FINAL PLAN AND ENVIRONMENTAL ASSESSMENT

National Elk Refuge Irrigation Expansion Project

Prepared By

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July 2009

EXECUTIVE SUMMARY

The 24,778 acre National Elk Refuge (Refuge) is located in Teton County, Wyoming, north of the Town of Jackson and south of Grand Teton National Park. As its name implies, the focus for the National Elk Refuge is elk. Congress established the National Elk Refuge in 1912 as a "winter game (elk) reserve." In 1927 the Refuge purpose was expanded to, "…for grazing of, and as a refuge for, American elk and other big game animals…" The Refuge purpose has also been broadened to include "refuges and breeding grounds for birds, the conservation of fish and wildlife, the protection of natural resources, and the conservation of threatened or endangered species."

PURPOSE AND NEED

The U.S. Fish and Wildlife Service (Service) has explored the potential to improve and expand the existing irrigation system. By expanding the irrigation system it is anticipated that there will be a reduction on the reliance for supplemental winter feeding, which is a primary management strategy identified in the 2007 Bison and Elk Management Plan/Environmental Impact Statement (Plan/EIS). Water resources will be utilized more efficiently. More water will be available to support Flat Creek fisheries resources and riparian habitat growth. Forage production will increase over an expanded area, increasing dispersal of elk and bison, thus reducing the opportunity to transmit diseases between animals. In addition to increasing the production of grazing forage by expanding the use of irrigation, decreasing the bison and elk herd size through hunting and achieving population management goals is vital. Inadequate forage production has contributed to the need to artificially feed elk during the winter for 87 of the last 96 years.

The Service engaged in public outreach as well as consultation with others. This outreach focused on the identification of issues, information sharing, and receiving input into the potential for expanding the irrigation system that was approved in the 2007 Plan/EIS. A public scoping meeting was held on Thursday, March 12, 2009 from 4:00 – 7:00 pm in the Town Council Chambers, located in the Town Hall building in Jackson, Wyoming. National Elk Refuge staff outlined plans for a proposed irrigation expansion as well as requesting and receiving comments from the public.

Issues identified during the public scoping meeting, through written comments and telephone calls include:

- Affect on winter density and dispersal of elk and bison.
- Winter access to forage by elk and bison under various snow conditions.
- Effects on elk and bison disease prevalence.
- Environmental contamination of Chronic Wasting Disease (CWD).
- Potential harm to plants and wildlife.
- Visual impact of irrigation equipment.
- Introduction of invasive weeds during construction.
- Project cost.

The Service followed up its initial scoping meeting with a public review of the Draft Environmental Assessment: National Elk Refuge Irrigation Expansion Project. The draft document was released to the public on April 27, 2009 for a 30-day review period. Service staff met with a variety of individuals and organizations during the review period as well as receiving several letters, phone calls and emails. A public open house was held on May 19, 2009 at the Teton County Commissioners" Chambers from 5:00pm to 7:00pm. The meeting was sparsely attended and comments were few. (Please refer to Appendix A for a discussion of review comments and the Service's response).

ALTERNATIVES INCLUDING THE PREFERRED ALTERNATIVE (FINAL PLAN)

Alternative A: No Action

This alternative would have implemented Alternative 4: Adaptively Manage Habitat and Populations (Preferred Alternative) from the 2007 Plan/EIS. The Jackson bison and elk herds and their habitat would be adaptively managed on the refuge with an emphasis on improving winter, summer, and transitional range, while at the same time ensuring that the biotic integrity and environmental health of the resources are sustained over the long term. The Service would irrigate a minimum of 1,600 acres, 1,100 of which would be sprinkler irrigated. Flood irrigation would be enhanced on an additional 500 acres. The Service would not expand or change the irrigation footprint or acreage identified in the 2007 Plan/EIS. A total of 2,400 acres of fields with a history of cultivation would be planted with introduced grasses but approximately 1,600 acres would be irrigated each year. The total estimated forage produced would be 5,000,000 pounds or 2,500 tons on 1,600 acres. The five year construction and setup cost for Alternative A was estimated at $2,847,113 in 1998. The Consumer Price Index adjusted cost for 2008 would be approximately $3,760,000. Construction would occur in 2010 or later during the months of May through September.

Alternative B: Preferred Alternative (Final Plan)

Alternative B uses irrigation for the same purpose as Alternative A, which is to: 1) decrease the cost of providing supplemental feed; 2) decrease the potential for disease transmission; 3) improve the efficiency of water use; 4) reduce the level of elk browsing on woody plant communities; and, 5) disperse wintering elk and bison over a larger portion of the Refuge for a longer period during the winter. Alterative B expands the total acreage of irrigated lands on the Refuge by 3,435 acres. The irrigated area includes those management units identified in Alternative A. The total area, covered by the sprinkler system, at the National Elk Refuge is 5,035 acres. Though a larger acreage of land will be irrigated, water usage may decrease because of the efficiency of the water delivery methods. Total forage production for the expanded irrigation project is an estimated 9,162,000 pounds or 4,581 tons on 5,035 acres. The construction schedule and five year construction and setup cost is estimated to be comparable to Alternative A.

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CHAPTER 1: PURPOSE AND NEED

The 24,778 acre National Elk Refuge (Refuge) is located in Teton County, Wyoming, north of the Town of Jackson and south of Grand Teton National Park. As its name implies, the focus for the National Elk Refuge is elk. Congress established the National Elk Refuge in 1912 as a "winter game (elk) reserve." In 1927 the Refuge purpose was expanded to, "…for grazing of, and as a refuge for, American elk and other big game animals…" The Refuge purpose has also been broadened to include "refuges and breeding grounds for birds, the conservation of fish and wildlife, the protection of natural resources, and the conservation of threatened or endangered species."

PURPOSE AND NEED FOR ACTION

The U.S. Fish and Wildlife Service (Service) has explored the potential to improve and expand the existing irrigation system. By expanding the irrigation system it is anticipated that there will be a reduction on the reliance for supplemental winter feeding, which is a primary management strategy identified in the 2007 Bison and Elk Management Plan/Environmental Impact Statement (Plan/EIS). Water resources will be utilized more efficiently. More water will be available to support Flat Creek fisheries resources and riparian habitat growth. Forage production will increase over an expanded area, increasing dispersal of elk and bison, thus reducing the opportunity to transmit diseases between animals. In addition to increasing the production of grazing forage by expanding the use of irrigation, decreasing the bison and elk herd size through hunting and achieving population management goals is vital. Inadequate forage production has contributed to the need to artificially feed elk during the winter for 87 of the last 96 years.

The Refuge has irrigated an average of 930 agricultural acres per year from 1996 through 2006 in an attempt to provide increased standing forage for wintering elk. Increasing grazing pressure on plant communities by high elk and bison populations, rising demands and costs of the supplemental feeding program, the inefficiency of the existing flood irrigation and water transfer systems, and disease transmission concerns, combine to emphasize the need for better forage production on the Refuge. This need has led to this Final Plan: Expanded Irrigation Project. When implemented, this new project will improve the production and management of winter forage for the benefit of elk and bison populations.

As stated earlier, a Plan/EIS was completed in 2007 for the National Elk Refuge, the Grand Teton National Park and John D. Rockefeller, Jr. Memorial Parkway. It will provide management direction for the next 15 years. This nine year National Environmental Policy Act process included extensive public input and close collaboration with several cooperative agencies and partners. Alternative 4: Adaptively Manage Habitat and Populations was selected in the 2007 Plan/EIS. It is the basis for Alternative A: No Action in this environmental assessment. In addition, this environmental assessment tiers off of the analysis and decisions reflected in the 2007 Plan/EIS and

Record of Decision (ROD). Those seeking additional information should go the 2007 Plan/EIS for more information.

GOALS

Four goals of the 2007 Plan/EIS were developed based on the desired conditions and purposes of the Refuge and Grand Teton National Park, the missions of the National Wildlife Refuge System and the National Park System, and other legal and policy directives. They are:

Goal 1: Habitat Conservation
Provide secure, sustainable ungulate grazing habitat that is characterized primarily by native composition and structure within and among plant communities and that also provides for the needs of other native species.

Goal 2: Sustainable Populations
Contribute to elk and bison populations that are healthy and able to adapt to changing conditions in the environment and that are at reduced risk from the adverse effect of non-endemic diseases.

Goal 3: Numbers of Elk and Bison
Contribute to the Wyoming Game and Fish Department (WGFD) herd objectives for the Jackson elk and bison herds to the extent compatible with Goals 1 and 2 and to the legal directives governing the management of the National Elk Refuge.

Goal 4: Disease Management
Work cooperatively with the state of Wyoming and others to reduce the prevalence of brucellosis in the bison and elk populations in order to protect the economic interest and viability of the livestock industry, and reduce the risk of adverse effects of or from other non-endemic diseases not currently found in the Jackson bison and elk populations.

PUBLIC INVOLVEMENT

The Service engaged in public outreach as well as consultation with others. This outreach focused on the identification of issues, information sharing, and receiving input into the potential for expanding the irrigation system that was approved in the 2007 Plan/EIS.

A public scoping meeting was held on Thursday, March 12, 2009 from 4:00 – 7:00pm in the Town Council Chambers, located in the Town Hall building in Jackson, Wyoming. National Elk Refuge staff outlined plans for a proposed irrigation expansion as well as requesting and receiving comments from the public. Five people attended this meeting.

Public comments to identify issues of concern were accepted through March 28, 2009. The only written comments received were submitted by the Jackson Hole Conservation Alliance in consultation with the Greater Yellowstone Coalition and Defenders of

U.S. Fish & Wildlife Service

National Elk Refuge
Teton County, Wyoming

Vicinity Map

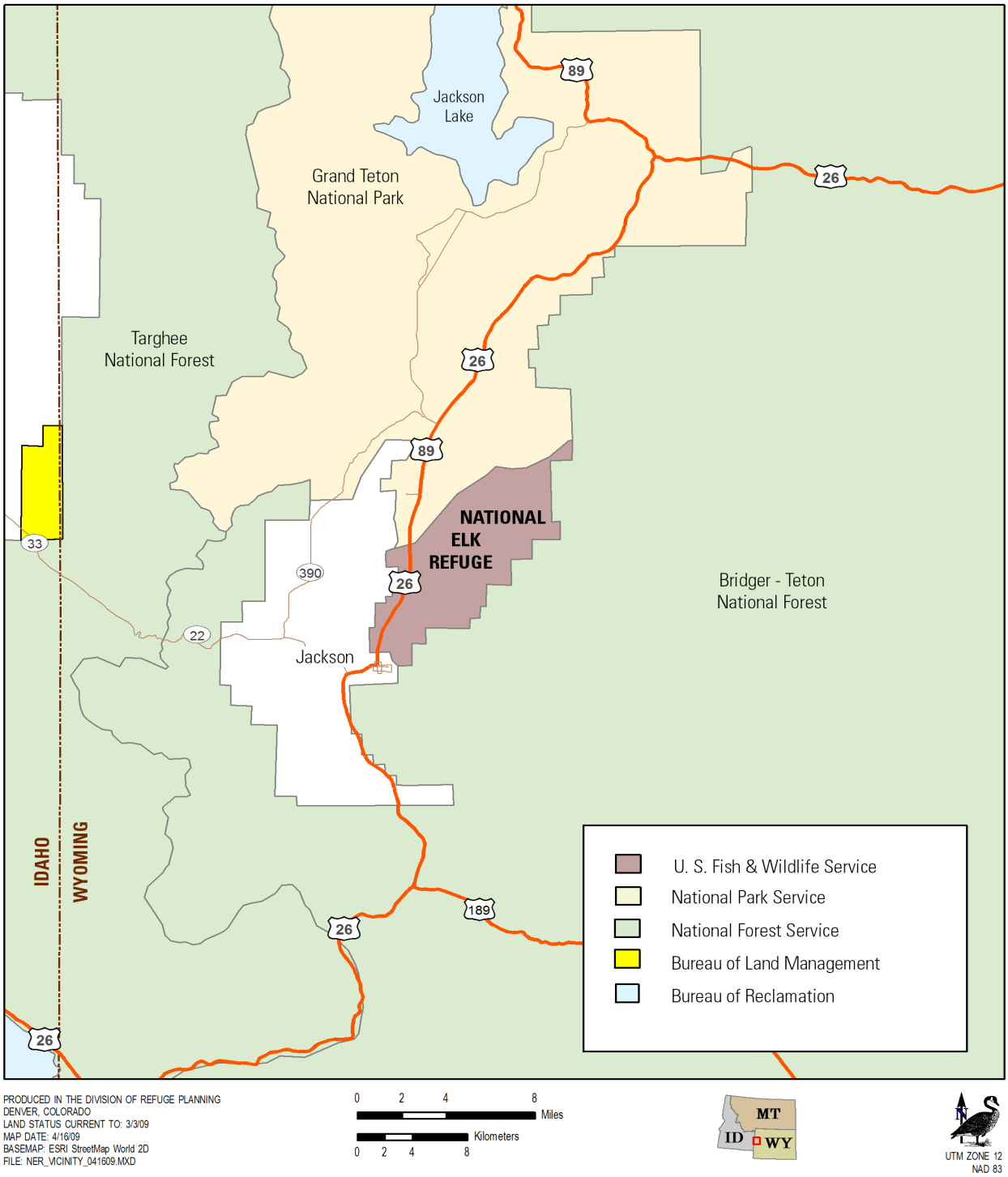

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Figure 1. Vicinity Map

Wildlife. These organizations expressed concerns about the benefits of an expanded irrigation system.

