat types in Montana, particularly in the Prairie Pothole Region. Historically, the northern Great Plains was a grassland-dominated system. This large expanse of treeless prairie has been fragmented by cropland, shelterbelts, human settlement, and the uncontrolled spread of nonnative Russian olive. Native mixed-grass prairie will be protected, restored, and enhanced to provide quality nesting habitat for targeted grassland-dependent birds.

Enhanced wetlands will be managed to mimic natural conditions for target wetland-dependent migratory birds during migrations and breeding.

In addition, 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.

Nonnative and Invasive Plants

Nonnative and invasive plants that are causing habitat losses and fragmentation will be controlled or eradicated. The refuge complex is constantly challenged to maintain its native grassland—critical to migratory birds—unfragmented by nonnative trees and shrubs. One of the most damaging species, Russian olive trees can take over and fragment native vegetation, interfere with nutrient cycling, damage water control structures and fences, and tax water reserves. These trees will be strategically removed and the treated sites will be monitored for reinvasion.



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The Service will conduct research to control crested wheatgrass, an invasive grass, and restore treated areas. Leafy spurge, perennial pepperweed, and Canada thistle are the primary invasive forb species. Left unmanaged, these species can have a detrimental effect on the diversity of native plants, wildlife, and habitat quality.

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. As water evaporates from Lake Bowdoin's closed system, salts become concentrated and water salinity increases. The progressively increasing salinity levels in Lake Bowdoin and the blowing salts out of Dry Lake threaten migratory birds and other wildlife, wetland habitats, and, potentially, neighboring landowners and downstream irrigators.

Management of salts at Bowdoin Refuge is tied to water management. To survive as a viable migratory bird refuge, Bowdoin National Wildlife Refuge needs more water and the means to reduce and dispose of saline water.

Long-term water management will be a flow-through system where the refuge receives a sufficient quantity of water that could eventually spill into Beaver Creek, carrying (flushing) with it a quantity of salts equal to what has entered the refuge. This system will allow salts to pass through the refuge rather than accumulating in Lake Bowdoin, which will minimize blowing salt events and improve wildlife habitat. 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.

The short-term target for salt management is to use management action—an underground injection well to force saline water deep into the ground—to remove sufficient salts so the Service can release wa-

Mike Artmann / USFWS

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

ter to Beaver Creek without significantly increasing the salinity of the creek water or negatively affecting downstream users. This will also prevent the salts in Lake Bowdoin from becoming extremely concentrated, which would negatively affect wetland habitat and wildlife.

Visitor Services

An estimated 25,000 visitors come to explore the Bowdoin Refuge Complex annually. A major attraction for wildlife observers and hunters, the refuge complex is also popular with local school groups.

Enhanced visitor services programs will provide more opportunity for visitors to learn about migratory shorebirds, waterfowl, and other wildlife species that rely on so many aspects of the native prairie. For self-guided visitors, the Bowdoin National Wildlife Refuge's auto tour route offers excellent opportunities, including an upcoming new observation site, for viewing and photographing wildlife. These opportunities will lead to a greater understanding of the importance of conserving migratory birds and the unique mixed-grass prairie and wetlands.

A sanctuary area, closed to all foot traffic, will be created for waterfowl on the east half of the Bowdoin Refuge during the hunting season. The Service will work with the State to investigate the potential for offering a safe, compatible, and quality big-game hunt at Bowdoin Refuge.

Partnerships and Operations

The Bowdoin Refuge Complex manages or protects 84,724 acres. The success of the plan's increased efforts and programs depends of the Service's ability to add staff and infrastructure, accomplish monitoring and research, and develop partnerships. The large size of the management area (four counties) requires long travel times for a limited staff. This makes it difficult to monitor units and conduct an effective habitat management program that can address challenging issues such as native grassland restoration.

Divestiture of Lake Thibadeau National Wildlife Refuge

The Service will divest the Lake Thibadeau National Wildlife Refuge because of its lack of habitat. This limited-interest refuge offers little value to wildlife, and the purposes for which this area was first established in 1937 are no longer attainable. Native prairie areas are now farmed intensively. Due to upstream development, Lake Thibadeau, Grassy Lake, and Mud Lake are often dry and farmed in most years. The Service owns less than 1 percent of the lands within the refuge's approved acquisition boundary; the remaining private lands are encumbered by easements that do not prohibit development, grazing, or agricultural uses.

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
ESFO	Ecological Services Field Office
°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 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
TSR	Township, section, range
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)
WMD	Wetland management district
WPA	Waterfowl production area

Definitions of these and other terms are in the glossary, located after chapter 4.

CHAPTER 1—Introduction

USFWS

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

The U.S. Fish and Wildlife Service (Service) has developed this final comprehensive conservation plan (CCP) to provide a foundation for the management and use of the Bowdoin National Wildlife Refuge Complex (refuge complex) in Montana for at least the next 15 years.

This chapter provides an introduction to the CCP with descriptions of the steps in the CCP planning process; the involvement of the Service, the State of Montana, the tribes, the public, and others; and other plans that may be affected or supported by the future management of the refuge complex.

The remainder of the document contains the information the Service used and the results of the Service's analysis that are the foundation of this final plan:

- Chapter 2 describes the refuge complex and planning issues.
- Chapter 3 describes the physical, biological, and social environments of the refuge complex.
- Chapter 4 describes objectives and strategies for all aspects of management of the refuge complex.
- The remaining document contains a glossary of terms, several appendixes, and a bibliography that support the information provided in the plan.

The Service manages the 84,724-acre refuge complex that is located 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 easements (refuge, flowage, wetland, and grassland) 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 National Wildlife Refuge System (Refuge System):

- Five national wildlife refuges: Bowdoin National Wildlife Refuge and four unstaffed satellite refuges—Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau.
- Nine waterfowl production areas within the four-county Bowdoin Wetland Management District (district). These 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.

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

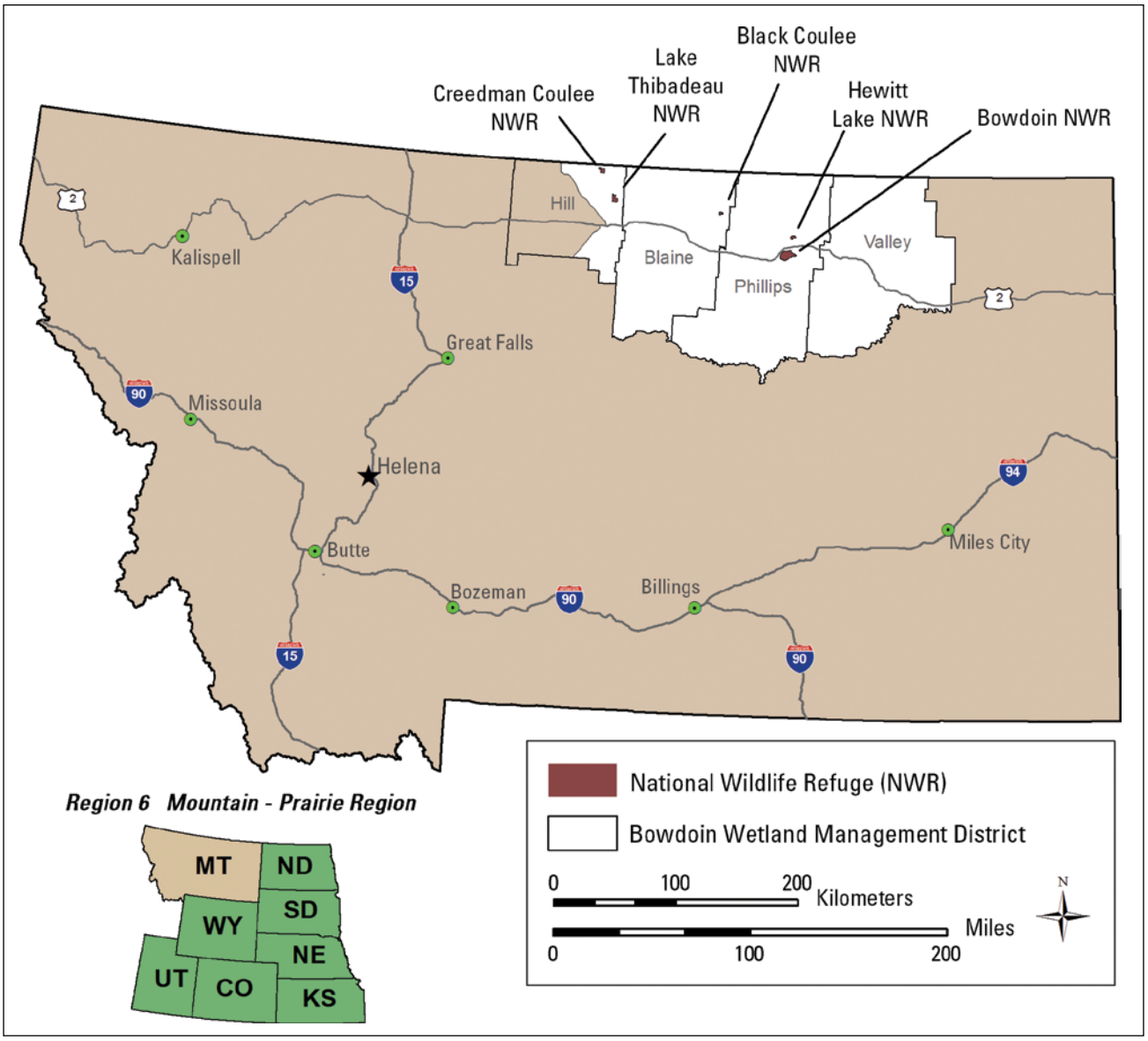

Figure 2. Vicinity map of the five refuges and one wetland management district in the Bowdoin National Wildlife Refuge Complex, Montana.

1.1 The Comprehensive Conservation Plan

The CCP specifies the goals and objectives necessary to achieve the vision and purposes of the Bowdoin National Wildlife Refuge Complex.

Final Decision

The Regional Director of the Mountain–Prairie Region of the Service selected the following alternatives from the draft CCP and environmental assessment (EA) as the preferred alternatives for the final CCP for the Bowdoin Refuge Complex:

- *Alternative B*—overall refuge complex management, including visitor services programs
- *Salinity Alternative 4*—underground injection and flushing by Beaver Creek (addresses the saline water and blowing salts issue)
- *Lake Thibadeau Refuge Alternative 2*—divest Lake Thibadeau National Wildlife Refuge

Appendix A documents the Regional Director's decision in the environmental action statement and the finding of no significant action. The preferred alternatives have been combined to compose this final CCP, with specific objectives for all aspects of the Bowdoin Refuge Complex contained in "Chapter 4–Management Direction."

Appendix B contains the final compatibility determinations for public uses in the refuge complex. The section 7 biological evaluation (appendix C) documents the effects of CCP actions on threatened and endangered species: a determination of no effect or may affect but not adversely, depending on the species. Appendix D contains the Region 6 divestiture model, which the Service used to evaluate Lake Thibadeau Refuge.

The CCP is a broad umbrella plan that provides general concepts and specific wildlife, habitat, visitor services, and partnership objectives over the next 15 years. Implementation begins with publication of the final CCP. The Service will carry out the plan with help from partner agencies, organizations, and the public. As the plan is implemented, stepdown management plans will be developed to provide greater detail to managers and employees for carrying out specific actions and strategies authorized by the CCP. Table 15 in chapter 4 lists the stepdown plans needed for the refuge complex.

The CCP details program planning levels that are sometimes substantially above current budget allocations and, thus, are primarily for Service strategic planning purposes. The CCP does not constitute a commitment for staff increases, operation and maintenance increases, or funding for future land acquisition.

Plan Development

The CCP was developed in compliance with the National Wildlife Refuge System Improvement Act (Improvement Act) and Service policy. The actions described in the CCP meet the requirements of the Council on Environmental Quality regulations that implement the National Environmental Policy Act of 1969 (NEPA).

Staff from several Montana State agencies provided critical support in developing the CCP. The Service's involvement of the public was another important aspect of planning and part of compliance with NEPA. In addition to the initial scoping with the public, there was a public review of the draft CCP and EA before the final CCP was completed.

The planning process is described in detail in section 1.8, and the public involvement portion is in appendix E.

Plan Amendment and Revision

The Service will annually review the final CCP to determine the need for amendment. An amendment would occur if significant information became available, such as a change in ecological conditions. The Service will evaluate the plan every 5 years and revise it after 15 years, as necessary.

1.2 Purpose and Need for the Plan

The purpose of this final CCP is to identify the role that the Bowdoin National Wildlife Refuge Complex plays 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, as appropriate.
- 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.

1.3 North American Model of Wildlife 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 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. 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, recreation for all Americans, and 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.

1.4 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

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

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.

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)

Arrowhead
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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 556 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.

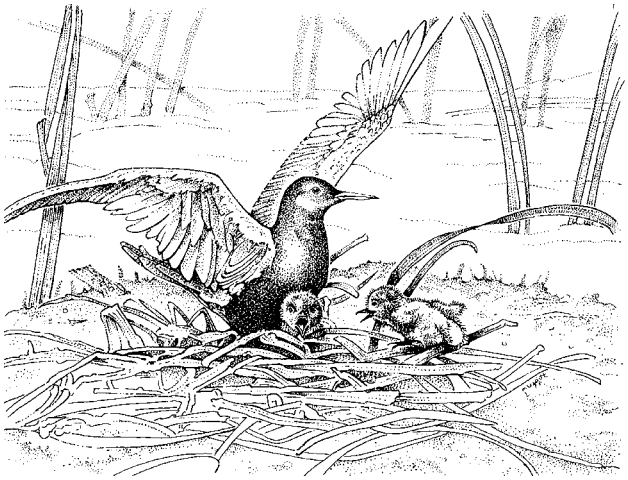
1.5 National and Regional Mandates

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 Code of Federal Regulations (CFR), 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 F–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."



Black Tern

1.6 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 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 1 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 2 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 actions in this plan 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.

USFWS

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

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).

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

Mike Morel / USFWS

Piping Plover

Gary Kramer / USFWS

Greater Sage-Grouse

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 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

1.7 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

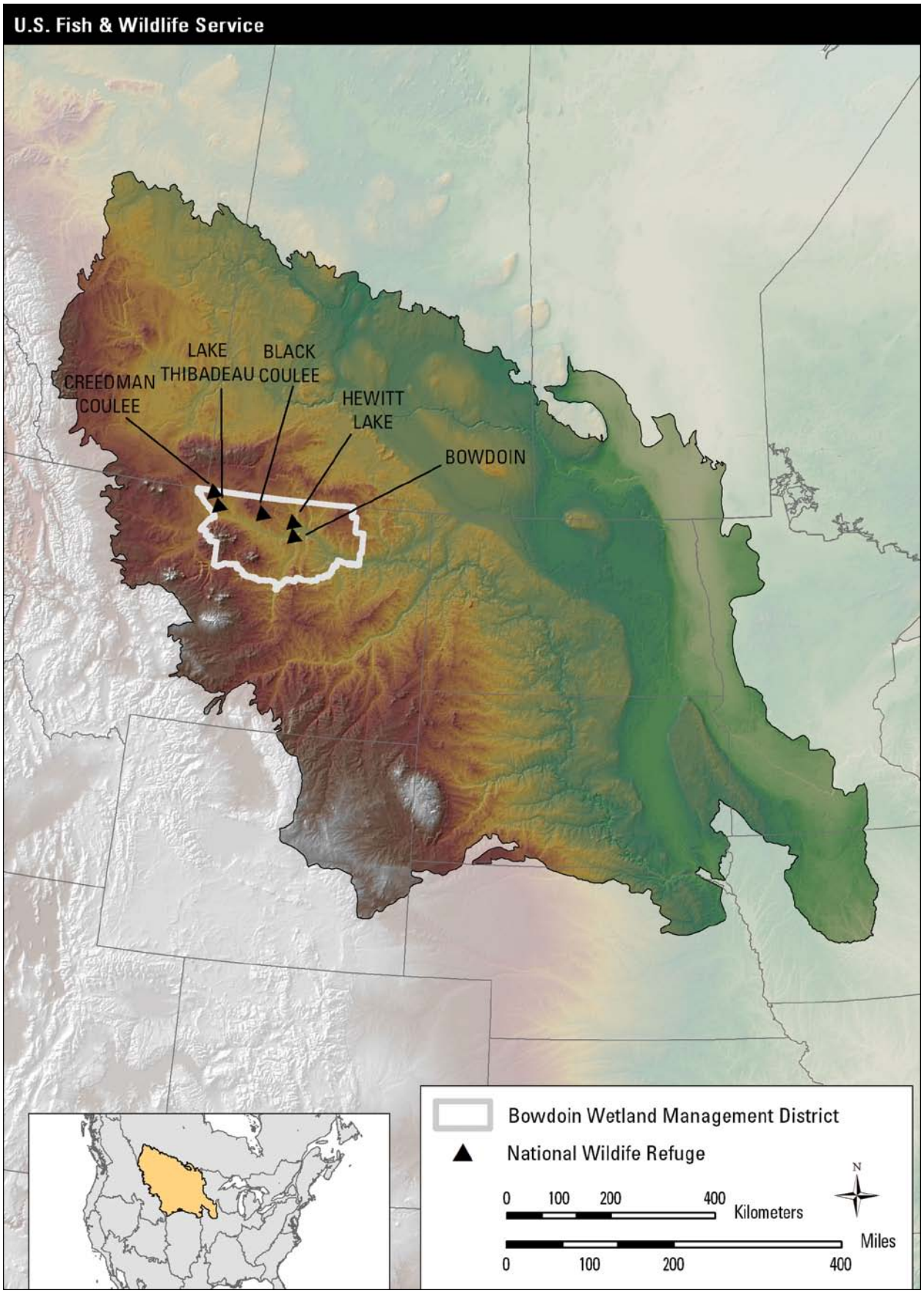


Figure 3. Map of the five refuges and one wetland management district in Bowdoin National Wildlife Refuge Complex within Geographic Area 13–Plains and Prairie Potholes.

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:

- *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.

1.8 Planning Process

This final CCP was prepared in compliance with the Improvement Act, NEPA, and part 602 (National Wildlife Refuge System Planning) of the "Fish and Wildlife Service Manual." Additional requirements and guidance are 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 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 other Federal and State agencies (refer to "Appendix G–Preparers, Consultation, and Coordination").

The planning team coordinated several opportunities for public involvement throughout the planning process as summarized below under "Public Coordination" and detailed in appendix E. The planning team reviewed a wide range of public comments and management needs for the refuge complex. This guided the team's development of a draft CCP and EA, which analyzed a set of alternatives for each of the following management aspects: (1) the management of the overall resources and uses at the refuge complex; (2) the salinity and blowing salts issue; and (3) the proposed divestiture of Lake Thibadeau National Wildlife Refuge.

Following public review of the "Draft Comprehensive Conservation Plan and Environmental Assessment–Bowdoin National Wildlife Refuge Complex," the Service analyzed the comments received. After the Regional Director's decision on which alternative to implement for each management aspect (refer to previous section 1.1), the planning team prepared the final CCP.

Table 1 lists the specific steps in the planning process for the preparation of this final CCP.

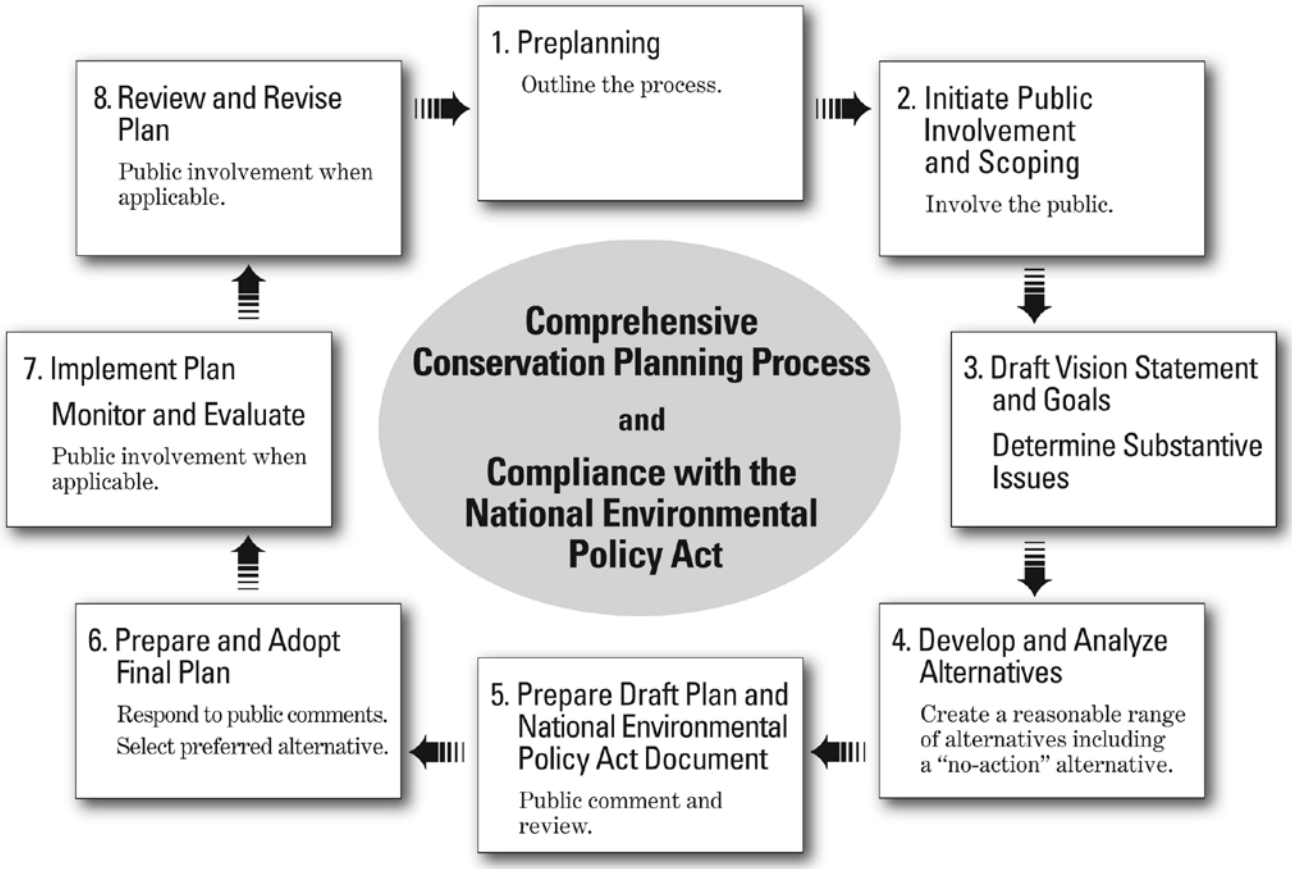


Figure 4. Process steps for comprehensive conservation planning and associated environmental analysis.

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.

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

Date	*Event*	*Outcome or purpose*
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	End of public scoping period	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.
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.

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

Date	*Event*	*Outcome or purpose*
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 CCP and EA for distribution to the public for review.
June 22, 2011	Notice of availability Draft plan public review Planning update	The notice of availability of the draft CCP and EA was published in the Federal Register (volume 76, number 120, page 36571–73). The draft CCP and EA was made available on the project Web page, and hard copies were distributed per requests. The public was provided 34 days to review and comment on the draft CCP and EA. A planning update was sent to the mailing list; the update summarized the draft plan and announced upcoming public meetings.
June 29, 2011	Public meeting in Malta, Montana	The public had an opportunity to learn about and provide comments on the draft CCP and EA.
July 25, 2011	End of public review period	Public comments that would be considered had to be received or postmarked by this date.
August 2–3, 2011	Public comments review	The planning team reviews the public comments and determines needed changes for the final CCP.
August 30, 2011	Decision on preferred alternatives	The Regional Director selected preferred alternatives for the three management aspects and signed the finding of no significant impact.
September 2011–April 2012	Final plan preparation	The planning team finished revising and editing the final CCP for printing and distribution.

Coordination with the Public

The Service prepared for public involvement by compiling a project mailing list of more than 170 names during pre-planning. The mailing list includes private citizens; local, regional, and State government representatives and legislators; other Federal agencies; and interested organizations.

The Service coordinated the following efforts to provide information and request ideas and comments from the public:

- *Web site:* The CCP Web page displayed background information on the refuge complex, the CCP development schedule, public meeting information, planning contacts, and electronic versions of planning updates, the draft plan, and other planning documents.

- *Three planning updates:* These fact sheets were sent to everyone on the project mailing list. Information was provided on the history of the refuge complex, the CCP process, the salinity issue, and alternatives in the draft CCP and EA. The updates had invitations to public meetings and included comment forms.

- *Three public meetings:* The Service presented information about the planning process; the resources and issues, in particular, the salinity and blowing salts issue; and the draft CCP and EA. Attendees were encouraged to offer comments and ask questions.

- *Public review of the draft CCP and EA:* The public had 34 days to review and provide comments about the draft plan for the refuge complex.

The Service recorded all comments given at the public meetings. In addition to oral comments, the planning team received written comments via email, comment forms, and letters. Planning team members, individually and as a team, reviewed all comments. Some modi-

fications, including clarifications, were made to this final document based on the public review. Appendix E has more detail about the Service's involvement of the public, including responses to substantive public comments on the draft CCP and EA.

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. A hydrologist 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 participated in both the internal and public review of the draft plan. Numerous changes were made to the final CCP based on their comments. Overall 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.

During the release of the draft CCP and EA for public review, the Service made additional contacts with the affected tribes. There was some interest in assisting with future efforts to identify cultural sites throughout the refuge complex.

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 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.

USFWS

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 the Bureau of Reclamation (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 more than 6,000 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 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

USFWS

Refuge headquarters, 1938.

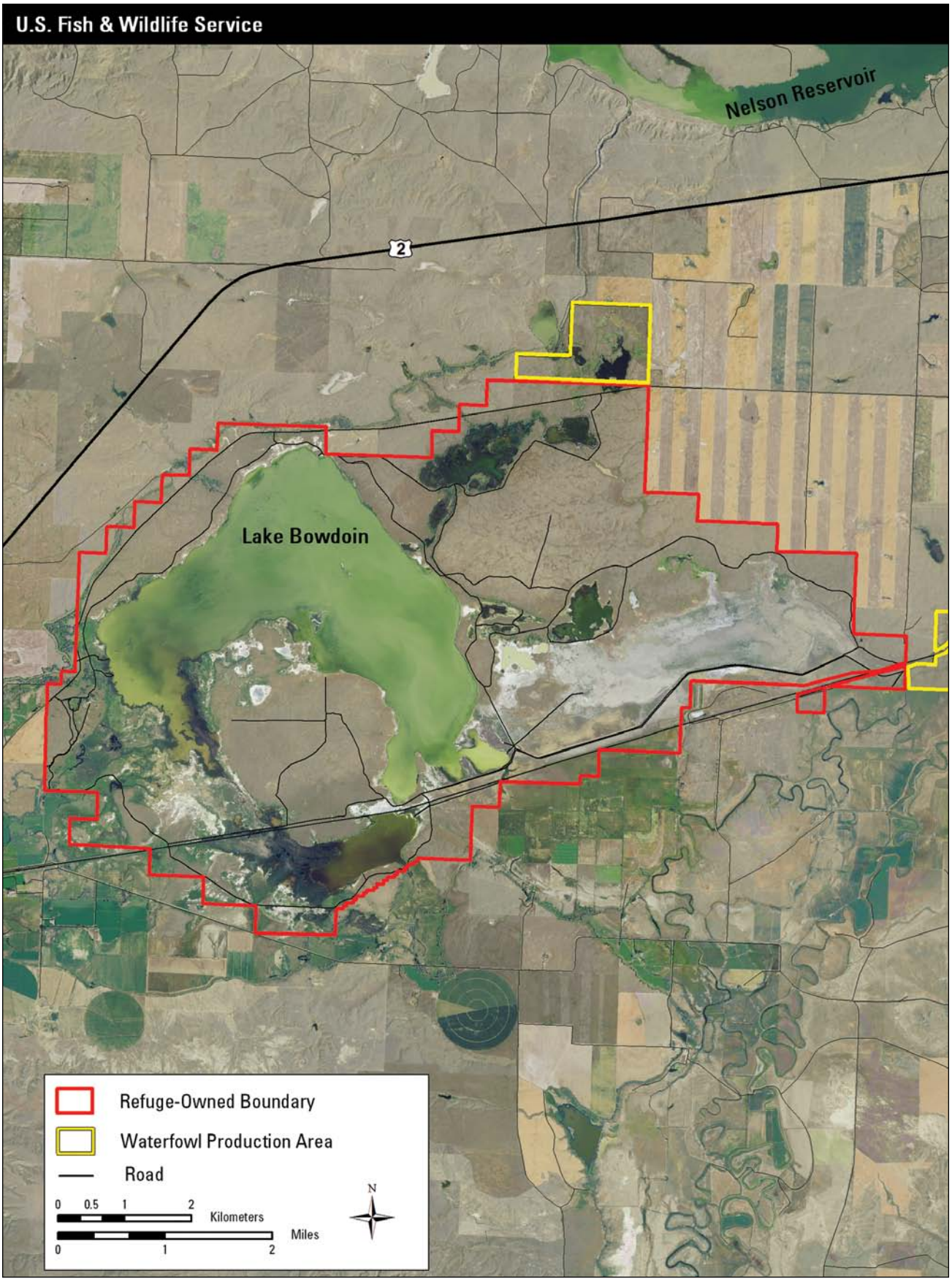

Figure 5. Base map of Bowdoin National Wildlife Refuge, Montana.

2,400 to 2,600 feet (Bureau of Sport Fisheries and Wildlife 1973).

There are three major wetland types on the refuge: (1) permanent wetlands; (2) semipermanent wetlands; and (3) 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, 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.

Donna A. Dewhurst / USFWS

Sandhill cranes nest at Bowdoin Refuge.

Lake levels fluctuated from year to year, depending on runoff conditions and evaporation during the hot, dry summers.

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 a memorandum of agreement (MOA) 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 4,470 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.

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.

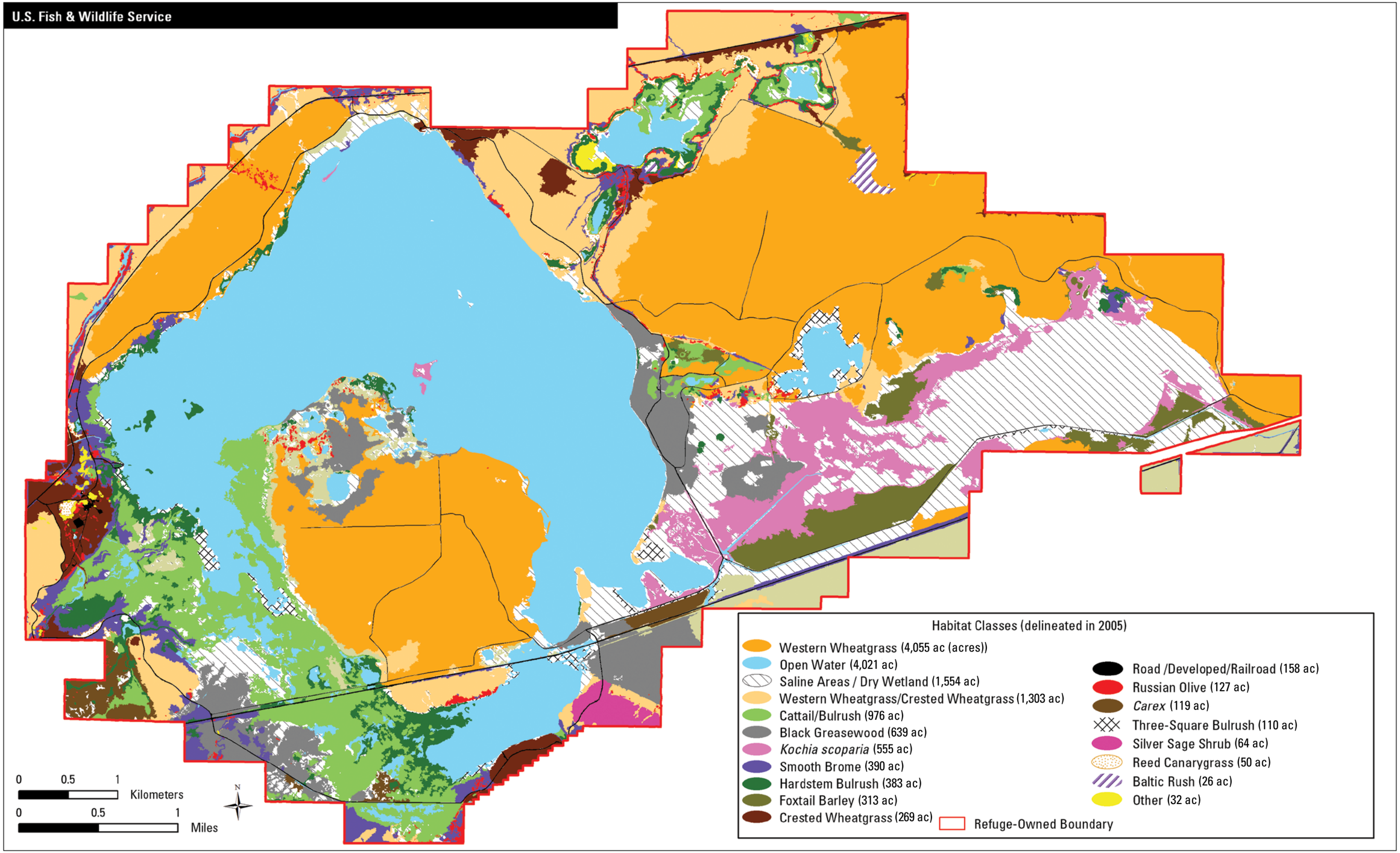

Figure 6. Map of habitat types at Bowdoin National Wildlife Refuge, Montana.

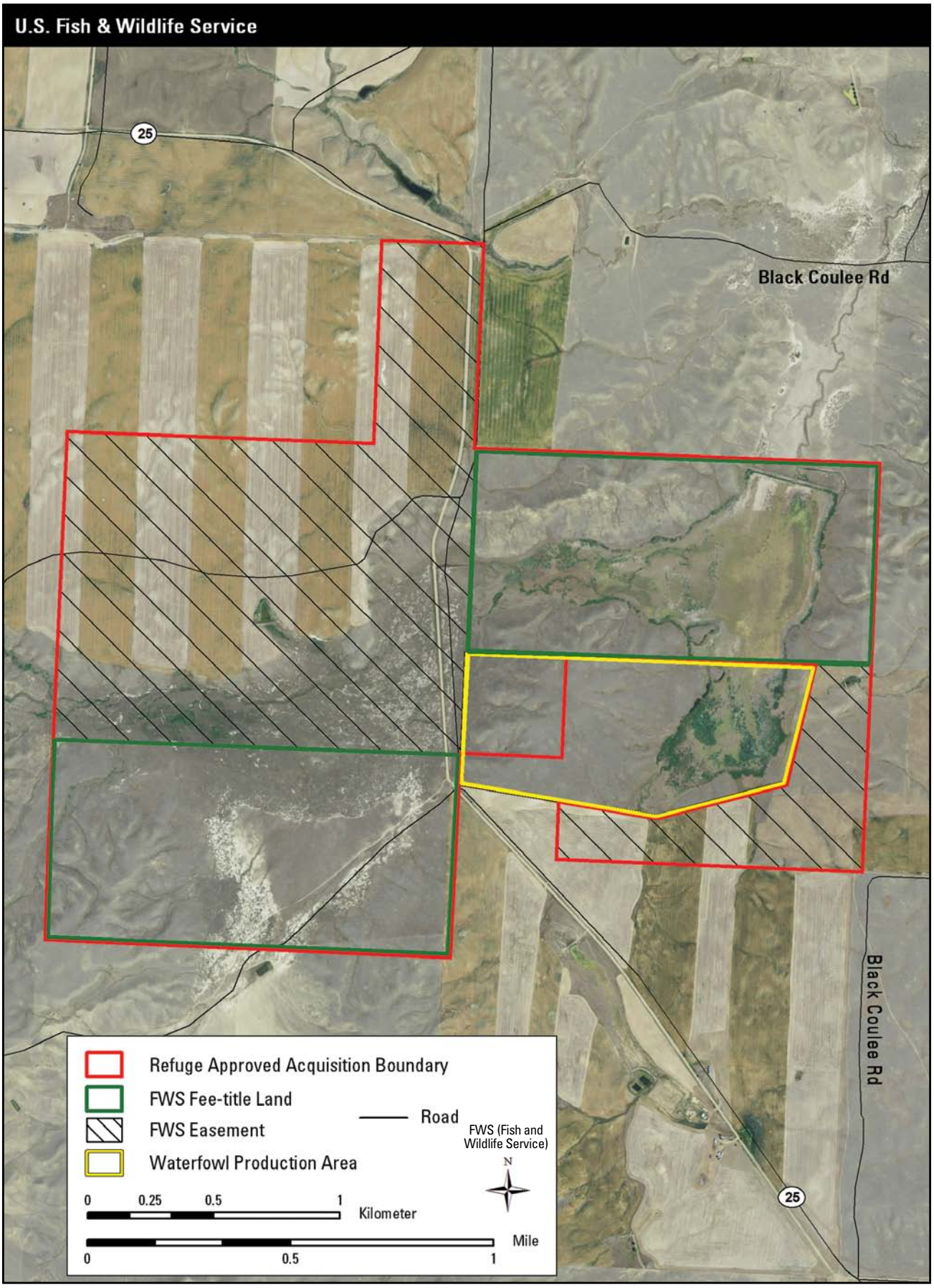

Figure 7. Base map of Black Coulee National Wildlife Refuge, Montana.