The Service followed up its initial scoping meeting with a public review of the Draft Environmental Assessment: National Elk Refuge Irrigation Expansion Project. The draft document was released to the public on April 27, 2009 for a 30-day review period. Service staff met with a variety of individuals and organizations during the review period as well as receiving several letters, phone calls and emails. A public open house was held on May 19, 2009 at the Teton County Commissioners" Chambers from 5:00pm to 7:00pm. The meeting was sparsely attended and comments were few. (Please refer to Appendix A for a discussion of review comments and the Service's response).

Issues

Issues of concern were obtained during the public scoping process and through consultation with public agencies and private consultants. These issues were used to help frame the analysis of the EA.

Issues identified during the public scoping meeting, through written comments and telephone calls include:

- Affect on winter density and dispersal of elk and bison.
- Winter access to forage by elk and bison under various snow conditions.
- Effects on elk and bison disease prevalence.
- Environmental contamination of Chronic Wasting Disease (CWD).
- Potential harm to plants and wildlife.
- Visual impact of irrigation equipment.
- Introduction of invasive weeds during construction.
- Project cost and construction schedule.

CHAPTER 2: ALTERNATIVES INCLUDING THE PREFERRED ALTERNATIVE (FINAL PLAN)

This chapter describes the two alternatives identified for this project related to the irrigation system at the National Elk Refuge. Again, Alternative 4: Adaptively Manage Habitat and Populations was selected in the 2007 Plan/EIS. It is the basis for Alternative A: No Action in this environmental assessment. The two alternatives are:

- Alternative A: No Action
- Alternative B: Preferred Alternative (Final Plan)

EXISTING IRRIGATION SYSTEM

Most cultivated fields on the refuge are flood irrigated, using the same ditch systems created by original homesteaders. The flood irrigation process involves diverting water from sources such as Flat, Cache, and Nowlin creeks and conveying it through open irrigation ditches. The water is then directed onto fields by using permanent water control structures or temporary canvas dams. Flood irrigation, however, is much more inefficient than other methods, in part due to the porous nature of soils on the refuge. Currently, an estimated 85% to 90% of the water that is being diverted is lost through infiltration and does not reach its destination.

The sprinkler project area includes seven designated management units; McBride Unit, Chambers Unit, Poverty Flats Unit, Peterson Unit, Ben Goe Unit, Nowlin Unit, and the Headquarters Unit. Water for four of the management units will be supplied by the Flat Creek gravity flow pipeline. The Headquarters Unit will be irrigated by a submersible pump with water supplied from Cache Creek.

ALTERNATIVE A: NO ACTION

This alternative would have implemented Alternative 4: Adaptively Manage Habitat and Populations (Preferred Alternative) from the 2007 Plan/EIS. The Jackson bison and elk herds and their habitat would be adaptively managed on the refuge with an emphasis on improving winter, summer, and transitional range, while at the same time ensuring that the biotic integrity and environmental health of the resources are sustained over the long term.

The Service manages approximately 24,778 acres of land at the Refuge. The Service would irrigate a minimum of 1,600 acres, 1,100 of which would be sprinkler irrigated. Flood irrigation would be enhanced on an additional 500 acres. The Service would not expand or change the irrigation footprint or acreage identified in the 2007 Bison and Elk Plan/EIS. A total of 2,400 acres of fields with a history of cultivation would be planted with introduced grasses but approximately 1,600 acres would be irrigated each year.

An underground pipeline water transfer system would be completed from Flat Creek near the east Refuge boundary and supply water for all management units except the Headquarters unit which would receive irrigation water from Cache Creek. For both

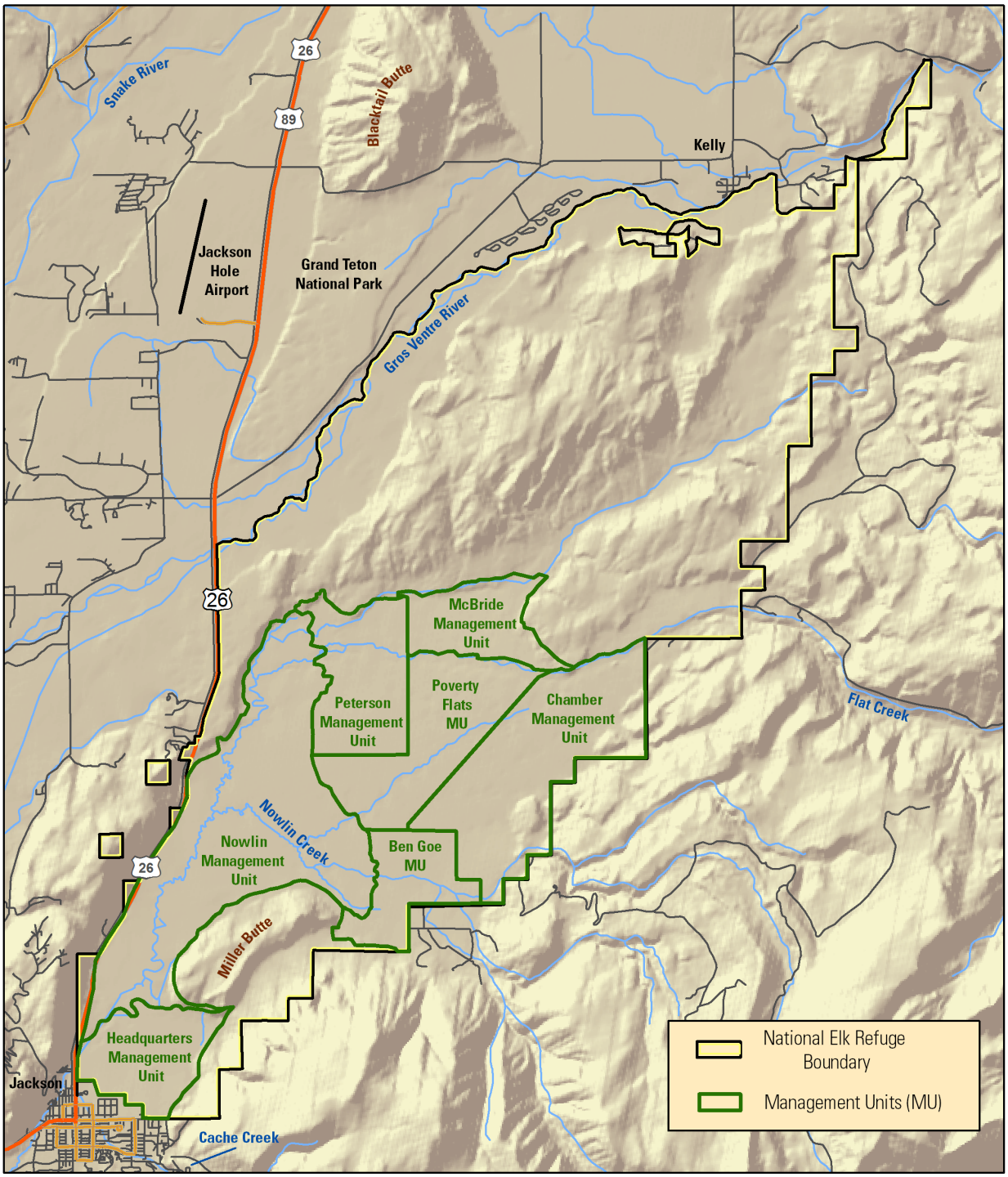

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Figure 2. Management Units

U.S. Fish & Wildlife Service

National Elk Refuge
Teton County, Wyoming

Alternative A: No Action

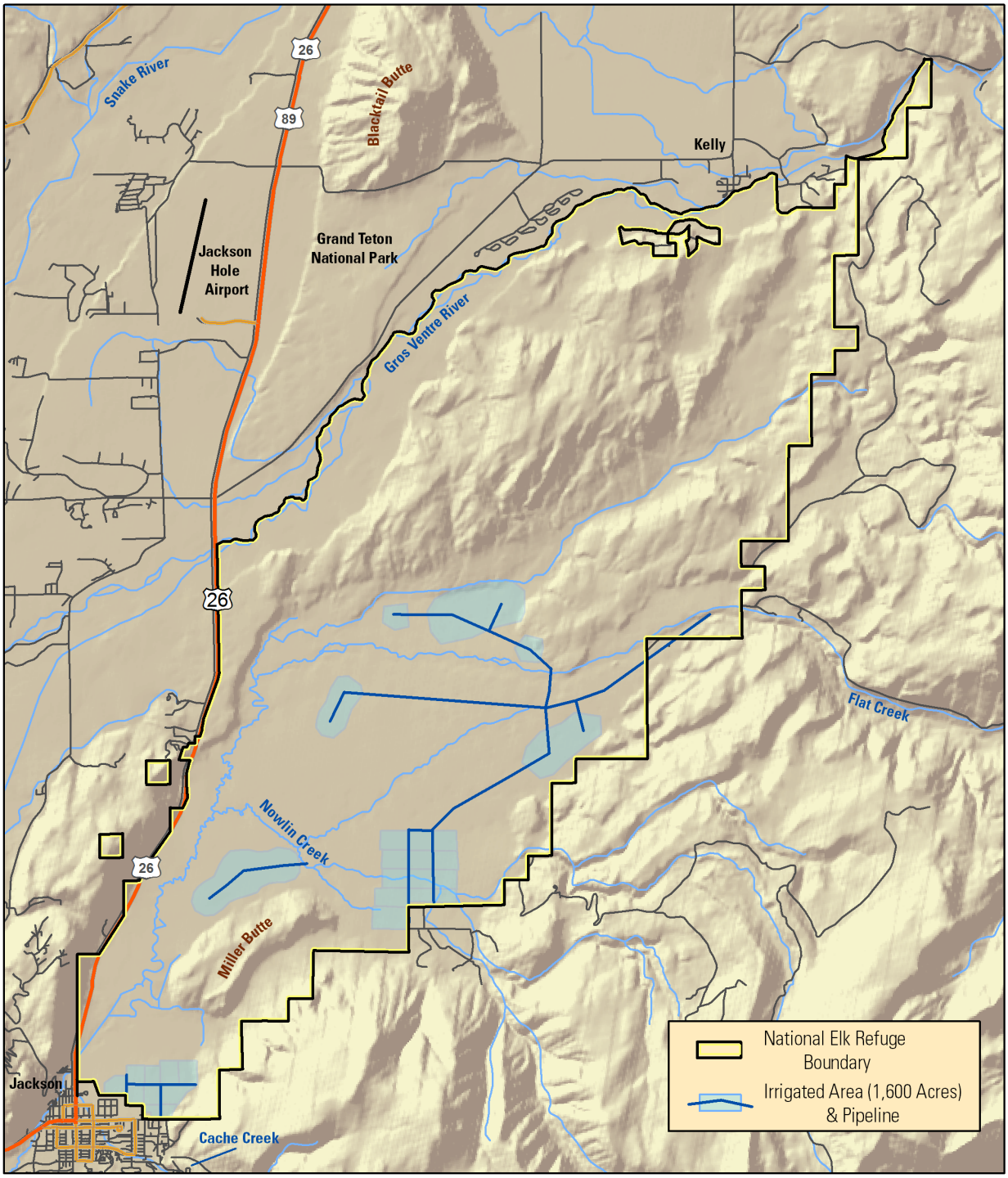

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Figure 3. Alternative A: No Action

Alternatives A and B, the Flat Creek pipeline would cross approximately 2,000 feet of the Bridger-Teton National Forest.

For both Alternatives A and B, the Headquarters Management Unit (296 acres) would be sprinkler irrigated using Cache Creek water with an electric pump to pressurize the system.

The sprinkler system design includes using a combination of 11 center pivots, 24 side-rolls and four hand-line sprinklers in addition to flood irrigation. This would irrigate Refuge range lands that were historically farmed and now are introduced tame grass species. The irrigation system is intended to increase herbaceous forage production. The objective of the irrigation system is to 1) decrease the cost of supplemental feeding, 2) decrease the potential for elk or bison disease transmission, 3) improve efficiency of water use, 4) reduce the level of elk browsing on woody plant communities, and 5) dispersing wintering elk and bison over a larger portion of the Refuge for a longer period during the winter.

Irrigation installation would be implemented in phases as funding becomes available. This alternative includes continued use of existing sprinkler irrigation facilities along with routine maintenance and upgrades to these facilities.

Based on annual monitoring of transitional and winter range and starting the first phase of plan implementation, annually produce on sprinkler-irrigated fields on the refuge an average of 5,000 pounds of forage per acre on about 400 acres and an average of 2,500 pounds per acre on 700 acres. Sprinkler irrigated fields would produce a total of 3,750,000 pounds or 1,875 tons of forage on 1,100 acres. Plant communities in these areas would be dominated by species with a high level of palatability, nutritional value, and productivity, while remaining upright under moderate snowpack. Seeded grasses, such as Russian wild rye, orchard grass, meadow brome and intermediate wheatgrass would be preferred by wintering elk and bison.

Based on annual monitoring of transitional and winter range and starting the first phase of plan implementation, on flood-irrigated fields annually produce a minimum average of 2,500 pounds of forage per acre on up to 500 additional acres on the refuge, with the plant communities in these areas dominated by species exhibiting the characteristics listed above. Flood irrigated fields would produce a total of 1,250,000 pounds or 625 tons of forage on 500 acres.

The total estimated forage produced under these combined irrigation techniques is 5,000,000 pounds or 2,500 tons on 1,600 acres.

The five year construction and setup cost for Alternative A was estimated at $2,847,113 in 1998. The Consumer Price Index adjusted cost for 2008 would be approximately $3,760,000. Construction would occur in 2010 or later during the months of May through September.

ALTERNATIVE B: PREFERRED ALTERNATIVE (FINAL PLAN)

Alternative B uses irrigation for the same purpose as Alternative A, which is to: 1) decrease the cost of providing supplemental feed; 2) decrease the potential for disease transmission; 3) improve the efficiency of water use; 4) reduce the level of elk browsing on woody plant communities; and, 5) disperse wintering elk and bison over a larger portion of the Refuge for a longer period during the winter. Alterative B would also expand the total acreage of irrigated lands on the Refuge by 3,435 acres. The proposed irrigated area includes those management units identified in Alternative A.

The total area, covered by the sprinkler system, at the Refuge, would be 5,035 acres. Though a larger acreage of land is irrigated under the new proposed irrigation plan, water usage will likely decrease because of the efficiency of the water delivery methods.

As with Alternative A, this alternative would improve the bison and elk habitat through adaptive management with an emphasis on improving winter and transitional range, while at the same time ensuring that the biotic integrity and environmental health of the resources will be sustained over the long term.

As with Alternative A, an underground pipeline system is used to transport and distribute water from Flat Creek on the eastern edge of the Refuge, to the irrigated fields and grasslands to the south and west. Water is gravity fed to 4,739 sprinkler irrigated acres, thus eliminating all pumping costs for this area, making this system extremely efficient both in terms of energy expenditures and water use. All hydrants, pressure reducing valves and vaults are placed underground with no structure extending above ground level.

The 296 acre Headquarters unit will be sprinkler irrigated using water from Cache Creek. This system would be pressurized using an electric pump.

Under this alternative, the Service will primarily use a K-Line Irrigation sprinkler system (or equivalent). Hand lines or side-rolls may be used on a small scale for special irrigation needs, then removed and stored when not in use.

The K-Line system is based on a series of 15” diameter by 9” tall, black, flat bottomed pods which are attached at 50’ intervals to a low density polyethylene water distribution tube. Each pod holds a single sprinkler nozzle and has an effective irrigation radius of approximately 50 feet. This system utilizes a slow absorption method over a 24 hour period and is moved to new sites by dragging.

Soils in the project area can hold 2.8” of water within the top 30” root zone. Water utilization for grassland is 0.15” of water per day. The irrigation rotation will allow for 80% water depletion within the 30” root zone before the next irrigation application. Two, 24 hour sets will apply 2.4” of water on 15 day cycles. It will take one month to complete irrigation on a site. Irrigation will be conducted from May through September.

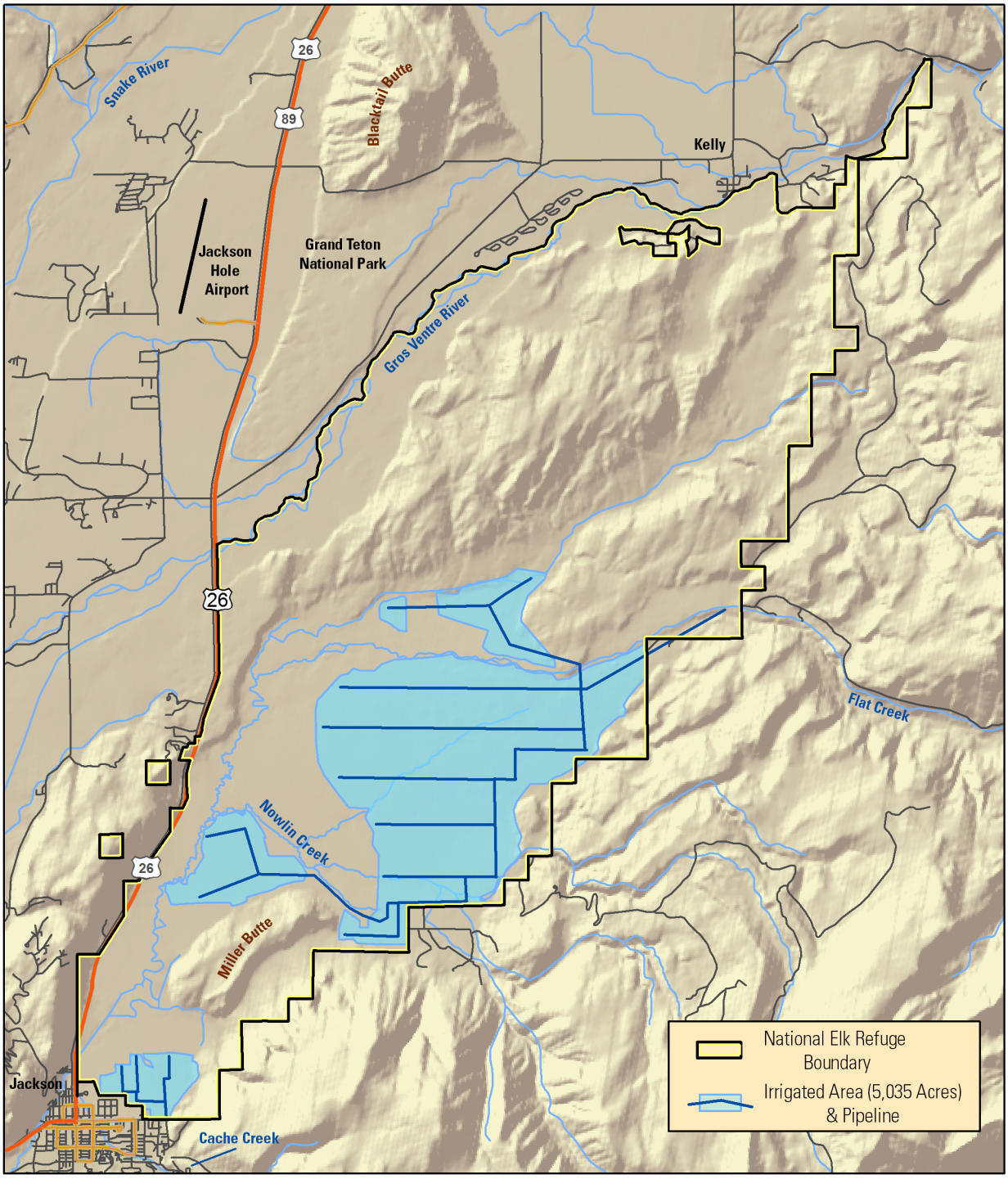

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Figure 4. Alternative B: Proposed Action

Figure 4 shows the conceptual design pipeline layout for the irrigated areas with a side-roll system. The main irrigation pipeline for a K-Line System is similar, but will locate underground hydrants in a different configuration. As with Alternative A, up to 2,400 acres that have a recent history of cultivation, will be reseeded under a phased schedule. The exact plant species to be grown in the project area are still under consideration, but will include primarily introduced grass species that have a preference of palatability, nutritional value, productivity and the ability to remain upright under moderate snow pack.

Many acres in Alternative B, especially in the Chambers, Peterson and Poverty Flats Management Units, may have been historically cultivated by the original homesteaders. This assumption is based on the presence of an extensive flood irrigation ditch network and the existence of introduced grasses such as crested wheat, smooth brome and Kentucky bluegrass. These areas will not be cultivated for conversion to introduced grasses. However, areas currently dominated by introduced grasses, may be cultivated or treated to restore to a native plant community.

The irrigation strategy for cultivated, seeded fields will be to produce a uniform forage base of approximately 2,500 pounds per acre on 2,400 acres. This forage production strategy is designed to achieve uniform distribution of elk, rather than concentrating elk on intensively irrigated and managed high yield fields. A total of 6,000,000 pounds or 3,000 tons of forage will be produced on these 2,400 acres.

The irrigation strategy for non-cultivated grasslands is to produce a uniform increase in forage over 2,635 acres. Forage production surveys conducted from 2000-2008 estimated the highest non-irrigated production during this time period was 1,060 pounds of herbaceous growth per acre. Irrigation is conservatively estimated to increase herbaceous growth to 1,200 pounds per acre. A total of 3,162 pounds or 1,581 tons of forage will be produced on the 2,635 acres.

Flood irrigation in the project areas will be phased out and replaced with sprinkler irrigation. The Service will close most irrigation ditches and seed any disturbed soil with a mixture of native grasses and forbs adapted to the Jackson area.

Total forage production for the expanded irrigation project is an estimated 9,162,000 pounds or 4,581 tons on 5,035 acres. The construction schedule and five year construction and setup cost is estimated to be comparable to Alternative A.

TABLE 1: SUMMARY COMPARISON OF ALTERNATIVES

	Alternative A	**Alternative B**
Irrigation-delivery system	11 Center Pivots, 24 side rolls, 4 hand-line sprinklers and flood irrigation	K-Line System, Flat bottom pods- 15" height, including side rolls and handlines where needed.
Sprinkler Irrigation		
Total acres available	1,590	5,035
Acres irrigated per year	1,100	5,035
Forage (pounds/tons)	3.75 million lbs./1,875 tons	9.2 million lbs./4,600 tons
Flood Irrigation		
Acres	500	
Forage (pounds/tons)	1.25 million lbs./625 tons	
Cultivated Lands		
Total acres available	2,400 (re-seeded)	Same as Alternative A
Acres irrigated per year	1,600	2,400
Forage (pounds/tons)	5 million lbs/2,500 tons	6 million lbs./3,000 tons
Non-cultivated Grasslands		
Total acres available		2635
Acres irrigated per year		2635
Forage (pounds/tons)		3.2 million lbs./1,600 tons
TOTAL		
ACRES	**1.600**	**5,035**
FORAGE(pounds/tons)	**5 million lbs/2,500 tons**	**9.2 million lbs./4,600 tons**

CHAPTER 3: AFFECTED ENVIRONMENT

INTRODUCTION

The affected environment describes those portions of the natural and human environment that could be affected by implementing alternatives A or B. A complete description of the Refuge's resources may be found in the 2007 Plan/EIS (Chapter 3: Affected Environment).