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.

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).

Rodney Krey / USFWS

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

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 benefits both parties. The existing dam height was increased, thereby increasing the storage capacity of the reservoir. To ensure that water was 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.

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 waterfowl production area (WPA) 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).

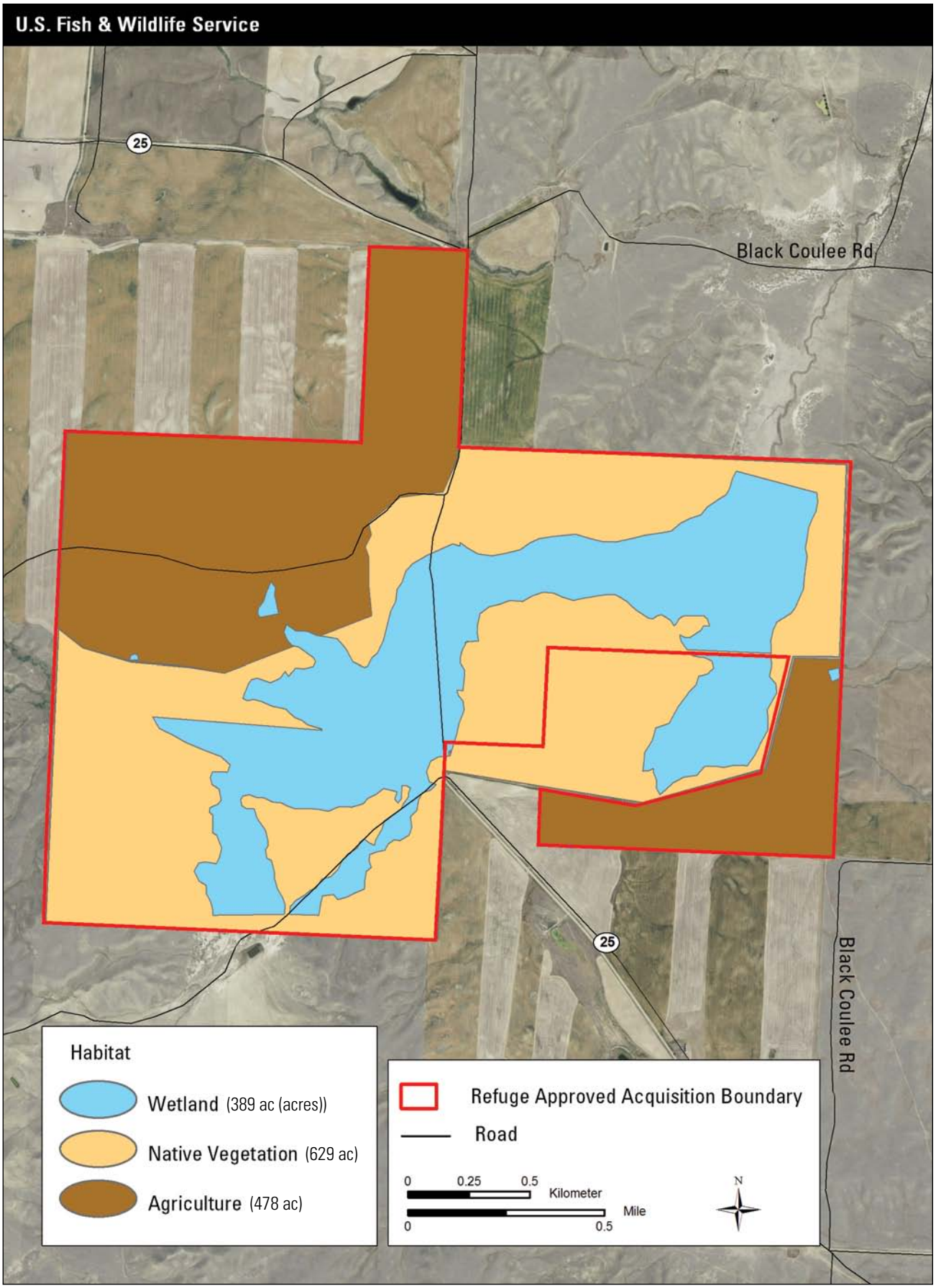

Figure 8. Map of habitat types at Black Coulee National Wildlife Refuge, Montana.

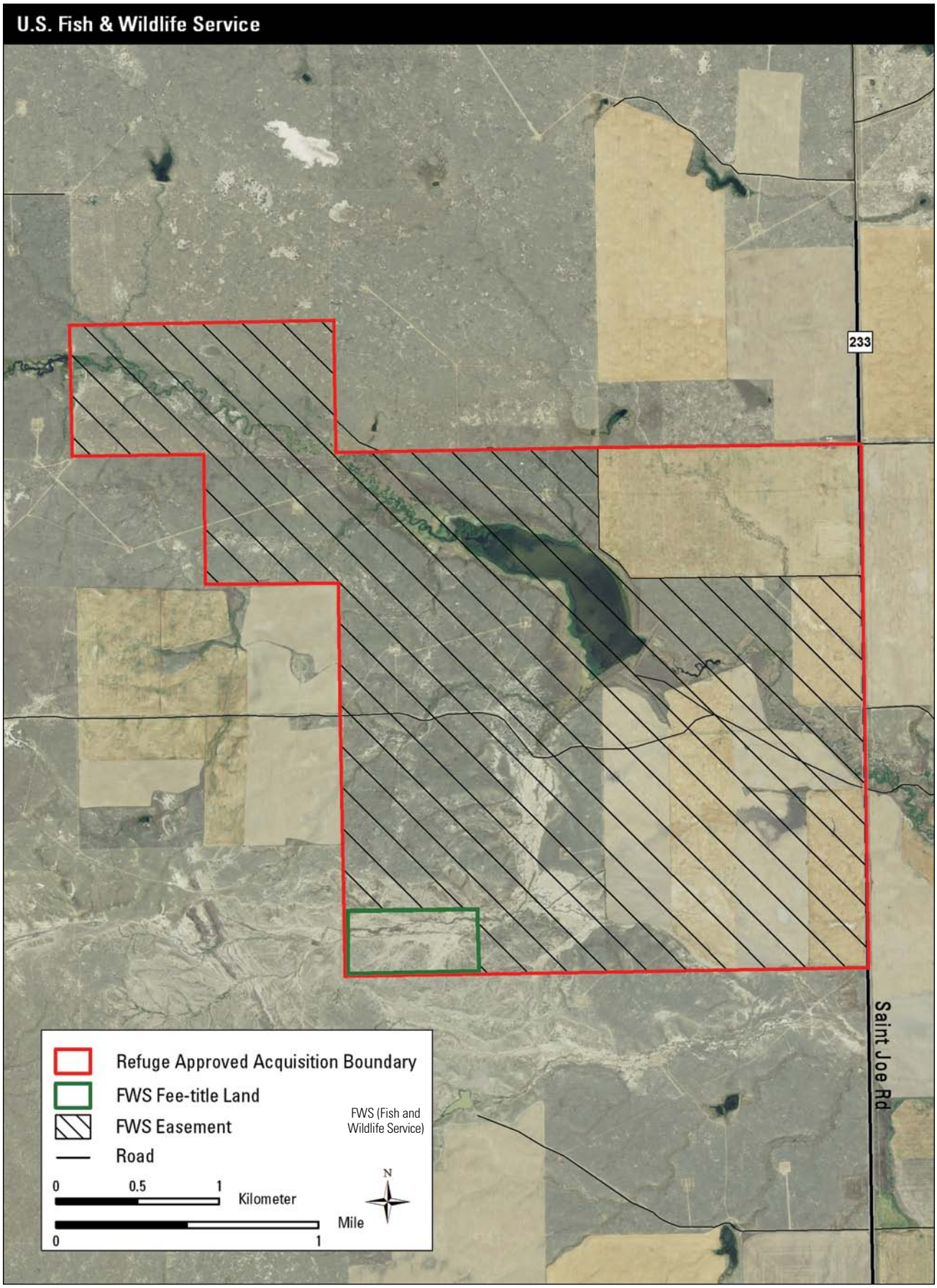

Figure 9. Base map of Creedman Coulee National Wildlife Refuge, Montana.

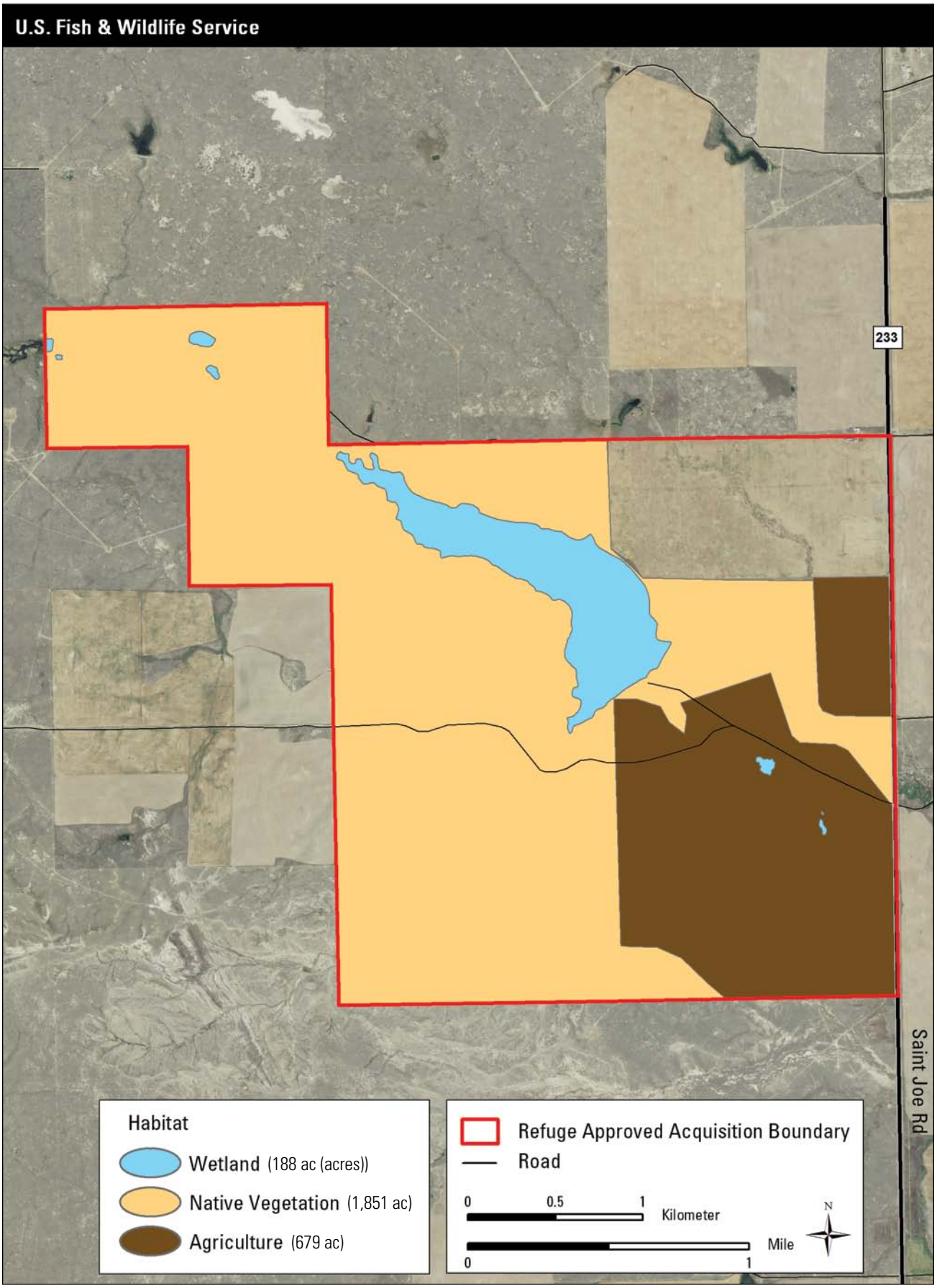

Figure 10. Map of habitat types at Creedman Coulee National Wildlife Refuge, Montana.

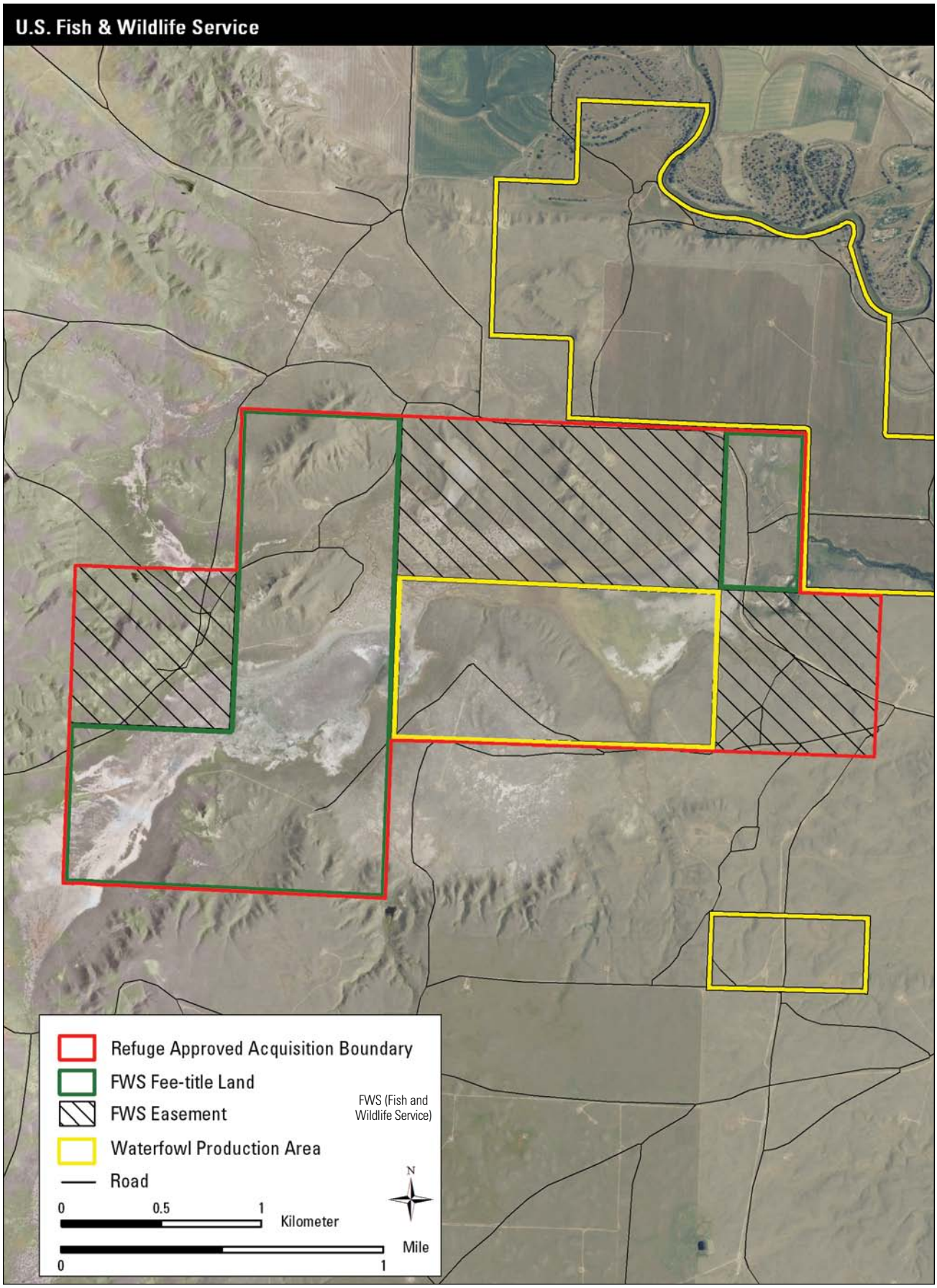

Figure 11. Base map of Hewitt Lake National Wildlife Refuge, Montana.

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).

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).

James Graham / USFWS

Hewitt Lake attracts many waterbird species, particularly white-faced ibis (foreground).

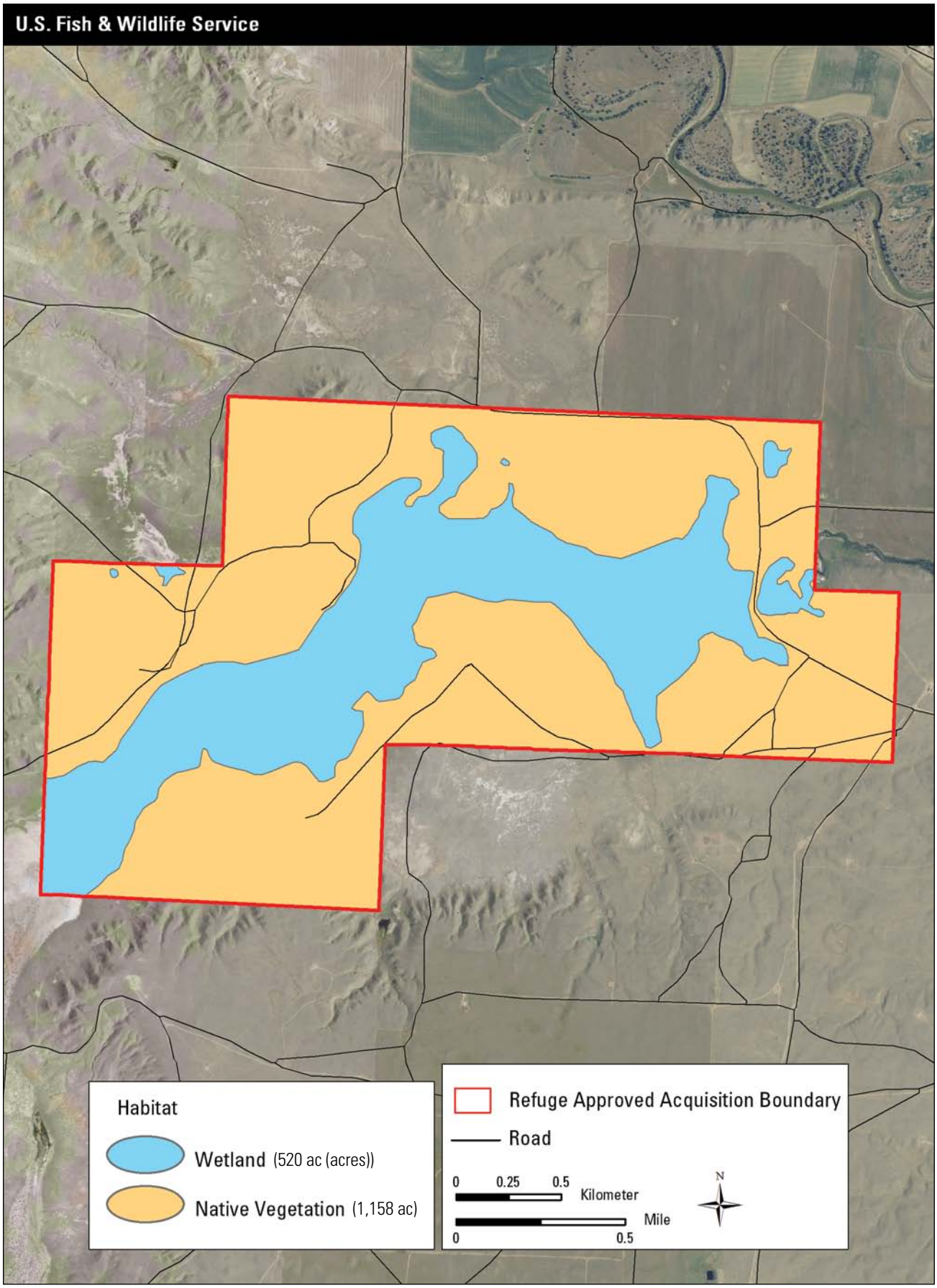

Figure 12. Map of habitat types at Hewitt Lake National Wildlife Refuge, Montana.

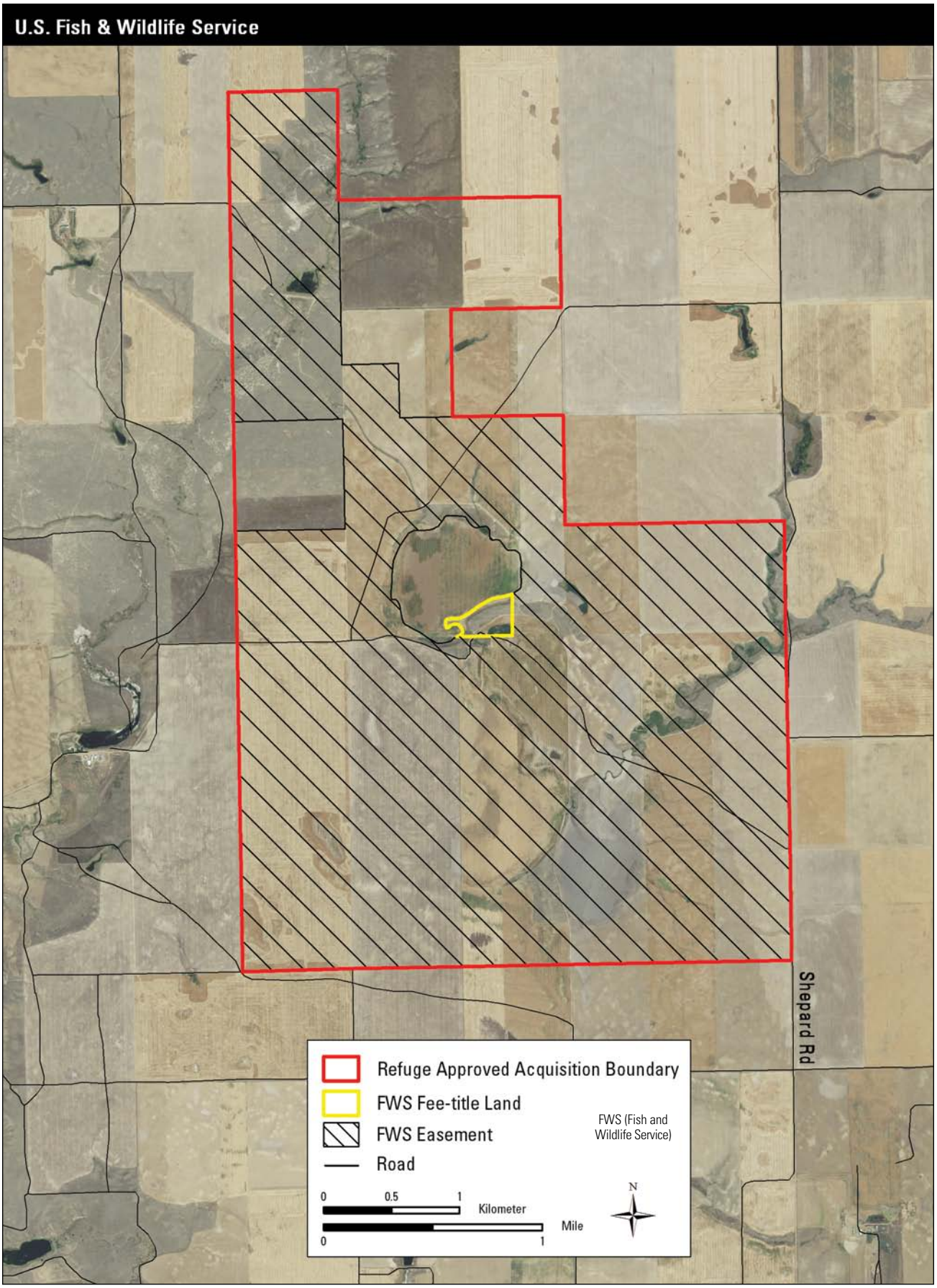

Figure 13. Base map of Lake Thibadeau National Wildlife Refuge, Montana.

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 conservation easements through the Farmers Home Administration (FmHA) 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. 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

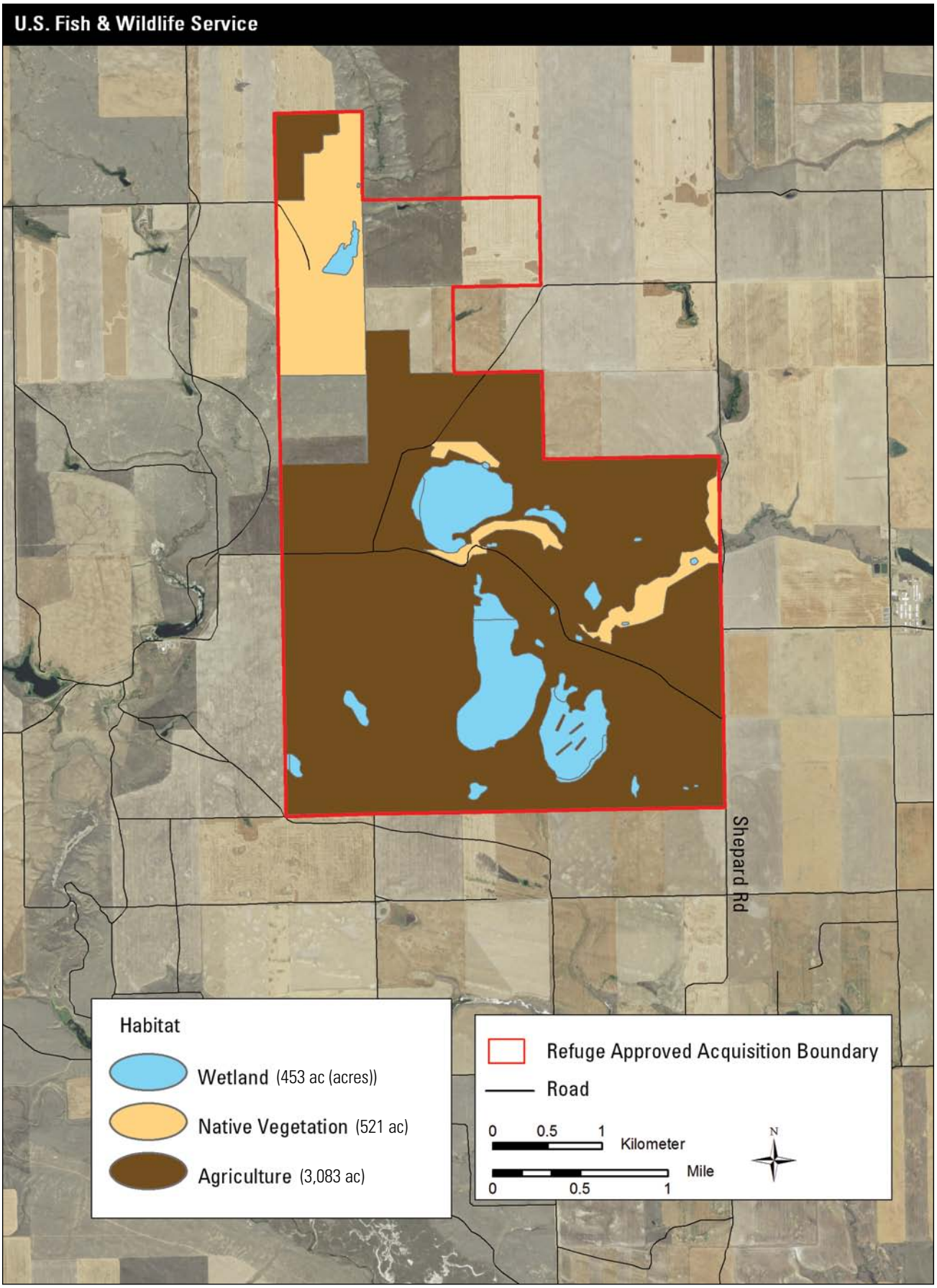

Figure 14. Map of habitat types at Lake Thibadeau National Wildlife Refuge, Montana.

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 next to 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).

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Dyrdahl WPA

- *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).

- *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).

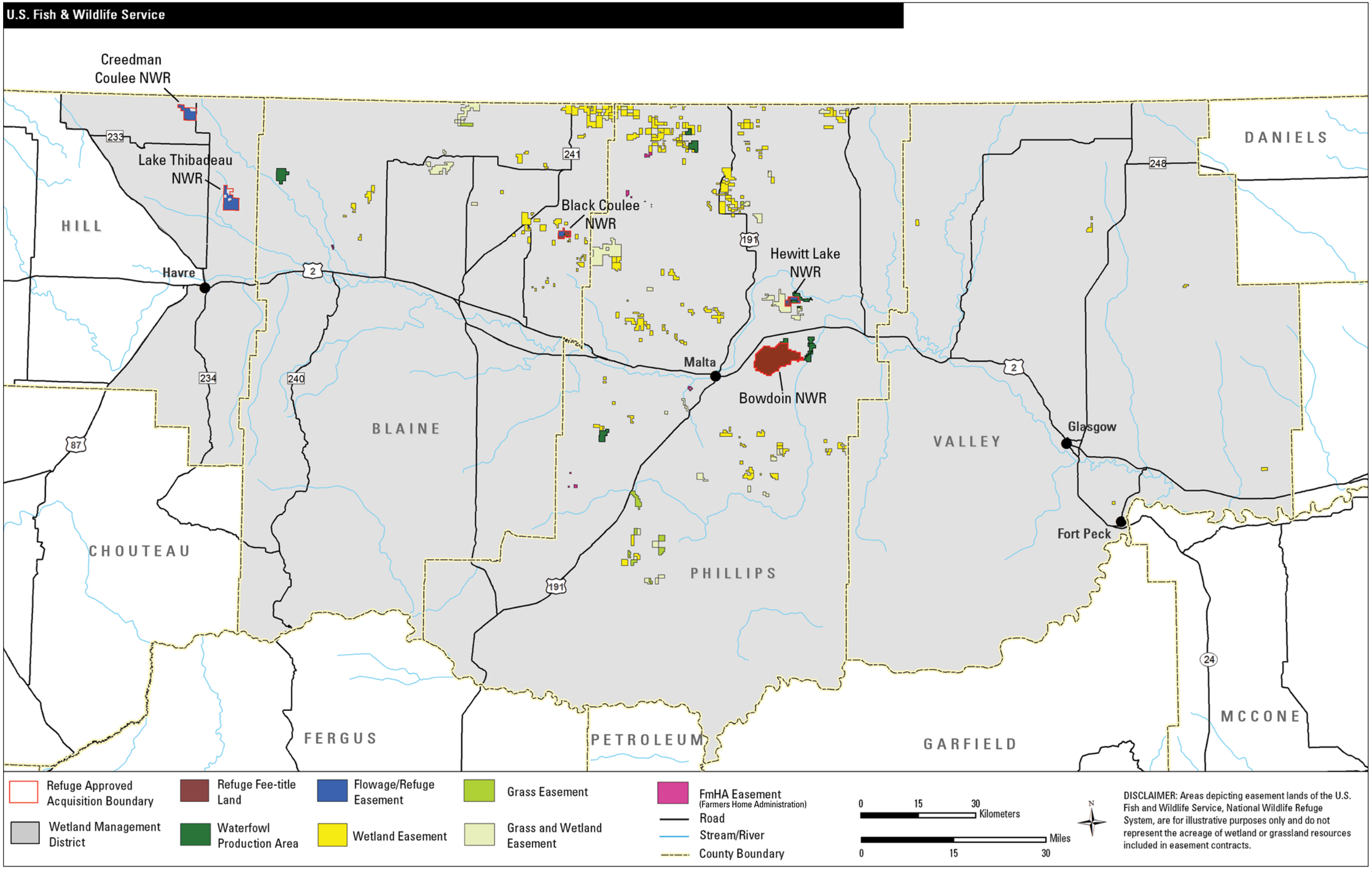

Figure 15. Map of conservation easements and waterfowl production areas in Bowdoin Wetland Management District, Montana.

- *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 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 in chapter 4 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 six goals for the refuge complex 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.

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 Salinity and Blowing Salts

Develop a water management system on Bowdoin National Wildlife Refuge that protects the environment and mitigates current and future blowing salt concerns for neighboring properties, while providing quality water and wildlife habitat for migratory birds and other wetland-dependent wildlife.

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.

John and Karen Hollingsworth / USFWS

Blue-winged Teal Hen and Drake

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.

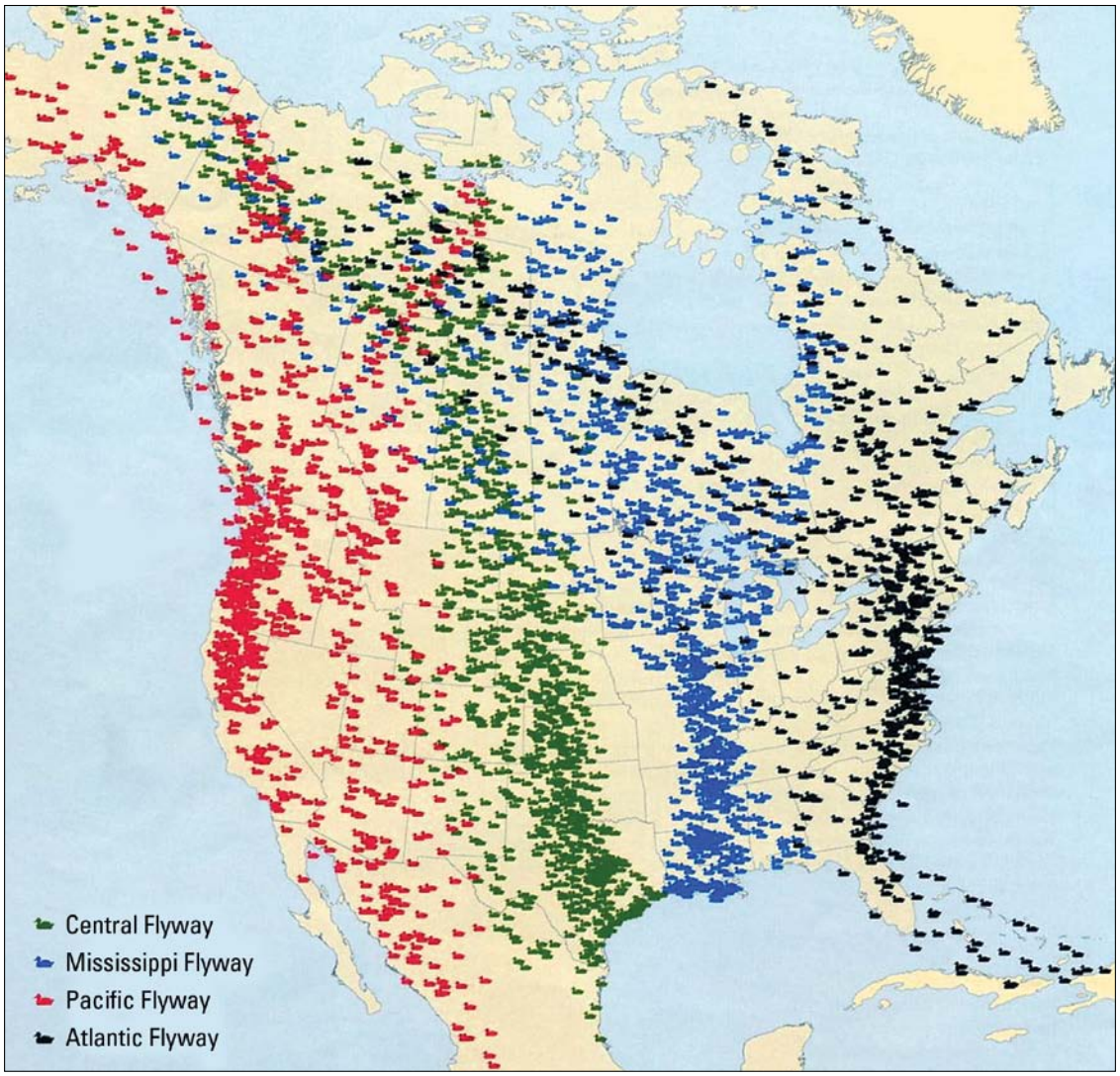

Figure 16. Map of waterfowl flyways in North America.

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.

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,

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

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.

- Moyles (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.

- 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.

Water Resources and Wetland Management at Bowdoin Refuge

The principle sources of water for Bowdoin Refuge are precipitation, floodwater from Beaver Creek, ground water seepage, delivered water from the Milk River, and irrigation return flows. The refuge relies on these sources 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 money targeted for purchasing water has been static, making it difficult to get the added water needed to properly manage wetland habitat.

Salinity in Lake Bowdoin and Blowing Salts

The most significant issue addressed through the planning process was the salinity and blowing salts at Bowdoin Refuge—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. Additionally, if no action were taken to improve water quality on the refuge, the progressively increasing salinity levels in Lake Bowdoin and the blowing salts out of Dry Lake would continue to threaten not only migratory birds but other wildlife, refuge wetlands, and, potentially, neighboring landowners and downstream irrigators.

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 has a direct relationship to the effect of salts carried in the water—quantity, evaporation, inflow, and outflow all contribute to the salt balance. 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 improving water quality.

The out-of-balance salt situation is due to a variety of factors—many from modifications to the landscape,

Mike Artmann / USFWS

Salt residue covers Dry Lake's northern bay, which supports salt-tolerant plants like bulrush and the low-growing saltgrass.

but others are natural. These factors contribute to increased salinity levels in Lake Bowdoin by preventing natural flooding and creating a closed basin (having no water outlets):

- *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 for irrigated or dryland farming.
- *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.

Water Resources and Wetland Management in Bowdoin 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.