REGIONAL SETTING

The Refuge is 6 miles at its widest point and 10 miles from southwest to northeast; elevations range from 6,200 to 7,200 feet. The northern half of the refuge consists of steep rolling hills. The southern half is glacial washout material, with one resistant formation (Miller Butte) rising approximately 500 feet above the valley floor. The town of Jackson borders the refuge on the south, and the town of Kelly lies near its northern boundary. Lands to the south and west are mostly privately owned. East of the refuge are lands administered by Bridger-Teton National Forest, including the nearby Gros Ventre Wilderness. The Grand Teton National Park borders the refuge on the north and northwest.

THE PHYSICAL ENVIRONMENT

Climate

Jackson Hole is characterized by long, cold winters with deep snow accumulations, and short, cool summers. January is the coldest month with an average daily maximum temperature of 24°F and a minimum temperature of 1°F at low elevations. Temperature extremes vary from summer highs of 92°F to 98°F to winter lows of –40°F to –63°F.
Precipitation levels are relatively steady throughout the year, with a total average annual accumulation of 15.2 inches in Jackson Hole. Average monthly precipitation levels range between 1 and 2 inches, with May and December being wettest, and July and February driest. Jackson Hole averages 90 inches of snowfall per year, accounting for 60% of annual precipitation. On the Refuge average snowfall ranges from 6 to 18 inches at the southern end up to 48 inches at the northern end.

One factor affecting forage availability for elk and bison is the amount of water contained within the snowpack, referred to as snow-water equivalents or how much water in inches is contained in the snowpack. Deep, light snow allows elk easier access to underlying vegetation than does a shallower, heavy snow. For modeling purposes, a snow-water equivalent of 6 inches was the threshold at which no forage would be available and elk would be unable to acquire sufficient food resources to survive on their own (Hobbs et al. 2003). Areas receiving 6+ inches of snow-water equivalents in one season would be unsuitable for elk winter range during that year. Temperature conditions that cause snow crusting would make forage less available at lower snow-water equivalent levels.

Soils

Over 20 different soil types are found on the Refuge (Young 1982). Soils at lower elevations are alluvial, generally sandy loam or loam, and are shallow and permeable. Soils at higher elevations are also loamy, with considerable areas of gravelly soils and cobblestone on south-facing slopes and ridges. Greyback gravelly loam, a deep, somewhat excessively drained soil, occurs in irrigated areas

of the refuge. About 20% of the irrigated area includes areas that have a cobbly loam surface layer but that are otherwise similar to Greyback gravelly loam. Permeability is moderately rapid, and available water capacity is low. Roots penetrate to a depth of 60 inches or more. On 0% to 3% slopes the surface runoff is slow, and the erosion hazard is slight. On 3% to 6% slopes the surface runoff is medium, and the erosion hazard is moderate.

Water Resources

Surface Water

Surface hydrologic features on the Refuge include the Gros Ventre River, Flat Creek, Cache Creek, Nowlin Creek, and several other small creeks and springs. The Gros Ventre River flows westerly through the northern portion of the refuge, forming much of the northern boundary of the refuge. Flat Creek flows east to west and nearly bisects the refuge. In addition to natural watercourses, there are many miles of irrigation ditches. Three wells and an enclosed water storage reservoir are used by the town of Jackson.

The Gros Ventre River, which drains approximately 600 square miles of eastern Jackson Hole and the mountains farther east, is the largest watercourse on the refuge. The relatively wide river channel is heavily braided in areas where geologic materials are of low erosional resistance, as is the case on the refuge. The numerous gravel bars in the river channel have little or no vegetative cover as a result of annual flooding and erosion.

Flat Creek originates in the Gros Ventre Mountains east of the refuge and drains approximately 120 square miles. Flows vary seasonally due to runoff, input of irrigation water diverted from the Gros Ventre River, diversions by irrigators, and losses due to infiltration. The porous nature of refuge soils through which a section of Flat Creek flows causes high infiltration losses and results in a seasonally dry channel bed in this area.

Water from Cache Creek reaches the refuge by way of an underground diversion that surfaces into a cistern located near Refuge headquarters. Nowlin Creek is a small spring-fed tributary of Flat Creek. From the southeastern portion of the refuge, the creek flows westerly through four constructed impoundments to its confluence with Flat Creek. Smaller water features include Twin Creek and Holland Spring near the southeastern boundary, Romney and Peterson springs in the western portion, and other miscellaneous springs throughout the refuge.

The Refuge has about 105 cubic feet per second (cfs) of adjudicated water rights for about 7,500 acres of irrigable land. The major water rights pertain to the Gros Ventre River (5.0 cfs), Flat Creek (74.4 cfs), Cache Creek (7.2 cfs), and Nowlin Creek (4.4 cfs).

Other water rights include Twin Creek, Holland Spring, Romney Spring, Peterson Spring, and several other springs on refuge land. The Refuge uses a negligible amount of the water that is diverted from the Gros Ventre River, getting most of the water used for irrigation from Flat, Cache, and Nowlin creeks.

Irrigation on the Refuge is accomplished by sprinkler irrigation and through a flood irrigation system using contour and lateral ditches controlled by head gates. Of the water that is being diverted annually, only an estimated 5%–10% actually reaches its destination (Kremer, pers. comm., as cited in USFWS 1998). This loss is due in part to the porosity of refuge soils and to the state of disrepair of ditches and head gates. This, as well as annual precipitation, staffing, other refuge activities, and access to and availability of water, affect how many acres are irrigated on the refuge. In 1997 no

fields were irrigated, and in 1993 a maximum of about 2,000 acres were irrigated; the annual average is about 960 acres.

Groundwater

Water-level contours indicate that groundwater flows from high areas, southwest through the valley toward the Snake River. Data for the alluvial valley aquifer indicate excellent water quality, supporting utilization for drinking water supplies, recreation, and other commercial uses. Much of the aquifer exhibits high permeability and significant interconnection to the rivers and lakes, making it vulnerable to contamination from facilities, visitor use, and transportation corridors in the recharge areas.

Groundwater resources on the Refuge as a whole are considered of high quality and are not subject to septic-related pollution concerns except perhaps in the vicinity of Twin Creek Ranch and other inholdings. Residential and commercial development in Jackson and elsewhere in the county may cause local reductions in groundwater quality (Jackson / Teton County, WY 1994). Although Jackson and surrounding areas use centralized wastewater treatment facilities, the perceived major threat to groundwater supplies elsewhere in the county is pollution from individual septic systems (Jackson / Teton County, WY 1994).

Visual Resources

The quality of visual resources is an important part of the recreational experience (USFS 1982). The visual appearance of a landscape is often the first thing to which a viewer responds. The most prominent view of the refuge, which is seen by several million visitors annually as they drive to and from Jackson on U.S. 26/89, is the expansive Nowlin meadow area. During winter thousands of elk make the refuge an important visual and ecological resource for the region. Although bison are fed in areas that are not visible to the public, they can be viewed along the fence north of the Fish Hatchery and in the McBride area before Flat Creek Road is closed in December. As the bison herd grows, bison are more frequently seen in the southern sections of the refuge.

HABITAT

Plant Communities

Thirty-four plant community types have been classified on the Refuge, of that total 23 are dominated by native plants and 11 by cultivated species that were introduced or are being perpetuated due to agricultural activities. While some communities have adapted to natural conditions, most cultivated species are supported by continued flood irrigation. For the purposes of this analysis, vegetative communities on the Refuge may be classified into one of six general categories: native grasslands, cultivated fields, wetlands (marshlands, wet meadows, and open water), sagebrush scrubland, riparian and aspen woodlands, and conifer forests. It should be noted that the native grasslands, cultivated fields, and wetlands are the three primary plant communities encompassed by the irritation project. As such, native grasslands, cultivated fields, and wetlands will be described here. For a more complete description of all habitats, please go to the 2007 Plan/EIS.

Native Grasslands

Native grasslands occur where there is sufficient precipitation to grow grasses but not trees, or where drought, frequent fires, grazing by large mammals, or human disturbances have prevented trees or shrubs from becoming established. Native grasslands are important plant communities on the refuge because they provide winter forage for elk and bison, which are primarily grazers. Native grasslands, including some bluegrass, wheatgrass, and needlegrass species, cover approximately 8,092 acres. Except for localized areas, native grasslands are in good condition, especially in the northern part of the refuge (Cole, pers. comm. 2002).

The south end of the refuge has been heavily grazed and little above ground grass remains. This removal can result in increased production of some perennial bunchgrass plants, although standing dead plant material has been shown to be beneficial to plant health by some authors (Sauer 1978; Briske 1991).

The largest continuous segment of native grassland occurs in the central part of the refuge northeast of the Nowlin Creek marshlands, and northwest, west, and east of Flat Creek Road. This area is being invaded by smooth brome grass, Kentucky bluegrass and crested wheatgrass, a nonnative wheatgrass that was once cultivated on the refuge. Crested wheatgrass currently covers approximately 650 acres. While this nonnative plant is very palatable to bison and elk in the spring, it has very little nutritional value to wildlife as winter forage. Its spread is a concern because the refuge is a winter range for ungulates. Although grassland condition in crested wheatgrass areas is good in terms of relative forage production, minimal erosion, and vigorous grass growth, the cover of native grass species has been reduced by 50% to 90% and replaced by crested wheatgrass in these areas (Cole, pers. comm. 2002). Therefore, the invasion of crested wheatgrass has the potential to degrade the condition of native grassland habitats on the refuge.

Cheatgrass has invaded an estimated 250 acres of native grassland on the refuge. This is an annual grass that is a prolific seed producer and cures out early in the summer, producing sharp pointed seeds that can injure the eyes and mouths of grazing animals. Cheatgrass may provide forage for bison and elk in the spring during green-up, but has little nutritional value as winter forage. It is considered a serious problem because the dry grass is highly flammable, and after a fire, cheatgrass spreads very quickly. In the past, cheatgrass was not considered a problem in Jackson Hole because the climate was too wet; the recent drought, however, has allowed cheatgrass to expand rapidly.

Most native grassland habitats are dominated by native perennial bunchgrass species with low growing, native woody species such as broom snakeweed and green rabbitbrush. There is little invasion by tap-rooted forbs between grass plants. Soil between grasses is not eroding on most native grasslands on the refuge. Additional plant species commonly found in native grasslands include rushes, smooth brome, brome snakeweed, yellow salsify, June grass, green rabbitbrush, fringed sage, and alfalfa. These communities, while heavily used by elk and bison, are considered to be in good condition. The Poverty Flats grasslands receive heavy use by elk, and Miller Butte receives moderate to heavy use. The grasslands on the northern end of the Refuge receive much less use due to snow depth and hunting.

Cultivated Fields

Ten plant community types are found in cultivated fields (approximately 2,400 acres) in the south and central part of the Refuge. Current plant species include intermediate wheatgrass, Russian wild

rye, Kentucky bluegrass, sub-irrigated bluegrass, smooth brome, meadow brome and alfalfa. Smooth brome, the most common, provides moderate-quality standing forage but is undesirable because of its inability to remain erect in heavy snow. It also requires irrigation in drought years and may spread to suitable sites in other cultivated fields and native grassland habitats. Cultivated grasslands, which are planted specifically to augment native forage that is available for elk in the winter, are used extensively by elk and bison. Cultivated species are chosen based on their palatability, persistence, ability to compete with weeds, low probability that they will invade native grasslands, and their ability to stand up after a heavy snowfall. Experiments with other plant species are continuing in an effort to find more productive crops. Only a portion of the approximately 2,400 acres available for cultivation would likely be cultivated in any particular year.

Irrigation Systems

Most cultivated fields on the refuge are flood irrigated using the ditch system created by original homesteaders but with some recent modifications. Current flood irrigation involves diverting water from Flat, Cache, and Nowlin creeks, or other water sources, conveying this water through open irrigation ditches, and then directing water onto fields by using permanent water control structures or temporary check dams. A total of 152 acres of cultivated fields are irrigated using a side-roll sprinkler irrigation system.