Bill Byrne / USFWS

The piping plover nests on open shorelines.

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). 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.

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 1950s as an ornamental for windbreaks and wildlife food and cover. Although this tree is currently not designated as a noxious species in Montana, its ability to outcompete native species and fragment habitat is well documented. As with most nonnative species, Russian olive trees have

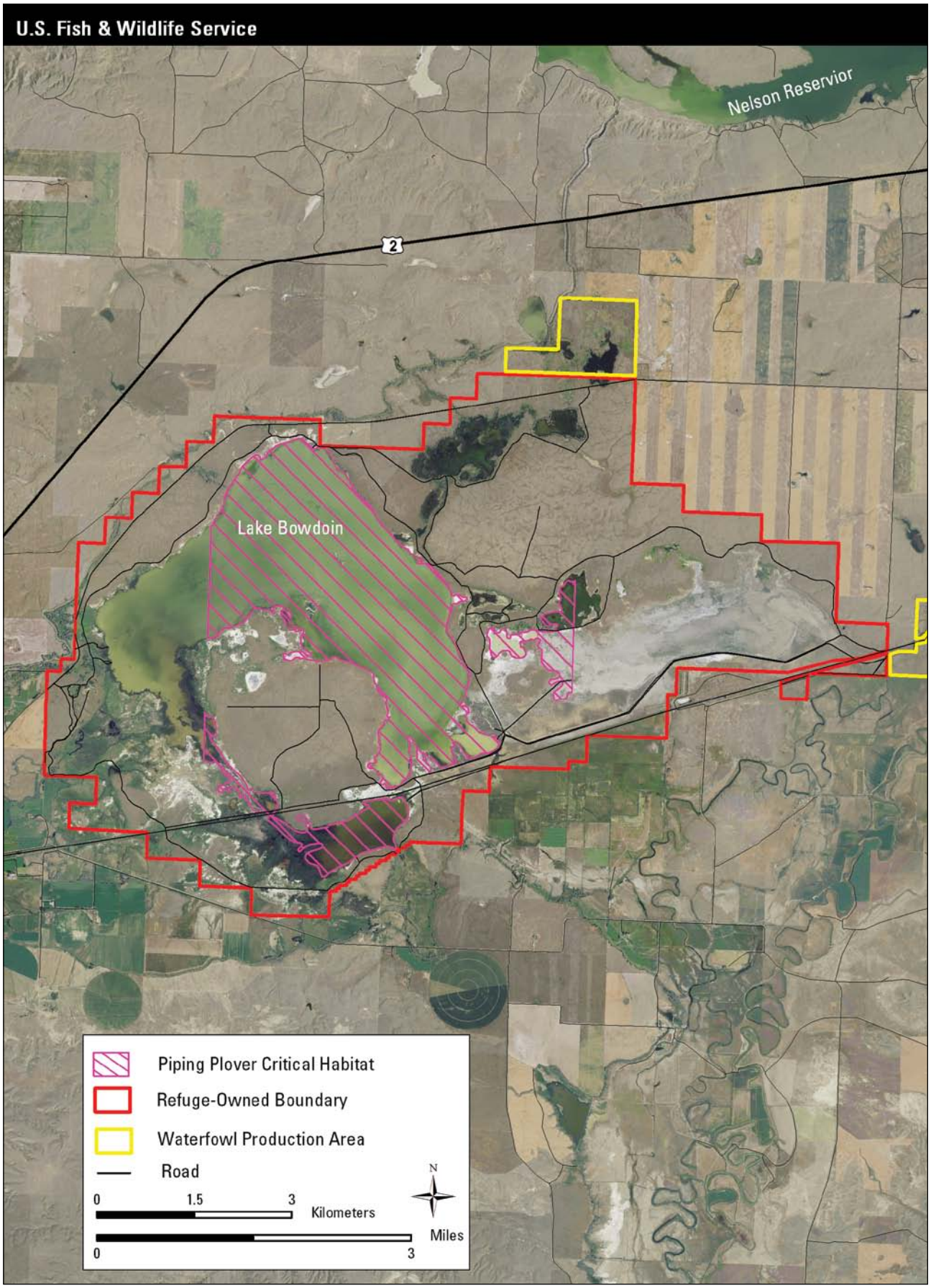

Figure 17. Map of critical habitat for piping plover at Bowdoin National Wildlife Refuge Complex, Montana.

Mike Artmann / USFWS

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

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.

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 B contains the required compatibility determinations 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 84,724 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 need to be expanded if more permanent staff are 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.

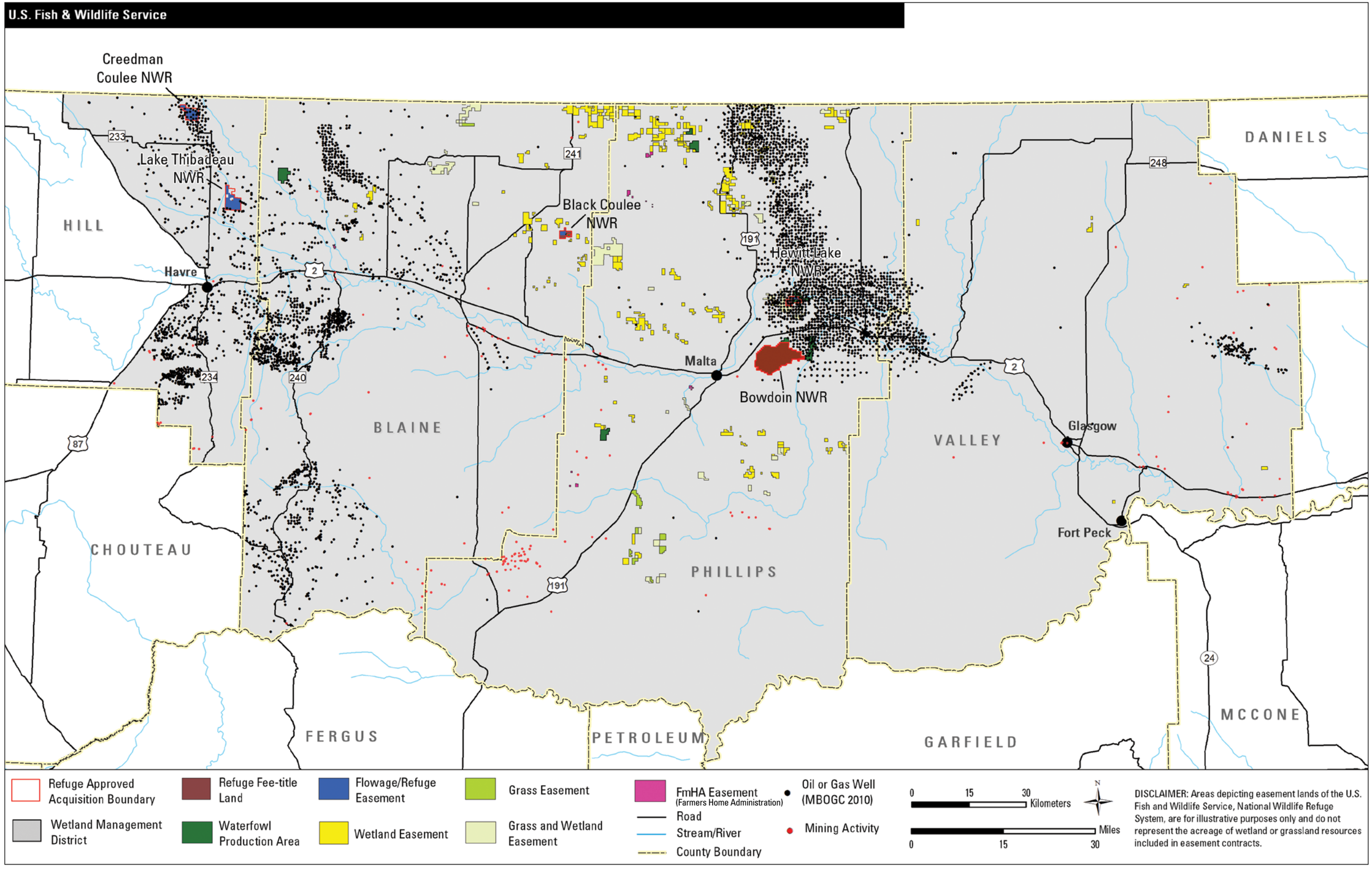

Figure 18. Map of oil and gas activities in and around Bowdoin National Wildlife Refuge Complex, Montana. *Source: MBOGC (2010).*

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 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 evaluated whether to keep Lake Thibadeau in the National Wildlife Refuge System.

CHAPTER 3—Refuge Complex Resources and Description

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:

- 3.1 Physical Environment
- 3.2 Biological Resources
- 3.3 Salinity Background
- 3.4 State and Federal Listed Species
- 3.5 Cultural Resources
- 3.6 Special Management Areas
- 3.7 Visitor Services
- 3.8 Management Uses
- 3.9 Socioeconomic Environment
- 3.10 Partnerships
- 3.11 Operations

3.1 Physical Environment

The following sections describe the physical characteristics of the Bowdoin National Wildlife Refuge Complex. 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 degrees Fahrenheit (°F) 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).

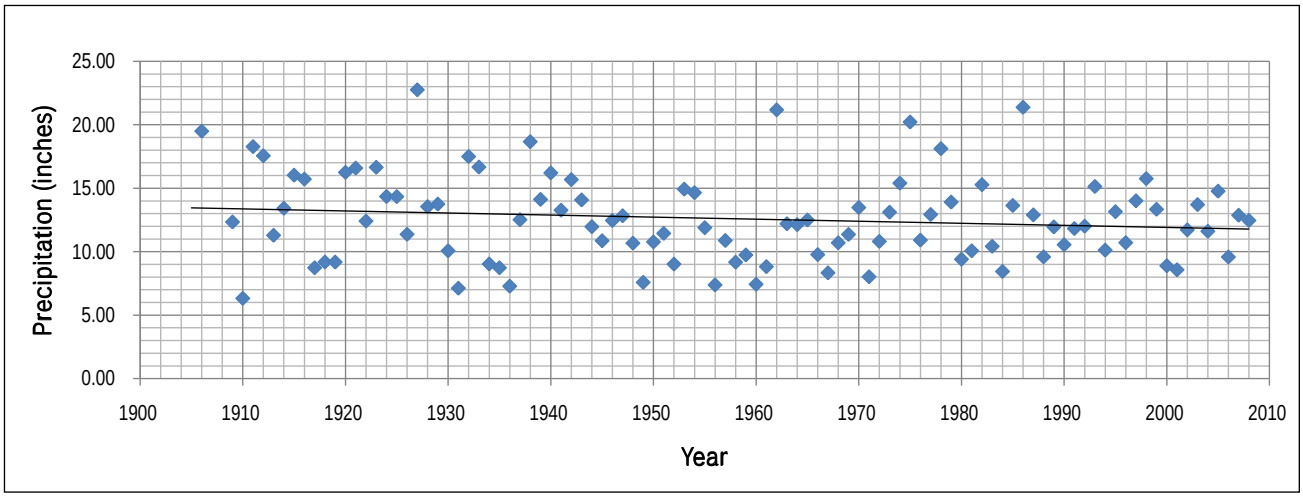

Figure 19. Graph of total annual precipitation at Bowdoin National Wildlife Refuge, Montana (1905–2008).

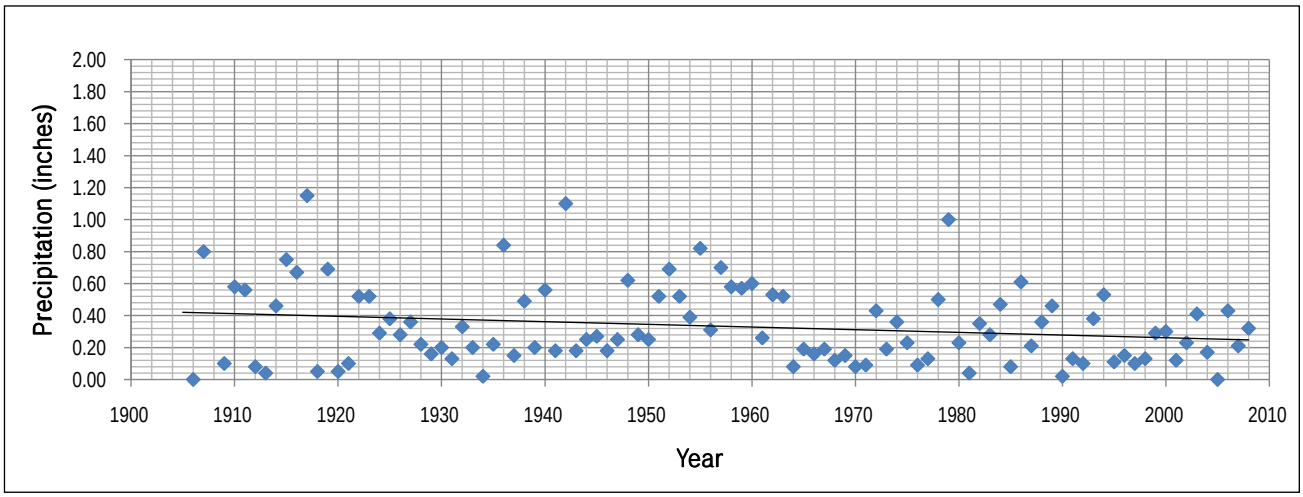

Figure 20. Graph of total February precipitation at Bowdoin National Wildlife Refuge, Montana (1905–2008).

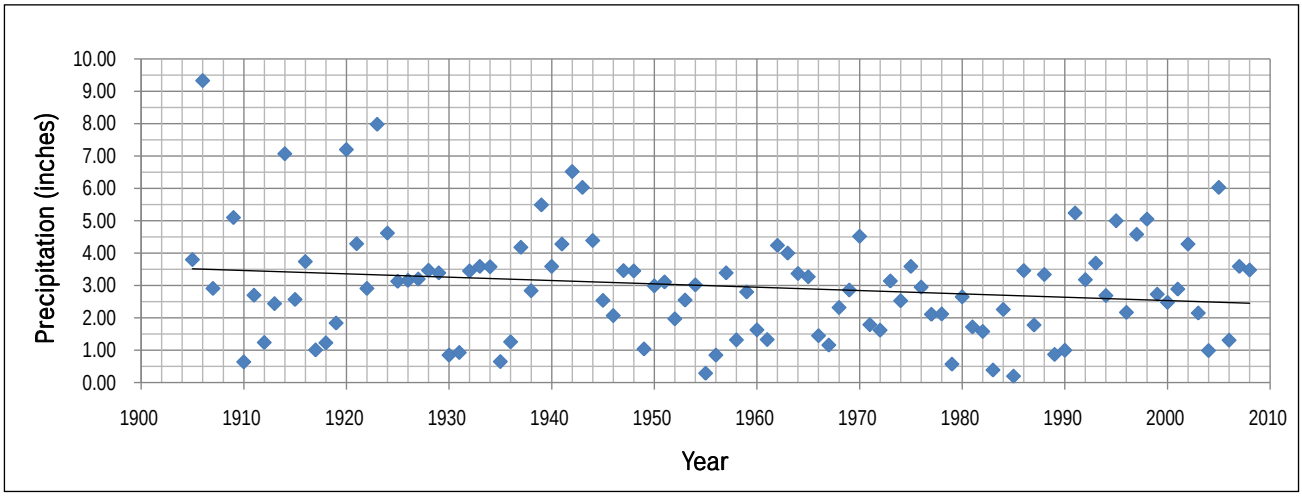

Figure 21. Graph of total June precipitation at Bowdoin National Wildlife Refuge, Montana (1905–2008).

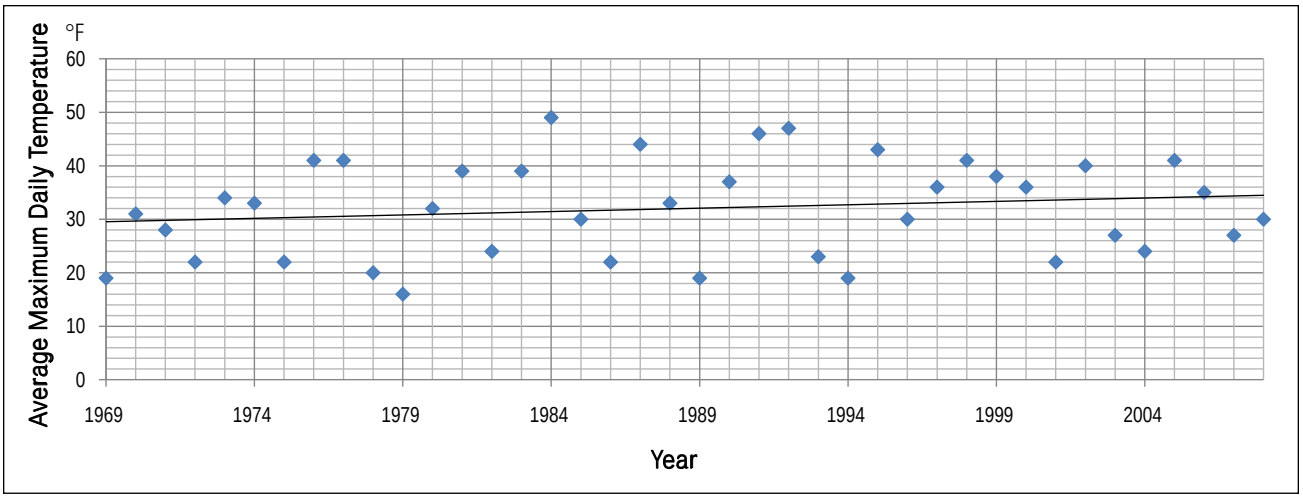

Figure 22. Graph of average maximum daily temperature for February at Bowdoin National Wildlife Refuge, Montana (1969–2008).

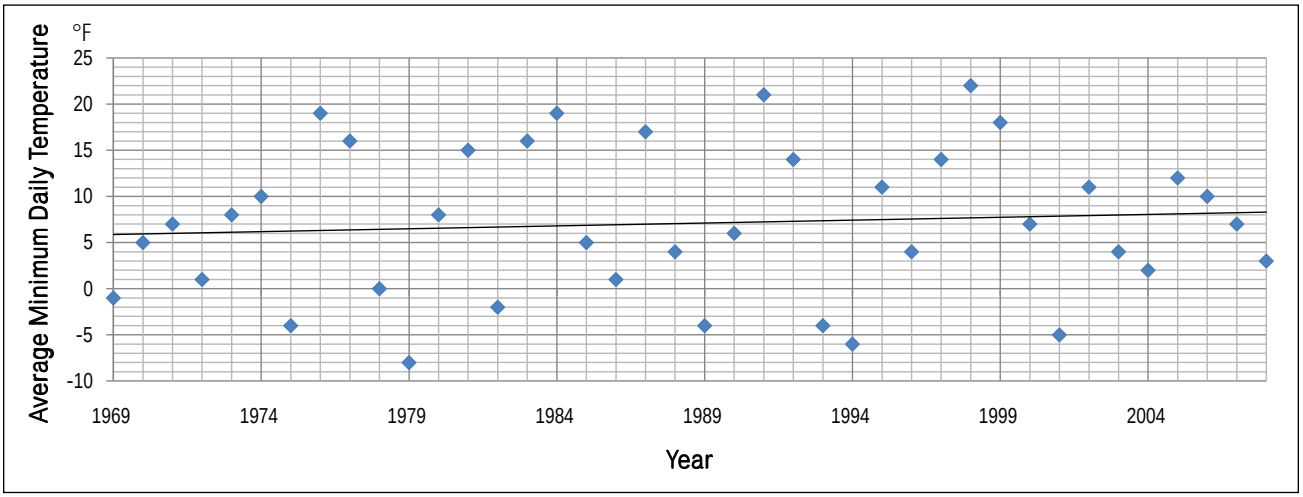

Figure 23. Graph of average minimum daily temperature for February at Bowdoin National Wildlife Refuge, Montana (1969–2008).

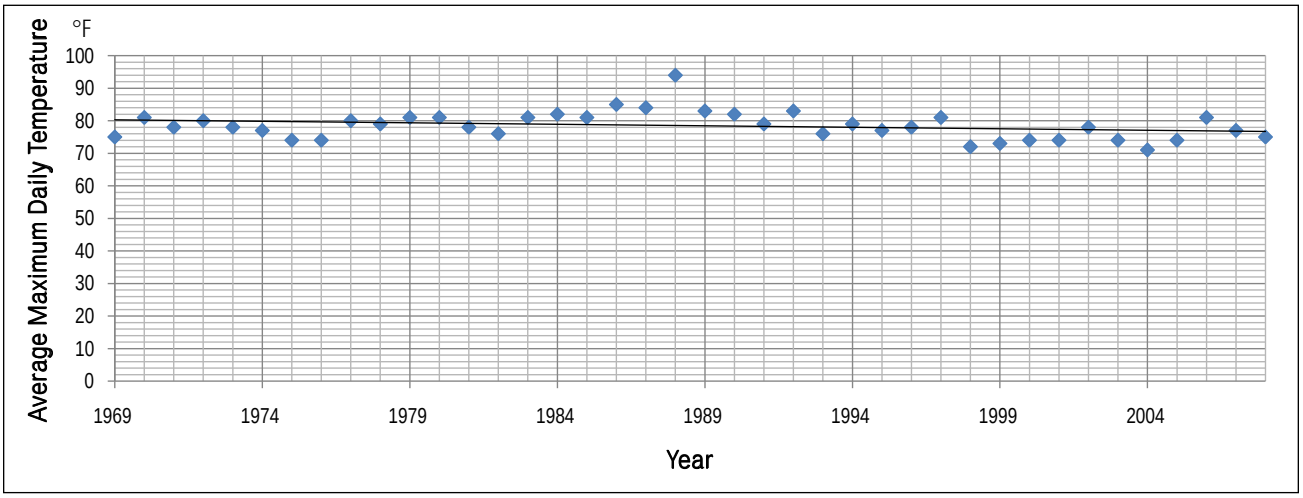

Figure 24. Graph of average maximum daily temperature for June at Bowdoin National Wildlife Refuge, Montana (1969–2008).

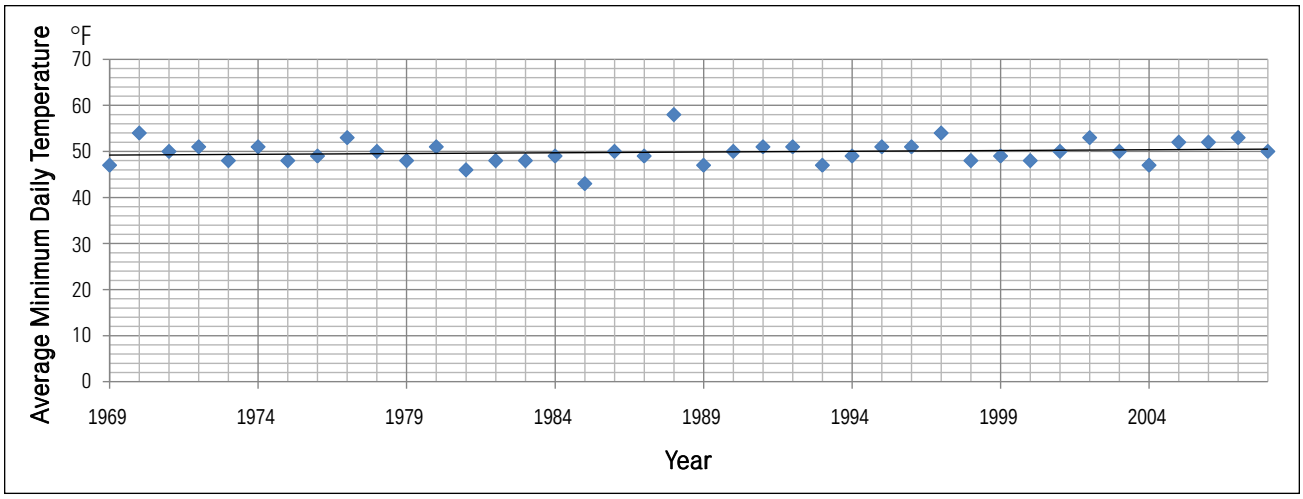

Figure 25. Graph of average minimum daily temperature for June at Bowdoin National Wildlife Refuge, Montana (1969–2008).

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

Vegetated land is a tremendous factor in carbon sequestration. Large, naturally occurring communities of plants and animals that occupy major habitats—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 semipermanent 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."*

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

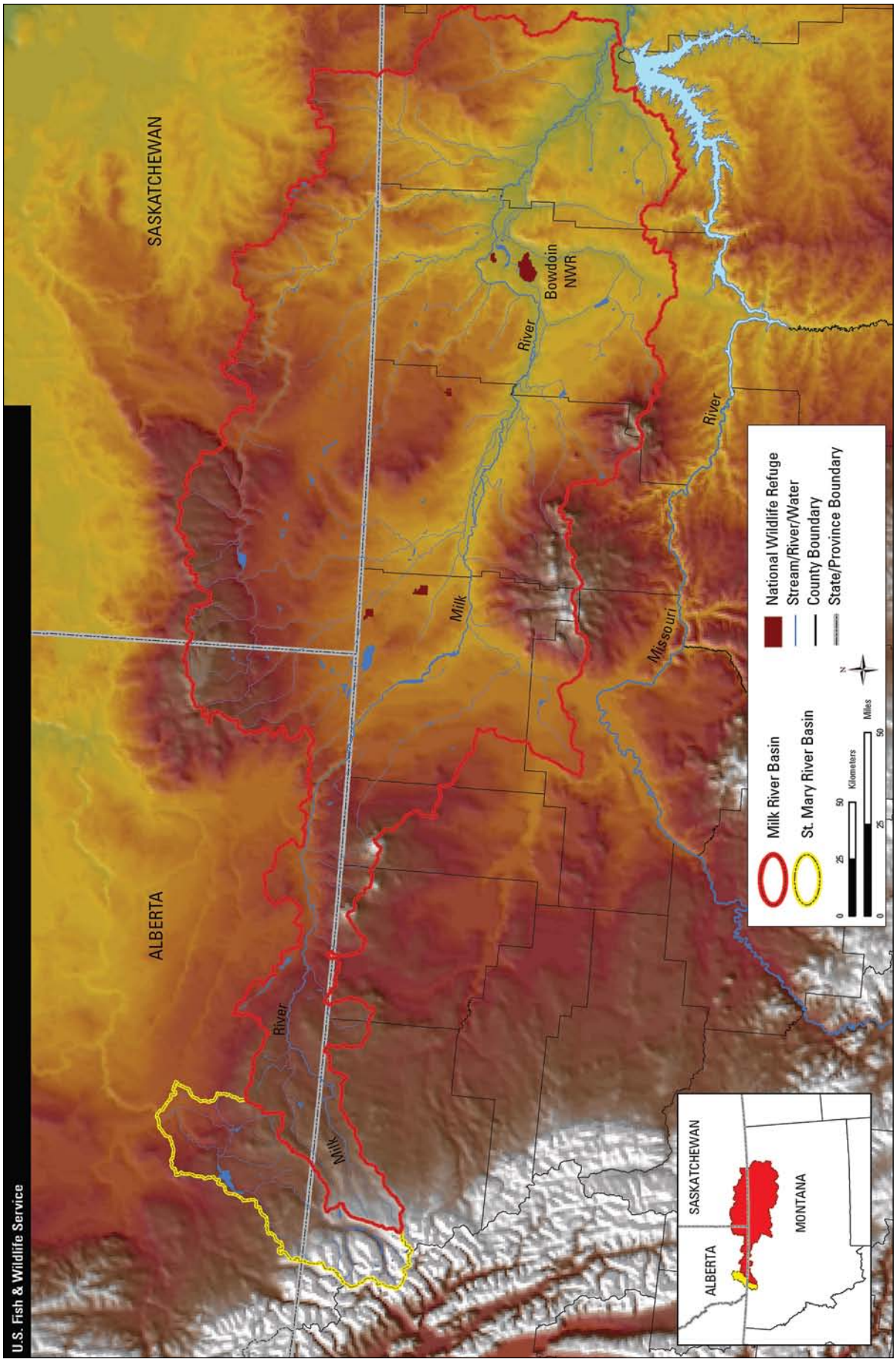

Figure 26. Map of Bowdoin National Wildlife Refuge Complex within the Milk River watershed.

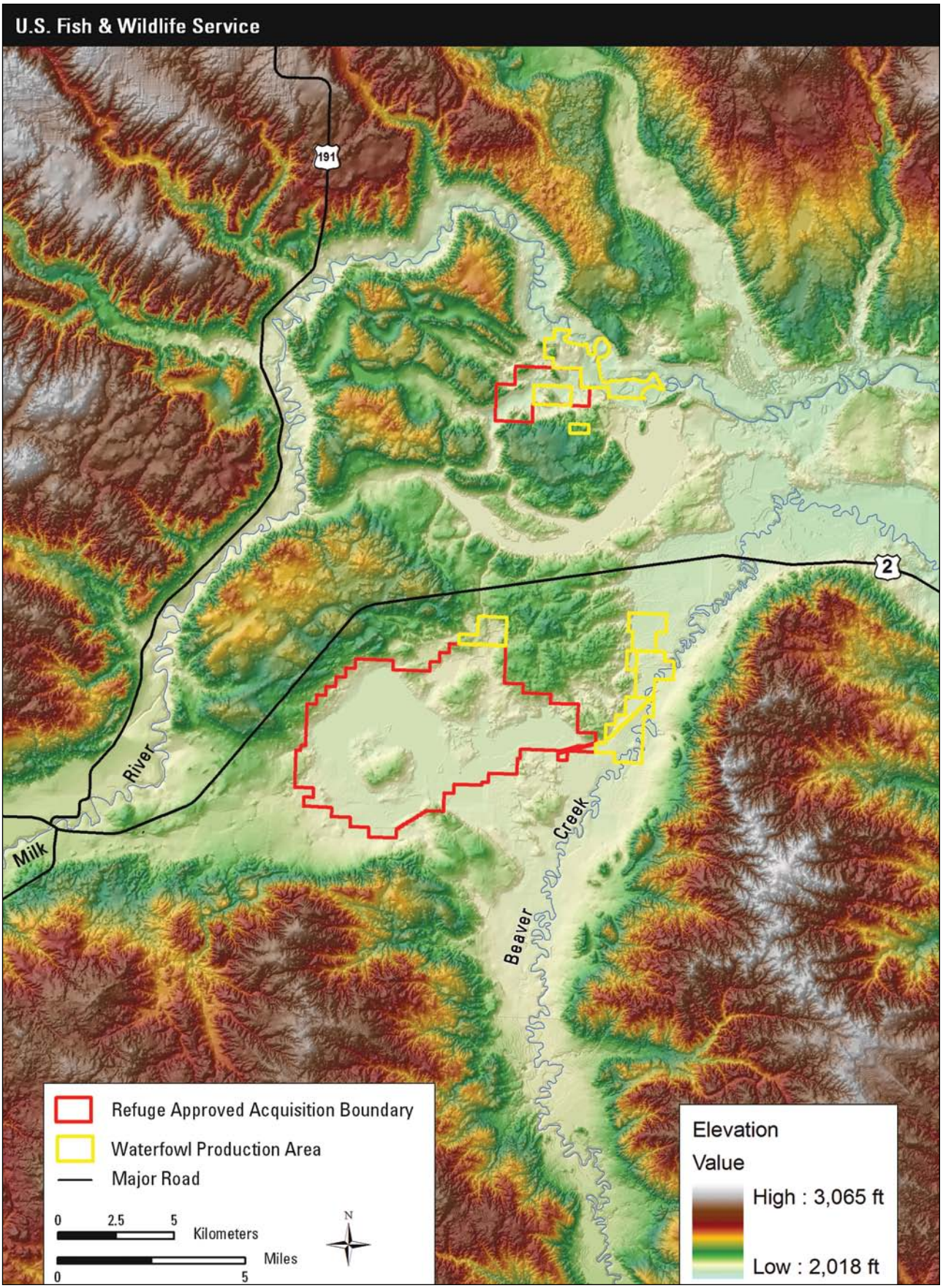

Figure 27. Map of Bowdoin National Wildlife Refuge Complex located between the Milk River and Beaver Creek watersheds.

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.

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

James Graham / USFWS

Ducks abound at Pearce Waterfowl Production Area.

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 milligrams of salt per liter (mg/L), 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 28). 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 developed five proposals, or alternatives, for addressing the increasing salinity levels (chapter 6 of the draft CCP and EA).

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 28 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 4) 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

Table 4. Water rights for Bowdoin National Wildlife Refuge, Phillips County, Montana.

Owner	*Water right number*	*Source name / type*	*Priority date*	*Water right type*	*Purpose*
Bureau of Reclamation	40J–40937–00	Milk River / Surface water	11/02/1903	Statement of claim	Fish and wildlife
Fish and Wildlife Service	40J–189872–00	Milk River / Surface water	03/09/1937	Statement of claim	Fish and wildlife
Fish and Wildlife Service	40M–187361–00	Beaver Creek / Surface water	11/12/1940	Compact[1]	Fish and wildlife
Fish and Wildlife Service	40M–187362–00	Black Coulee / Surface water	11/12/1940	Reserved claim	Fish and wildlife
Fish and Wildlife Service	40M–187363–00	Spring, Unnamed tributary of Beaver Creek / Ground water	11/12/1940	Compact	Fish and wildlife
Fish and Wildlife Service	40M–187364–00	Ground water	11/12/1940	Compact	Wildlife
Fish and Wildlife Service	40M–187365–00	Ground water	11/12/1940	Compact	Wildlife
Fish and Wildlife Service	40M–189874–00	Ground water	11/12/1940	Compact	Institutional
Fish and Wildlife Service	40M–25539–00	Ground water	11/12/1940	Compact	Domestic

[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.*

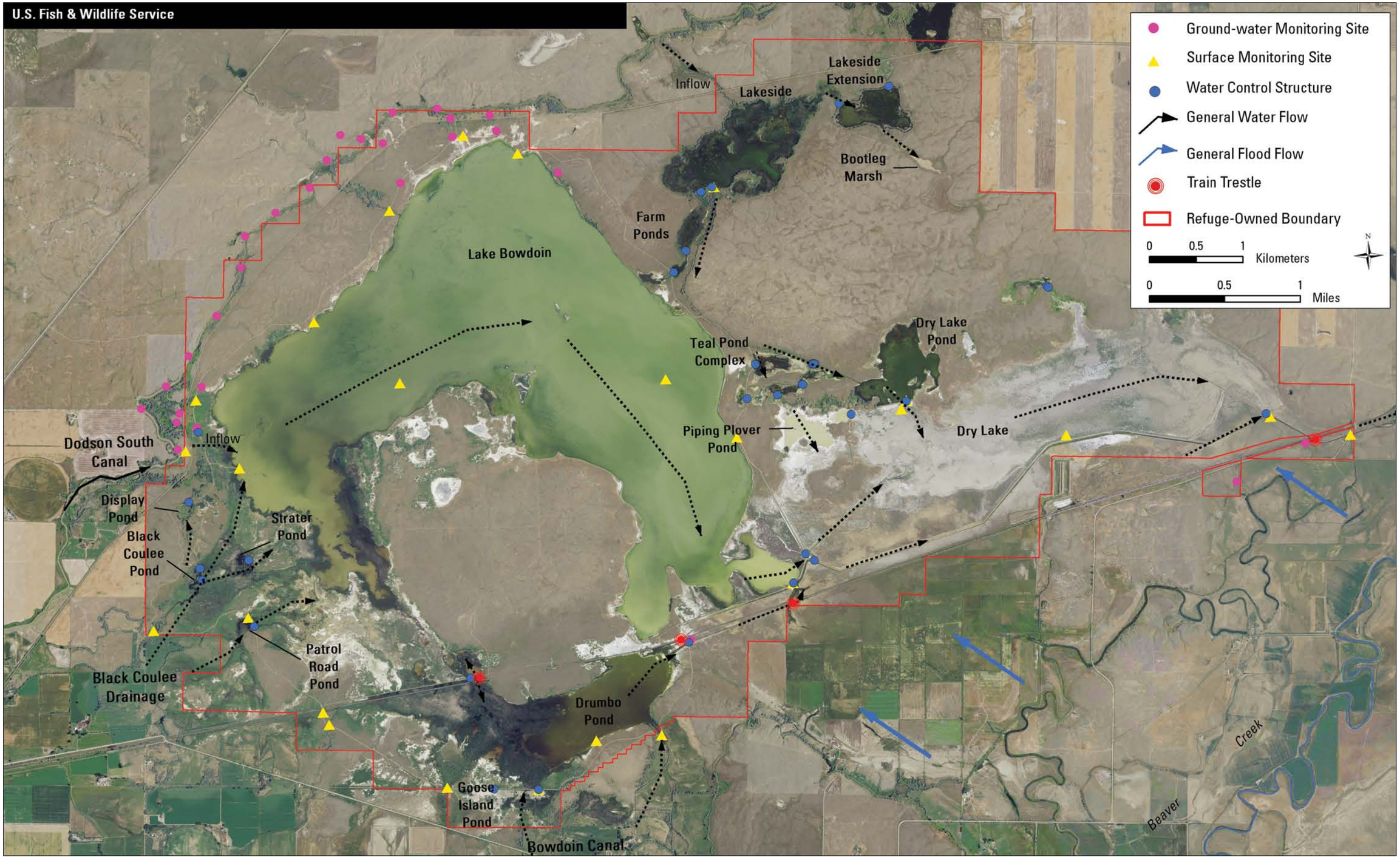

Figure 28. Map of wetlands, water management infrastructure, and monitoring sites on Bowdoin National Wildlife Refuge, Montana.

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.

Bowdoin Wetland Management District. All waterfowl production areas except Webb WPA have recorded water rights (table 5). Sources for these

Table 5. 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*
Beaver Creek WPA	Phillips	40M–5987–00	Beaver Creek	09/08/1900	Statement of claim	Irrigation
	Phillips	40M–22930–00	Unnamed tributary of Beaver Creek	09/08/1900	Statement of claim	Irrigation
	Phillips	40M–169663–00	Beaver Creek	09/08/1900	Statement of claim	Irrigation
	Phillips	40M–22928–00	Unnamed tributary of Beaver Creek	07/11/1903	Statement of claim	Irrigation
	Phillips	40M–19581–00	Spring, Unnamed tributary of Beaver Creek	12/31/1930	Statement of claim	Stock
Dyrdahl WPA	Phillips	40J–167498–00	Natural pit, Unnamed tributary of interior drainage	12/31/1911	Statement of claim	Stock
	Phillips	40K–167499–00	Surface water	12/31/1911	Statement of claim	Stock
	Phillips	40J–167505–00	Unnamed tributary of interior drainage	01/30/1923	Statement of claim	Irrigation
	Phillips	40J–167516–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock
	Phillips	40J–167517–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock
	Phillips	40J–167518–00	Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock
	Phillips	40J–167519–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock
	Phillips	40J–167521–00	Natural pit, Unnamed tributary of interior drainage	12/31/1923	Statement of claim	Stock
	Phillips	40J–167506–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock

[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 5. 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*
Dyrdahl WPA (continued)	Phillips	40J–167507–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40J–167508–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40J–167509–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40J–167510–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40J–167511–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40J–167512–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40J–167513–00	Natural pit, Unnamed tributary of interior drainage	07/12/1928	Statement of claim	Stock
	Phillips	40K–167497–00	Unnamed tributary of closed basin	05/10/1940	Statement of claim	Stock
	Phillips	40J–167504–00	Natural pit, Unnamed tributary of interior drainage	12/31/1945	Statement of claim	Stock
	Phillips	40J–167522–00	Ground water	06/05/1964	Statement of claim	Stock
	Phillips	40J–34882–00	Ground water	08/23/1981	Ground water certificate	Stock
	Phillips	40J–47460–00	Ground water	12/07/1981	Ground water certificate	Domestic and Stock
Holm WPA	Blaine	40J 183201 00	Unnamed tributary of Hay Coulee	03/06/1942	Statement of claim	Stock
Korsbeck WPA	Phillips	40J–43760–00	Unnamed tributary of interior drainage	12/31/1905	Statement of claim	Stock
	Phillips	40J–43936–00	Constructed pit, Unnamed tributary of West Alkali Creek	12/31/1945	Statement of claim	Stock
	Phillips	40J–43940–00	Constructed pit, Unnamed tributary of West Alkali Creek	12/31/1954	Statement of claim	Stock
	Phillips	40J–102275–00	Ground water	10/06/1958	Statement of claim	Stock

[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 5. 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*
McNeil Slough WPA	Phillips	40J–163022–00	Unnamed tributary of Milk River	06/21/1930	Statement of claim	Wetlands
Pearce WPA	Phillips	14–06–600–59081	—	10/17/1961	Statement of claim	—
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
Hewitt Lake NWR	Phillips	40J–183198–00	Unnamed Tributary to Spring Coulee	07/16/1902	Statement of claim	Fish and wildlife
Lake Thibadeau NWR	Hill	40J–187366–00	Unnamed Tributary to Redrock Coulee	10/25/1937	Statement of claim	Fish and wildlife
	Hill	40J–187367–00	Lohman Coulee	10/25/1937	Statement of claim	Fish and wildlife
	Hill	40J–188170–00	Martin Coulee	10/25/1937	Statement of claim	Fish and wildlife

[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.*

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 were to 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 continue 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 5). 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 (EPA) 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 EPA 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 eventually evaporated and left 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 Montana Department of Environmental Quality (DEQ).

3.2 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.

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 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

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.

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

North-central Montana does not have many new invasive plant species when compared to other parts of the State; however, refuge complex lands will be constantly monitored for new nonnative species that can occur in this area including Russian knapweed, hoary alyssum, and baby's breath. Although most of the native prairie is free from invasive and nonnative plants, there is 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 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

Cassondra Skinner / USDA–NRCS PLANTS Database

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

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 to 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. Over the years, the trees have encroached into native prairie, fragmenting grassland habitats throughout the refuge complex, but particularly on Bowdoin Refuge. Research has proven that 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. Labor-intensive control methods, combined with a lack of staff, has slowed progress in reducing the infestation.

In September 2010, the State reclassified Russian olive as a priority 3 regulated plant. Regulated plants are not listed as noxious weeds but have the potential to have significant impacts. This plant species may no longer be intentionally spread or sold.

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. Japanese brome is an early invader and spreads quickly, particularly in disturbed sites. Not only does this plant compete for the resources needed by desirable native plants, it provides poor cover for grassland birds and decreases in nutritive content and digestibility as it matures.

Leafy Spurge. Leafy spurge is an aggressive perennial species that is known to displace desirable grasses and forbs. The plant's ability to spread rapidly by seed and vegetative reproduction and its extensive deep-root system are factors that can make eradication of this species extremely difficult.

Leafy spurge was first discovered growing on Bowdoin 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 (Bowdoin District) 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. The Service's Montana Strike Team has been surveying, treating and monitoring this species on McNeil Slough for the last 3 years, and evidence suggests that infestations are decreasing. 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.

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 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

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Baird's Sparrow

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The chestnut-collared longspur is a Montana species of concern that nests on Bowdoin Refuge.

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 tame-grass 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).

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 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

Dr. Thomas G. Barnes / USFWS

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

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 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

Lee Karney / USFWS

Long-billed Curlew

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

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Sprague's Pipit

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).

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.

Across the entire Bowdoin Refuge Complex, wetlands are diverse in size and type including the following: permanent wetlands (4,544 acres); semipermanent wetlands (1,016 acres); and seasonal or temporary wetlands (1,900 acres). Most of these wetlands are found on Bowdoin Refuge including the largest, Lake Bowdoin (refer to figure 28).

Many of the wetlands on Bowdoin Refuge have been sampled and fall into the following salinity classes defined by Stewart and Kantrud (1971):

- *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, Piping Plover 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).

Invasive and Nonnative Species in Wetlands

The refuge complex has several invasive, 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 infesta-

tions. Labor-intensive, but effective, 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 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 Global Positioning System (GPS) and sprayed with herbicide. No saltcedar was found in 2010. Constant monitoring and repeated treatments will be needed to prevent further spread.

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

Lake Bowdoin at full pool is a 4,470-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 evaporates 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 water 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 1999.

Patrol Road Pond (4 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-

Mike Artmann / USFWS

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

Mike Artmann / USFWS

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

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.

Black Coulee Pond (8 acres), Lakeside Extension (46 acres), Lakeside Pond (296 acres), Lower Farm Pond (5 acres), and Upper Farm Pond (15 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.

George F. Russell / USDA–NRCS PLANTS Database

Broadleaf cattail is an emergent plant species in wetland habitat.

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,

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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.

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.

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 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).

R.A. Howard / USDA–NRCS PLANTS Database

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

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, damselflies, 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 H–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 H–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.

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). On the Bowdoin Refuge Complex, pintails typically arrive in early March, and they normally initiate nesting earlier in the 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). On the Bowdoin Refuge Complex, mallards typically arrive the first week in March. 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).

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); however, they typically arrive on the Bowdoin Refuge Complex as early as the second week in March. 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,

John and Karen Hollingsworth / USFWS

Northern Pintail

Gene Nieminen / USFWS

Mallard Pair

Donna Dewhurst / USFWS

Redheads feed in large, open areas.

Mike Artmann / USFWS

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

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 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. Godwits typically arrive on the Bowdoin Refuge Complex the third week in April. 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).

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Marbled Godwit

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Wilson's phalarope is a small "wader."

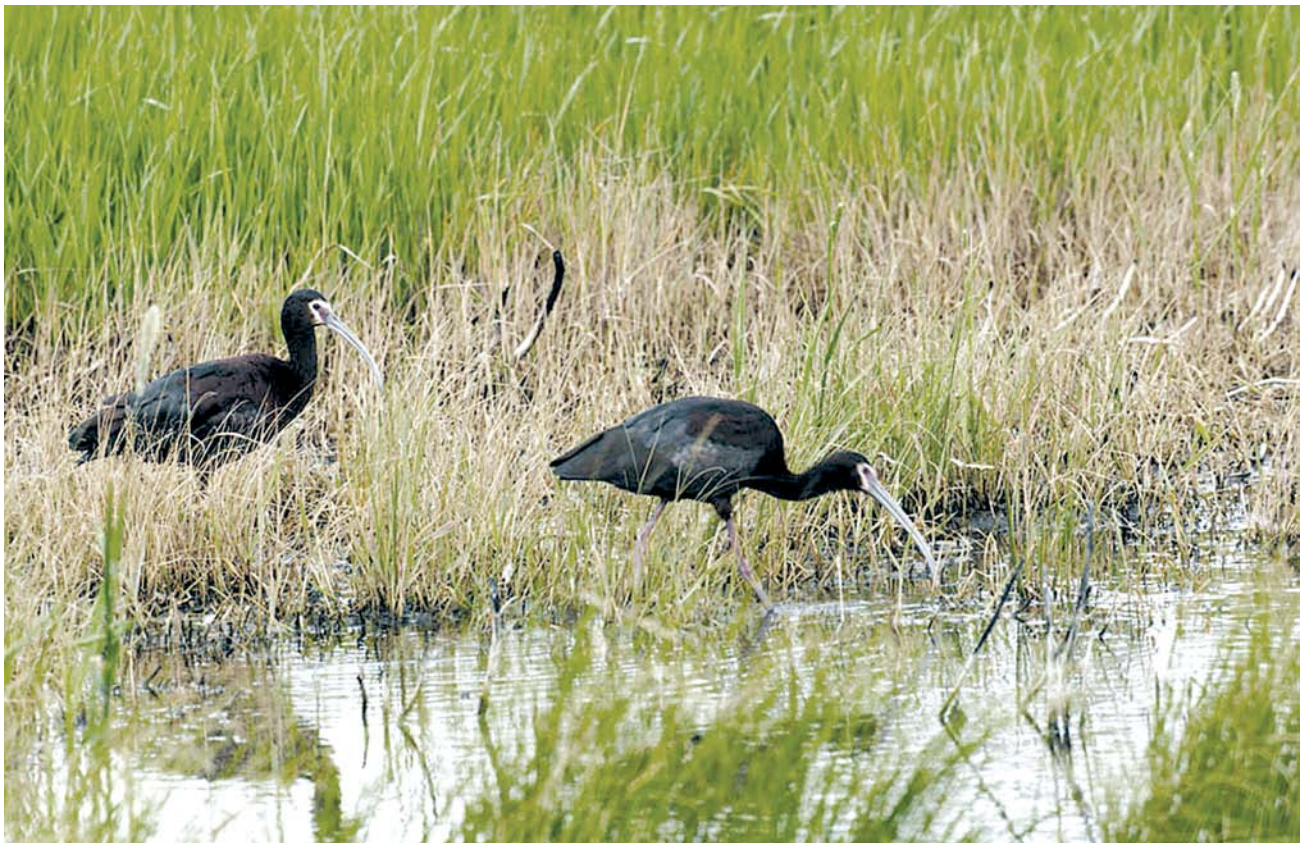
Wilson's Phalarope. Wilson's phalaropes are small wading birds that use both fresh and alkali wetlands with three characteristics: open water, emergent vegetation, and open shoreline (Hohn 1967, Naugle 1997, Prescott et al. 1995, Saunders 1914, Stewart 1975, Stewart and Kantrud 1965). Phalarope need 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 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). Typically, phalaropes begin arriving on the Bowdoin Refuge Complex the last week in April.

Wilson's phalarope begins nesting in June in sparse to dense vegetation. Its nest is a grass-lined depression. 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); however, they typically arrive on the Bowdoin Refuge Complex the third week in April. 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).



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White-faced ibis are large wading birds.

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, including the Bowdoin Refuge Complex, 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). According to the Western Colonial Waterbird Survey, from 2009 to 2011, Franklin's gulls were known to nest in five locations in Montana, averaging 8,097 breeding pairs, with 8,100 documented in 2011 (Wightman et al. 2011). Median colony size during the survey period was estimated at 1,200 breeding pairs while colony

size ranged from 16 to 4,833 breeding pairs (Wightman and Tilly 2011). Between 2009 and 2011, it is estimated that Bowdoin Refuge contained an average of 1,765 breeding pairs (ranging 1,025–2,450) or about 21.8 percent of Montana's breeding population (Wightman et al. 2011).

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 will 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.

3.3 Salinity 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 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.

Donna Dewhurst / USFWS

Salinity can decrease the diversity of the wetland vegetation and the invertebrates that ducks like mallards rely on.

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,

Mike Artmann / USFWS

Salt residue accumulates at the southeastern outflow area of Lake Bowdoin.

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 Nashua, 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.

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 parts per thousand (ppt), percent, 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 electrical conductivity (EC) 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 microSiemens per centimeter (µS/cm), milliSiemens (mS), or millimhos (mmhos). 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.

$$(500 \text{ mg/L}\times1{,}360{,}000 \text{ tons})/1{,}000{,}000=680 \text{ tons of salts}$$

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 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 6 (Stewart and Kantrud 1972), this concentration places the lake in the subsaline (second most concentrated) class.

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 28 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 (1971), 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

Mike Artmann / USFWS

With the fresher water it receives, Black Coulee Pond supports a greater amount of cattail than in more saline wetlands.

Table 6. 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

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.

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.

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 General Land Office (GLO) survey, helps shed light on how the system functioned in the past (figure 29). 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

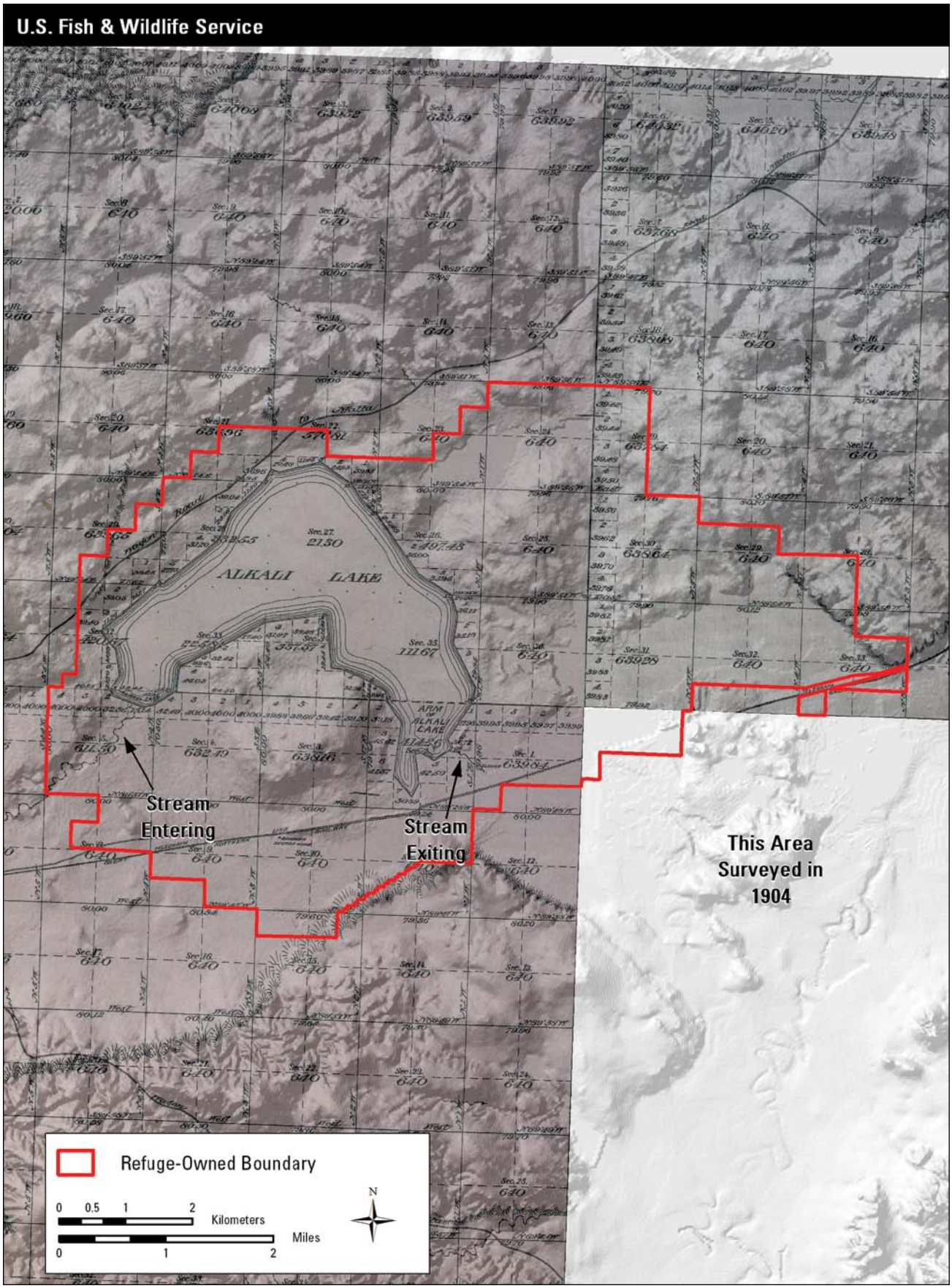

Figure 29. Map of a historical survey showing the location of Bowdoin Refuge on the topographic features of the landscape. *Source: General Land Office, 1892.*

was constructed just a couple years prior in 1887. In addition, the survey shows that Lake Bowdoin was originally called "Alkali Lake" (figure 29), 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 entering 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 makes 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 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 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 of flooding, which greatly reduced the primary mechanism for removing salts.

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

Mike Artmann / USFWS

This railroad trestle over a wetland south of Lake Bowdoin creates a constricted waterway.

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 (John Simpson, hydrologist, USFWS Region 6; personal communication, 2011). 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.

USFWS

The Brady ditch and structure changed the flow-through lake system to increase the water storage for irrigation uses.

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 30). 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 the St. Mary River was 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, enlarged, 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

Mike Artmann / USFWS

Salt residue covers Dry Lake's northern bay, which supports salt-tolerant plants like bulrush and the low-growing saltgrass.

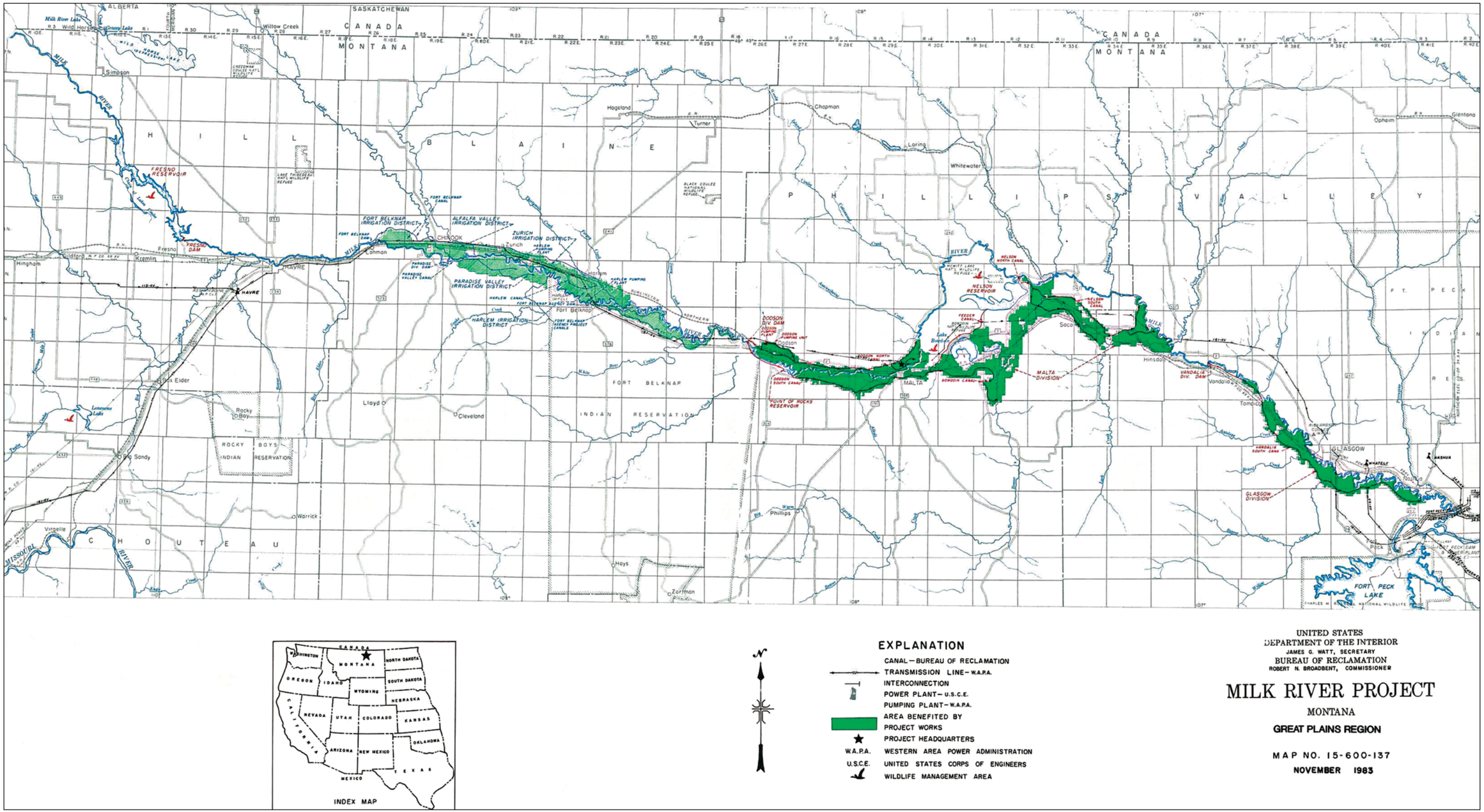

Figure 30. Map of the Milk River Project, Montana. *Source: Bureau of Reclamation, 1983.*

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-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 31 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 32 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 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 32). 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 33, 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, generally

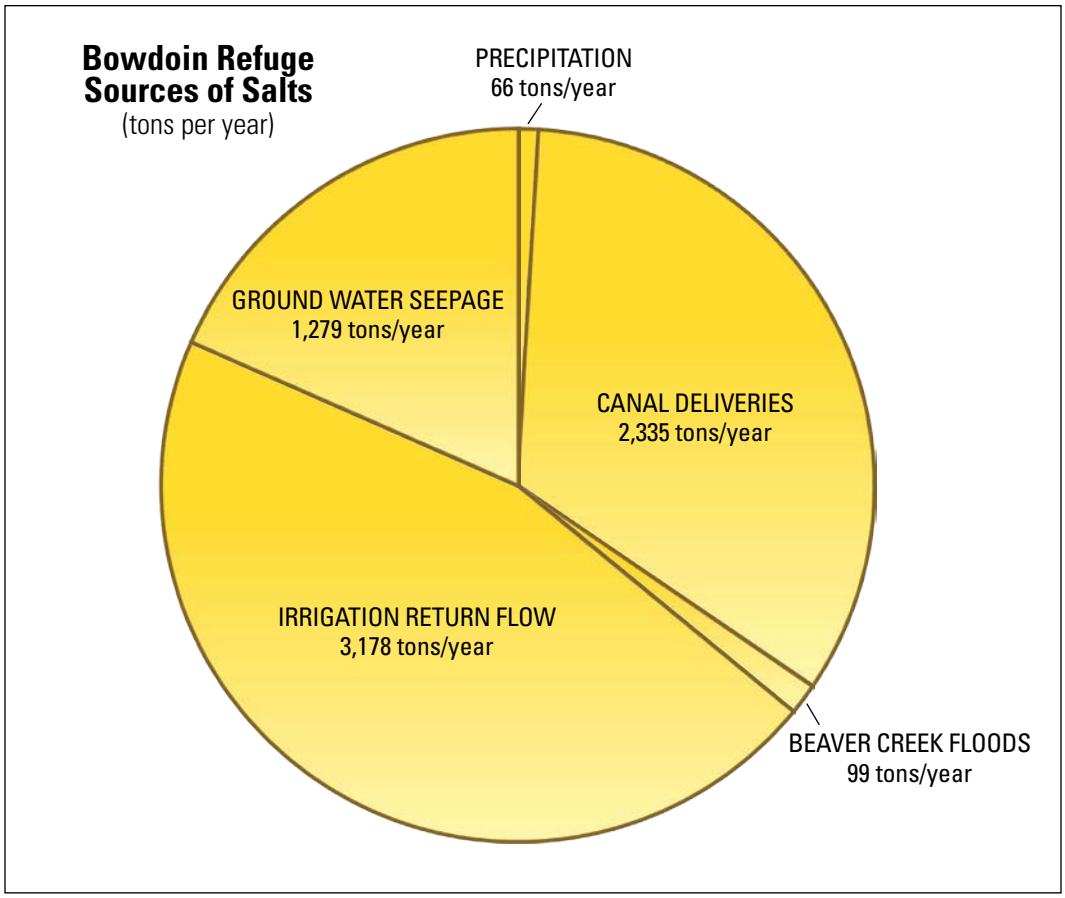

Figure 31. Chart of sources of salts into Bowdoin National Wildlife Refuge, Montana.

occurred 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 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 remained 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

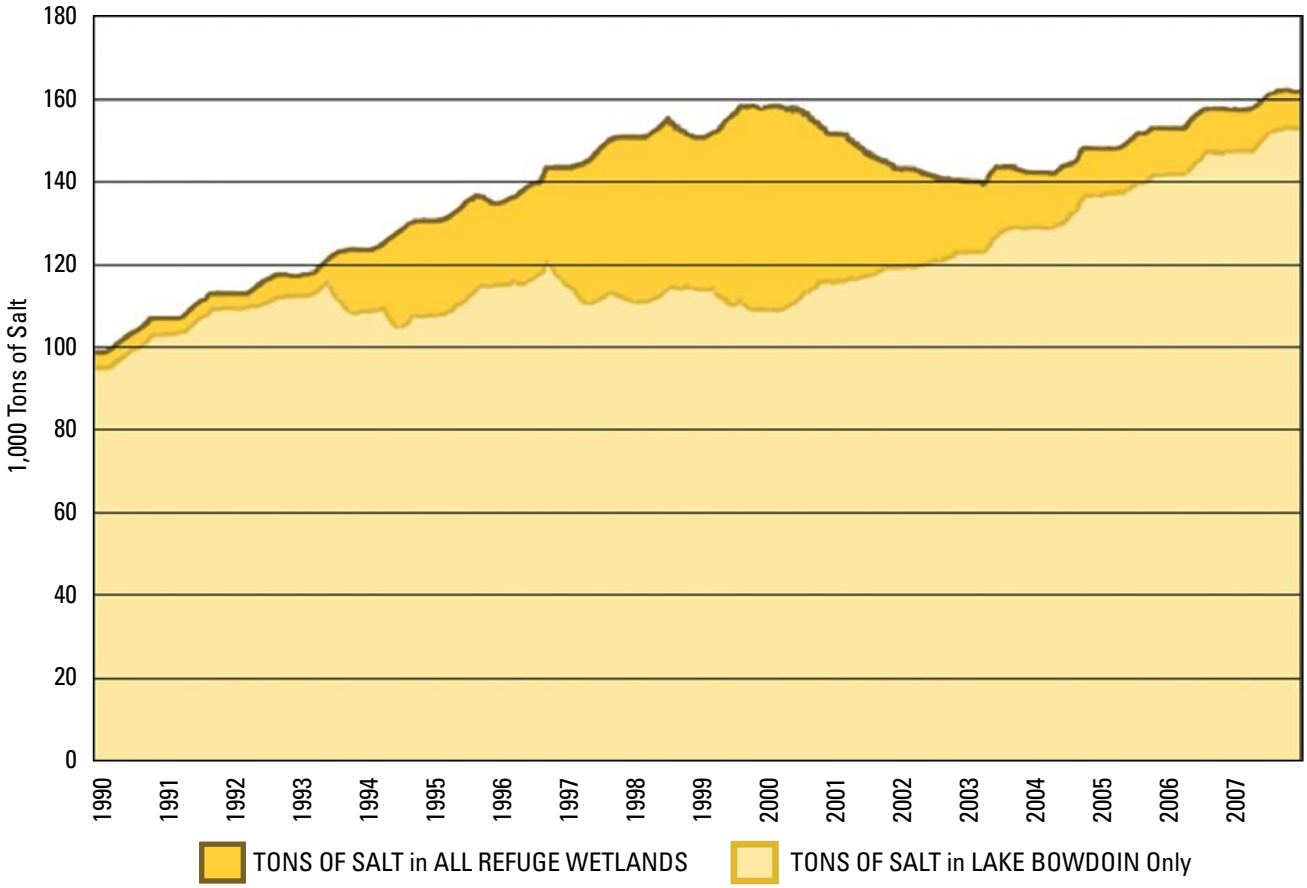

Figure 32. Graph of tons of salt in the lakes and wetlands at Bowdoin National Wildlife Refuge, Montana (1990–2007).

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 is 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.

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 34). 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

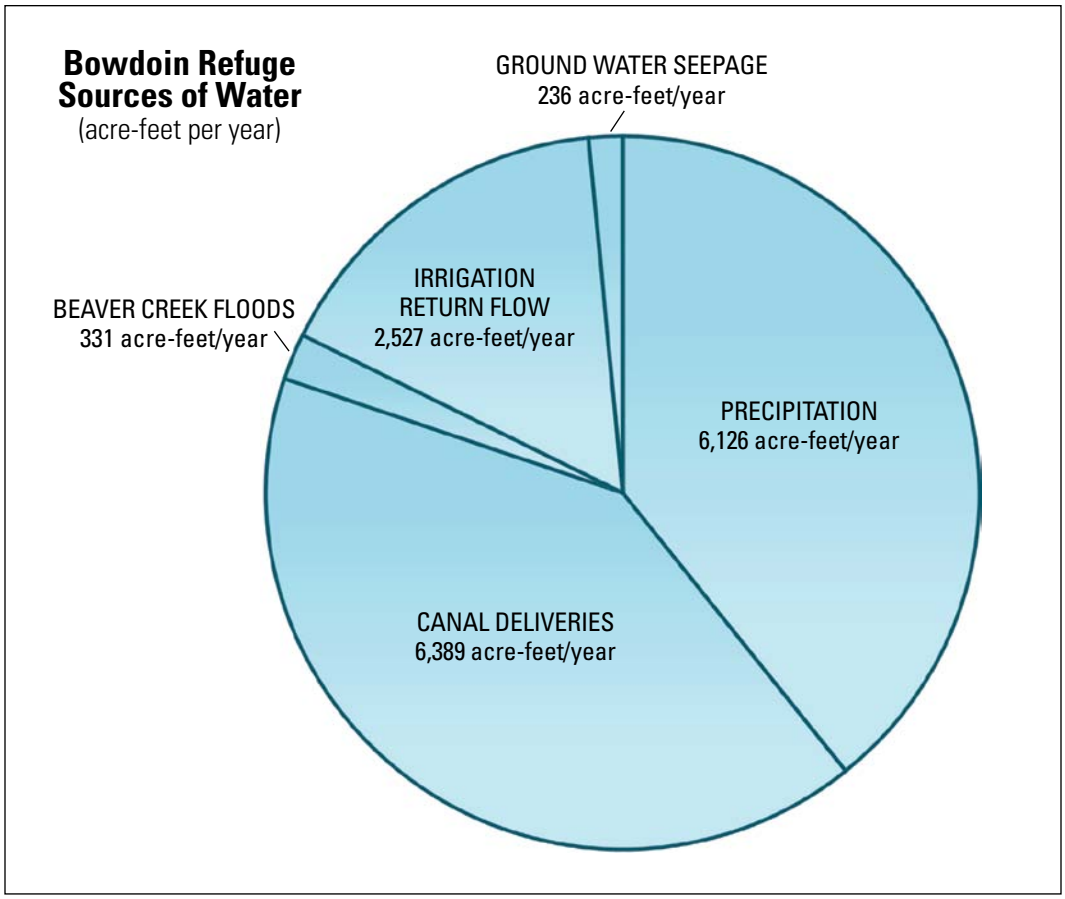

Figure 33. Chart of sources of water into Bowdoin National Wildlife Refuge, Montana.

rainstorm led to a 200-year flood episode in the Beaver Creek drainage, subsequently flooding the refuge and surrounding landscape (figure 34). 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 33 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 recreate 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 refuge. 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 will provide up to 3,500 acre-feet of water to the refuge each calendar year for improvement and maintenance of the refuge.

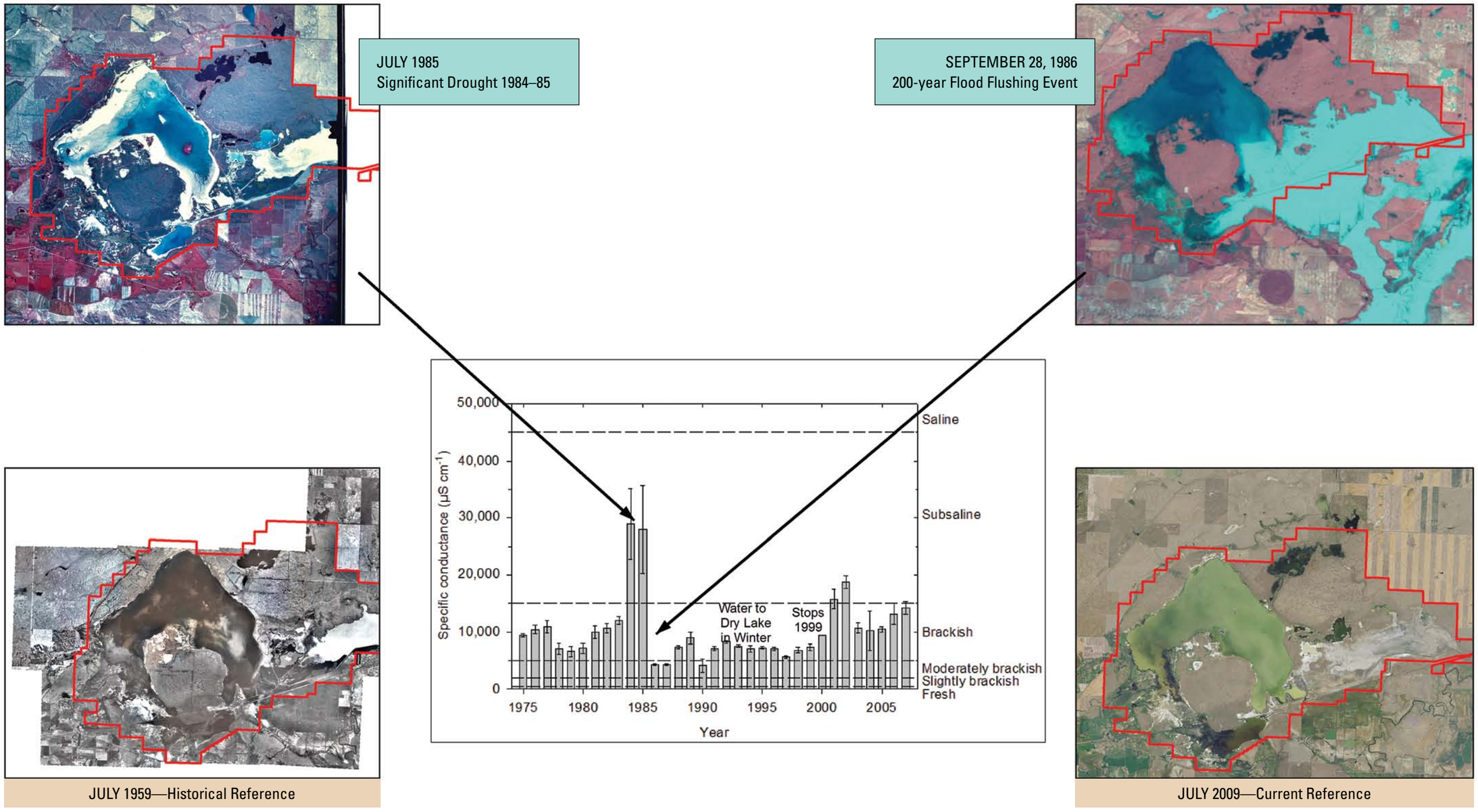

Figure 34. Map of water levels and salinity for Lake Bowdoin, Montana (1975–2007).

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 35 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.

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, are to be adjudicated statewide in all 85 basins. The State established the Montana Reserved Water Rights Compact Commission (Compact Commission) for negotiating compacts with Federal agencies and Indian tribes to quantify their reserved water rights. Thereafter, these compacts are included in adjudications.