Currently, the Refuge flood irrigates approximately 665 to 2,000 acres per year, with a 10-year average of 930 acres per year. Sprinkler irrigation could increase to 260 acres under existing authority. Cultivated fields that are not irrigated vary from an estimated 500 to 2,400 acres per year (with a 10-year average of about 1,400 acres per year).
Forage production in any given year depends on crop species planted, the number of years since seeding occurred, and infestation by insect herbivores such as grasshoppers, fertilizer application, precipitation, amount of water available for irrigation, and number of staff available for irrigation activities. The time of year that precipitation occurs is also important. Rain in the spring and early summer is more beneficial than later in the year. Water available for irrigation depends more on snowpack than growing season precipitation.

Forage Production outside Exclosures

Forage production on the refuge varies annually, depending on precipitation, temperature, insects, fields allowed to lie fallow, and other factors. The refuge produces an estimated average of 22,195 tons of forage annually, about 18,049 tons (81%) of which is herbaceous forage. This estimate is most meaningful for elk management in terms of usable and preferred forage. However, not all herbaceous forage produced on the refuge is available to or used by wintering elk. Factors such as topography, location, snow accumulation and condition, species preference and palatability, growth form of vegetation, trampling and manure contamination by elk and bison, hunting pressure, and other factors work in concert to influence forage availability and elk use.

Forage Production Monitoring Data

Forage production has been monitored on the refuge using comparable methods for the past 23 years, with data collected annually along 51 transects throughout the refuge to determine production rates associated with community types. From this information, refuge-wide production estimates have been extrapolated. There is a degree of variability in terms of site-specific range condition and forage production, and the generalized data are not well suited to predict forage production outside

transect locations. An analysis of forage production data against several possible explanatory variables found that precipitation accounted for most of the annual variability (Cole and Farnes 2007). For example, record-breaking precipitation both rain and snow in 1993 resulted in increased forage production. Another variable is grasshopper populations, which are typically associated with drought; they play a lesser role in forage production, but their exact effect is more difficult to quantify.

Wetlands (Marshlands, Wet Meadows, and Open Water)

The Refuge contains approximately 2,676 acres of wetlands, including marshlands, wet meadows, and open water. Wetlands function as a natural sponge that stores and recharges groundwater supplies. Wetlands moderate stream flow by releasing water to streams (especially important during droughts), and reduce flood damage by slowing and storing floodwater. Wetland plants protect stream banks against erosion because the roots hold soil in place and the plants break up the flow of stream or river currents. Wetlands improve water quality by filtering sediment, pollutants, and excess nutrients from surface runoff. Wetlands are one of the most biologically productive ecosystems in the world. Wetlands provide food and habitat for a variety of wildlife.

Nonnative Invasive Plant Species

Many nonnative plant infestations on the refuge are a direct result of abandoned livestock feeding areas and corrals, old homesites, and roadbeds. At least 19 species of invasive nonnative plants are present. Such species reduce the diversity and number of native plants and modify habitats (i.e., replacing a grass community with a forb community). Elk forage in bunchgrass sites was decreased by 50%–90% after a spotted knapweed invasion (Teton County, WY, Weed and Pest 2002).

Plant Species of Special Concern

No plant species in Teton County have been federally listed or proposed for listing as threatened or endangered species. There are 13 Wyoming plant species of special concern on the National Elk Refuge.

WYOMING PLANT SPECIES OF SPECIAL CONCERN — NATIONAL ELK REFUGE

Scientific Name	Common Name
Aster borealis	Rush aster
Astragalus terminalis	Railhead milkvetch
Carex buxbaumii	Buxbaum's sedge
C. parryana	Parry sedge
C. sartwellii	Sartwell's sedge
C. scirpoidea scripiformis	Canadian single-spike sedge
Eriophorum viridicarination	Green-keeled cotton-grass
Heterotheca depressa	Teton golden aster
Lesquerella carinata	Keeled bladderpod
Muhlenbergia glomerata	Marsh muhly
Salix candida	Hoary willow
Scirpus rollandii	Pygmy bulrush
Utricularia intermedia	Flat-leaf bladderwort

SOURCE: Fertig 1998

WILDLIFE

Elk, as well as bison, play an important ecological role in Jackson Hole and are recognized as vital elements of the native biota that interact dynamically with their environment. A more complete description of all wildlife species may be found in the 2007 Plan/EIS.

Elk

Elk are the primary wildlife species occupying the Refuge, and their conservation is the reason the refuge was established. The creation of Yellowstone National Park in 1872 and the National Elk Refuge in 1912 were crucial in terms of protecting elk and their winter ranges in the greater Jackson Hole area. Supplemental elk feeding was initiated to mitigate the loss of natural winter range and impacts to livestock operations. By the 1930s the feeding program had successfully stabilized the elk population. The creation of Grand Teton National Park in 1929, as well as its expansion in 1950, consolidated and protected elk summer ranges within this area.

The initiation of feeding in any given year depends on elk numbers, the timing of migration, winter temperatures, snow depths, and the accessibility of standing forage. Non-feeding years have occurred irregularly and infrequently. Since the refuge was established in 1912, there have been nine years when no feeding was provided. The last such winter was in 1980–81. Elk were fed hay during at least a portion of most winters from 1912 to 1975. In 1975, after several years of testing, a switch was made to alfalfa pellets (Smith and Robbins 1984). Biologists evaluate several factors to determine whether feeding is needed, and if so, when it should begin and end. Since 1912, the period of supplemental feeding has ranged from "no feeding" to a maximum of 147 days. Elk currently are fed an average of 70 days annually.

Elk are versatile generalists (Houston 1982) and use a mixture of habitat types in all seasons. Having evolved as an ecotone species in cold, temperate climates, elk retain features adaptive to both wooded and plains environments; they prefer open areas (Geist 1982) but also use dense coniferous forests for shelter (Clark and Stromberg 1987).

Adaptable foragers with a mixed diet, elk frequent a variety of habitats and move about seasonally. While they make short movements in the fall after the first frosts occur, they generally remain on summer range until heavier snow covers forage, stimulating migrations to lower elevation wintering areas. A few elk forgo migration and winter on wind-swept, more exposed parts of their summer range.

Existing and Potential Diseases

Diseases could affect the numbers, distribution, and health of the elk and bison herds in several ways. Infectious diseases in the Jackson elk herd are also of concern because of potential transmission to domestic animals (mainly cattle and horses). Please refer to the 2007 Plan/EIS for more complete information on this important issue.

Bison

The American bison is native to Jackson Hole (Fryxell 1928; Ferris 1940; Skinner and Kaisen 1947; Haines 1955; Hall and Kelson 1959; Long 1965; Love 1972; Wright et al. 1976; McDonald 1981). Prehistoric bison remains have been found throughout the valley, along the Gros Ventre River, on the west slope of the Gros Ventre Range, on the National Elk Refuge, and along the Snake River south of Jackson (Fryxell 1928; Ferris 1940; Love 1972). Historically, bison likely inhabited the northern areas of Jackson Hole as well, especially in summer. Areas where bison remains have been found represent key ungulate wintering areas, where most bison mortality would be expected to occur.
The near extinction of the American bison occurred throughout the 19th century. Bison were eliminated in the Jackson Area around 1840. They were later reintroduced in 1948 when 20 animals (3 bulls, 12 cows, and 5 calves) from Yellowstone were transported to the private, 1,500-acre Jackson Hole Wildlife Park near Moran. In 1964, 12 certified brucellosis-free bison from the Theodore Roosevelt National Park were added to this population, bringing the total number of animals to 21. In 1968, the herd escaped confinement and were allowed to free-range on the Grand Teton National Park. Since discovering the elk feedlines on the refuge in 1980, the bison herd has increased exponentially until 2008. Herd reductions were discontinued in 1990 and began again in 2008 on the Refuge. The bison population is now in a state of slow decline.

Most of the Jackson Hole herd winters on the Refuge, although some use open grasslands, the hills beyond the eastern boundary of the refuge, and the hills and open sage-steppe land east of Elk Ranch. During spring and fall transitional periods bison may be found throughout both summer and winter range. Bison are primarily grazers whose diet is composed of grasses, sedges (*Carex* species, which grow in moist areas), some forbs, and rarely shrubs, and appear to need water every day (Cooperrider, Boyd, and Stewart 1986). A dietary study conducted on shortgrass plains in north-eastern Colorado noted that bison consumed at least 85% grasses and sedges (Peden et al. 1973). Bison preferred warm-season grasses and added shrubs to their diet when grasses were not available. Please refer to the 2007 Plan/EIS for more complete information.

Other Wildlife.

Please refer to 2007 Plan/EIS for detailed descriptions of threatened, endangered, and special concern species; other ungulates; predators and scavengers; small mammals; large rodents; birds; and reptiles and amphibians.

Long-billed curlews (*Numenius americanus*), a Wyoming Avian Species of Special Concern, have been observed in low numbers within the project area. Wyoming Game and Fish have recorded negative surveys for long-billed curlew on the refuge in 1992 and 1993 (WGFD, unpublished data). Monitoring of the Refuge route was discontinued due to low numbers of breeding curlews (WGFD 2006) In 2008 the route was run on May 22, and 6 individual curlews were detected (WGFD, unpublished data). Long-billed curlews nest in grassland, primarily native short-grass and mid-grass prairie, on territories that average 35 acres. Curlews prefer to nest in areas with short vegetation (under 30 cm) and wide visibility, and require a 300-500 m buffer zone free of other nesting curlews (Dechant et al. 1999). Curlews are most vocal during courtship and territorial displays, principally from late April through May 15th.

CULTURAL RESOURCES

Indigenous People of Western Wyoming

During prehistoric times, no one tribe occupied Jackson Hole. Native Americans living on surrounding lands used this neutral valley primarily during the warm months. Traditional uses of the lands included hunting or fishing, collection of plants and minerals, and ceremonial activities. The most prominent groups that occupied the eastern Idaho and western Wyoming area prior to settlement by Euro-Americans were the Bannock, Northern Shoshone, and Eastern Shoshone. Other American Indian tribal groups have some historic or continued association with lands now within the National Elk Refuge and Grand Teton National Park, including the Assiniboine, Athabascans, Comanche, Salish, Kiowa, Kootenai, Crow, Gros Ventre, Teton Sioux, Umatilla, and Nez Perce. In addition, the Arapaho, Blackfeet, Cheyenne, and other Siouan groups and people of the Plains made excursions into the region for hunting, warfare, and trade.

Euro-American History

John Colter, a member of the Lewis and Clark expedition and later an explorer and trader for the Manuel Fur Company, may have visited Jackson Hole in 1807. Other trappers and traders from the Missouri Fur Company trapped the rivers and streams of Jackson Hole in 1810–11 (Daugherty 1999). During the 1820s and 1830s Jackson Hole served as a crossroads of the fur trade in the northern Rocky Mountains. Except for a few prospectors searching for gold, Jackson Hole was virtually deserted by Euro-Americans from the 1840s to the 1880s. However, three military surveys passed through the valley in the 1860s and early 1870s. These military surveys were followed by the Hayden surveys (1872, 1877, and 1878), which were sponsored by the U.S. Geological Survey and explored the Jackson Hole and Yellowstone country. It was during the first Hayden survey in 1872 that the first photographs of the Tetons were taken by William H. Jackson.

In 1884 the first permanent settlers arrived and built cabins along Flat Creek inside the boundaries of the present-day National Elk Refuge. By 1900, 638 people resided in Jackson Hole. In 1912, when the U.S. government allocated money to buy up homesteads to set aside land for the National Elk Refuge, many homesteaders willingly sold their property and moved into town. In other parts of the valley cattle ranching continued and expanded through the 1930s. . Even before the Jackson Hole environment was changed by the arrival of homesteaders, early hunters and settlers noted that winters of unusually heavy snow caused thousands of elk to starve to death. This situation ultimately led to the establishment of the Refuge in 1912.

Bison played no role in early settlers' lives due to the fact that bison had been extirpated from the valley by the 1840s. By 1900 less than 1,000 bison existed in the entire United States. Bison were reintroduced into Jackson Hole in 1948.

Archeological Sites on the National Elk Refuge

The majority of the land within the Refuge has not been inventoried for cultural resources; to date 10 sites have been identified and surveyed. Several features occurring on the refuge fall under the jurisdiction of the National Historic Preservation Act. Four prehistoric archeological sites have been recorded, which include roasting pits, stone circles, and a bison kill site. Among the artifacts that

have been discovered are bones from bison and elk, numerous flakes, choppers, scrappers, and projectile point pieces.

SOCIAL AND ECONOMIC CONDITIONS

Recreational Opportunities

Biannual visitor surveys conducted by the Jackson Hole Chamber of Commerce consistently document that 80%–90% of valley tourists identify natural resource based activities (principally sightseeing and summer and winter outdoor sports and recreation) as their primary reasons for visiting Jackson Hole.

The Refuge had an average of 851,220 visitors per year from 1992 to 2001. In 2001 there were 881,361 visitors, of whom 780,299 participated in on-site interpretation and nature observation, including 24,664 sleigh riders, 304,987 stops at the visitor center, and 439,148 visitors using observational facilities such as auto turnouts. An additional 2,000 people participated in environmental education activities, and 99,062 people enjoyed recreational opportunities on refuge lands. Recreationists included 2,193 big game hunters, 3,600 anglers, and 93,394 people engaged in miscellaneous activities (including approximately 30,000 people walking, hiking, jogging, and biking on refuge roads). Except for certain main roads where most vehicular traffic and all foot traffic is confined, a large portion of the refuge is closed year-round to public use. Fishing is allowed on lower Flat Creek from August 1 to October 31 and throughout the regular fishing season on upper Flat Creek.

Economic Setting

Approximately 97% of Teton County's total land area is managed by the federal government, leaving only 3% of the county's land base in private ownership. Of the total private lands, about 14,600 acres are under conservation easements and nearly 40,000 acres are in agricultural production, primarily for grazing and raising hay for cattle. Conservation easements are held by the Jackson Hole Land Trust, Teton County Scenic Preserve Trust, and The Nature Conservancy. Approximately 26,000 acres of undeveloped private land in the Jackson Hole area are not protected from development through conservation easements, and an estimated 15,000 acres could be developed in the next few years (Jackson Hole Land Trust 2003).

Jackson is the primary destination for visitor activities in the Jackson Hole area, and it serves as the gateway community to the National Elk Refuge, Grand Teton National Park, Bridger-Teton National Forest, and southern Yellowstone National Park. Mainly because of its scenic and recreational activities, Teton County's year-round population experienced more than a sixfold increase between 1960 and 2000 (Charture Institute 2003a).

The median cost of a house in Teton County nearly tripled between 1990 and 2000 (Charture Institute 2003a). Due to the high cost of living in Jackson, a large percentage of the town's tourist-based service and trade industry workforce lives in communities outside Teton County and commute to work in Jackson. The towns of Victor and Driggs in Teton County, Idaho, have been the most affected by this trend (Charture Institute 2003a). For the purposes of this economic analysis, the local economy includes both Teton County, Wyoming, and Teton County, Idaho.

The 2000 census estimated the total population for the two counties at 24,250 persons, of which 75% (18,251 persons) lived in Wyoming, and 25% (5,999 persons) in Idaho. Total full- and part-time employment in 2000 was estimated at 25,607 jobs, of which 89% (22,828 jobs) were in Wyoming and 11% (2,779 jobs) in Idaho. Jackson's attractiveness as a place to live has become a bigger economic driver in terms of growth in population and personal income than the tourist industry (Charture Institute 2003a). The 2000 average per capita personal income in Teton County, Wyoming, was well over $20,000 higher than the state or national averages (BEA 2002). According to IRS tax return data, Teton County, Wyoming, was ranked as the wealthiest county in the nation for 2002, and it has ranked either first or second in per return income since 1997 (*Jackson Hole News and Guide* 2004).

The economic value of Grand Teton National Park and the National Elk Refuge resources is only partly measured by the demand for onsite use by visitors, hunters, and others. These areas are clearly a resource of national and even international significance. Many individuals value the idea that this resource and its wildlife are being maintained in a viable state independent of whether they will actually be able to visit the area (USFWS 1994b). This type of nonmarket value is sometimes termed "intrinsic," or "existence," or "bequest" value (Krutilla 1967). The existence of the resource itself (separate from direct use) or the motivation to provide the resource for future generations is the basis of this economic value.

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

This chapter assesses the environmental impacts expected to occur from the implementation of alternatives A or B, as described in Chapter 2. The Service assessed the environmental consequences of carrying out each alternative on biological, physical, cultural, social, and economical resources for each alternative.

This chapter also summarizes the ability of the Service to meet legal responsibilities under each alternative, as well as the consistency of each alternative with wildlife management principles. Existing conditions of the environment, biological resources, and socioeconomic factors are described in Chapter 3, and care was taken to ensure that the elements of each major issue identified in Chapter 1 were addressed in the analysis contained in this chapter. The analysis of potential effects on the environment, biological resources, and socioeconomic factors was used in assessing the effects of each alternative on the ability of the agencies to meet legal requirements.

SHORT-TERM VERSUS LONG-TERM EFFECTS

Potential impacts are discussed in relation to short-term and long-term time frames. Short-term effects cover those that would be apparent within 15 years of implementing an alternative. Long-term effects are those that would either continue from the short term beyond the 15-year timeframe into the next 30 or more years or that would not be expected to occur until 15–30 years or longer.

BASELINE CONDITIONS AND THE NO ACTION ALTERNATIVE

The effects of alternatives are compared to baseline conditions and to the No-Action Alternative (Alternative A). Baseline conditions represent the conditions that have resulted from those management decisions as described in the 2007Plan/EIS and the Record of Decision, April 26, 2007.

EFFECTS ON THE BIOLOGICAL ENVIRONMENT

Soils

Potential effects on soils would primarily result from the installation of a pipeline water distribution system on an expanded irrigation footprint. Other effects also include the continued, periodic tillage of cultivated fields and the potential restoration of native grass and forb communities.

Impacts of the Alternatives

Alternative A (no action)

The no action alternative would result in short-term soil disturbance of an estimated 9.4 acres along approximately 61,106 feet of water pipeline right-of-way on the refuge, with minor adverse effects. Additionally, soil in the historically farmed units of the Refuge would be periodically disturbed during disking and reseeding activities.

Alternative B (preferred alternative)

Effects of increased irrigated acreage on refuge soils will be similar to the effects described in Alternative A, but on an expanded footprint. Soil erosion associated with reseeding activities will be minimal because farmed fields are nearly level. Up to 2,400 acres will continue to be cultivated (similar to Alternative A). This alternative results in short-term soil disturbance of an estimated 23.4

acres along approximately 126,720 feet of water pipeline right-of-way on the refuge, with minor adverse effects.

Areas with remnant native plants which are dominated by introduced non-native grasses (smooth brome grass, Kentucky Bluegrass, crested wheatgrass) may be temporarily tilled to facilitate the seeding and restoration of a historic native plant community. This tillage will occur on level topography and the impacts temporary and negligible.

Most flood irrigation ditches will be closed or the vertical sides sloped to reduce safety conflicts with vehicles used for supplemental feeding and other management purposes.

All disturbed soil will be seeded with a mixture of native grasses and forbs to prevent erosion. Short-duration soil disturbances, such as the disturbance during the construction of irrigation pipelines and the closure/sloping of flood irrigation ditches, will be mitigated by use of erosion screening or certified, weed-free hay bales to reduce the potential of sediment reaching stream channels.

The use of tractors pulling alfalfa pellet trailers for supplemental feeding during the Spring thaw period can result in soil disturbance, erosion and rutting. This soil disturbance can increase the potential for the invasion and establishment of introduced noxious weeds. Increased forage resulting from expanded irrigation will likely reduce the need for supplemental feeding during snow melt periods, as increased forage is exposed and available for grazing, and reduce soil disturbance. Benefits are minor but potentially widespread.

Water Resources

Potential effects on water quantity on the refuge are primarily the result from irrigation practices, including the methods of conveying water from source waters to irrigation systems. Effects on water quantity were evaluated in the 1998 *Irrigation System Rehabilitation Plan Environmental Assessment* (USFWS 1998), and the following assessment incorporates these findings, as well as supplementary assessments. The potential effects also include evaluating a lateral sprinkler irrigation system.

Impacts of the Alternatives

Alternative A (no action)

While more efficient use of water under Alternative A increases stream flows, irrigation water would be diverted during the most critical period (July–August). Sprinkler irrigation system acres would increase water-use efficiency to an estimated 60%–70% (Kremer and Cornia, pers. comm., as cited in USFWS 1998). Water saved through more efficient conveyance, distribution, and use would remain within the watercourses.

The 500 acres of flood irrigation would operate at significantly lower water-use efficiency than the sprinkler irrigation system.

Alternative B (preferred alternative)

The effects of alternative B are similar to the no action alternative. The difference between these alternatives is that more acreage will be irrigated during this period. By phasing out the 500 acres of flood irrigation, significantly more acreage can be sprinkler irrigated using the same amount of water. It is anticipated the total water used between Alternatives A and B are comparable.

The Refuge has adjudicated water rights of 74.4 cfs (cubic feet per second; ft^3/s) from Flat Creek. Water discharge in Flat Creek was measured and reported by the United States Geological Survey during two separate time spans (1933 – 1941 and 1989-1993) during the April through November season. This gauge, USGS 13018000 in SW1/4, NW1/4, SW ¼ section 35, T. 42 N., R. 115 W., Teton County Wyoming, was located upstream of the existing Fish and Wildlife Service diversion structure. The available gauge summary data yield the following average monthly flow estimates:

Month	Monthly Mean Discharge, cfs
April	13
May	56
June	147
July	83
August	39
September	26
October	22

The pipeline to transfer Flat Creek water is designed for a maximum discharge of 22 cfs. Refuge water rights and Flat Creek flows are in excess of maximum irrigation system discharge during all potential periods of irrigation. The primary irrigation period is during the months of May and June. Significant amounts of water in excess of maximum irrigation needs, will continue to flow down Flat Creek and be available for riparian habitat growth and fisheries support.

The Refuge has water rights of 7.4 cfs from Cache Creek. The maximum water use to sprinkler irrigate the Headquarters Unit is 2.74 cfs. Significant amounts of water in excess of maximum irrigation needs, will continue to flow down Cache Creek and be available for riparian habitat growth and fisheries support.

Visual Resources

Visual resources could be adversely affected by the action of installing and operating sprinkler irrigation systems. The potential effects of changes in the sprinkler irrigation system on the refuge were analyzed in the *Irrigation Systems Rehabilitation Plan Environmental Assessment* (USFWS 1998).

Impacts of the Alternatives

Alternative A (no action)

Under this alternative the irrigation system would be mostly hidden from view or would be difficult to visually distinguish because of their distance from roads and highways and because they would blend into the background. An irrigation system in the Nowlin Unit area would blend into the strong visual backdrop of Miller Butte when viewed from the highway turnout near the fish hatchery. The irrigation system in the Peterson Unit area would be easier to see from most locations along the highway, but given the distance would not be noticeable to many viewers traveling at highway speeds along this view corridor. Also, the metal-roofed Quonset huts and cabins in the middle ground include a human agricultural element in the view plane and make the irrigation equipment compatible within this context. Irrigation equipment would be less conspicuous during late summer and fall when taller, honey-colored grasses are present than in the spring and early summer. The visual impacts of side-roll sprinklers in the Ben Goe and Headquarters Unit areas would be negligible to minor.

Converting to sprinkler irrigation under this alternative would contribute to a slightly less natural looking landscape on the Refuge near the town of Jackson but the impact would be minor.

Alternative B (preferred alternative)
The visual impairments from permanent irrigation equipment in Alternative A will be further reduced with Alternative B where above ground metal sprinkler systems would be eliminated. A K-Line or equivalent system uses black plastic pods and green water transfer tubing which rests on the ground. The low profile, 9" tall pods are virtually invisible from a moderate distance. This sprinkler irrigation system results in negligible adverse impacts on the foreground character and background views of the Refuge.

Restoring to native vegetation will be a more natural looking and more appealing landscape for some people, although many people will not notice the difference. The process of disking and reseeding former fields would adversely affect the natural appearance of a small part of the Refuge for a temporary period.

Moderate to large numbers of elk and bison on the refuge and in the park would continue to be important elements of the scenery of Jackson Hole. This alternative does not result in the impairment of visual resources of the Refuge.

With the purpose of irrigating more acreage and distributing the elk and bison over more of the management units, views of elk and bison on the Refuge will be more natural because animals are not be artificially concentrated along feedlines, which will enhance the experience of some visitors. However, visible numbers of elk and bison may be lower than under the no action alternative, which may diminish the visual quality of the refuge for some people.