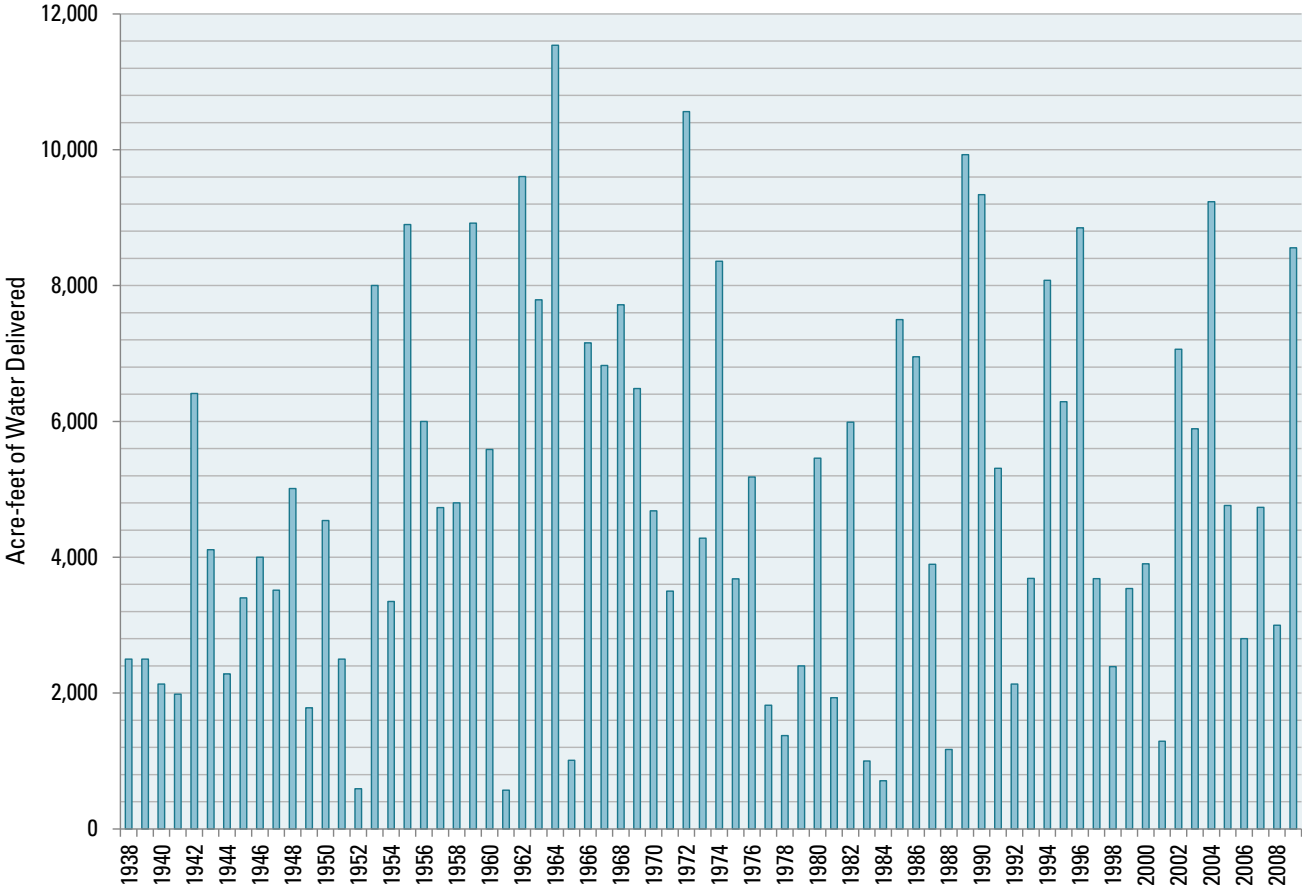

Figure 35. Graph of water deliveries to Bowdoin National Wildlife Refuge, Montana (1938–2008).

The Montana Supreme Court issued an order requiring everyone who believed they had existing water rights to file statements of claim with Montana Department of Natural Resources and Conservation (DNRC) 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 gallons per minute (gpm) 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 a memorandum of understanding (MOU) 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.

3.4 State and Federal 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 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.

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 1999). Because of its history of piping plover use, 3,325 acres of Bowdoin Refuge has been designated as critical habitat for the piping plover.

Gene Nieminen / USFWS

The Bowdoin Refuge has critical habitat for 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 are 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 nongamebirds, gamebirds without hunting seasons, subsistence-hunted nongamebirds 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 H–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.

3.5 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.

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.

Carmen Luna / USFWS

Rocks define a tipi ring at the Bowdoin Refuge.

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 headquarters 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,

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Crews from the Works Progress Administration constructed several buildings for the Bowdoin Refuge headquarters (1961).

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 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.

3.6 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 are 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 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. According to the National Audubon Society, 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. In Montana, it has been declining in range and abundance.

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.

3.7 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 hunt-

ing 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 head-counts 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 gamebirds (ducks, geese, coot, swan, sandhill crane, and mourning dove), upland gamebirds (pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge), fox, and coyote is permitted in the designated portions (about 40 percent) of Bowdoin Refuge (figure 36). 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 gamebird hunting throughout December. The first 2 days of the special opening are limited to only young hunters. Waterfowl generally remain on Bowdoin Refuge until freezeup. To avoid disturbance to these migratory birds, the opening of the late-season hunt for upland gamebirds 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 gamebirds (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 gamebirds (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 gamebirds (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 per-

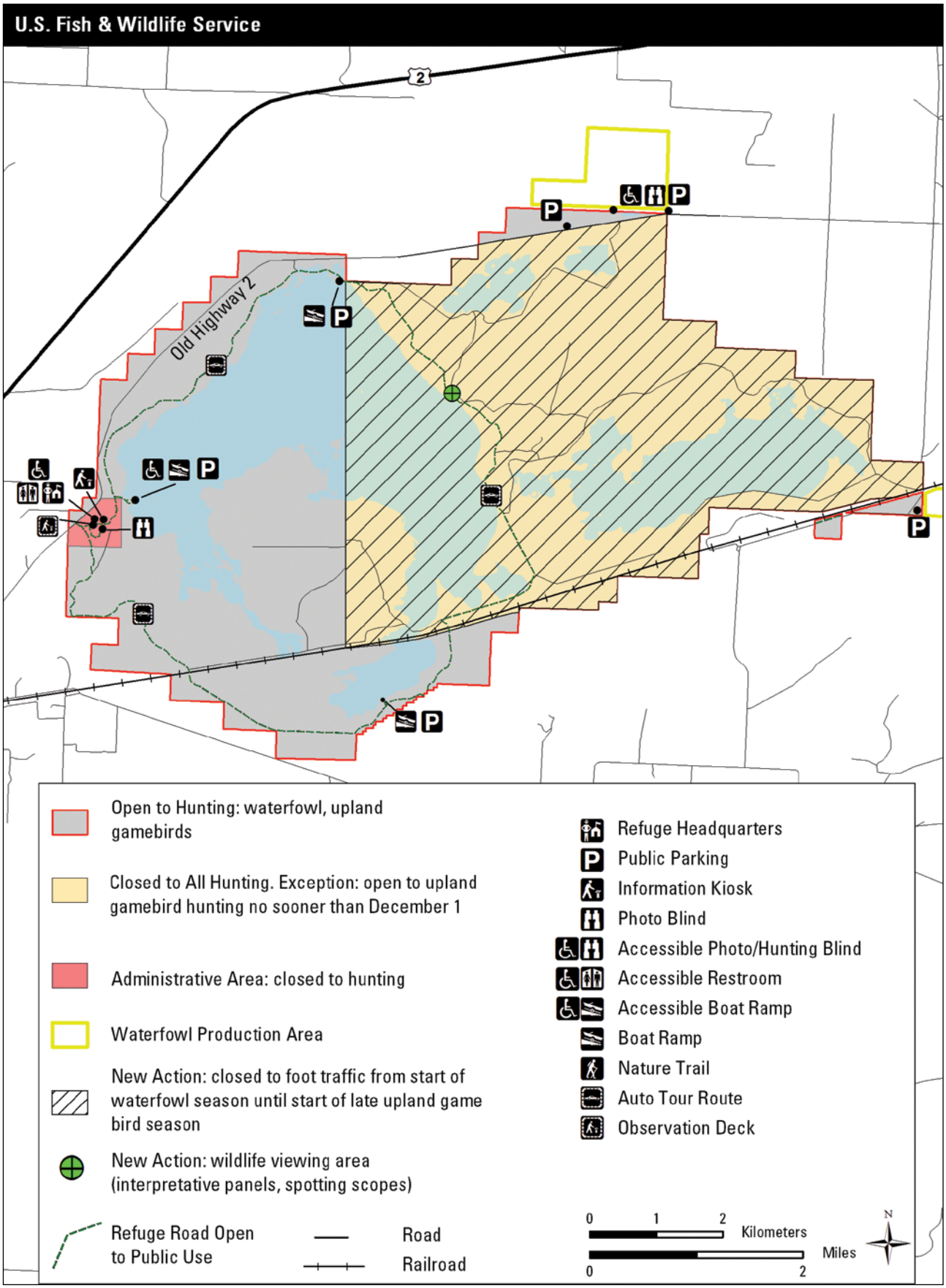

Figure 36. Map of current and planned public use sites and activities at Bowdoin National Wildlife Refuge, Montana.

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Carmen Luna / USFWS

Waterfowl hunting continues to be popular at the Bowdoin Refuge Complex (top photo—1940; bottom photo—2009).

mission from the landowner. The refuge is otherwise open to hunting for big game, migratory gamebirds (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.

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

David Brezinski / USFWS

Birdwatchers look for the Baltimore oriole in riparian areas, this bird's habitat.

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
- 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.

3.8 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.

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-

James Graham / USFWS

The Service uses prescribed fire to rejuvenate grasses and reduce vegetative litter.

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.

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 15 years, before plant diversity has declined and it becomes necessary to reestablish 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.

Mike Artmann / USFWS

Winterfat

3.9 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 un-

employment 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 gamebirds and upland gamebirds 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 gamebirds, 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.

Pasqueflower
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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.

3.10 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.

3.11 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 7). 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 7. 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

Carmen Luna / USFWS

- 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 4—Management Direction

The U.S. Fish and Wildlife Service selected the management direction described in this chapter after determining that it does the following:

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

This chapter first describes the management focus for the refuge complex, and then sets out the associated objectives and strategies that the refuge complex staff will carry out to achieve the CCP goals. The stepdown management plans listed in table 15 (section 4.9) will provide implementation details for specific programs. The chapter sections follow:

- 4.1 Management Focus
- 4.2 Goal for Upland Habitat and Associated Wildlife
- 4.3 Goal for Wetland Habitat and Associated Wildlife
- 4.4 Objectives that Support the Goals for Upland and Wetland Habitats
- 4.5 Goal for Salinity and Blowing Salts
- 4.6 Goal for Visitor Services and Cultural Resources
- 4.7 Goal for Partnerships
- 4.8 Goal for Operations
- 4.9 Stepdown Management Plans
- 4.10 Research, Monitoring, and Evaluation
- 4.11 Plan Amendment and Revision

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The American avocet is a target waterbird for the Bowdoin Refuge Complex.

4.1 Management Focus

The Service will 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, will be controlled, reduced, or eliminated and areas will be restored to native plants, as needed.

Refuge complex staff will manage enhanced wetlands 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 will enhance the waterfowl sanctuary area on the eastern half of Bowdoin Refuge by closing this portion of the refuge to all foot traffic until migrating waterfowl depart, no sooner than December 1. This will not affect current waterfowl-hunting areas.

The Service will work with the State to determine the feasibility of offering a compatible, big game hunt on Bowdoin Refuge. Programs for the other wildlife-dependent public uses—fishing, wildlife observation, photography, environmental education, and interpretation—will be maintained or improved.

The visitor contact area will be expanded, and a visitor services specialist will be added to the staff. All programs will provide visitors with information on the purposes of the refuge complex including the protection of migratory birds and their habitats, 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 are required to accomplish the goals, objectives, and strategies for the refuge complex, outlined in this chapter.

Donna Dewhurst / USFWS

The canvasback duck is one of many migratory bird species that use Lake Bowdoin.

Salinity and Blowing Salts

The Regional Director selected "Salinity Alternative 4" (from the draft CCP and EA) as the preferred alternative to address the salinity and blowing salts issue at Bowdoin Refuge. The Service will design and construct an underground injection well to force saline water from Lake Bowdoin below the lowermost geologic formation containing drinking water. This pumping will continue until a salinity objective of 7,000 mg/L is achieved. At that time, the Service will determine the best way to recreate a flow-through water system that maximizes the flushing effects of natural flooding. The pump may also be operated periodically to maintain this saline objective. Section 4.5 provides background information about the salt situation and management considerations at Bowdoin Refuge, followed by specific objectives and strategies.

Divestiture of Lake Thibadeau Refuge

The Regional Director selected "Lake Thibadeau Alternative 2" (from the draft CCP and EA) as the preferred alternative—divestiture—for Lake Thibadeau National Wildlife Refuge. The Service will prepare a proposal to divest this refuge from the National Wildlife Refuge System. This proposal will be reviewed by the Migratory Bird Conservation Committee and require an Act of Congress to be approved. The refuge and flowage easements will then be revoked and the water rights voluntarily relinquished back to the State. Subsequently, all other rights will be given to the landowner, including the management of all structures or the Service may choose to remove them. This divestiture process will be completed within 5 years. The goals, objectives, and strategies described in this chapter do not apply to this refuge.

Refuge Complex Objectives and Strategies

Sections 4.2–4.8, organized by goal, set out the objectives and strategies that serve as the steps needed to achieve the CCP goals for the 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 will 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 B contains the required compatibility determinations for public and management uses associated with the CCP.

4.2 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 8). The upland habitat objectives, for both native and disturbed grasslands, focus on providing quality habitats (table 9) 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 4.3).

Native Grassland Objective 1

Over the next 15 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.
- Develop a grassland habitat management plan that incorporates tested methods for preserving and enhancing native grassland.

Table 8. 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 9. 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 long-spur	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

Source: Davis (2004), Dechant et al. (2003), Dieni and Jones (2003), Green et al. (2002), Jones (2010), MSGWG (2005).

[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.*

- 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.

Gary A. Monroe / USDA–NRCS PLANTS Database

Silver Sagebrush

- 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 is a long-term project that goes well beyond the 15-year scope of the CCP. Ideally, upland habitats in the refuge complex will 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 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 will 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 will get along the restoration trajectory over the 15 years of the CCP; but with an initial 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 U.S. Department of Agriculture (USDA)–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 will need to determine the severity of the grazing and, if necessary, determine how to better distribute and reduce herd sizes.

M.C. Stensvold / USDA–NRCS PLANTS Database

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).

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 will help in the restoration of the uplands to the historical climax plant community. Small research plots and a combination of treatments will be used to simultaneously reduce clubmoss and reintroduce decreaser species such as green needlegrass and bluebunch wheatgrass. Suc-

D.M. Prellwitz / USFWS

Refuge employees apply bands to grassland-nesting birds such as Baird's sparrow to gather scientific information.

cessful methods will 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 dense nesting cover (DNC), 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 wheatgrass, 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 will 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 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 will reduce habitat fragmentation and attract grassland birds that have adapted to the diverse structure of native prairie; whereas DNC limits 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 will be maintained in their current state of cover, and periodic treatment will remove accumulated duff and rejuvenate plants. Vegetative cover including DNC plantings older than 15 years will 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 will be western wheatgrass, slender wheatgrass, and tall wheatgrass and alfalfa will 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.

4.3 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 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).

Dave Menke / USFWS

The sora is a small marshbird that uses ponds in the Bowdoin Refuge Complex.

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 4,470-acre (at full pool) 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 10). Table 11 displays the habitat needs for

Table 10. 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.*

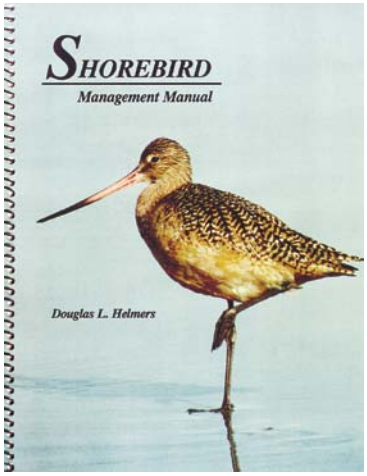
[3] Special status or Sensitive=*Proven to be imperiled in at least part of its range and documented to occur on Bureau of Land Management lands.*

[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.*

these target species. Managing for the life history needs of these species provides 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 will 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 (bloodworms), 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, will 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 godwit, willet, spotted sandpiper, American avocet, Wilson's phalarope, black-necked stilt, and mountain plover. Shorebird habitat management in the refuge complex emphasizes provision of breeding habitat for three target species: piping plover, marbled godwit, and willet (table 12). 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 will likely provide quality habitat for all shorebirds.

Spring migration habitat should be available on the refuge complex

Table 11. 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

Source: Unless otherwise the noted, this information came from Birds of North America Online (Poole 2005) and Montana Field Guide (2010).

[1] *Frank Belrose (1980).*

[2] *Ryan and Renken (1987).*

[3] *Melcher et al. (2006).*

[4] *Eldridge (1992).*

[5] *Refuge staff observations.*

Table 12. 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).

by mid-April that provides foraging water depths of 0 (dry mud) to 0.6 foot (18 centimeters), which meets the needs of these species, as specified below and in figure 37:

- *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.

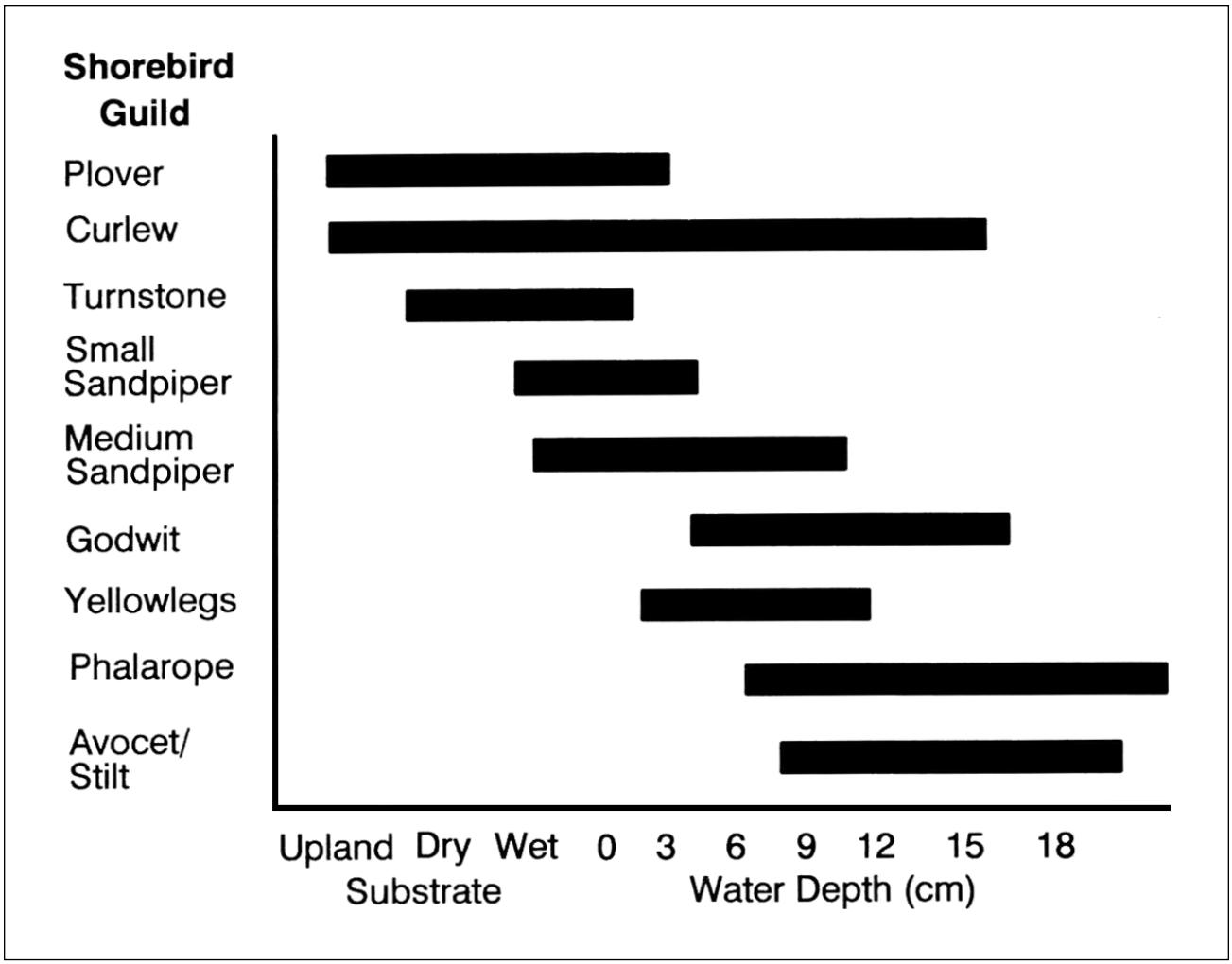


Figure 37. Graph of water depth and substrate preferences of shorebird foraging guilds (Helmers 1992).

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.
- 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.

- 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 wetland drawdowns 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. Wetland edges with mudflats or shallow areas create feeding habitat for shorebirds and resting areas for other waterbirds. As a wetland deepens toward the center, it creates different feeding depths for various species of waterbirds.

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

USFWS

White-faced ibis congregate in a wetland at Bowdoin Refuge Complex.

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 will 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 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).

USFWS

Piping Plover Chick

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.

4.4 Objectives that Support the Goals for Upland and Wetland Habitats

To meet the goals for both upland and wetland habitats, the Service will treat invasive and nonnative species, suppress wildfires, and carry out habitat protection and acquisition. All of these activities 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, will 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 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.

- 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. This may be directly tied to the invasion of Russian olive trees 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 38). 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 will benefit this threatened species. In addition to the two target areas, about 8 acres of shelterbelts in the refuge complex will be removed, and additional Russian olive removal will 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 39). 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 act on the plant at all life stages (Natural Resources Conservation Service 2002). Treatment requires 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 removal of at least 25 acres of Russian olive trees over 15 years may seem like a small amount given the timeframe and infestation. However, it is difficult to control this species in this part of Montana, making this a realistic objective for the following reasons:

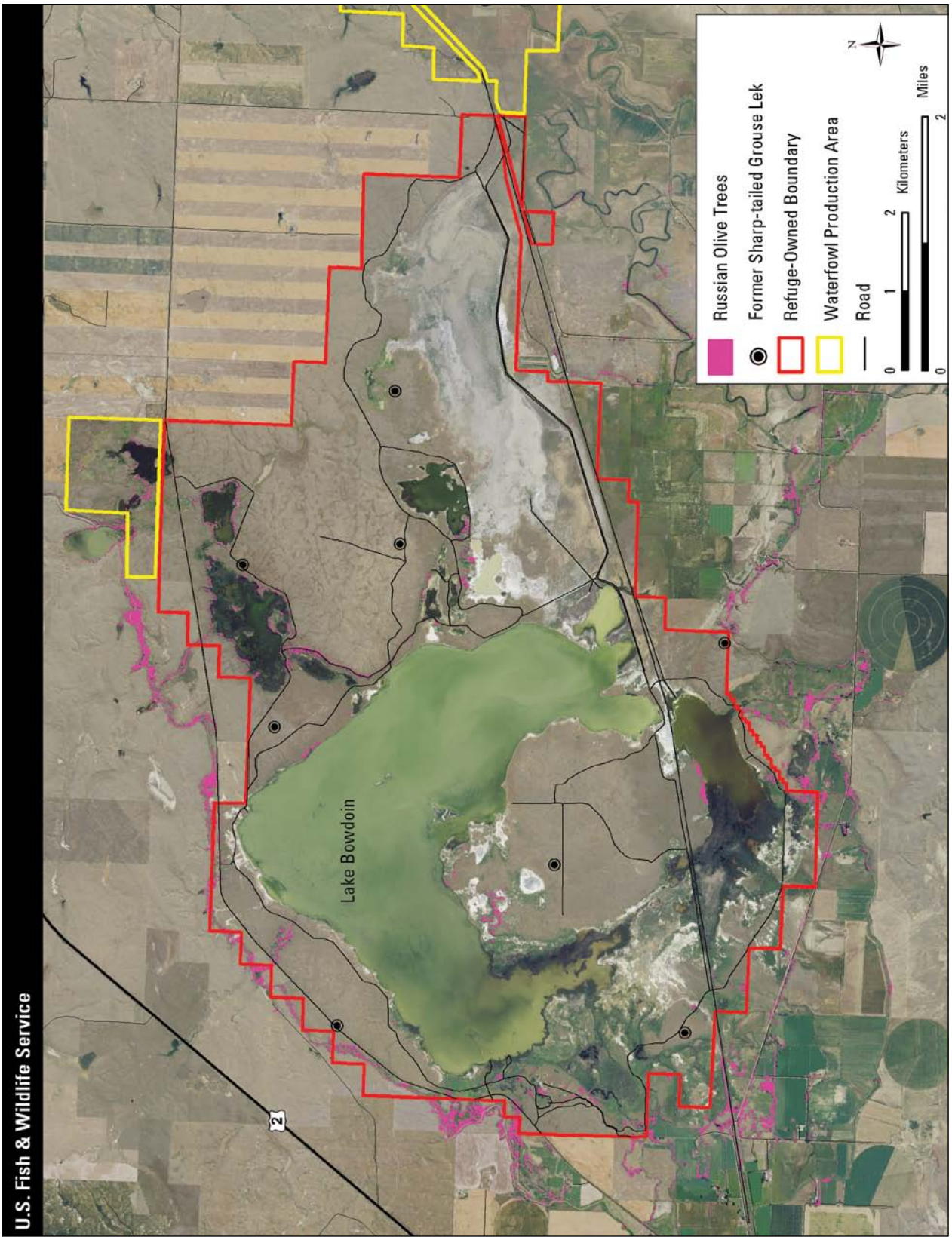


Figure 38. Map of Russian olive tree infestations in and around Bowdoin National Wildlife Refuge, Montana.

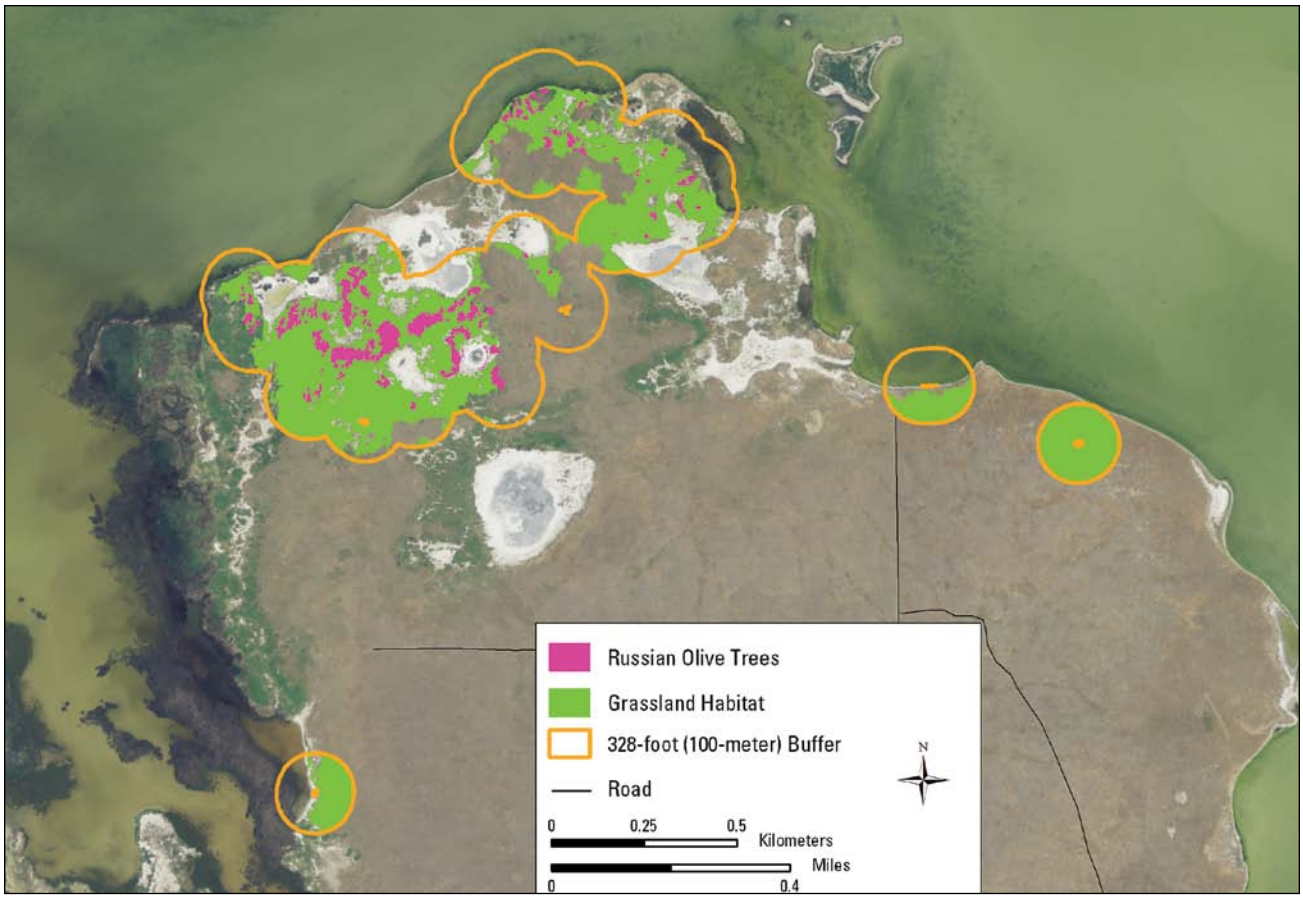


Figure 39. Map of Russian olive evaluation areas (Big Island) for grassland restoration at Bowdoin National Wildlife Refuge, Montana.

- 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 will 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 will take many years.

- Russian olive trees on private land surround Bowdoin Refuge (figure 38). 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;

Mike Artmann / USFWS

Nonnative Russian olive along Lakeside Canal in the Teal Pond area.

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.

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 Refuge Lands Geographic Information System (RLGIS) 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.

Sheri Hagwood / Bureau of Land Management

Reed Canarygrass

- 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 will 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 jeopardizes the efficiency of the control efforts and waste precious time and resources. An inventory will 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.

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.

Mike Granger / USFWS

Prescribed fire can be an effective tool to manage grassland vegetation.

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.

The BAR treatments are nonemergency efforts made within 3 years of wildfire containment. The treatments (1) will improve fire-damaged lands that are unlikely to recover to management-approved conditions and (2) will repair or replace minor facilities damaged by wildfire.

The use of BAER and BAR monies will follow national and regional policy and guidance. It is likely BAR money will be used the most within the refuge complex, including repairing or replacing fences dam-

aged 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 will be maintained or pursued.

Appendix I further describes the fire management program for the refuge complex.

Habitat Protection and Acquisition

Habitat protection and acquisition will 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

Dave Menke / USFWS

The northern shoveler is one of the duck species that nests in upland habitats.

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 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.

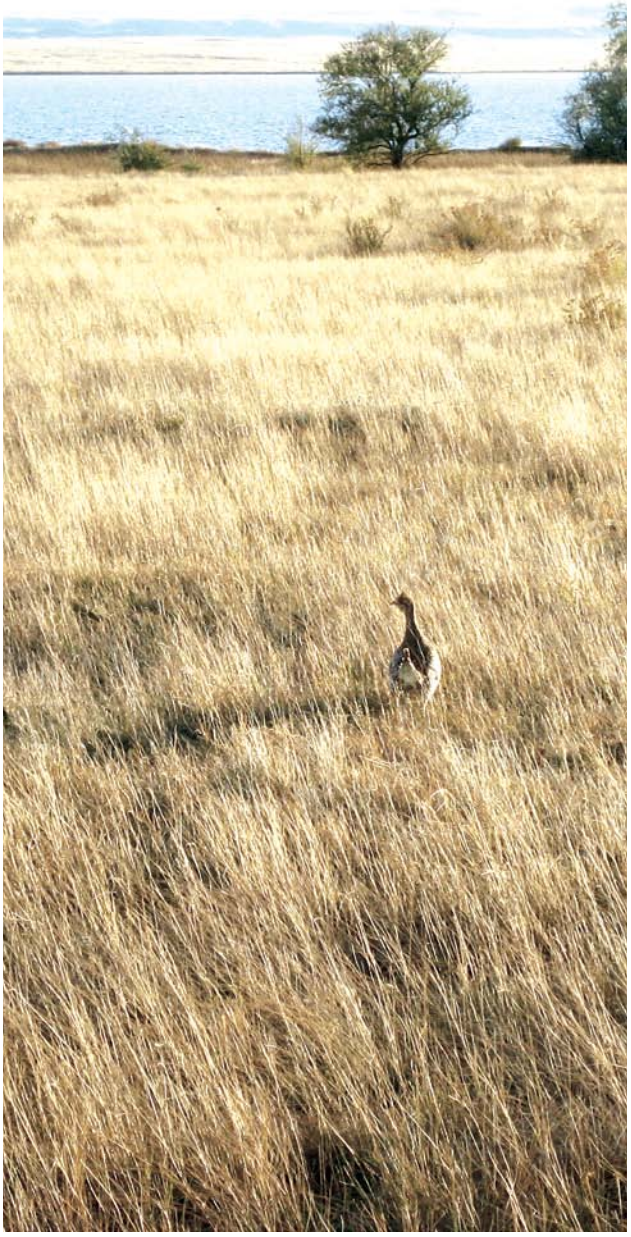
Funding for grassland conservation easements comes from a variety of sources including Migratory Bird Hunting and Conservation Stamp Act (with Governor approval), North American Wetland Conservation Act grants, and Land and Water Conservation Funds. Thirty-three grassland easements have been purchased 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.



Mike Artmann / USFWS

The sharp-tailed grouse is a year-round resident on the Bowdoin Refuge.

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 the Habitat and Population Evaluation Team (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.

- 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 will be negligible. Priorities for acquisitions will be 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 conservation 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 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 40]. *Wetland den-*

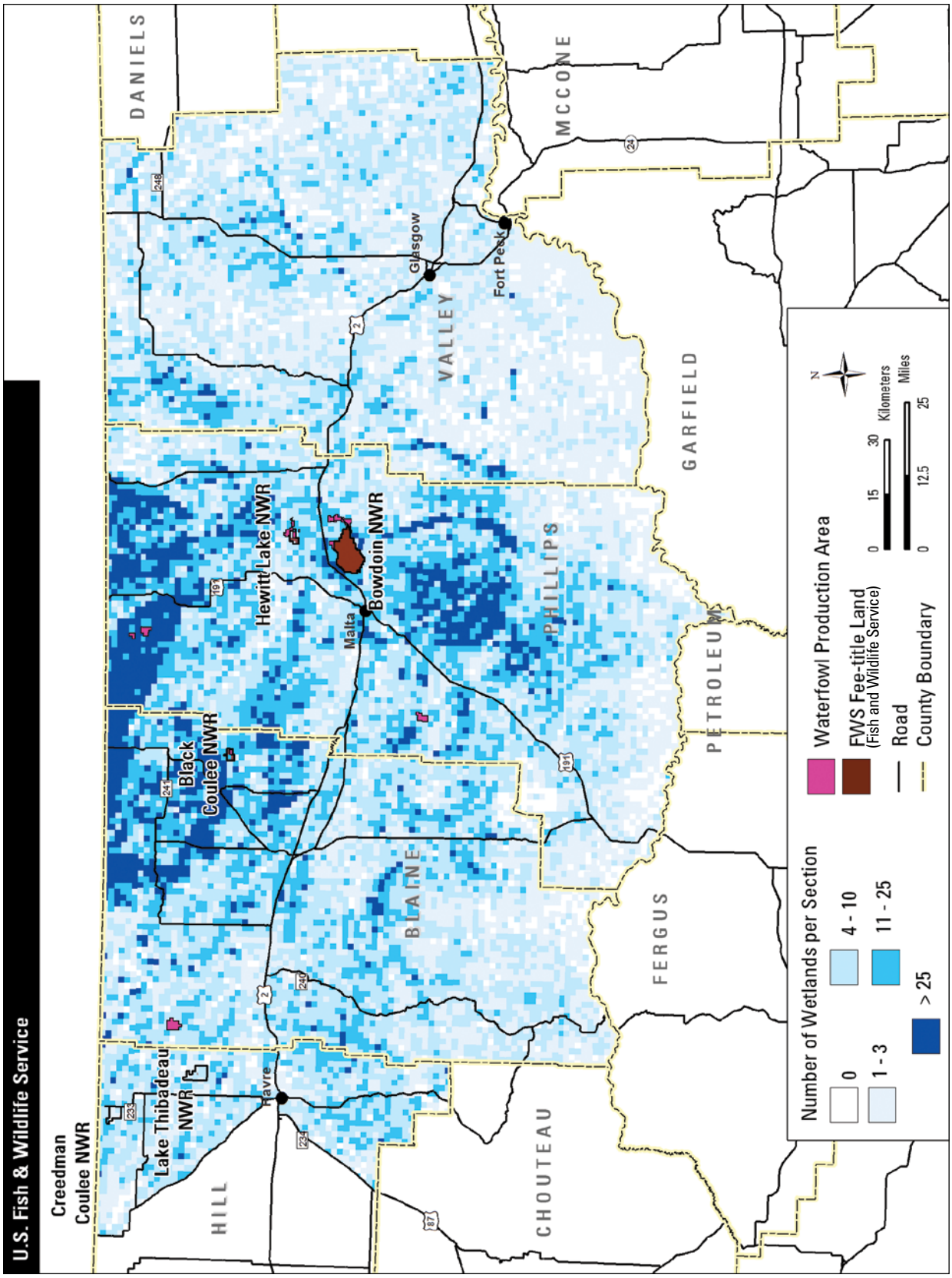


Figure 40. Map of wetland density per square mile in Bowdoin National Wildlife Refuge Complex, Montana.

sities 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 41]. *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 42]. *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 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 is 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 affords 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.

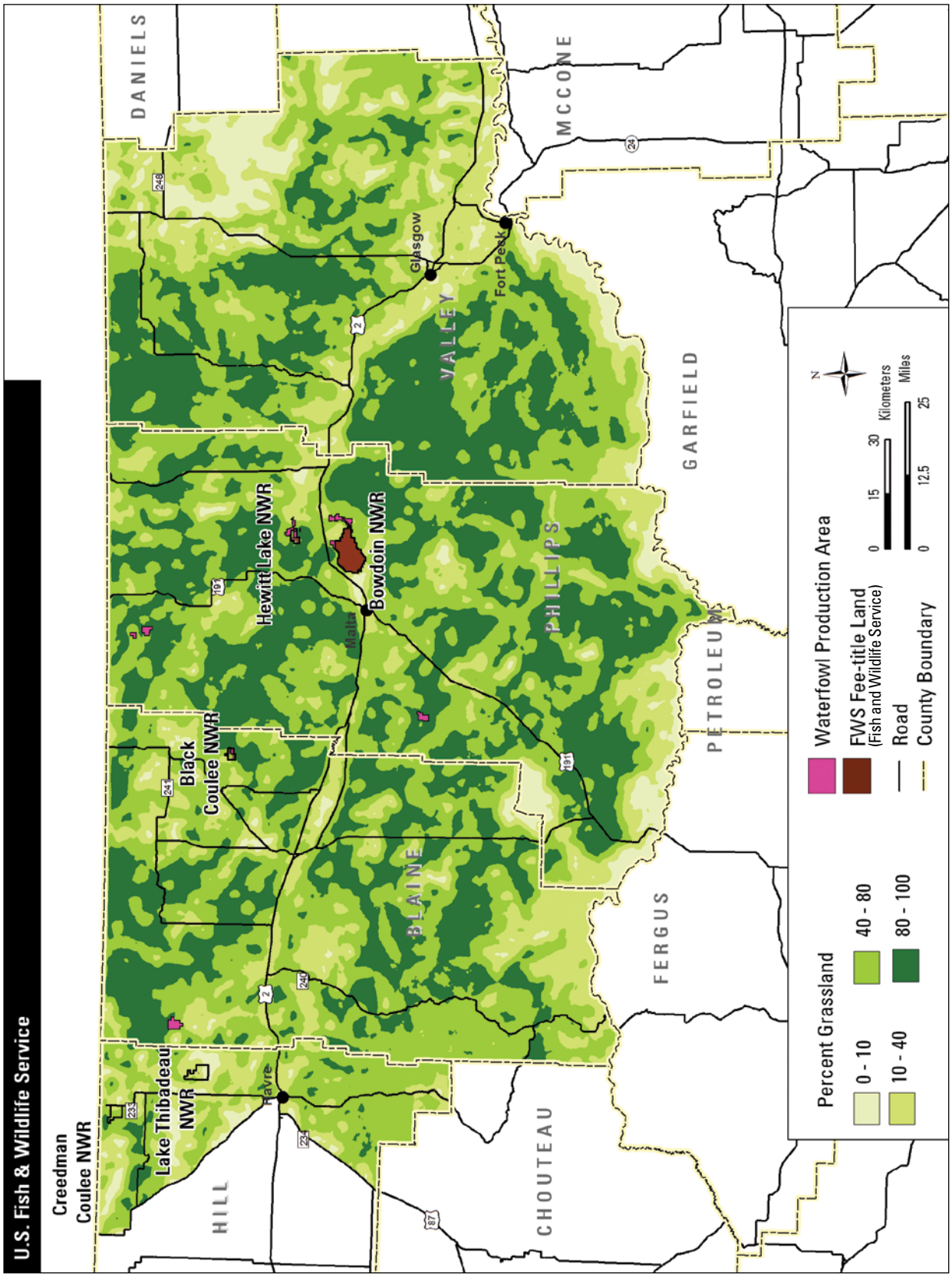


Figure 41. Map of grassland density in Bowdoin National Wildlife Refuge Complex, Montana.

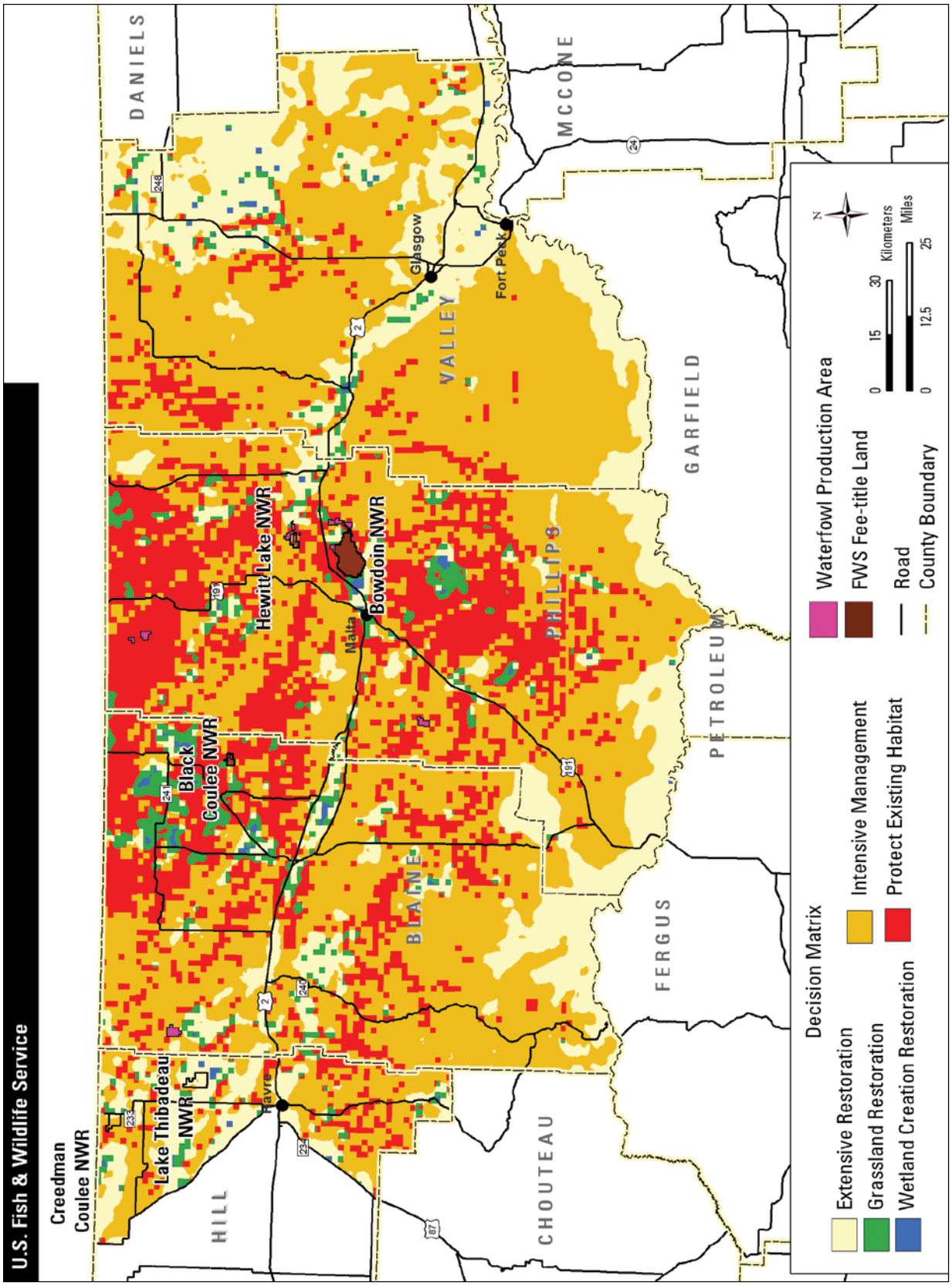


Figure 42. Map of areas with high densities of wetlands and grasslands for use as a decision matrix to determine protection priorities in Bowdoin National Wildlife Refuge Complex, Montana.

4.5 Goal for Salinity and Blowing Salts

Develop a water management system on Bowdoin National Wildlife Refuge that protects the environment and mitigates current and future blowing salt concerns for neighboring properties, while providing quality water and wildlife habitat for migratory birds and other wetland-dependent wildlife.

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 will 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 will 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 will 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 will average around 7,000 mg/L at a lake elevation of 2,209 feet (figure 43). However, the salt concentration of Lake Bowdoin will 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 will match the historical delivery rates (1990–2007). The modeling effort to predict future salinity concentrations assumes that in some years there will be floods and in other years there will be droughts. In addition, modeling for the short-term target assumed that additional water supplies will not be received. As a result of maintaining a TDS concentration of 7,000 mg/L, approximately 80,000 tons of salt will remain on the refuge, primarily stored in the water in Lake Bowdoin.

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 will 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 provided a reliable method to maintain the salt balance.

Water Management

The desired long-term water management plan is 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 will be minimized and wildlife habitat will 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 will 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 needs 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 will 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 will 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.

Mike Artmann / USFWS

Refuge staff use this outflow dropboard structure to release water from Drumbo Pond to control the pond's water level.

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 will 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 cubic feet per second (cfs) 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 will 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 needs 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 will 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 will be conducted safely in coordination with downstream irrigators and in accordance with State guidance from DEQ. The quality of the discharged water will be monitored. Until that time, the refuge staff will maintain the stoplogs, dikes, and spillways primarily to prevent accidental

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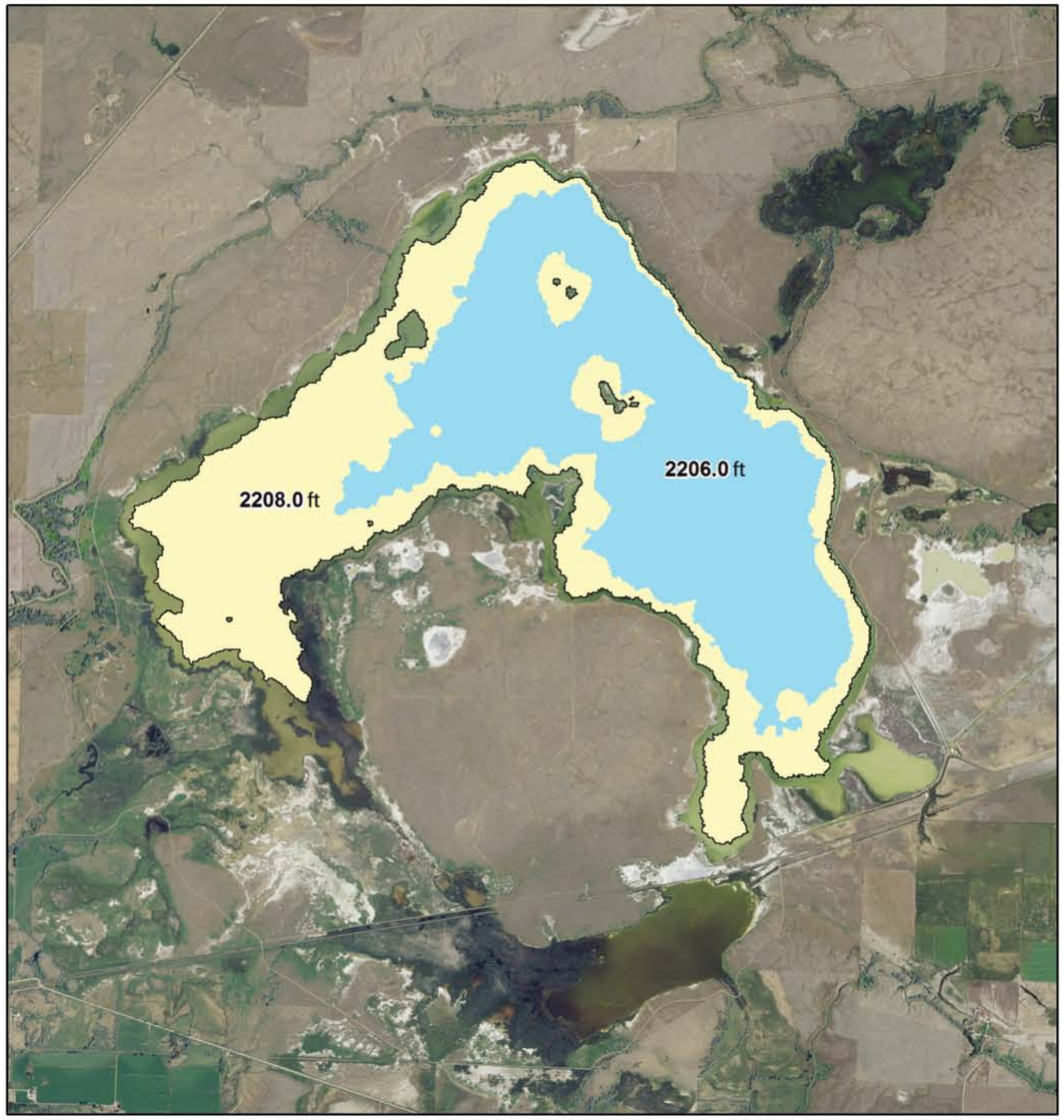
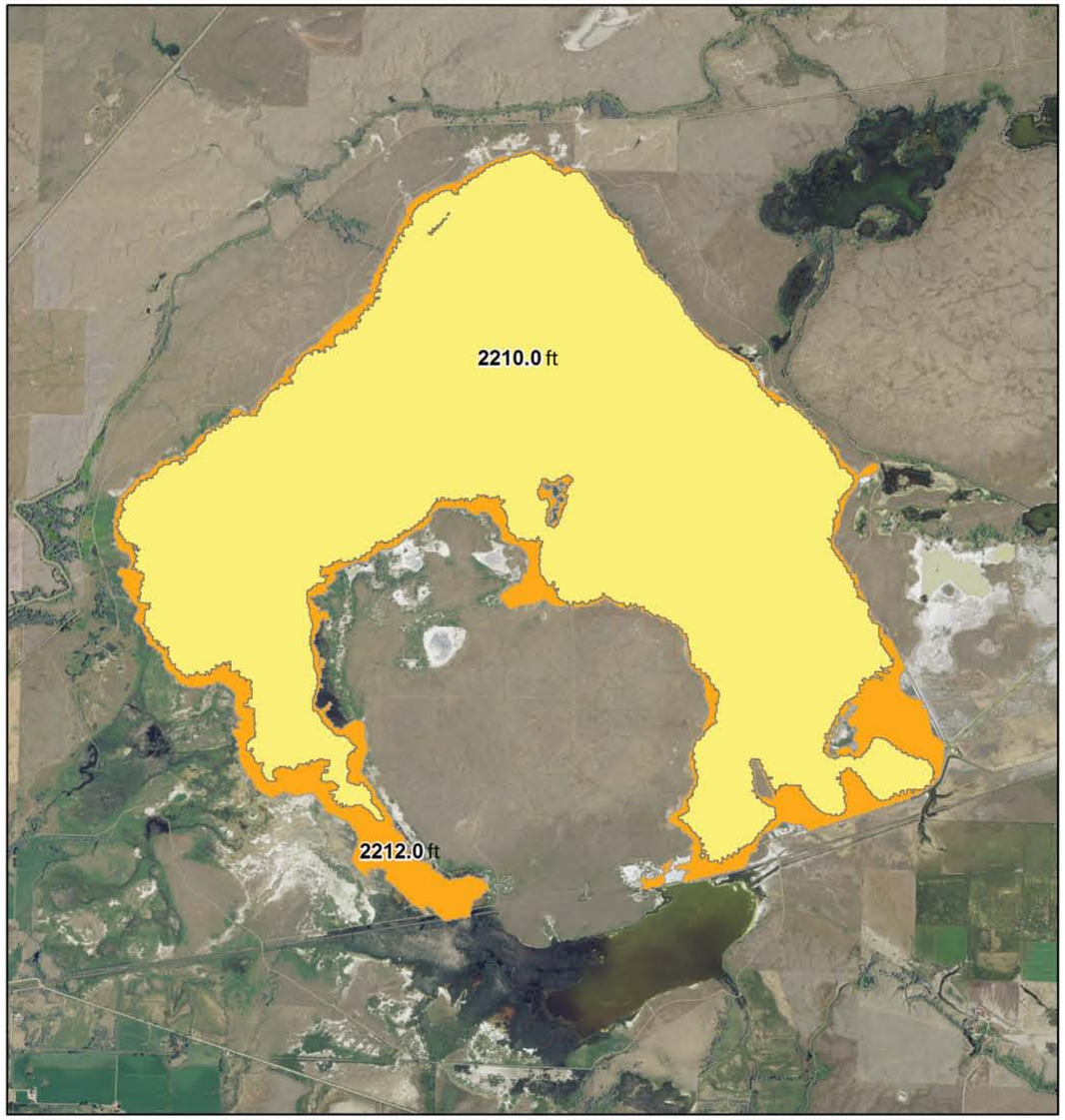
Lake Extent at 2206.0 ft and 2208.0 ft Elevation



At Lake Elevation of 2206.0 ft
Estimated Volume of water = 1,030 acre-feet
Surface Area = 1,521 acres

At Lake Elevation of 2208.0 ft
Estimated Volume of water = 5,472 acre-feet
Surface Area = 2,828 acres

Lake Extent at 2210.0 ft and 2212.0 ft Elevation



At Lake Elevation of 2210.0 ft
Estimated Volume of water = 11,748 acre-feet
Surface Area = 3,498 acres

At Lake Elevation of 2212.0 ft
Estimated Volume of water = 19,351 acre-feet
Surface Area = 4,082 acres

Figure 43. Map of the extent of Lake Bowdoin at various water elevations.

releases. In addition, the refuge will manage water levels to reduce the chance of a breach in the dike.

Salt and Water Management 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.

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 short-term solution is to inject 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.

Objectives for Salinity and Blowing Salts

The following objectives guide the management actions for addressing the issue of salinity and blowing salts at Bowdoin Refuge.

Objective for Salinity and Blowing Salts 1

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.

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Alkali salt blows off Dry Lake at Bowdoin Refuge, Phillips County, Montana (1988).

- 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 will continue to manage for quality habitat under the current subsaline wetland conditions. In the absence of a large flood event, conditions in Lake Bowdoin will 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 will continue to provide wetland habitat throughout summer and fall. The refuge will continue monitoring salinity and wildlife use. In addition, collection of baseline data will be needed to effectively monitor the results of the injection well project.

Objective for Salinity and Blowing Salts 2

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.

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 will not be operational for at least 5 years. During this time, the Service will continue to provide information on the progress for getting money and starting construction. This will be accomplished through news articles and presentations provided at Bowdoin Refuge and to community groups. When the Service starts the injection well process, the refuge staff will develop a fact sheet and other outreach methods to describe the installation and operation plan for the injection well, including where the injection well will be drilled. Once the project was fully implemented, the Service will provide updates on how the project was proceeding and meeting the objectives.

Objective for Salinity and Blowing Salts 3

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 13).

- Work with the local community including landowners, the conservation district, Natural Resources Conservation Service, and DNRC for long-term management to reduce saline inputs. Emphasize land use changes that will reduce the shallow ground-water levels that provide some of the salt load.

- Work with the irrigation district and landowners to improve irrigation water management to reduce salt leaching into shallow ground water that eventually resurfaces when ground water evaporates.

- Work with the irrigation district to line portions of the canal known to leak and cause salt accumulation on the refuge.

- 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-effective methods to drill and operate the injection well.

Table 13. 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

- Work with the Montana Bureau of Mines and Geology in determining how deep the injection well should be drilled to avoid potable ground water and the best placement location.
- 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 lowered 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). There may be opportunities to reduce some of these salt inputs. This will require working closely with surrounding landowners and the organizations focused on salinity issues in Montana, in particular, the Montana Salinity Control Association. 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.

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Three-square bulrush grows on the salt-covered shoreline along the southwestern edge 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 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.

Mike Artmann / USFWS

Glasswort plants are scattered on the salt-covered edge of southeastern Lake Bowdoin.

Working with local groups, irrigation districts, partners, and congressional members is essential to garnering support to develop and operate the injection well and reduce salt inputs. The small refuge staff needs expertise and support from partners to successfully carry out the project. The Service will seek expertise from public and private entities (oil and gas companies) to help guide the project.

Objective for Salinity 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 is 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 will 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, will be a part of managing salt levels in Lake Bowdoin. There will be times when the lake level needs to be low to facilitate more salt being removed from the system. Adaptive management will be used extensively throughout this process.

Objective for Salinity Management Research

Pursue and develop research projects that 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 will 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 will develop partnerships with universities to provide potential projects for graduate students and will 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 will assist the refuge in determining how successful the project was in achieving the salinity objective and expected habitat improvement. These results will also help to determine if modifications were needed in the stepdown plan for installation and operation.

4.6 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 B contains compatibility determinations for public uses associated with the 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 are needed for a broad-based program that reaches the maximum number of visitors to achieve the goal. Current staff might be able to provide some of the additional opportunities in these objectives and strategies but not without sacrificing the ability to conduct other visitor, biological, or maintenance programs. Meeting the visitor services objectives is 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 gamebirds on 40 percent (western portion) of Bowdoin Refuge (refer to figure 36 in chapter 3), according to State and Federal regulations.
- Continue to require hunters to use approved non-toxic shot for hunting of migratory and upland gamebirds on Service lands.
- Continue to allow trapping on designated areas within the wetland management district, excluding Holm WPA, according to State seasons and limits. Continue to allow trappers to use body-gripping traps, commonly known as Conibear® traps, and live traps. Continue to prohibit leg-hold traps.
- Continue to issue special use permits for a limited number of trappers on Bowdoin Refuge to remove burrowing animals that threaten to damage or cause failure of water control structures, roads, dikes, and canals.

- Continue to issue special use permits on Bowdoin Refuge to permit the trapping of mammalian predators that are negatively affecting migratory birds. Continue to prohibit leg-hold traps.

- Continue to permit compatible hunting opportunities for upland gamebirds in the waterfowl sanctuary portion of Bowdoin Refuge (refer to figure 36 in chapter 3) 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 allows 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 (refer to figure 36 in chapter 3).

- 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 remains 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 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. Habitat that normally supports healthy wildlife populations produces harvestable surpluses that are a renewable resource. As practiced on Bowdoin 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.

Trapping is a tool used by the Service to remove animals that are damaging water management structures or preying on migratory birds, particularly nesting birds. All lands within the Bowdoin District will continue to be open to some form of hunting and trapping with the exception of Holm WPA. Trapping on the district is conducted according to State seasons and regulations.

Mike Artmann / USFWS

Black Coulee Pond is one of several ponds that are overgrown with cattail.

Trapping on Bowdoin Refuge is by permit only. The refuge encourages the use of live traps to prevent the capture of nontarget species. The Service prohibits the use of leg-hold traps on Bowdoin Refuge but allows the use of Conibear® traps.

Closing the eastern half of Bowdoin Refuge to foot traffic during the waterfowl season provides additional protection and rest for waterbirds and may actually improve hunting on other parts of the refuge. The western portion (40 percent of the refuge) is open to compatible hunting of waterfowl and upland gamebirds 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 gamebirds, contingent on when waterfowl migrate 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 is 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).

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 (refer to figure 36 in chapter 3).
- 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 (refer to figure 36 in chapter 3). 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. 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.

Enhancements to the photography and wildlife-viewing areas within the refuge complex will 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 will be closed to foot traffic during the waterfowl-hunting season. This provides 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 need to remain in their vehicles in designated sanctuary areas.

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 programs for at least six school groups, or 300 students, per year onsite at the refuge complex.

- 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 information 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 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.

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.

Strategies

- Work with the Service's zone archaeologist and with contractors, universities, and tribal and State historic preservation officers and culture committees 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 will 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 will 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 a kiosk in the community with information on the area's cultural resources and history of the refuge complex.
- Work with interested tribes to identify and interpret the cultural history of resources within 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.

Carmen Luna / USFWS

Petroglyph

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 will generate additional interest and understanding of these resources while encouraging people to visit the refuge complex to learn more.

4.7 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, tribes, 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 will 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 will 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 Sys-

tem 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, the reservation of minerals is 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.

Regardless of the circumstances, the Service will 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 will 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).

4.8 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 14 shows the current staff and additional staff required to fully implement the CCP. If all positions are funded, refuge staff will be able to carry out all aspects of this CCP, which will provide maximum benefit to wildlife, improve facilities, and provide for public use. Projects that have adequate funding and staffing will receive priority for accomplishment. Staffing and funding are requested for the 15-year life of this CCP.

Table 14. Current and additional staff for Bowdoin National Wildlife Refuge Complex, Montana.

Program	*Current positions*	*Position changes and additions*
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–404–8 biological science technician[1]
Administration	GS–303–07 administrative support assistant	GS–326–5 office generalist[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.*

Staff Objective

In addition to current employees, recruit additional staff and volunteers needed to fully carry out the actions in the CCP including maintenance, monitoring, inventory, and research.

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 expanded staff.
- Convert the current GS–485–12 refuge manager position to a supervisory wildlife refuge specialist to function as the deputy refuge manager.
- Recruit a permanent, full-time, GS–326–5 office generalist.
- Recruit a permanent, full-time, GS–025–9 visitor services specialist to design and carry out the expanded public use programs.
- 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 actions for the public use, maintenance, and biological programs.
- 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 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. The addition of any staff is fully dependent on the appropriation of funds available to the Service and the priorities for the Refuge System in Region 6. Even if additional staff are not provided, there are opportunities to change the priorities of current resources to address some of the issues and management actions described in this plan.

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 vehicles as needed for the added 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 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 needs to be expanded when permanent staff are added. Although recently remodeled, the bunkhouse is still not adequate to provide housing for all seasonal and volunteer staff. Availability of this housing is 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.

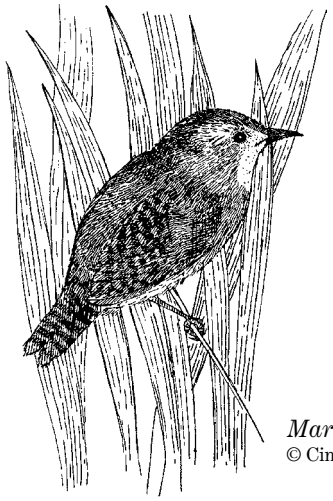
- Continue to maintain entrance signs on all waterfowl production areas.

- 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 will 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 will 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 will continue to work with the regional Division of Realty and willing landowners to address these issues.



Marsh Wren
© Cindie Brunner

4.9 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 15 lists the stepdown plans needed for the refuge complex, status, and next revision date.

Table 15. 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
Salt management	—	2017
Sign	1984	—
Spill prevention	2007	2012
Upland management	1992	2018
Visitor services	2008	2018
Wetland management	—	2018
Wildlife management	—	2018

Mike Artmann / USFWS

Pronghorn graze in the eastern uplands along Lake Bowdoin.

4.10 Research, Monitoring, and Evaluation

Appendix B contains the 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 44) (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 CCP and the 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

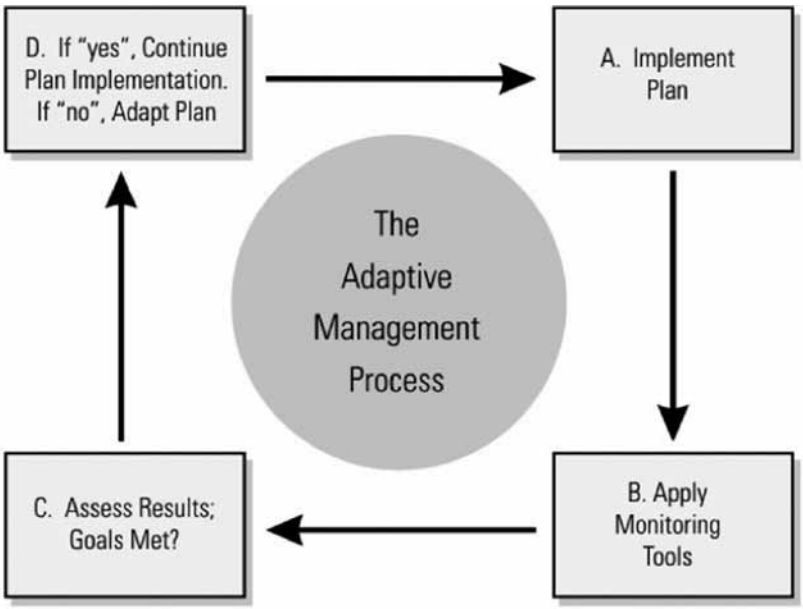


Figure 44. Adaptive management process.

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.

USFWS

Refuge employees record data about vegetation to measure conditions and response to management actions.

Development of adaptive resource management plans for habitat management will 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.

4.11 Plan Amendment and Revision

The Service will annually review the final CCP to determine the need for amendment. An amendment would occur if significant information became available such as a change in ecological conditions. Revisions to the CCP and the stepdown management plans will be subject to public review and compliance with NEPA. At a minimum, the Service will evaluate the plan every 5 years and revise it after 15 years, if needed.

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 temperatures. 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—Foot, 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 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 introduction 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, conservation 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 become 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 establish-

ing 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.

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

Environmental Compliance

Environmental Action Statement

U.S. Fish and Wildlife Service, Region 6
Lakewood, Colorado

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record.

I have determined that the action of implementing the "Comprehensive Conservation Plan—Bowdoin National Wildlife Refuge Complex" is found not to have significant environmental effects, as determined by the attached "finding of no significant impact" and the environmental assessment as found with the draft comprehensive conservation plan.

8/30/11

Stephen D. Guertin — Date
Regional Director, Region 6
U.S. Fish and Wildlife Service
Lakewood, Colorado

Aug 30 2011

W. Dean Rundle — Date
Refuge Supervisor, Region 6
U.S. Fish and Wildlife Service
Lakewood, Colorado

8/30/11

Richard A. Coleman, Ph.D. — Date
Assistant Regional Director, Region 6
National Wildlife Refuge System
U.S. Fish and Wildlife Service
Lakewood, Colorado

08/30/2011

Carmen Luna — Date
Refuge Manager
Bowdoin National Wildlife Refuge Complex
U.S. Fish and Wildlife Service
Malta, Montana

Finding of No Significant Impact

U.S. Fish and Wildlife Service, Region 6
Lakewood, Colorado

Three separate alternative analyses were completed for the Bowdoin National Wildlife Refuge Complex to determine their effectiveness in achieving the refuge complex purposes and their impacts on the human environment. The three analyses include:

1. Overall management of the Bowdoin National Wildlife Refuge Complex
2. Divestiture of Lake Thibadeau National Wildlife Refuge
3. Addressing the increasing salinity and resulting blowing salts on Bowdoin National Wildlife Refuge

1. Overall Refuge Complex Management

- Alternative A, the "no-action" alternative, would continue current management.

- Alternative B focuses on 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. Enhanced wetlands would be managed to mimic natural conditions for wetland-dependent migratory birds during migration and during the breeding and nesting season. The Service would pursue additional water deliveries to better manage wetland habitats.

  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, the 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. 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 refuge complex would work with partners to begin developing a comprehensive cultural resources inventory.

  Implementing many of these additional efforts and programs require extra staff, funding, research, monitoring, and new and expanded partnerships. Nevertheless, even with the current staff and funding, some of the objectives of this alternative can be achieved.

- Alternative C 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 wetlands) 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.

2. Divestiture of Lake Thibadeau National Wildlife Refuge

The Service developed and analyzed two alternatives to evaluate the proposal to divest Lake Thibadeau from the National Wildlife Refuge System.

- Alternative A, the "no-action" alternative, would continue current management and retain the refuge in the National Wildlife Refuge System.

- Alternative B proposes to divest Lake Thibadeau from the Refuge System. Using the divestiture model for the Mountain–Prairie Region, the Service evaluated the habitat quality and the 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 the 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 decision to divest this refuge.

3. Salinity and Blowing Salts

The Service developed and analyzed five alternatives to address the salinity and blowing salts issue for Lake Bowdoin in the Bowdoin National Wildlife Refuge. Alternatives B through E describe different processes for achieving the desired salinity concentration of 7,000 mg/L.

- Alternative A, the "no-action" alternative, would continue current management.

- Alternative B proposes to remove salts 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, where it would be loaded onto railcars and properly disposed of in an approved landfill site. Modeling showed that a water withdrawal rate of 800 acre-feet per year would be required to reach the desired salinity objective, removing about 7,000 tons of salt per year. It is estimated that the cost of this alternative would be $44 million with an annual cost of $2 million and would take up to 20 years to achieve the salinity objective.

- Alternative C evaluated the effectiveness of flooding by Beaver Creek as the primary means to remove salts from Bowdoin Refuge. Historically, flooding by Beaver Creek played a major role in removing salts from the lake system and maintaining the salt balance. Many factors have changed, altering the flood frequency of Beaver Creek. 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. 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. The time to reach the salinity objective for this alternative would likely be more than 100 years. 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. The cost of implementing this alternative would depend on how many water level management structures and roads would need to be removed or modified to maximize the effects of natural flooding.

- Alternative D would use an underground injection well to force saline water deep into the ground, possibly more than 6,000 feet. 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 recreate a flow-through system that maximized the effects of natural flooding. The injection well might need periodic operation once the salinity objective was met, if flooding did not naturally flush salts from the system or if more water was not available. The time to reach the salinity objective would be 10–20 years with a water withdrawal rate of 800 acre-feet per year and accepting all sources of water and salt to match historical management. The injection well would cost at least $6.7 million, with an estimated annual operating cost of at least $100,000. Additionally, there would be a Service employee assigned to maintaining and operating the injection well and to working with the necessary contractors.

- In alternative E, 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 (from willing landowners). 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. 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. The costs

to construct the pipeline would vary between $3 and $9 million, depending on the route chosen. The annual operating cost is estimated at $100,000 per year. 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.

Based on this assessment and comments received, I have selected the following preferred alternatives:

1. Alternative B for overall refuge complex management

2. Alternative B for divestiture of Lake Thibadeau National Wildlife Refuge divestiture

3. Alternative D for salinity and blowing salts

These preferred alternatives were selected because they best meet the purposes for which the Bowdoin National Wildlife Refuge Complex was established and are preferable to the "no-action" alternatives in light of physical, biological, economic, and social factors. These preferred alternatives will continue to provide public access for wildlife-dependent recreation at Bowdoin National Wildlife Refuge Complex (i.e., hunting, fishing, wildlife observation, photography, environmental education, and interpretation).

I find that the preferred alternative are not major Federal actions that would significantly affect the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act of 1969. Accordingly, the preparation of an environmental impact statement on the proposed actions is not required.

The following is a summary of anticipated environmental effects from implementation of these preferred alternatives:

- The preferred alternatives will not adversely impact endangered or threatened species or their habitat.

- The preferred alternatives will not adversely impact archaeological or historical resources.

- The preferred alternatives will not adversely impact wetlands nor does the plan call for structures that could be damaged by or that would significantly influence the movement of floodwater.

- The preferred alternatives will not have a disproportionately high or adverse human health or environmental effect on minority or low-income populations.

The State of Montana has been notified and given the opportunity to review the comprehensive conservation plan and associated environmental assessment.

8/30/11

Stephen D. Guertin — Date
Regional Director, Region 6
U.S. Fish and Wildlife Service
Lakewood, Colorado

Appendix B

Compatibility Determinations

B.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

B.2 Dates Established

February 14, 1936
August 1, 1958
January 28, 1938
October 25, 1941
March 7, 1938
September 23, 1937

B.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

B.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*

B.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.

B.7 Description of Uses

The following uses are evaluated for compatibility within the Bowdoin National Wildlife Refuge Complex:

- Recreational hunting and trapping
- Recreational fishing
- Wildlife observation and noncommercial photography
- Environmental education and interpretation
- Cooperative farming, haying, and grazing
- Commercial filming, commercial audio recording, and commercial still photography
- Research and monitoring

Recreational Hunting and Trapping

In addition to the site-specific regulations mentioned below, the State hunting and trapping regulations apply to all Service-owned lands in the refuge complex. Hunters and trappers 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's Web site and public use brochures provide guidance on site-specific regulations. The general hunting and trapping regulations are available from Montana Fish, Wildlife & Parks.

The CCP continues the hunting and trapping uses described for each unit below. In addition, the Service will add the following to improve recreational hunting opportunities within the refuge complex:

- The eastern portion of Bowdoin Refuge will 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 remains open through this portion of the refuge, visitors need to remain inside their vehicles outside of the hunting areas.

- On Black Coulee Refuge, the Service will 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 gamebirds (ring-necked pheasant, sharp-tailed grouse, greater sage-grouse, and gray partridge) is permitted on the western portion (approximately 40 percent) of Bowdoin Refuge excluding the railroad right-of-way and around the residences, shop, and maintenance areas, or where otherwise posted. Upland gamebird hunters must wear at least one item of blaze orange clothing above the waist.

Limited hunting of fox and coyote will be permitted through issuance of a special use permit from the refuge manager on Bowdoin Refuge. Trapping is by permit only. No leg-hold traps are permitted. Only centerfire rifles, rimfire rifles, or shotguns with Service-approved nontoxic shot are permitted.