Wetlands (Marshlands, Wet Meadows, and Open Water)
Marshlands and open water habitats will not be affected by either Alternative A or B.

Potential effects on wet meadows primarily result from the increase of irrigation acreage and management of lateral irrigation practices on the Refuge. Management of wet meadows will not change from the selected preferred alternative in the 2007 Plan/EIS.

Impacts of the Alternatives
Alternative A (no action)
Few wetlands exist in irrigation management unit areas. Flat Creek is considered a "water of the United States" by the U. S. Army Corps of Engineers and as such receives protection under the Clean Water Act of 1977. Similarly, a small linear wetland feature along Flat Creek between the Chambers and the southeastern portion of the McBride Unit would be impacted as a result of the proposed pipeline crossing of Flat Creek (Cole, pers. comm. 2002). Whenever possible, construction in wetlands would not take place, but any unavoidable impacts to wetlands or waters of the United States would have to be authorized and permitted by the U.S. Army Corps of Engineers prior to the implementation of sprinkler irrigation projects.

Flood irrigation may enhance the sub-irrigated sedge/rush eastern fringe of the Nowlin Wetland. This wetland area extends into the Peterson, Nowlin, Poverty Flats and Ben Goe Management Units. Conversion of flood irrigation to sprinkler irrigation would improve water use efficiency and reduce the excess flood irrigation water entering the Nowlin Wetland through irrigation ditches or subsurface transfer in these management units. The decreased flow of excess flood irrigation water

would likely be offset by increased flow entering the wetland area via Flat Creek as a result of improved water use efficiency by the sprinkler irrigation system. The ultimate effect on this fringe of wet meadow vegetation is unknown.

Alternative B (preferred alternative)
The effects of alternative B are similar to the no action alternative for the pipeline installation and possible small areas of wetland vegetation in sprinkler irrigated areas.

Flood irrigation under Alternative B will be phased out and replaced by sprinkler irrigation. Excess irrigation water which entered the Peterson wetland through irrigation ditches or by subsurface transfer will be eliminated. The amount of water entering this wetland area from Flat Creek will likely increase because of reduced irrigation water consumption by the conversion to sprinkler irrigation. The ultimate effect on wet meadow vegetation is unknown.

Cultivated Fields

Potential effects on cultivated fields would primarily result from farming practices and irrigation use on increase acreage on the National Elk Refuge.

Impacts of the Alternatives
Alternative A (no action)
Management of cultivated fields would not change from the selected preferred alternative in the 2007 Plan/EIS. The objective of Alternative A is to produce more natural standing vegetation through irrigation, for use by elk and bison as winter forage. Nutritious and palatable grass species which remain upright under moderate snowpack will be periodically re-established on up to 2,400 acres of cultivated fields. Vegetation studies conducted on the Refuge have shown intermediate wheatgrass to be an attractive forage species to bison. Meadow brome, orchard grass, Russian wildrye, and certain legumes have desirable characteristics which are attractive to elk and improve Refuge soils.

Vegetation outside the project area will not be negatively affected. Elk and bison are expected to utilize the increase in herbaceous vegetation at irrigation sites, which should reduce browsing pressure on currently suppressed woody plant species.

Sprinkler irrigation will be used to produce an average of 5,000 pounds of forage per acre on about 400 acres and an average of 2,500 pounds per acre on 700 acres. Flood irrigation will be used to produce an average of 2,500 pounds of forage per acre on about 500 acres. The total annual estimated forage produced under the combined use of flood and sprinkler irrigation is 5,000,000 pounds or 2,500 tons on 1,600 acres.

Numerous nonnative invasive weed species are present on the refuge in relatively low abundance. The following species may benefit from irrigation and expand in abundance (personal communication with John Moeny, GTNP Plant Restoration Ecologist):
- Whitetop (*Cardaria draba*)
- Musk thistle (*Carduus nutans*)
- Canada thistle (*Cirsium arvense*)
- Oxeye daisy (*Leucanthemum vulgare*)
- Scotch thistle (*Onopordum acanthium*)
- Perennial pepperweed (*Lepidium latifolium*)
- Leafy spurge (*Euphorbia esula*)

Increased nonnative invasive weed monitoring and control will likely be necessary.

Alternative B (preferred alternative)
Vegetation impacts will be similar to cultivated fields as those described in Alternative A; however there will be an expansion of irrigation from 1,600 acres per year to 2,400 acres per year. Sprinkler irrigation will be used to phase out flood irrigation. Unlike Alternative A, which targets 5,000 pounds of produced forage per acre on 400 acres, the strategy under Alternative B is to produce an average of 2,500 pounds of palatable and nutritious standing forage per acre on 2,400 acres. This strategy produces an estimated increase of 1,000,000 pounds of forage over Alternative A. More importantly, it creates a more uniform stand of forage across the entire 2,400 acres, resulting in a greater dispersion of wintering elk compared to the same number of animals on fewer acres (1,600 acres) in Alternative A.

An increase of irrigated acreage leads to increased forage production. Increased utilization of this forage will reduce the grazing impact on other vegetation communities. Woody plant communities on the Refuge are expected to benefit from reduced browsing pressure by elk and bison, resulting from the increased availability of herbaceous forage.

As with Alternative A, an increased level of invasive weed monitoring and control will likely be necessary.

Non-Cultivated Grasslands

Non-cultivated grasslands are grasslands located primarily in the Chambers, Peterson and Poverty Flats Management Areas which may have historically been cultivated by homesteaders, but have not been cultivated through Refuge management activities in recent history. These areas contain native grasses, as well as introduced grasses such as crested wheatgrass, smooth bromegrass and Kentucky bluegrass.

Impacts of the Alternatives
Alternative A (no action)
Irrigation is not proposed on non-cultivated grasslands under Alternative A.

Reduced elk and bison grazing pressure is expected on non-cultivated grassland because grazers will be attracted to, utilize and be more concentrated on the 1,600 acres of cultivated and irrigated fields.

Alternative B
Irrigation will be expanded to approximately 2,635 acres of non-cultivated grasslands. Crested wheatgrass, which was introduced by Homesteaders, dominates approximately 873 of these acres. A curly bluegrass (Poa secunda) herbaceous alliance with various levels of introduced smooth bromegrass, Kentucky bluegrass and crested wheatgrass make up the balance of this grassland.

The average natural annual precipitation over 47 reliable years of data (1905-2008) is 15.89 inches, with a minimum of 8.26 inches and a maximum of 25.29 inches. The proposed irrigation increase will result in “average” precipitation years having a total annual precipitation on the high end of the natural average range. The addition of irrigation to “dry” precipitation years results in total precipitation closer to but below average natural precipitation.

The proposed irrigation strategy will create soil moisture conditions that may eventually result in a higher frequency of smooth bromegrass, Kentucky bluegrass and curly bluegrass in some areas (pers. Comm. John Moeny, GTNP Plant Restoration Ecologist). Where smooth bromegrass is found with high frequency and few native grasses are present, smooth bromegrass will eventually become dominant. In areas with a high frequency of native grasses and a low frequency of smooth bromegrass, the native grasses will continue to dominate in the short term (1-10 years), but an encroachment by smooth brome with the potential for dominancy would be expected in the long term. Kentucky bluegrass will increase in frequency in most areas but not become the dominant plant component. Crested wheatgrass dominated areas will continue to be dominated by this grass.

Since 2000, natural, non-irrigated production of herbaceous plants (grasses and forbs) on these grasslands has fluctuated from a low of 219 lbs./ac. to 1,060 lbs./ac. A conservative estimate of 1,200 lbs. /ac. will be produced per year under sprinkler irrigation. This will result in a net increase of approximately 2,585,000 pounds of forage over years of low precipitation and forage production.

Areas that are or become dominated by crested wheatgrass or other non-native plants, may be tilled and treated for restoration of native plant communities to increase habitat diversity.

Increased nonnative invasive weed monitoring will be necessary to identify changes in prevalence of undesirable plant species. Appropriate integrated pest management actions will be taken to prevent an expansion of invasive weeds.

Threatened and Endangered Species

No federal or state listed threatened or endangered species will be adversely impacted by either Alternative A or B as outlined in the 2007Plan/EIS.

The yellow-billed cuckoo (*Coccyzus americanus*) population in the western United States meets the criteria to qualify as a distinct population segment and is consequently warranted protection under the Endangered Species Act. This neotropical migratory bird was historically distributed throughout most of the United States, southern Canada, and northern Mexico but is considered a rare summer resident of Wyoming. Due to its breeding requirement for relatively large tracts of woody riparian habitat below 7,000 feet (Wyoming Natural Diversity Database 2002). Neither Alternative A nor B will adversely affect yellow-billed cuckoo habitat.

Greater sage-grouse *(Centrocercus uropasianus)* is a resident, non-migratory upland game bird of the greater Jackson Hole area. Greater sage-grouse populations have been in decline across their entire North American range for nearly 20 years and the U.S. Fish and Wildlife Service is currently conducting a 12 month status review of the greater sage-grouse to determine if threatened or endangered status is warranted (73 Federal Register 38, February 26, 2008).

Two active leks are present on the Refuge. The North Gap lek is located approximately one mile from the closest irrigation site. Greater sage-grouse naturally abandon active leks each morning shortly after sunrise. Morning irrigation activities would commence after 8:00 AM and would not cause disturbance to birds using the lek.
Sage-grouse throughout Wyoming selected nesting sites with increased shrub cover and height, and increased residual grass cover (patches that provided overhead and lateral concealment cover) relative to available habitats (Holloran 2004). Irrigation project areas do not include sage brush or greater sage-grouse habitat.

Impacts of the Alternatives

Alternative A (no action)

The following species would not be affected by any of the alternatives considered in this document, and they are not discussed further: lynx, and wolverines.

Scattered sage brush occurs on approximately 80 acres of center pivot irrigated land in the McBride management unit. Irrigation may reduce the vigor of sage brush and may lead to its eventual replacement by grass species. This would negatively impact greater sage-grouse use of these 80 acres.

Alternative B (preferred alternative)

Threatened and endangered species impacts will be the same to those described in Alternative A.

Alternative B excludes all sage habitat from the project area.

Wildlife

Reduced reliance on winter supplemental feeding is a primary strategy to mitigate the potential for elk and bison disease transmission. Irrigation to grow high quality winter forage over a broad area would encourage animal dispersal and reduce temporal and spatial herd concentrations. Continued herd size reduction through hunting is necessary to complement and enhance this dispersal effort. Continued herd health monitoring will be necessary to verify and quantify disease reduction results.

An average of 930 agricultural acres have been irrigated from 1996 through 2006 in an attempt to provide wintering elk with additional forage opportunities. Alternative A authorizes a 72% increase of 670 acres above this average. Alternative B would expand irrigation acreage by 4,105 acres, a 440% increase over the above average irrigation acreage.

A pre-irrigation season, ground nesting bird survey would be conducted for both alternatives on cultivated and non-cultivated lands. The purpose of this survey is to identify the location of nesting species of special concern. Irrigation of these areas would be delayed until after the nesting season to avoid direct or indirect impacts to nests, nestlings and breeding adults. This process will mitigate the adverse effects on species of special concern.

Impacts of the Alternatives

Alternative A (no action)

The use of an irrigation system has been determined to have no negative impacts to wintering elk or bison on the Refuge. Increase herbaceous forage production within the management units would provide more natural forage to winter on, reducing the need to supplement feed. Increase in forage production may result in reduced disease transmission, feedline related stress to animals, and grazing pressures on woody plant communities. Increased production of herbaceous forage species is not expected to affect elk migration to or from the Refuge but will likely influence the distribution of animals on the Refuge during portions of the winter.

Other ungulates such as mule deer, bighorn sheep, moose and antelope are not negatively affected. Reducing elk browsing on woody plant communities would, in turn, reduce competition and improve foraging opportunities for mule deer and moose. Increased herbaceous forage production in the management units may also reduce competition between elk and bighorn sheep on traditional sheep winter ranges in and around the Refuge.

Winter freeze/thaw condition in the Jackson Area can result in snow crusting which prevents elk and bison from accessing natural standing forage. Access to forage can be temporarily provided by using agricultural tillage equipment (discs or harrows) to break up crusted snow layers. Three tracked Caterpillar Challenger tractors are currently used up to three hours per day to tow trailers which distribute alfalfa pellets for supplemental feeding. These three tractors equipped with 30 foot wide agricultural disks, could break a crusted snow layer at a combined rate of approximately 50 acres per hour. Several hours of "snow tillage" each day could provide elk and bison access to natural standing forage and maintain improved animal dispersal compared to concentrations which result from supplemental feeding.