Big game hunting is not permitted on Bowdoin Refuge. The refuge may not be used to access adjoining land, except the Pearce and Beaver Creek WPAs, for big game hunting. Using the refuge to access adjoining land to retrieve a big game animal is not allowed unless approved and the hunter is accompanied by a refuge employee or State game warden. Shooting from roads is prohibited. If hunters must retrieve dead or injured gamebirds from closed areas, they may not carry their firearms.

An accessible boat dock, a pier, and a parking area are available at the west boat launch on Lake Bowdoin. Hunters on Bowdoin Refuge are required to sign in and out at the hunter registration kiosk. Brochures with current public use regulations will 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 gamebird 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 freezeup, the opening of the late-season, upland gamebird hunt is 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 and trappers wishing to gain access to this inholding must get permission from the landowner. The refuge is otherwise open to trapping of furbearers and 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 and trappers wishing to gain access must get permission from the landowner. The refuge is otherwise open to trapping of furbearers and 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 and trappers wishing to gain access to these areas must get permission from the landowner. The refuge is otherwise open to trapping of furbearers and 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. Hunt-

ers wishing to gain access must get permission from the landowner. The refuge is otherwise open to trapping of furbearers and 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 Bowdoin District are open to trapping of furbearers and hunting of migratory birds, upland game, furbearers, and big game. Big game hunting at the McNeil Slough WPA is restricted to archery, muzzleloader, and shotgun only. An accessible hunting and photography blind and parking area are provided at the Pearce WPA. Unless otherwise noted, all Service lands open to hunting and trapping are subject to State hunting regulations and seasons.

Availability of Resources

Existing programs such as current refuge directional signs and brochures will be updated with available resources. Maintenance of access roads, parking, hunting and information kiosks, and public use signs is closely tied to funding through the Service Asset Maintenance Management System. The refuge complex's base funding will pay for the update and printing of existing and new brochures.

Additional law enforcement staff and resources may be required to (1) manage significant changes to the hunting program to minimize disturbance to wildlife and habitat, and (2) monitor compliance with public use and hunting regulations.

Anticipated Impacts of Use

The hunting and trapping program on Service lands in the refuge complex provides 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 complex's Web site will be kept up-to-date and made readily available to hunters. Hunter success and satisfaction will 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 and trapping activities are considered by many to be legitimate, traditional, recreational uses of renewable natural resources. 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 and trapping might seem an inconsistent use of the National Wildlife Refuge System. However, habitat that normally supports healthy wildlife populations, which produce harvestable surpluses, are renewable resources. As practiced on the Bowdoin Refuge Complex, hunting and trapping do not pose a threat to the wildlife populations and, in some instances, is necessary for sound wildlife management. By their very nature, hunting and trapping create a disturbance to wildlife and directly impact the individual animals being hunted. However, it is well recognized that these activities have 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 and trapping, a goal of the refuge complex is to provide opportunities for quality wildlife-dependent recreation. Hunting and trapping will be designed and monitored to offer a safe and quality program and to keep adverse effects within acceptable limits.

Although hunting and trapping directly impact the hunted species and may indirectly disturb other species, limits on harvest and access will ensure that populations do not fall to unsustainable levels. Closed areas on the refuge complex provide sanctuary to migratory birds. In some cases, hunting and trapping can be used as a management tool to control elevated populations that are having a negative effect on wildlife habitat. In particular, trapping can be used to remove animals that are damaging water management structures such as levees. Removing animals such as skunks and raccoons that will hunt for and kill nesting grassland birds (including waterfowl and their young) can increase production of these species, some of which are imperiled.

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 are required to manage this program.

Determination

Recreational hunting and trapping are compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in recreational hunting will be provided the Service's public use regulations,

including site-specific regulations and the State's hunting regulations.

- Hunters will be required to use approved nontoxic shot for hunting migratory birds and upland gamebirds on Service-owned lands.

- Trappers need to acquire special use permits to trap on Bowdoin Refuge. No leg-hold traps are permitted and, if practical, trappers will use live traps to ensure nontarget animals are not killed.

- Trapping in open areas in Bowdoin District will follow State seasons and limits.

- Vehicles will be restricted to county and public roads and parking areas in the refuge complex.

- Signage and brochures will 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 Refuge System is to provide opportunities, when found compatible, for the public to develop an understanding and appreciation for wildlife. Recreational hunting and trapping 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.

The use of trapping as a management tool can reduce the damage on infrastructure caused by burrowing furbearers and reduce the predation on migratory birds.

Based on anticipated biological impacts described above and in the EA, the Service has determined that recreational hunting and trapping within the refuge complex will 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 will help limit any adverse effects. Except for the Holm WPA, all lands and waters within the wetland management district are open to hunting in accordance with the Migratory Bird Hunting and Conservation Stamp Act, under which they were acquired. In some cases, trapping will be by special use permit only.

Mandatory 15-year Reevaluation Date: 2026.

Recreational Fishing

Recreational fishing is identified as a wildlife-dependent recreational use under the Improvement Act. The Service does not actively manage sport fisheries within the Bowdoin Refuge Complex, but recreational fishing opportunities are 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 District have only minimal habitat or have high salinity levels, or both, and do not support a game fishery. The Bowdoin, Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau Refuges are 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 CCP does not call for the implementation of any new fishing programs.

Availability of Resources

The fishing program can 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 is not a compatible use at the Bowdoin, Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau National Wildlife Refuges.

Recreational fishing is 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 will be provided the Service's public use regulations and State fishing regulations and limits.

- Vehicles will be restricted to county and public roads and parking areas on the waterfowl production areas.

- Use of motorized boats is 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 EA, the Service has determined that recreational fishing will 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: 2026.

Wildlife Observation and Noncommercial Photography

Wildlife observation and photography are identified as wildlife-dependent recreational uses under the Improvement Act. All lands within the Bowdoin Refuge Complex are open to these activities although portions of the Black Coulee, Creedman Coulee, Hewitt Lake, and Lake Thibadeau Refuges are private land, and visitors must get permission from the landowners to access those areas.

Bowdoin Refuge provides 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 provides an accessible blind with parking and a boardwalk. The refuge complex provides interpretive brochures and panels, which allow self-guided access to the Bowdoin Refuge, and a bird list that can be used throughout the refuge complex. Public roads, trails, and photography blinds will be maintained as needed. Walk-in access is allowed anywhere on Bowdoin Refuge and Bowdoin 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 Refuges is by landowner permission only.

The CCP will 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 will be added at stop number 5 along the auto tour route. Two permanent spotting scopes and interpretive panels will be added. At least one spotting scope will be set at a level accessible to visitors in wheelchairs and small children. The panels will describe the natural history of the birds and the area.

- The Service will 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 primarily migratory waterfowl and shorebirds. The auto tour route will be open but visitors will 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 directional signs and brochures can be updated with available resources.

Additional staff and resources are 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 will keep this impact to a minimum, and this opportunity can be used to educate all attendees on proper wildlife-viewing and photography etiquette. Increased visitation can also lead to other short-term impacts such as increased litter and trampled vegetation.

The added wildlife observation area along the auto tour will provide more opportunities to see birds and other wildlife but from longer distances, for minimal disturbance. A small concrete pad and spotting scope will be added to an expanded pulloff to accommodate additional vehicles. The expansion and additions will be minimal and should not cause any impacts.

Sanctuary will 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 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 are compatible uses on the Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in wildlife observation and photography must follow all public use regulations. Guided tours will be held where minimal impact to habitat and wildlife would occur.

- Non-Service vehicles will be restricted to county and public access roads in the refuge complex.

- Viewing areas will 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 will 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 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 Improvement Act and will 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 EA, the Service has determined that wildlife observation and noncommercial photography within the refuge complex will 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: 2026.

Environmental Education and Interpretation

Environmental education and interpretation are identified as wildlife-dependent recreational uses under the Improvement Act. All lands within the Bowdoin Refuge Complex remain open to these activities. These programs have been opportunistic as time and staff allow. Interpretive panels and brochures will 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 Refuges are private land, and visitors must get permission from the landowners to access these areas.

The CCP will continue environmental education and interpretation and add the following to improve these programs:

- The Service will expand the opportunities for environmental education and interpretation to foster appreciation and understanding of the Refuge System and the resources of the Bowdoin Refuge Complex. Additional interpretive panels will be developed for the refuge complex and an accessible observation site with spotting scopes will be developed along the auto tour route at Bowdoin Refuge. The mammal, reptile, and amphibian lists will be updated for the refuge complex and a brochure will be developed.

- The Service will 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 will be placed in the town of Malta.

Many of these actions are contingent on recruiting a visitor services specialist to develop and carry out these additional programs.

Availability of Resources

Environmental education and interpretation activities, directional signs, and brochures will be mainly funded by annual operation and maintenance money. Funding from other sources such as grants, regional project proposals, challenge cost-share agreements, and other temporary sources will also be sought and used as they become available.

Funding requests for new facilities will 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 will be updated as needed to meet Service requirements. Features such as the auto tour route and accessible observation sites provide access to the many sights and sounds of the refuge complex.

The Service will continue to promote a greater public understanding and appreciation of the refuge complex resources, programs, and issues through interpretive, outreach, and environmental education programs. Working with the Friends group and other local groups, the Service will provide environmental education and interpretation onsite and off Service lands. Presentations will be provided to refuge visitors, school groups, and organizations, allowing the Service to reach a broader audience. Onsite presentations will be managed to minimize disturbance to wildlife, habitat, and cultural resources.

Determination

Environmental education and interpretation are compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Visitors participating in environmental education and interpretation programs must follow all Service regulations. Onsite activities will be held where minimal impact to wildlife and habitats would occur.

- The Service will review new environmental education and interpretation activities to ensure activities meet program objectives and are compatible.

Justification

One of the secondary goals of the 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 Improvement Act and will help meet the above secondary goal with only minimal conflicts. Environmental education and interpretation will 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 will also provide visitors and students a greater understanding of the mission and importance of the Refuge System to the American people.

Based on anticipated biological impacts described above and in the EA, the Service has determined that environmental education and interpretation on the refuge complex will 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 will help reduce any adverse effects.

Mandatory 15-year Reevaluation Date: 2026.

Cooperative Farming, Haying, and Grazing

The Service will use cooperative farming, haying, and prescriptive livestock grazing as management tools throughout the refuge complex. These tools will 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 will 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 will be issued a cooperative farming agreement or special use permit by the refuge manager and will be allowed to till seed, harvest small grain, control invasive plants, or harvest hay on Service-owned lands. The agreement generally will 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 will 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 will be deposited in the Refuge Revenue Sharing Account.

The CCP provides for cooperative farming and haying to manage habitats by establishing goals and objectives for specific habitat types where these activities may be used. The Service has identified target wildlife species (for example, northern pintail and Sprague's pipit), their habitat requirements, and objectives that guide management to achieve the habitat needs of these species.

The refuge complex will 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 will be 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 electrical fence can be used where there is no existing fence. Forage conditions, habitat objectives, and available water will determine stocking rates in each grazing unit. Two stockwater wells exist on the eastern part of Bowdoin Refuge but need rehabilitation before they can be used again by livestock.

The CCP provides for prescriptive livestock grazing to meet habitat objectives. Furthermore, the CCP establishes goals and objectives for specific habitat types where prescriptive livestock grazing may be used. The Service has identified target wildlife species (for example, northern pintail and Sprague's pipit), their habitat requirements, and objectives that guide the prescriptive grazing program to achieve the habitat needs of these species. The refuge complex will 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 will be investigated to determine the best methods for meeting the habitat goals and objectives.

Availability of Resources

Existing resources are sufficient to administer the farming, haying, and grazing programs at current levels. These programs will be conducted through special use permits or cooperative farming agreements, which minimizes the need for staff time and Service assets to complete work. A refuge complex biologist will be needed to plan and oversee monitoring and research of to assess the impacts and effectiveness of these management programs. One temporary biological technician will be necessary to carry out the on-the-ground monitoring.

Rehabilitation of existing stockwater wells and drilling of additional wells in strategic locations will increase the effectiveness of the grazing program 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 will be used to meet habitat- and species-specific goals and objectives identified in the 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 will be a long-term benefit.

Some wildlife disturbance will occur during the operation of noisy farming equipment, and some animals may be temporarily displaced. Wildlife will 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 will prevent soil erosion, improve water quality, and lessen the need for chemical use.

It is anticipated that grazing will 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 will also increase the risk of invasive plants getting established. If fences are not maintained, it may be difficult to meet habitat objectives.

The presence of livestock may be disturbing to some wildlife species and some public users. Some trampling by livestock may occur around watering areas or mineral licks. Grazing in the spring could have adverse effects on grassland bird nests due to trampling and loss of vegetation. However, 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 are compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- To ensure consistency with management objectives, the Service will 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 will be included in the farming and haying program. To minimize impacts to nesting birds and other wildlife, the refuge manager will determine and incorporate any needed timing constraints on the permitted activity into the cooperative farming agreement or special use permit. For example, haying will not be 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 will specify the type of crop to be planted. Farming permittees will 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 determines where fences, water tanks, and livestock supplements are placed within the management unit. Temporary electrical fencing will 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 will be required to remove fences at the end of the grazing season.

- Grazing fees will 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 will be included on the special use permit.

- The refuge complex will carry out a vegetation-monitoring program to assess if habitat requirements of target species are being met. A minimum of one temporary biological technician will be necessary to monitor and document these activities. A biologist will 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 will be controlled and the results monitored (for example, vegetation monitoring) so that adjustments in the programs are made to meet habitat goals and objectives.

Using local cooperators to accomplish the work will be 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 10-year Reevaluation Date: 2021.

Commercial Filming, Commercial Audio Recording, and Commercial Still Photography

Commercial filming is the digital or film recording of a visual image with or without sound. Commercial audio recording is the recording of sound. 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 Refuge Complex provides tremendous opportunities for commercial filming, commercial audio recording, and commercial still photography of migratory birds and other wildlife. Each year, the refuge complex staff receives one to three requests to conduct these commercial activities on Service lands.

The staff will evaluate each request on an individual basis, and, if the use is allowed, the requesting individual or group will be issued a special use permit. The permit will 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 will 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

These commercial 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 described in a proposed rule that would modify the commercial filming and still photography policy for agencies within the Department of the Interior.

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 to habitat (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 will be denied.

Determination

Commercial filming, commercial audio recording, and commercial still photography are compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- These commercial uses must (1) demonstrate a means to extend public appreciation and understanding of wildlife or natural habitats; (2) enhance education, appreciation, and understanding of the Refuge System; or (3) facilitate outreach and education goals of the refuge complex. Failure to demonstrate any of these criteria will result in denial of a special use permit request.

- All commercial filming and commercial audio recording requires a special use permit that (1) identifies conditions that protect the refuge complex's values, purposes, resources, and public health and safety and (2) prevents 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 is not allowed, establishing time limitations, and identifying routes of access. These conditions will 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 will stipulate that imagery produced on refuge complex lands 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 Refuge Complex, the Refuge System, and the Service.

- Commercial still photography requires a special use permit (with specific conditions as previously outlined for filming and audio recording) 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 props that are not part of the location's natural or cultural resources or administrative facilities.

  - The Service incurs additional administrative costs to monitor the activity.

  - The Service provides management and oversight to (1) avoid impairment of the resources and values of the site, (2) limit resource damage, or (3) minimize health and safety risks to the visiting public.

- To minimize the impact on Service lands and resources, the refuge complex staff will ensure that commercial filmmakers, commercial audio recorders, and commercial still photographers (regardless of whether a special use permit is issued) comply with policies, rules, and regulations. The staff will monitor and assess the activities of filmmakers, audio recorders, and still photographers.

Justification

Commercial filming, commercial audio recording, and commercial still photography are economic uses that, to be considered compatible uses, 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 previously and conditions imposed in the special use permits issued to commercial filmmakers, commercial audio recorders, and commercial still photographers will ensure that these wildlife-dependent activities occur with minimal adverse effects to resources or visitors.

Mandatory 10-year Reevaluation Date: 2021.

Research and Monitoring

The Bowdoin Refuge Complex receives one to three requests each year to conduct scientific research or monitoring on Service lands. The Service will give priority 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 short- and long-term disturbance, injury, or mortality
- Description of measures the researcher will take to reduce disturbance 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, will review research proposals case-by-case and issue special use permits if approved. Criteria for evaluation includes, but is not be limited to, the following:

- Research that would contribute to specific refuge complex management issues will be given priority over other requests.
- Research that would conflict with other ongoing research, monitoring, or management programs will not be approved.
- Research that would cause undue disturbance or be intrusive will likely not be approved. The degree and type of disturbance will be carefully weighed when evaluating a research request.

Proposals will 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 will be considered and agreed on before approval.

Availability of Resources

Current resources are adequate to administer the research and monitoring on a very limited basis. A refuge complex biologist will be necessary to administer large and long-term projects, which generally require more indepth evaluation of applications, management of permits, and to provide oversight of research projects. The biologist will identify research and monitoring needs and work with other Service staff, universities, and scientists to develop studies that benefit the refuge complex and address the goals and objectives in the CCP.

Anticipated Impacts of Use

Some degree of disturbance is 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 is expected with research studies, because special use permits will include conditions to ensure that impacts to wildlife and habitats are kept to a minimum.

Determination

Research and monitoring are compatible uses on Bowdoin National Wildlife Refuge Complex.

Stipulations Necessary to Ensure Compatibility

- Extremely sensitive wildlife habitats and species will be sufficiently protected from disturbance by limiting research activities in these areas. All refuge complex rules and regulations will be followed unless otherwise exempted by refuge complex managers. Projects will be reviewed annually.

- Refuge complex staff will use the previous criteria for evaluating and determining whether to approve a proposed study. If research methods are determined to have potential impacts on habitat or wildlife, it must be demonstrated that the research is necessary for conservation of resources on the refuge complex. Measures to minimize potential impacts will be developed and included as part of the study design; these measures will be conditions on the special use permit.

- Refuge complex staff will 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 can cancel a special use permit if the researcher is out of compliance or to ensure wildlife and habitat protection.

Justification

Potential impacts of research activities on refuge complex resources will be minimized through restrictions included as part of the study design, and research activities will be monitored by the refuge complex staff. Results of research projects will contribute to the understanding, enhancement, protection, preservation, and management of the refuge complex's wildlife populations and their habitats.

Mandatory 10-year Reevaluation Date: 2021.

B.8 Signatures

Submitted by:

Carmen Luna August 30, 2011

Carmen Luna, Project Leader Date
Bowdoin National Wildlife Refuge Complex
Malta, Montana

Reviewed by:

W. Dean Rundle August 30, 2011

W. Dean Rundle, Refuge Supervisor Date
U.S. Fish and Wildlife Service
Mountain–Prairie Region
National Wildlife Refuge System
Lakewood, Colorado

Approved by:

Richard A. Coleman August 30, 2011

Richard A. Coleman, Ph.D. Date
Assistant Regional Director
U.S. Fish and Wildlife Service
Mountain–Prairie Region
National Wildlife Refuge System
Lakewood, Colorado

Appendix C

Intra-Service Section 7 Biological Evaluation

Originating Person: Carmen Luna Date Submitted: July 29, 2011

Telephone Number: 406-654-2863

I. **Service Program and Geographic Area or Station Name:** Bowdoin National Wildlife Refuge Complex
Bowdoin National Wildlife Refuge (Phillips County)
Black Coulee National Wildlife Refuge (Blaine County)
Creedman Coulee National Wildlife Refuge (Hill County)
Hewitt Lake National Wildlife Refuge (Phillips County)
Lake Thibadeau National Wildlife Refuge (Hill County)
Bowdoin Wetland Management District (Blaine, Hill, Phillips, and Valley counties)

II. **Flexible Funding Program** (e.g., Joint Venture, etc.) if applicable: N/A

III. **Location:** Location of the project including county, State and TSR (township, section and range):
See attached map (page 3) in accompanying comprehensive conservation plan (CCP).

IV. **Species/Critical Habitat:** List federally endangered, threatened, proposed, and candidate species or designated or proposed critical habitat that may occur within the action area.

Species	*Status*	*Relevance*	*Critical Habitat*
Sprague's pipit	Candidate	Documented on Bowdoin Refuge	None
Piping plover	Threatened	Has been known to migrate through Bowdoin Refuge (last nested in 1999)	Bowdoin Refuge
Whooping crane	Endangered	Never documented	None
Black-footed ferret	Endangered and experimental non-essential population	Never documented	None
Pallid sturgeon	Endangered	Never documented	None
Greater sage-grouse	Candidate	Hewitt and Bowdoin Refuges, Bowdoin District	None
Interior least tern	Endangered	Never documented	None

V. **Project Description:** Describe proposed project or action or, if referencing other documents, prepare an executive summary (attach additional pages as needed)

This proposed action is to implement the goals, objectives, and strategies of the Bowdoin National Wildlife Refuge Complex Comprehensive Conservation Plan for the next 15 years, while fulfilling the goals of the National Wildlife Refuge System.

The CCP proposes to 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 (refuge complex). The Sprague's pipit, piping plover, and greater sage-grouse have each been selected as target species for management and monitoring.

Although not abundant, greater sage-grouse has been documented on Bowdoin Refuge and Beaver Creek, McNeil Slough, Hewitt Lake, and Korsbeck Waterfowl Production Areas (WPAs). 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. Public hunting of upland game birds (ring-necked pheasant, sharp-tailed grouse, greater sage-grouse, gray partridge), would continue throughout the refuge complex in designated areas and according to state seasons and limits.

Sprague's pipits arrive at Bowdoin Refuge in late April and begin nesting in mid-May. The CCP is proposing to enhance breeding and nesting habitat for the pipit and other target grassland nesting birds including restoring large blocks of contiguous grassland habitat by removing Russian olive trees and non-native and invasive shrubs. These trees have not only fragmented habitat but increased predation of ground nesting birds. Research would be conducted to control crested wheatgrass and clubmoss that unnaturally dominate grassland areas, primarily due to overgrazing, historically. In all cases, treated areas would be restored and monitored, including the response of target species. The Service would use prescriptive grazing, fire, and haying to control invasive and noxious species and restore and enhance grassland habitat. Bird use and climate history would be monitored prior to implementing any of these actions; particularly when using prescribed fire in this arid climate.

Bowdoin National Wildlife Refuge (Bowdoin Refuge) is located on the extreme western edge of the breeding range for the northern Great Plains population of the piping plover. Bowdoin Refuge has 3,325 acres of designated critical habitat. The piping plover has not nested on the refuge since 1999, when 9 nests were documented. There has been migrating piping plover documented on Bowdoin Refuge in some years, most recently in 2011. It is suspected that a lack of water to manage the preferred nesting area and the presence of trees, particularly Russian olive trees, have discouraged plovers from nesting on the refuge. The CCP is proposing to address these and other habitat management concerns including removing trees from around Piping Plover Pond. In addition, the Service would work with other agencies to acquire additional water resources and improve the current water delivery system, primarily to Piping Plover Pond. This should allow the Service to better manage or increase piping plover habitat on Bowdoin National Wildlife Refuge.

Invasive and nonnative plants that are causing habitat losses and fragmentation would be controlled or eradicated throughout the refuge complex. In particular, the Service would expand efforts to remove Russian olive trees to restore contiguous, treeless, grassland areas. In addition, the control of invasive grass and forb species would improve habitat quality by restoring native plant diversity and structure.

Divest Lake Thibadeau National Wildlife Refuge

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. These easements do not prohibit development, grazing, or agricultural uses. These rights were retained by the landowner. These listed species have never been documented using this refuge.

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. 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. Due to this lack of habitat and current land uses, the model recommended this refuge be considered for divestiture.

Salinity and Blowing Salts

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 is 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. 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.

The Service evaluated five alternatives to address this issue. The proposed action is to construct an injection well and recreate a flow through system. An underground injection well would be used to force saline water deep into the ground, between 3,500–6,000 feet. Once the salinity objective was met and water in Lake Bowdoin met all applicable water quality standards, as determined by Montana Department of Environmental Quality, modifications to the lake's infrastructure would be evaluated to determine the best way to recreate 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.

VI. **Determination of Effects:**

A. **Description of Effects:** Describe the action(s) that may affect the species and critical habitats listed in item IV. Your rationale for the Section 7 determinations made below (B) should be fully described here.

The proposals to restore and enhance grassland and wetland habitat, including acquiring additional deliveries of water, should increase desirable habitat for the Sprague's pipit, piping plover, and greater sage-grouse, all of which have or did occur on the refuge complex. Recreating large, contiguous blocks of grassland habitat on Bowdoin Refuge should increase the nesting success and brood survival of these species.

Restoring silver sagebrush habitat to waterfowl production areas, where greater sage-grouse occur, should provide expanded areas of nesting and feeding habitat, increasing the survival of this candidate species.

Divesting Lake Thibadeau Refuge should not have any impact on any of these listed species. Not only is there no suitable habitat for these species, but they have never been documented on this refuge.

The proposed injection well site on Bowdoin Refuge will be placed in an area that will have the least impact. In addition, except for the initial construction, there should be minimal disturbance to any wildlife as a result of operating the injection well. Any noise from the pump would be reduced using a silencing device. The reduced salinity levels will improve habitat and survival of wetland dependent wildlife species.

B. **Determination:** Determine the anticipated effects of the proposed project on species and critical habitats listed in item IV. Check all applicable boxes and list the species (or attach a list) associated with each determination.

	Determination
No Effect: This determination is appropriate when the proposed project will not directly or indirectly affect (neither negatively nor beneficially) individuals of listed/proposed/candidate species or designated/proposed critical habitat of such species. **No concurrence from ESFO required.** (pallid sturgeon, interior least tern, whooping crane, black-footed ferret)	X
May Affect but Not Likely to Adversely Affect: This determination is appropriate when the proposed project is likely to cause insignificant, discountable, or wholly beneficial effects to individuals of listed species and/or designated critical habitat. **Concurrence from ESFO required.** (Piping plover, Sprague's pipit, greater sage-grouse)	X
May Affect and Likely to Adversely Affect: This determination is appropriate when the proposed project is likely to adversely impact individuals of listed species and/or designated critical habitat. **Formal consultation with ESFO required.**	
May affect but Not Likely to Jeopardize candidate or proposed species/critical habitat: This determination is appropriate when the proposed project may affect, but is not expected to jeopardize the continued existence of a species proposed for listing or a candidate species, or adversely modify an area proposed for designation as critical habitat. **Concurrence from ESFO optional.**	
Likely to Jeopardize candidate or proposed species/critical habitat: This determination is appropriate when the proposed project is reasonably expected to jeopardize the continued existence of a species proposed for listing or a candidate species, or adversely modify an area proposed for designation as critical habitat. **Conferencing with ESFO required.**	

Signature Carmen R. Luna Date 07/29/2011

Carmen Luna, Refuge Manager
Bowdoin National Wildlife Refuge Complex
Malta, MT

Reviewing Ecological Services Office Evaluation (check all that apply):

A. Concurrence __X__ Nonconcurrence _____

Explanation for nonconcurrence:

B. Formal consultation required _____

List species or critical habitat unit

C. Conference required _____

List species or critical habitat unit

Ecological Services
U.S. Fish and Wildlife Service
Helena, MT

Signature ____ R. Mark Wilson 8-1-11 _____

R. Mark Wilson, Ecological Services Supervisor,
Ecological Services
Helena, MT

Appendix D

Divestiture Model Results for Lake Thibadeau 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 in chapter 3 of the draft CCP and EA.

D.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, photography, 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 provide this seasonal habitat any time moisture is made available and will continue to function in this capacity whether or not the area is 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 45). 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 meets 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.

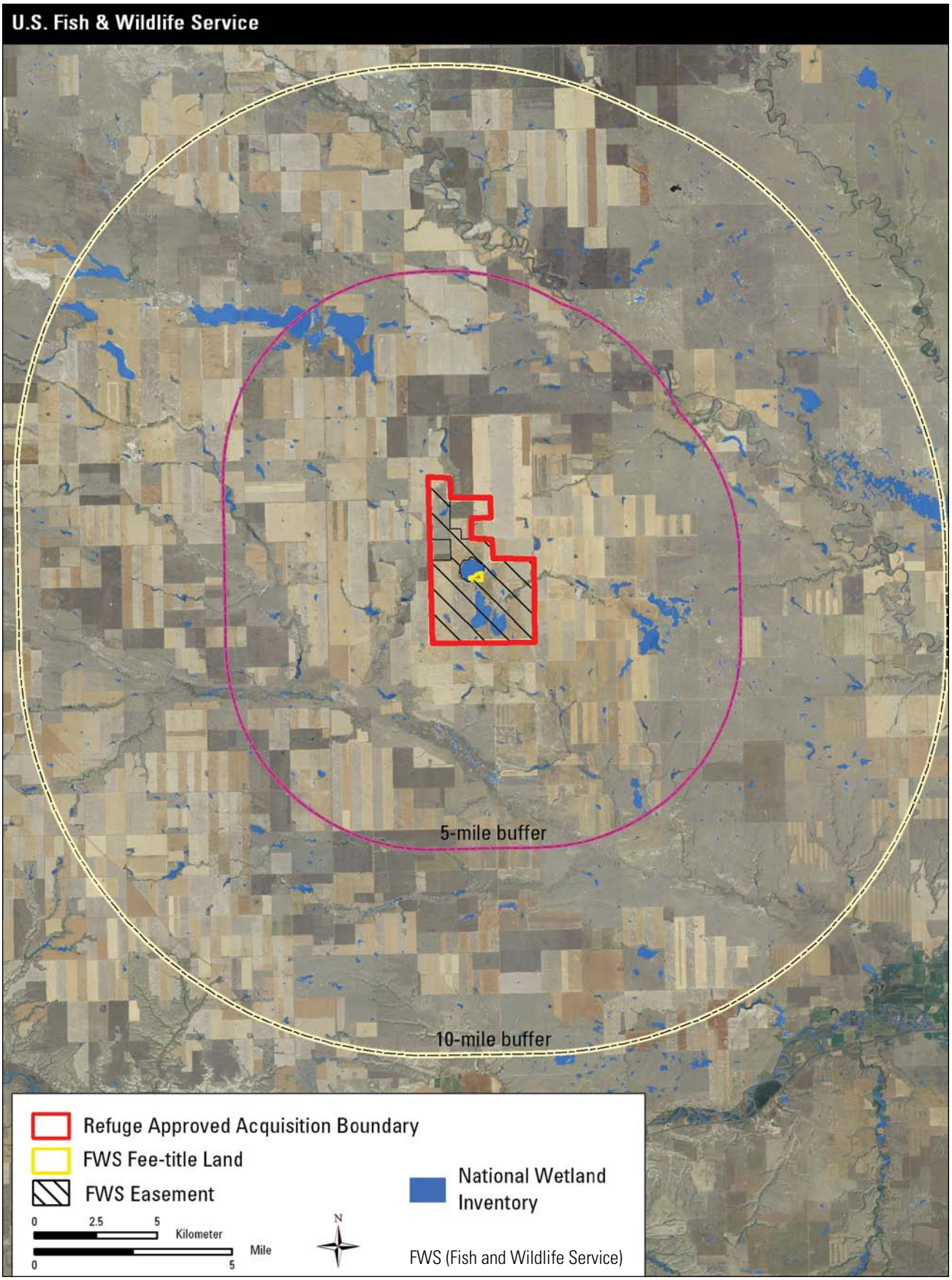


Figure 45. Map of wetlands within 10 miles of Lake Thibadeau National Wildlife Refuge, Montana.

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 is 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 (refer to 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.

D.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 E

Public Involvement

This appendix describes how the Service conducted public involvement and considered the resulting information for developing the CCP for the Bowdoin Refuge Complex. The appendix is organized by the following topics:

- E.1 Public Involvement Activities
- E.2 Public Mailing List
- E.3 Public Comments on the Draft Plan

E.1 Public Involvement Activities

A notice of intent to prepare a CCP for the Bowdoin National Wildlife Refuge Complex was published in the Federal Register on May 14, 2007.

The Service prepared to involve the public by compiling 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

Public scoping began immediately after publication of the notice of intent and was announced in May 2007 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 NEPA 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; 15 emails and letters were received in addition to the verbal comments recorded at the scoping meeting. All comments were shared with the planning team and considered throughout the planning process.

Briefing on Salinity and Blowing Salts

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 the draft CCP and EA, particularly chapter 6 of that document, which addressed the salinity and blowing salts problem.

Review of the Draft Plan

The draft CCP and final EA was released to the public on June 22, 2011, though a notice of availability published in the Federal Register. Copies of either

the draft CCP and EA or a planning update were mailed to individuals on the planning mailing list. The document was also available online through the refuge complex's Web site. The public was offered 34 days to review this document and provide comments.

On June 29, 2011, the Service held a public meeting attended by more than 20 participants in Malta, Montana. Two weeks before the meeting, a news release was issued and planning updates were mailed providing details on where and when this meeting would be held. A short presentation was given on the draft plan, followed by an opportunity for participants to ask questions and offer comments. In addition to the oral comments recorded at the meeting, 24 emails and letters were received. All comments needed to be received or postmarked by July 25, 2011.

E.2 Public Mailing List

The Service sent planning updates to all individuals and organizations on the mailing list. In addition, many hard copies of the draft CCP and EA were distributed using the mailing list and additional requests.

Federal Officials

U.S. Representative Dennis Rehberg, Washington, DC
U.S. Senator John Tester, Washington, DC
U.S. Senator Max Baucus, Washington, DC

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

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

Montana State Officials

Attorney General's Office, Helena
Governor Brian Schweitzer, Helena
Representative Tony Belcourt, Box Elder
Representative Kristin Hansen, Havre
Representative John Musgrove, Havre
Representative Wayne Stahl, Saco
Representative Wendy Warburton, Havre
Senator John Brenden, Scobey
Senator Rowlie Hutton, Havre
Senator Jonathan Windy Boy, Box Elder

Montana State Agencies

Farm Services Agency, Malta
Montana Department of Environmental Quality, Helena
Montana Department of Natural Resources and Conservation, Glasgow
Montana Department of Natural Resources and Conservation, Great Falls
Montana Department of Natural Resources and Conservation, Havre
Montana Department of Natural Resources and Conservation, Helena
Montana Department of Tourism, Helena
Montana Fish, Wildlife & Parks Commissioner, District 4, Scobey
Montana Fish, Wildlife & Parks Director, Helena
Montana Fish, Wildlife & Parks, Glasgow
Montana Fish, Wildlife & Parks, Malta
Montana Historical Society and Preservation Office, Helena

Local Government

Blaine County Commissioners, Chinook
Glasgow Irrigation District, Glasgow
Hill County Commissioners, Havre
Malta Irrigation District, Malta
Mayor of Malta, Malta
Phillips County Commissioners, Malta
Valley County Commissioners, Glasgow
Montana Salinity Control Association, Conrad

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 Natural Heritage Program, Helena
Montana National Wildlife Federation, Helena
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

Universities and Schools

Colorado State University Libraries, Fort Collins
Malta Elementary School, Malta, Montana
Malta High School, Malta, Montana
Northwestern University, Evanston, Illinois

Montana Media

Billings Gazette Online, Billings
The Billings Outpost, Billings
Fort Belknap News, Harlem
The Glasgow Courier, Glasgow
Great Falls Tribune, Great Falls
Havre Daily News, Havre
KLAN Radio, Glasgow
KLTZ Radio, Glasgow
KMMR Radio, Malta
Montana Public Radio, Missoula
News Media Broadcasters, Havre
Phillips County News, Malta
Yellowstone Public Radio, Billings

Individuals

81 private individuals

E.3 Public Comments on the Draft Plan

The public provided many comments during the public review period for the draft CCP and EA. The Service read all comments and found the following comments to be substantive. The Service developed responses to each of these comments after grouping them in the following topics:

- Salinity and blowing salts (comments 1–12)
- Russian olive (13–34)
- Divesting Lake Thibadeau Refuge (35–36)
- Upland habitat (37–38)
- Wetland habitat (39–43)
- Predator management (44–45)
- Prescriptive grazing (46–51)
- Climate change (52–53)
- Public use (54–58)
- General (59–63)

Salinity and Blowing Salts

Comment 1. *"The scope, complexity and longevity of this plan, most especially the Salinity and Blowing Salts Plan, seem to argue for completion of not just an Environmental Assessment, but instead of a comprehensive Environmental Impact Statement."*

Response 1. The preferred alternative is not a major federal action that will significantly affect the quality of the human environment within the meaning of Section 102(2)C of the National Environmental Policy Act of 1969. Accordingly, the preparation of an environmental impact statement is not warranted. The issues identified in the CCP, including the salinity and blowing salts issue, are not significant and neither are the changes to the management of the Bowdoin Refuge Complex.

Comment 2. *Reduce or stop adding saline water to the Bowdoin system.*

Response 2. The Service wants to control salinity inputs; however, this can be challenging since irrigation return flows, which the Service does not control, are significant contributors of salts. The Service will work with the Montana Salinity Control Association, surrounding landowners, and other partners to implement strategies that reduce salt inputs, where possible. Some new strategies have been added to the final plan based on this and other saline input comments.

Comment 3. *"Allow the lake's footprint to flux and notably shrink back toward historic acreage, rather than managing for artificially inflated lake levels during dry seasons and dry years."*

Response 3. During the salt removal process, Lake Bowdoin will be kept at a lower level to better concentrate salts for removal using an injection well. Once the salinity objective is achieved and can be maintained, the Service will recreate a flow-through system to allow for more natural water fluctuations.

Comment 4. *Allow technology time to advance in hopes of future development of a low-risk, affordable solution. Hold additional consultations on this matter before deciding on a preferred alternative.*

Response 4. The Service, State, and other partners have spent significant time, effort, and money to develop a range of viable alternatives including the preferred alternative. The analysis, documented in the draft CCP and EA, supports the chosen direction as the most viable method to address the salinity and blowing salts issue. Nevertheless, as the plan is implemented, the Service will continue to seek and evaluate proven technologies that may increase the effectiveness of removing salts, while reducing costs and time to achieve the salinity objective.

Comment 5. *"I believe we need to quit managing the Bowdoin refuge to have certain elevated salt levels for those species that prefer it."*

Response 5. The Service is not managing for elevated salt concentrations. All the alternatives evaluated were developed to reduce the current, unnaturally high salinity concentrations.

Comment 6. *"It is essential to keep the Malta Irrigation District informed of any plans that may affect the irrigation system Bowdoin uses for water conveyance."*

Response 6. The Service will work closely with the Malta Irrigation District on any needs related to the irrigation system.

Comment 7. *"Salinity control and abatement of blowing salts are major concerns, and we recommend that Bowdoin staff consult soon and frequently with Jane Holzer and the Montana Salinity Control Association on these issues."*

Response 7. The Service will continue to work with the Montana Salinity Control Association and other partners to address this issue. Many of the suggestions provided by Jane Holzer, primarily to address salinity inputs, have been added to the final CCP.

Comment 8. *"The Bowdoin Refuge is a saline sink. If the Russian Olives are no longer drawing salty water away from the surface, the Refuge shorelines will become more saline."*

Response 8. The Service does not agree with this statement. Russian olive trees are a salt-tolerant tree that grows well in wet, saline soils. However, they have little effect on drawing salty water away from the surface especially when considering the tons of salt added to the system annually.

Comment 9. *"Lake Bowdoin is within the Beaver Total Maximum Daily Load Planning Area. A Total Maximum Daily Load will need to be prepared by the MDEQ to improve water quality and restore full support for designated beneficial uses in Lake Bowdoin. We encourage the Service to coordinate its efforts to address Lake Bowdoin water quality impairments with MDEQ staff involved in this planning area and water quality planning."*

Response 9. The Montana Department of Environmental Quality has served as a key member on the planning team since the beginning of this process and has been instrumental in developing the alternatives. The Service will continue this close coordination during implementation of the CCP.

Comment 10. *"Let the Bowdoin wetland function the same as all other wetlands in this area. When there is an abundance of water the wetland may have standing water during the spring and summer depending on weather. But if there is limited moisture then the wetland may only have standing water during the early spring. The only reason this may not work is if there is a saline seep situation occurring. But this can be dealt with also and is frequently by the Montana Salinity Association. They identify and treat the recharge areas and I've seen some great success with their work."*

Response 10. Lake Bowdoin functions as a sump for irrigation return flows and does receive subirrigation. There will likely always be some water in this area, regardless of weather or canal deliveries. One of the long-term goals of reducing salinity to acceptable concentrations is to be able to recre-

ate a more natural flow-through system for Lake Bowdoin. Recreating this system should restore the appropriate concentration of salts in the lake. The Service will continue to work with the Montana Salinity Control Association, particularly on strategies to reduce salt inputs.

Comment 11. *"I believe we need to quit managing the Bowdoin refuge to have certain elevated salt levels for those species that prefer it. We obviously cannot control this when salts and other contaminants reach toxic levels and begin killing the inhabitants."*

Response 11. The Service does not purposely manage for elevated saline concentrations. The species the Service is managing habitat for are negatively affected by unnaturally elevated saline concentrations. The goal for this issue is to reduce saline concentrations and blowing salts.

Comment 12. *"Be certain to work with MT Bureau of Mines and Geology in determining how deep the injection well should be drilled to avoid potable water and where the best placement should be located. USFWS should work with the local community including landowners, conservation district, Natural Resources Conservation Service, and MT Dept Natural Resources and Conservation for long term management to reduce saline inputs. Work with local irrigation district to line portions of canal known to leak and cause salt accumulations on the Refuge."*

Response 12. The final CCP incorporates these suggestions.

Russian Olive

Comment 13. *"Pheasant hunter economic input to the local community will drop significantly due to the decline in the pheasant population (as a result of controlling Russian olive trees)."*

Response 13. The primary purpose and resulting management actions performed on the Bowdoin Refuge Complex are for migratory birds. The Service does not manage for pheasants; however, pheasants do benefit from management actions designed to benefit migratory birds. The Service does not believe that the removal of Russian olive trees, particularly those that are scattered, will significantly affect the pheasant population on or surrounding the refuge complex. The refuge complex and surrounding landscape will continue to provide winter cover, food, and nesting habitat for pheasants.

Comment 14. *"Will the Service replace shelter belts with shrubs that provide cover and a winter food source for sharp-tail grouse and ring neck pheasants? If not, will Service plant food plots of either native perennials and/or annuals such as wheat and/or barley to compensate for the loss of the Russian olive, which is the primary winter food source for upland birds, both native and nonnative."*

Response 14. Upland gamebirds including sharp-tailed grouse and pheasants should benefit from the grassland and native shrubland restoration projects. The Service will not plant food plots.

Comment 15. *"On those areas outside the Refuge (WPAs and adjacent Bureau of Reclamation lands along the canal), would BNWR consider not removing Russian olive shelterbelts that are not within the riparian area? We would recommend that specific shelterbelts be removed only when they directly expand blocks of grassland habitat. Our preference would be to maintain some shelterbelts for wintering habitat, mainly for upland game birds."*

Response 15. The Bowdoin Refuge Complex was established for migratory birds, species that rely on large blocks of unfragmented grassland habitat for survival. In addition, the Service requires the refuge complex to treat any nonnative or invasive species that impede the biological integrity or health of the lands and waters on which these birds depend. Grassland birds, such as Sprague's pipit, are the most imperiled birds in North America primarily due to habitat loss and fragmentation. The Service will not commit to protecting any Russian olive trees, because they are a nonnative species that affects the Service's ability to achieve the purpose for which the refuge complex was established. Nevertheless, the removal of Russian olive trees will be challenging and systematic. The objective is to remove at least 25 acres of Russian olive trees over the next 15 years; most of these trees will be removed from Bowdoin Refuge and Pearce WPA. Initially, scattered trees will be removed where their removal will result in an enhancement and restoration of large, contiguous blocks of grassland. In addition, trees that are impeding water conveyance systems will be targeted. Other larger, contiguous blocks of trees will be a lower priority unless proven treatment methods improve. The Service has no jurisdiction or management rights on adjacent Reclamation lands along the canal.

Comment 16. *"Would Bowdoin Refuge consider not removing other shrub shelterbelts, such as Caragana even though it is in the riparian areas?"*

Response 16. No, the Service will not guarantee the protection of any shelterbelts, particularly those that contains nonnative species. Caragana and

other nonnative trees and shrubs may be removed but could be replaced by native species such as silver buffaloberry, if they occurred historically in the same area including riparian areas.

Comment 17. *"We recommend that if Bowdoin Refuge chooses to remove Russian olive, that they be replaced with native shrubs such as buffalo berry, hawthorn, or chokecherry in areas where Russian olive are being eradicated."*

Response 17. The CCP calls for restoring native shrubs to portions of the refuge complex where they historically occurred; however, not all areas where Russian olive trees occur today had native shrubs. Most areas were native mixed-grass prairie and will be restored to this habitat.

Comment 18. *"The misguided attempt to eradicate Russian olive trees from the Bowdoin refuge will have irreparable damage to the sharp-tail grouse and pheasant populations."*

Response 18. The Service disagrees with this statement. Pheasants will adapt and continue to exist on Bowdoin Refuge. The refuge has lost all of its sharp-tailed grouse leks. Research shows that grouse will not establish or use leks or nesting sites near trees. The removal of these nonnative trees may allow sharp-tailed grouse to reestablish leks and nesting areas on the refuge. The contiguous grasslands will also provide more-protected areas for nesting pheasants, which are vulnerable to the same predators of upland-nesting migratory birds. Nevertheless, the Service will not manage for pheasants on the refuge, but pheasants will continue to benefit from the Service's management actions designed to protect migratory birds.

Comment 19. *"The plan will result in fewer hunters due to the eradication of the Russian olive trees which will result in fewer game birds."*

Response 19. The Service does not agree. Pheasants will adapt and continue to exist on the refuge complex.

Comment 20. *"The direction, in the CCP, is to remove all nonnative shelterbelts and grasses and replace them with native species. What are the native species that will tolerate high salinity soils?"*

Response 20. Species such as western wheatgrass, saltwort, and saltgrass are native to this area. The Bowdoin Refuge naturally has somewhat saline soils. The native vegetation that remains throughout the refuge persists in naturally saline soils.

Comment 21. *"Continue the systematic removal of shelterbelts. The goal of this work should be to enhance and restore large blocks of native prairie grasslands. No additional shelterbelts should be permitted."*

Response 21. The Service agrees with this comment. Native shrubs will be reestablished only where they historically occurred.

Comment 22. *"Eradicate the Russian olives completely. Let the non-native pheasant adapt and thrive in areas without the Russian olive, as most surely will do."*

Response 22. The Service does not disagree with this concept; however, the eradication of Russian olive trees from an area that is heavily infested, such as Bowdoin Refuge, will be time-consuming and costly. The CCP directs the systematic removal of Russian olive trees from the refuge complex, focusing on those areas where contiguous grassland habitat can be restored by removing trees, both scattered and in large blocks. These areas will then be retreated as needed and restored to native species. The tremendous seed source from trees both on and off the refuge complex will make the success of this program very challenging. The Service agrees that restored grassland will benefit pheasants and other upland gamebirds.

Comment 23. *"I believe the plan to increase efforts to control and eradicate Russian olive trees is not consistent with the established purpose of the refuge, federal law, and its basis is scientifically questionable and perhaps motivated by a 'nativist' prejudice against non-native species and even by a prejudice by some at FWS against hunting on National Wildlife Refuges."*

Response 23. The establishment purposes, laws, and policies that guide management of the Bowdoin Refuge Complex and the Refuge System prohibit the protection of nonnative species, particularly those that prevent the refuge complex from meeting its purposes. There is no prejudice against hunting on national wildlife refuges or the refuge complex—the refuge complex commits significant resources and efforts to provide hunting opportunities and provide for the safety of hunters and other visitors while enforcing game laws.

Comment 24. *"There is no reference in the National Wildlife Refuge System Improvement Act of 1997 to 'native' birds and wildlife or 'native' plants and there is no mandate that refuges be managed for the benefit of 'native' species only."*

Response 24. The Improvement Act states that in administering the Refuge System, "the Secretary shall … ensure that the biological integrity, diversity, and environmental health of the System are maintained." Secondarily, the Service will restore lost or severely degraded elements of integrity,

diversity, environmental health at the refuge scale and other appropriate landscape scales where it is feasible and supports achievement of refuge purposes and Refuge System mission. Biological integrity is the biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historical conditions, including the natural biological processes that shape genomes, organisms, and communities. Russian olive is a nonnative species that threatens the biological integrity, diversity, and environmental health of the Bowdoin Refuge Complex. By law and policy, the Service must manage this nonnative species to achieve the purposes of the refuge complex and to maintain and restore native habitats.

Comment 25. *"The CCP authors should review and consider 'Relationships between Olive and Duck Nest Success in Southeastern Idaho' (Gazda et al. 2002). While this reference supports many of the same findings that are cited in the CCP, it is not conclusive on the impact to duck nest success from birds using Russian olive trees as nesting and brooding sites."*

Response 25. The Service reviewed this study and used it as a reference in the CCP. While the study was inconclusive due to the limited number of data sets, it did show a trend that the success of duck nests decreased as the presence of Russian olive trees increased and recommended against introducing trees into historically treeless areas. This document references many credible studies on the negative effects of introducing trees into grassland habitat on waterfowl and other grassland-nesting birds.

Comment 26. *"A study by Pietz et al 2009 found that 'parasitism of grassland passerine nests was lower in landscapes with trees than in those without trees'."*

Response 26. The Pietz study looked at parasitism by only brown-headed cowbirds. Cowbirds prefer woodland habitat, particularly edge habitat. Parasitism of grassland birds increases along the woodland edges, a preferred habitat of the cowbird. The key to discouraging cowbird parasitism or controlling populations of brown-headed cowbirds in the Great Plains is maintaining large expanses of grassland, eliminating foraging areas (such as feedlots) and perch sites, and reducing the extent of overgrazed pastures. Cowbird parasitism is present on the refuge complex and increases in areas where trees have been introduced. A much greater threat of nonnative Russian olive trees is the opportunity for increased predation and the avoidance of these fragmented grasslands by grassland-nesting birds. The Pietz report supports this, stating, "Finally, our results should not be viewed as a rationale for enhancing tree cover in grassland landscapes. Many grassland bird species exhibit area sensitivity and may avoid nesting in areas with too much tree cover."

Comment 27. *"I agree with the removal of the Russian Olives and a return to natural species. I am concerned the many birds that use these trees as winter cover and as a winter food source will be negatively impacted."*

Response 27. We do not disagree that pheasants and other birds use Russian olive trees, particularly in the winter. However, many of these bird species have come to this area or expanded their territories since these nonnative trees were introduced. Many of these birds are avian predators including magpies and hawks. The plan to remove Russian olive trees may cause pheasants and other bird species to shift to other Russian olive trees on and off the refuge or into other types of thermal cover found throughout the refuge complex, particularly cattails. The Service feels that these birds will adapt and survive. Grassland-nesting birds are the fastest declining group of birds, and they do not and will not adapt to the invasion of trees in their nesting areas. Habitat loss, particularly from the fragmentation of grassland habitats or conversion of lands for agriculture or other developments, is the major cause of this decline.

Comment 28. *"The plan states attempts would be made to replace lost Russian olive trees with some native shrubs. In reality, funds will be provided to remove trees, but funds will not be found to provide for the replanting of other native wildlife food or cover producing shrubs."*

Response 28. If the Service does not conduct some sort of restoration when a Russian olive tree is removed, the tree will return or some other opportunistic invasive species will become established. This would be counterproductive. This is one of the greatest challenges of the treatment process but is crucial to its long-term success. Removal of trees, particularly larger blocks of trees, requires that money for restoration back to native grasses and shrubs is available.

Comment 29. *"Although Russian olive is not designated as an 'invasive species' in Montana, as of September 2010, Russian olive can no longer be sold in the state of Montana. It is now classified as a Priority 3 regulated plant, which prohibits its sale but does not require removal. Because of this development, we do not believe that the Refuge Complex needs to spend precious resources educating the public about this issue."*

Response 29. Based on the response to the Service's proposal to remove and treat Russian olive trees, there is a clear misconception about the benefits and impacts of these trees on native wildlife, particularly grassland birds. Even though this tree species may someday be designated as a noxious weed in Montana, the treatment and restoration of the large areas infested by these trees may take decades, if not lifetimes, to convert back to grassland. These are very prolific and successful invaders in this part of Montana. An effective education and outreach program may benefit the efforts called for in the final CCP.

Comment 30. *"To the extent that the biological opinion has changed at FWS, I believe it is due to a 'nativist' prejudice against 'invasive' species. A number of biologists are challenging the orthodoxy that alien species are inherently bad and believe many introduced species have increased the diversity and resiliency of native ecosystems."*

Response 30. Restoring an area back to historical communities is difficult and may not be possible. However, no invasive or nonnative species or artificial process can ever function or benefit wildlife as well as the native habitats and their supporting processes, such as fire and flooding. Sustaining biological diversity and integrity, where possible, is the focus for the refuge complex and the Refuge System.

Comment 31. *"The CCP is flawed in that a discussion on the effects of converting vegetation within the Bowdoin Refuge to native species does not include impacts on the production and harvest of upland game birds."*

Response 31. This was not included, because the Service feels the removal of Russian olive trees will not have significant impacts on the production of and subsequent harvest of upland gamebirds. Restoring fragmented grasslands will benefit upland gamebirds, particularly sharp-tailed grouse, which depend on these areas for breeding and nesting.

Comment 32. *"Management direction for upland game birds on the Montana Fish, Wildlife and Parks strategic plan for managing both native and non-native upland game birds on Montana encourages the planting of shelterbelts."*

Response 32. The State completed a document in 2004 titled, "Literature Review of Montana Upland Game Bird Biology and Habitat Relationships as Related to Montana Fish, Wildlife, and Parks' Upland Game bird Habitat Enhancement Program." This review states that the planting of trees and shrubs for upland gamebirds in agricultural landscapes is a habitat management strategy intended to provide shelter from extreme weather and predators. Tree and shrub cover, however, appears to be unrelated to survival of pheasants in some regions. Pheasants in Illinois experienced high mortality during two severe winters regardless of the amount, configuration, or structure of woody cover present. In South Dakota, however, researchers noticed increased use of shelterbelts by pheasants during a severe winter and concluded that this type of cover was important during unusually cold periods accompanied by deep snow. Nonetheless, the majority of the radio-marked pheasants in the study died from predation rather than exposure. Some researchers have speculated that plantings of mature trees may provide habitat for avian predators such as owls and, when gamebirds move into these areas during periods of severe weather, their mortality rates may increase considerably due to predation. The Service agrees that planting trees in treeless areas increases predation of grassland-dependent birds, even upland gamebirds.

Comment 33. *"The plan should be revised to restrict attempts to eradicate Russian olive trees and restore the native prairie to Big Island and the nonhunting eastern part of Bowdoin Refuge where the refuge has 'relatively pristine, native prairie.' I understand the need to control Russian olive trees when they interfere with irrigation canals, the maintenance of boundary fences and when they are encroaching upon open water."*

Response 33. The Service will focus its initial efforts to remove Russian olive trees in the areas described in addition to scattered trees in grassland habitat throughout the Bowdoin Refuge. However, the remaining Russian olive areas will be treated once these higher priority areas have been effectively treated and restored.

Comment 34. *"A large section of Russian olive trees has already been removed along the refuge's northern border, north of old highway #2 in order to gain access to the border fence. The hillside north of old highway #2 has been an excellent hunting area and further attempted eradication of Russian olive trees there will destroy the area for pheasant hunting. The area is far enough away from Lake Bowdoin to not cause harm to migratory birds."*

Response 34. The Service will not protect any Russian olive tree stands.

Divesting Lake Thibadeau Refuge

Comment 35. *"We support divesting of Lake Thibadeau National Wildlife Refuge. From the description in the Draft Plan, it appears that the wildlife values for this refuge are minimal. It would be helpful to know what would happen to any funds from the divesture."*

Response 35. This Service will no longer maintain structures associated with these private lands. Also, the refuge staff will no longer need to monitor the Lake Thibadeau Refuge, which will free the staff to work on other units of the refuge complex that have greater potential to benefit migratory birds and other wildlife. There is no specific annual budget associated with the refuge; however, not having to use special project money to maintain structures on the refuge will free this money for use on other units within the Bowdoin Refuge Complex or other refuges in the Mountain–Prairie Region.

Comment 36. *Could the water right for Lake Thibadeau be traded for a water right that would benefit one of the other wetlands within the Bowdoin Refuge Complex rather than voluntarily relinquishing the water right to the State?*

Response 36. Service policy is to relinquish voluntarily the water rights associated with a divested refuge back to the State.

Upland Habitat

Comment 37. *"Will there be modification made to the Native grass/forbs mixes that will allow for native grass to be planted with a combination of tall and intermediate wheat grass, great basin rye along with native and nonnative forbs?"*

Response 37. The Service will strive to use a native mixed-grass and forb mix in all grassland habitat restoration.

Comment 38. *"Roads deemed inappropriate or unnecessary should be not only closed but also reclaimed."*

Response 38. The Service agrees. Roads deemed unnecessary for management, maintenance, and adequate visitor access will be targeted for removal and reclamation. Before completion of this CCP, the Service had already decommissioned some roads that did not meet these criteria.

Wetland Habitat

Comment 39. *"Why are cattails and bulrush considered an undesirable emergent? Both plants provide winter cover for pheasants and nesting habitat for several native migratory birds."*

Response 39. Native cattail and bulrush species are not undesirable unless they become unnaturally dominant to the point of reducing or eliminating open-water areas and the diversity and productivity of wetland habitat.

Comment 40. *"The target species of birds for wetlands is missing two important species: American White Pelicans and Black-crowned Night-Herons. Both are species of concern in the state of Montana, and for both species, the Bowdoin Refuge Complex plays an essential role."*

Response 40. Although the target species list does not include these two species, the Service feels they will benefit from the actions in the CCP. These species will be monitored as Lake Bowdoin is lowered to concentrate salts for removal. In addition, the Service will continue to conduct an annual over-water and colonial bird nest survey. Ultimately, the Service's management actions will protect and support any species of concern, regardless of their status as a target species in the plan.

Comment 41. *"According to current records from the Montana Dept. of Fish, Wildlife & Parks, there are only four colonies of Franklin's gull in the state of Montana. These gulls have not been found breeding at Freezout Lake for several years. Numbers used in the Draft Plan should be updated from the 1994-95 numbers—the breeding pair numbers are dramatically lower in recent years. These facts should be corrected."*

Response 41. The Service researched these numbers and made this correction in the final CCP.

Comment 42. *"We do not think it would be a wise use of resources to identify wetland creation projects. The Refuge Complex has a long history of not being able to deliver water to the wetlands that are currently on-site. It is more important to secure long-term consistent water for current wetlands—rather than creating new ones."*

Response 42. The Service will restore natural wetland basins that were drained, primarily for agricultural use. Many of these wetlands are completely dependent on runoff and rainfall and function as temporary or seasonal wetlands. These types of wetlands are very beneficial during migration periods and for amphibians. The strategies have

been corrected in the final CCP to clarify that the Service will not create wetlands in areas where they did not historically exist.

Comment 43. *"The Conservation District would like to see inclusion of grassland management techniques to bolster competitive advantages of native vegetation."*

Response 43. The actions for managing grassland and wetland habitats, including controlling invasive species, will assist native species in competing against invasive species; however, the Service welcomes additional suggestions. The stepdown plan for habitat management, which is revised every 5 years, will provide more details on actions and techniques.

Predator Management

Comment 44. *"Gulls have major impacts on the nests of ground nesting birds, which have been reported in many studies. Will the Bowdoin Refuge remove gull nesting sites to reduce impacts to ground nesting bird populations?"*

Response 44. Gulls and other avian predators can have an impact on ground-nesting birds. The removal of trees and the restoration of contiguous grassland habitat will significantly reduce the vulnerability of ground-nesting birds to being located and depredated by gulls and other nest predators. The Service may investigate the potential to control specific gull species if monitoring shows significant impacts to imperiled grassland-nesting species.

Comment 45. *"The CCP needs to address the impact to ground nesting birds from other predators."*

Response 45. The Service will continue to allow limited harvesting of other predators such as skunks and coyotes. An even greater effect on reducing the success of these predators will occur through restoring contiguous blocks of native grassland habitat by reducing the fragmentation caused by nonnative trees. Contiguous grassland makes it more difficult for these and other predators to locate ground-nesting birds.

Prescriptive Grazing

Comment 46. *"Whether in the CCP or in subsequent step-down plans, the details of grazing lease administration need to be geared to assuring the best possible outcomes for both the lessor and the lessee, which in turn guarantees the best possible outcome for the long-term health of the land."*

Response 46. Any grazing will be prescriptive, based on specific objectives designed to enhance habitat for migratory birds and at the same time benefit the lessee. Grazing operations will be monitored to ensure objectives are met. The stepdown plan for habitat management will describe these objectives and techniques in detail.

Comment 47. *"We strongly encourage Bowdoin NWR to network extensively with leading range, fire and soil scientists in the exploration of grassland management alternatives, including the strategic use of cattle, sheep or goats to control undesirable vegetation and boost vigor of desirable plants."*

Response 47. The wildlife biologist and other refuge complex staff will work with many partners to ensure that the most effective and proven techniques are used to boost the vigor of desirable plant species and restore and manage habitats for target wildlife species.

Comment 48. *"We ask that Bowdoin staff consider development of stewardship contracts with local ranchers to use their livestock as tools to meet Bowdoin's vegetation management objectives."*

Response 48. Habitat management objectives and subsequent monitoring will be the determining factors for where and when to use prescriptive grazing and the duration of grazing activities. The Service will work with cattle ranchers to meet specific habitat objectives when using prescriptive grazing as a habitat management tool.

Comment 49. *"The grasslands evolved under disturbance. Disturbance being events that altered the vegetation and this included drought/floods, extreme temperatures, snow pack, disease, grazing by mammals and insects, trampling, and fire. Of all those natural disturbances grazing is probably the most manageable and should be used as a management tool also. Haying could also be a vegetative manipulation tool and is very manageable."*

Response 49. The CCP describes the use of prescriptive grazing, haying, fire, invasive species management, and native vegetation restoration to meet habitat objectives by attempting to mimic natural processes.

Comment 50. *"Get all cattle ranchers grazing cows and cattle out of this site."*

Response 50. Prescriptive cattle grazing is a management tool for enhancing, maintaining, and restoring native grassland habitat and for meeting other habitat objectives. Bison historically grazed these grasslands; since the bison have been extirpated, proper cattle grazing can be used to mimic the natural (bison grazing) process.

Comment 51. *Boundary fences need to be evaluated and replaced with wildlife-friendly fences as needed. "Interior fencing such as riparian fencing should be similarly evaluated to allow for wildlife passage. This is especially pertinent to facilitated antelope migration."*

Response 51. There is no fencing of riparian areas or other internal areas in the refuge complex. If areas adjacent to riparian habitat are grazed, a temporary electrical fence will be used to keep cattle out of this important habitat.

Climate Change

Comment 52. *"We recommend that the final Comprehensive Conservation Plan include a process to work on climate change in a systematic and scientific way that benefits wildlife—and enhances wildlife adaptation—by first identifying (1) species of plants that are likely to be first to decline; (2) animals that are associated with these plant species including insects, birds, and mammals; and (3) species of plants and animals that could increase."*

Response 52. The Service agrees that this information is important for understanding the long-term health of the refuge complex. This type of monitoring will be incorporated into more broad-scale management plans currently being developed by the landscape conservation cooperative. Landscape conservation cooperatives are management–science partnerships that guide integrated resource management actions addressing climate change and other stressors within and across landscapes. The cooperative's recommendations, including monitoring programs, will be incorporated as appropriate into the stepdown for habitat management at the Bowdoin Refuge Complex.

Comment 53. *"In order to better address climate change, we recommend that the USFWS consider the following actions: (1) replacing all vehicles with more fuel-efficient vehicles; (2) upgrading all refuge buildings to "green" standards; (3) installing solar panels for refuge buildings; (4) making buildings more energy efficient; (5) providing more recycling bins; (6) using more teleconferencing instead of traveling for meetings; (7) encouraging staff to be more energy efficient (and providing incentives for those behavior changes); (8) and studying and promoting the carbon sequestration benefits of the refuge."*

Response 53. The Service agrees and does much of this on the refuge complex today, some due to Service policy (such as vehicle purchases) and some voluntarily as conservationists. In fact, the Service conducted most of the planning process for the CCP using online meetings and conference calls. Bowdoin Refuge uses a wind turbine to provide electricity to building facilities. Any new construction on the refuge complex will use the "green" technologies described in this comment.

Public Use

Comment 54. *"Ban all hunting and trapping. The wildlife and birds deserve a site to live their lives."*

Response 54. Hunting is a compatible, traditional, public use of the Bowdoin Refuge Complex, excluding Holm WPA. The National Wildlife Refuge System Administration Act of 1966, other laws, and Service policy permit hunting on a national wildlife refuge when it is compatible with (does not materially detract from) the purposes for which the refuge was established and acquired. National wildlife refuges exist primarily to safeguard wildlife populations through habitat management and conservation. 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 Refuge System. However, habitat that supports healthy wildlife populations produces harvestable animal surpluses, with wildlife being a renewable resource in these situations. Hunting, trapping, and fishing as practiced on refuges do not pose a threat to wildlife populations and, in some instances, are actually necessary for sound wildlife management.

Comment 55. *Montana Fish, Wildlife & Parks recommends that big game diseases be recognized and suggests that white-tailed deer populations be managed at lower densities to prevent disease transmission.*

Response 55. The CCP describes known big game diseases in the wildlife disease section (chapter 4 in the draft plan and chapter 3 in this final plan). The refuge complex completed a chronic wasting disease plan in 2006. The Service agrees that higher density big game populations are more susceptible to disease. Service and State biologists will collaborate to determine the feasibility and compatibility of offering a big game hunt on Bowdoin Refuge.

Comment 56. *Montana Fish, Wildlife & Parks suggests that, if a big game hunt is allowed on Bowdoin Refuge, the permitted weapons be expanded beyond archery to increase harvest. Nearby State wildlife management areas allow archery equipment, shotgun, traditional handgun, muzzleloader, or crossbow. These weapons still provide*

for safety, but expand the hunting opportunity and harvest potential. Furthermore, maintaining consistency between Bowdoin Refuge and State-managed wildlife management areas would be less confusing to hunters.

Response 56. The final CCP incorporates the consideration of other types of weapons when evaluating the potential for offering big game hunting on Bowdoin Refuge. As this new hunting program is evaluated with assistance from the State, it will be determined which weapons are be appropriate and safe.

Comment 57. *"The proposal to close the east end of Bowdoin Refuge to all foot traffic during the waterfowl hunting season will have unknown effects to hunting opportunity and will limit other recreational opportunities, such as hiking, photography and wildlife viewing. MFWP recommends that this be considered experimental by nature and we do not recommend this action. At a minimum MFWP recommends that it be reversible should it not provide the intended sanctuary that increases waterfowl numbers in the area during hunting season."*

Response 57. The east half of Bowdoin Refuge is designated as a waterfowl sanctuary area during waterfowl hunting season. The purpose of this closure is to provide an undisturbed resting area for waterbirds, particularly during waterfowl hunting (October through November or until freezeup). Currently, the Service allows visitors to walk throughout this area, which does cause waterfowl to flush and expend energy. As a sanctuary area, waterfowl should be permitted to rest and feed with minimal disturbance. Other areas currently open to foot traffic and the auto tour route (that travels through the sanctuary area) will remain open, providing many opportunities for wildlife viewing and hiking. The Service predicts that the sanctuary may encourage waterfowl to remain in the overall area during hunting season, thereby creating greater opportunities for harvest in non-sanctuary areas. Nevertheless, these plans are adaptable. If the closure does not result in less disturbance, the Service will decide at that time whether to reopen the area to foot traffic.

Comment 58. *"The contention that there are 25,000 visitors per year is not backed up by a statistically valid survey. I find it hard to believe that there is an average of 68 visitors per day."*

Response 58. This is the Service's best estimate of visitors throughout the refuge complex, which spreads across a four-county area. This number does not represent just visitors to the Bowdoin Refuge.

General

Comment 59. *"Wherever possible, the USFWS should work to ban mining and mineral leasing within the refuge complex. Plans should be made to institute a permanent withdraw of all Refuge Complex lands from mining and mineral leasing, particularly where the U.S. government owns the mineral rights."*

Response 59. The Service has not permitted mining or fluid mineral (natural gas or oil) extractions on areas where the Government owns the mineral rights. Natural gas extractions occur throughout the Bowdoin Refuge Complex where the Government has not bought the mineral rights or the private-land easements do not restrict this activity. By law, the Service is required to provide access to the owners of mineral rights, even on Federal lands. In the future, the Service will evaluate the effects of not being able to acquire mineral rights on lands proposed for easement or acquisition.

Comment 60. *"None of the management alternatives evaluated in this plan are inexpensive. Given substantial differences in cost of proposed actions among the three alternatives, and the perilous state of our national economy, the CCP should include a rigorous economic cost-benefit analysis."*

Response 60. The CCP is a 15-year management plan. It is difficult to predict what a project will cost over that time, particularly since costs will change. Some of the objectives and strategies in the CCP can be accomplished with current resources, but it will require a change in priorities. That is a benefit of long-term planning. Even if the refuge complex does not receive additional resources, particularly given the current economic realities, the plan helps the refuge complex staff ensure they are using resources (such as staff and money) on the highest priority habitats, species, and issues. More money and staff to carry out the CCP will depend on available funds and regional priorities for the Service, as stated in beginning of this plan and repeated here:

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

Comment 61. *"In regard to overall CCP/EA refuge management, the EPA supports Alternative C that would improve refuge water management infrastructure (water delivery systems, dikes, and levees to manipulate individual wetlands) to create a more diverse and productive wetland complex. With Alternative C biological staff would also monitor the level of sedimentation occurring in natural wetlands and plan for its removal to restore the biological integrity of these wetlands; and Alternative C would also restore grasslands to provide the diverse habitats needed for target species of resident and migratory birds, and increase the acreage of invasive and nonnative species treated annually. The Bowdoin Refuge would serve as a conservation learning center for the local area, and public access would be improved to Creedman Coulee National Wildlife Refuge. We believe Alternative C provides greater potential for fish and wildlife habitat and environmental improvements than no action (Alternative A) and the proposed action (Alternative B)."*

Response 61. The Service does not disagree. However, given the 15-year timeframe of the plan, the Service feels the objectives and strategies in alternative B are more achievable. It is possible that the focus and actions of alternative C could be incorporated into a followup CCP once the Service achieves the goals and objectives in this plan.

Comment 62. *"I think eradication of invasive species is not a reasonable expectation, and I would prefer management to maintain less harmful levels of these species."*

Response 62. The Service agrees with this statement especially for well-established invasive plant species. It is very time-consuming and costly to treat established infestations, which makes early detection and rapid response critical. The invasive species focus of the CCP is to eradicate these species where possible but, at a minimum, to manage invasive plants at less harmful concentrations.

Comment 63. *"The Conservation District endorses voluntary, incentive-based conservation of private lands. Toward that end, we concur that it is important to retain a staff person to administer the private lands Partners for Fish and Wildlife Program."*

Response 63. The CCP specifies retention of this position at the refuge complex headquarters.

Appendix F

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.

F.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

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, fish, 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.

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, photography, 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.

F.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.

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 G

Preparers, Consultation, and Coordination

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

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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.

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Appendix H

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).

H.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*	—

H.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*	—

H.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

Common Name	Scientific Name	Designation
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
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*	—

Common Name	Scientific Name	Designation
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
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

Common Name	Scientific Name	Designation
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*	—
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

Common Name	Scientific Name	Designation
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*	—
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*	—

Common Name	Scientific Name	Designation
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*	—
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*	—

Common Name	Scientific Name	Designation
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 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*	—

Common Name	Scientific Name	Designation
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
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

H.4 List of Mammal Species

Common Name	Scientific Name	Designation
SHREWS		
Masked shrew	*Sorex cinereus*	—
Merriam's shrew	*Sorex merriami*	Species of concern

Common Name	Scientific Name	Designation
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*	—
NEW WORLD PORCUPINES		
Porcupine	*Erethizon dorsatum*	—
CANIDS		
Coyote	*Canis latrans*	—
Red fox	*Vulpes vulpes*	—
Swift fox	*Vulpes velox*	Species of concern

Common Name	Scientific Name	Designation
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*	—

H.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*
Baby's breath	*Gypsophila paniculata*
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*

Common Name	Scientific Name
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 Name	Scientific Name
Common plantain	*Plantago major*
Common ragweed	*Ambrosia artemisiifolia*
Coontail	*Ceratophyllum demersum*
Crested wheatgrass	*Agropyron cristatum*
Curlycup gumweed	*Grindelia squarrosa*
Cutleaf goldenweed	*Haplopappus spinulosus*
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*
Hoary alyssum	*Berteroa incana*
Horsemint	*Monarda stricta*
Horsetail	*Equisetum fluviatile*
Inland saltgrass	*Distichlis spicata*
Jacob's ladder	*Polemonium pulcherrimum*
Japanese brome	*Bromus japonicus*

Common Name	Scientific Name
Juniper	*Juniperus communis*
Kentucky bluegrass	*Poa pratensis*
Kochia	*Kochia scoparia*
Lambstongue ragwort	*Senecio integerrimus*
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 pepperweed	*Lepidium latifolium*
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*

Common Name	Scientific Name
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Rush skeletonweed	*Lygodesmia juncea*
Russian knapweed	*Acroptilon repens*
Russian olive	*Elaeagnus angustifolia*
Russian thistle	*Salsola iberica*
Sago pondweed	*Potamogeton pectinatus*
Saltcedar	*Tamarix ramosissima*
Saltgrass	*Distichlis spicata*
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*

Common Name	Scientific Name
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*
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 I

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.

I.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

I.2 Wildland Fire Management Policy and Guidance

Based on Federal interagency policy (Fire Executive Council 2009), wildland fire is defined as any non-structure 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.

I.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, will be used in an ecosystem context to protect both Federal and private property and for habitat management purposes. Fuel reduction activities will be applied in collaboration with Federal, State, private, and nongovernmental partners. In addition, the Service will 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" will 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 will be conducted consistent with applicable laws, policies, and regulations. Bowdoin National Wildlife Refuge Complex will maintain a fire management plan to accomplish the fire management goals described below. Prescribed fire and manual and mechanical fuel treatments will 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 will 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 will 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 will 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, will be used. Wildfire suppression, prescribed fire methods, manual and mechanical means, timing, and monitoring will be described in detail within the stepdown fire management plans for the refuge complex.

All fire management actions will 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 will 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 will meet the Clean Air Act emission standards by adhering to the Montana requirements during all prescribed fire activities.

I.4 Fire Management Organization, Contacts, and Cooperation

Using the fire management district approach, the Mountain–Prairie Region of the Service will establish qualified technical oversight of fire management for the refuge complex. Under this approach, the level of fire management staffing will be determined by established modeling systems and be based on the fire management workload of a group of refuges and pos-

sibly 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 will 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 will 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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