Chronic wasting disease (CWD) is a fatal, incurable spongiform encephalopathy which infects elk, deer and moose. CWD has not been detected on the refuge but has been found only 45 miles away. It is anticipated this disease will eventually reach the refuge.

Prions, the mutant proteins which cause CWD, can be shed into the environment by infected animals, bind to a variety of soil minerals and whole soils, and remain infectious for years (Johnson 2006). This binding can be especially strong to certain clay minerals. The soils in Alternative A are predominately sandy, gravelly loams. The ability of prions to bind to these soils is unknown, but it is assumed it would occur to some degree.

The primary factor influencing prion deposition is the number of CWD infected elk on the Refuge. Herd size affects the potential number of CWD infected elk on the refuge. The Refuge winter herd objective for both Alternatives A and B is 5000 elk.

The supplemental feeding of high numbers of elk may increase the probability that prions are shed on alfalfa pellets, snow or grass along the feed lines. This could increase the transmission of CWD between animals during the feeding process. Increased elk foraging on natural standing grass will reduce the need for supplemental feeding and the time elk spend "nose to nose" along feed lines, which could reduce CWD transmission.
Alternative A will increase production of natural standing forage on 1,600 acres per year and should reduce the need for supplemental feeding. Reduced supplemental feeding and increased elk dispersal on natural standing forage may reduce the rate of CWD infections.

Installation of the underground water distribution pipeline will cause temporary disturbance of ground nesting, grassland-dependent birds during the year of construction. Studies in Jackson Hole have found that riparian, wetland, and shrub-dominated habitats generally contain the highest density of neotropical migrants in the valley (Wallen 1994). These habitats and the associated bird use will not be impacted by the installation of the pipeline.

Grassland-dependent birds, including migratory songbirds and shorebirds, may experience direct, adverse affects by farming, operation and maintenance activities associated with irrigation efforts occurring during the nesting season (Rodenhouse, et al. 1995). Ground nesting species that could occupy the project area include killdeer, Wilson's snipe, long-billed curlew, burrowing owl, horned lark, green-tailed towhee, vesper sparrow, savannah sparrow, western meadowlark and possibly lark sparrow. The nests of these ground-nesting species may be disturbed or destroyed by machinery during planting and irrigation activities. Flood irrigation may destroy nests and disrupt nesting activities due to an overabundance of moisture.

Standard farming practices used on the Refuge would minimize the impacts to ground nesting birds. Tillage of areas to be reseeded occurs almost immediately after snow loss and before the initiation of nesting by ground nesting species (personal communications, Eric Cole). This forces most species to select more attractive nesting sites with residual plant growth located outside of the tilled area. This results in a minor reduction of available nesting habitat but eliminates most direct destruction and disturbance of nests.

Reseeding of cultivated areas would occur once approximately every 15-20 years. Only a portion of the acreage available for cultivation would be cultivated in any particular year. An average of 125 acres would be tilled each year to reseed the cultivated acreage on a 20 year rotation.

A variety of shrub-grassland raptors inhabit the project areas and their vicinity. These species include prairie falcon, red-tailed hawk, Swainson's hawk, American kestrel, northern harrier, rough-legged hawk, long-eared owl, short-eared owl and great horned owl. With the exception of rough-legged hawk (winter residents) and great horned owl (year-round residents), these species are present during spring, summer, and autumn months. Possible direct, adverse impacts to prairie falcon, red-tailed hawk, American kestrel, and northern harrier would involve short-term reductions in prey species within project area fields that would be farmed. Following re-vegetation of these fields, small mammal populations are expected to return to pre-disturbance levels and perhaps even increase in response to improved production of grasses and forbs. Great horned owl and rough-legged hawk will not be impacted. Short-eared owl and to a lesser degree northern harrier are two ground nesting raptor species that may be impacted by agricultural activities during the nesting season.

There would be no significant impacts to avian species, including grassland birds and raptors, as a result of Alternative A. Perceived impacts would be both beneficial and adverse, short-term and long-term.

Alternative B (preferred alternative)

Wildlife impacts will be similar to those described in Alternative A. No new adverse impacts to elk or bison will occur from increasing the irrigated acreage. Forage production and herd dispersal is expected to significantly increase due to the larger acreage of management units being irrigated. Enhanced disease mitigation will also result with an increase in irrigated acreage and corresponding increase in elk and bison dispersal. Woody plant communities on the Refuge are expected to benefit from reduced browsing pressure by elk resulting from the increased availability of forage.

Permanent sprinkler irrigation structures are eliminated under this Alternative B, which will eliminate the risk of injury to elk and bison from becoming entangled or colliding with these structures.

Winter snow conditions are often variable across the Refuge. Expanding irrigation and increasing natural standing forage across 5,035 acres, significantly expands the probability that elk and bison will find areas where they can access forage. This may reduce the need for winter snow tillage as described in Alternative A.

Alternative B provides more uniform forage production across the southern portion of the Refuge. This will reduce the concentration of herds compared to Alternative A and may provide more disease mitigation benefits than Alternative A.

Alternative B provides an estimated 84% increase in forage production compared to Alternative A. This will likely further reduce the length of the supplemental feeding season, increase the time elk are dispersed on natural standing forage and increase potential CWD and other disease mitigation benefits.

Increased forage is produced on 5,035 acres, which is a 215% expansion in acreage compared to Alternative A. Available forage on increased acreage will encourage elk and bison to disperse more than Alternative A and will likely result in a commensurate increase in disease mitigation benefits.

This risk of environmental contamination by CWD prions is similar to that for Alternative A.

Beneficial and adverse impacts to resident and migratory birds under Alternative B will be greater in intensity, given the increased area under irrigation. Birds utilizing wetlands, riparian habitat, forests and shrub-dominated upland plant communities will not be directly affected by irrigation activities. Increased efficiency of water delivery may impact the timing and volume of subirrigation and hydrological support of wetland and riparian habitat, though the extent of this affect has not been determined.

Avian species of grassland-dominated plant communities will be affected by additional irrigation activities under Alternative B. Importantly; this includes the elimination of flood irrigation on 500 acres, which will result in beneficial affects for ground nesting grassland bird species.

Irrigation infrastructure (K-Line system or equivalent) under Alternative B will be moved across the ground via ATV. Sprinkler pods and connective hoses moved between watering sites are dragged across approximately 20% of the area during the irrigation cycle. ATVs, which move the irrigation infrastructure, cause a heavier impact on approximately 4% of the irrigated area. Movement of irrigation infrastructure has direct adverse affects on species nesting in these grassland habitats. Disturbance or nest damage may cause nest abandonment and initiate re-nesting efforts. Ground-nesting birds that occupy the refuge include killdeer, Wilson's snipe, horned lark, green-tailed towhee, vesper sparrow, savannah sparrow, western meadowlark and possibly lark sparrow. Burrowing owl observations have occurred several times in the history of the Refuge and the discovery of an active nest are considered extremely rare.

Irrigation of cultivated fields, native grasslands and historic agricultural lands dominated by crested wheatgrass will affect bird species differently dependent upon cover type, percent ground cover, and grassland structure. Direct impacts to the nests of ground nesting birds from the movement of irrigation infrastructure would be minor. Such impacts would be greatest in May and June, and progressively less impactful from July through September. The cumulative adverse effects to regional grassland nesting bird populations are negligible.

Long-billed curlews (*Numenius americanus*), is a Wyoming Avian Species of Special Concern and is found in low numbers across much of the state. Greatest nesting concentrations are found in the Pinedale area. Long-billed curlew nests have been found infrequently and in low numbers on the Refuge. Breeding season surveys by the Wyoming Game and Fish Department have been conducted on the Grand Teton National Park and the Refuge. The Refuge survey routes were discontinued in 2005 because no observations occurred. The Refuge survey was again conducted in 2008 and six long-billed curlews were either observed or heard. It is uncertain if these were breeding birds but it is suspected there was some nesting activity on the Refuge in 2008. This species is more susceptible to direct disturbance or accidental nest destruction during the nesting phase of the breeding season. Curlews will not re-nest following nest abandonment. Long-term

impacts to the Refuge long-billed curlew population are adverse and minor to moderate. Direct impacts include loss of nests from movement of irrigation infrastructure or indirect as a result of disturbance of nesting birds, and potential nest abandonment. Mitigation measures as described on page 33 would be successful in limiting impacts to long-billed curlews. The cumulative adverse effects to the regional long-billed curlew population will be negligible.

Impacts to resident and migratory raptors will generally be the same as under Alternative A. Increased irrigation area will have a long term, minor beneficial impacts on raptor foraging habitat, due to the increase in forbs, native grass species, and invertebrate and small mammal populations. Short-eared owl and to a lesser degree northern harrier are two ground nesting raptor species that may experience minor, adverse impacts from agricultural activities during the nesting season. Mitigation measures as described on page 33 can effectively limit these impacts.

Increases in suitable nesting and brood rearing habitats are assumed to result in beneficial impacts to avian species that benefit from increased plant height, percent ground cover, and available forbs and grasses. Irrigation, and subsequent increases in plant and invertebrate food sources, will have minor, beneficial impacts to many shrub-steppe and grassland bird species. Late brood-rearing habitat for greater sage-grouse would be improved by these practices as well (USRBWG 2008). Ruffed grouse and blue grouse habitat is absent within all project areas and these birds are not affected.

The use of a mobile, temporary irrigation system ensures the versatility of irrigation management. Adaptive mitigation measures as previously described will be most successful in response to the identification of resident, nesting bird species; principally shorebirds and raptors that are more visible and/or vocally territorial. Wilson's snipe, killdeer, long-billed curlew, short-eared owl, and northern harrier nests could be identified during the movement of the sprinkler system and avoided. Efforts will be made to identify nest sites for avian species of special interest, such as the long-billed curlew, short-eared owl, and northern harriers and observe appropriate buffers to mitigate disturbance where practicable.

EFFECTS ON CULTURAL RESOURCES

Archeological Resources

The National Historic Preservation Act of 1996 requires that effects be analyzed for the cultural resources that could be affected by federal actions. Cultural resources include historic structures, cultural landscapes, archeological sites, ethnographic resources, and museum objects. Native American tribes define cultural resources very broadly as the resources necessary for the survival and maintenance of their way of life.

Since farming and grazing activities have occurred within the assessment area for an extended period of time, the potential for adverse effects to archeological resources on the Refuge and the Bridger-Teton National Forest is low. The impact analysis is focused on prehistoric sites within high-use areas, which is where effects would likely occur.

Archeological Resources
Impacts of the Alternatives
Alternative A (no action)

Alternative A, no action enhances forage production on the refuge, through the use of a irrigation system. Installing an irrigation system would include digging trenches to bury underground pipes and the use of movable sprinklers. Some of the pipe would be installed outside of cultivated fields. Installing irrigation pipes would have negligible adverse impacts on archeological resources.

Alternative B (preferred alternative)
Archeological impacts will be similar to those described in Alternative A. No new impacts to archeological resources will occur from the addition of irrigation acreage or the use of K-Line sprinklers. Restoring native vegetation and closing or sloping the sides of irrigation ditches will have negligible adverse impacts on archeological resources. Some areas within the proposed pipeline pathways have not been surveyed for cultural resources or been previously disturbed and the existence of antiquities in these areas is presently unknown.

Prior to any soil disturbance from new projects, archeological resources within the proposed project area will be assessed for potential effects as well as their significance in accordance with section 106 of the National Historic Preservation Act. Mitigation of adverse effects will be coordinated with the Wyoming State Historic Preservation Office and may include avoidance of the site or data recovery efforts. Significant sites located within the assessment area will be monitored following project implementation to ensure protection from future cumulative effects.

EFFECTS ON SOCIO-ECONOMIC ENVIRONMENT

Socioeconomic Environment

This section describes the estimated effects on the social and economic conditions based on the actions shown in alternatives A and B.

Economics
Impacts of the Alternatives
Alternative A (no action)
A few relatively minor benefits to the economics of Teton County and the region will result within the first 5 years of the irrigation project, but no significant long-term impacts are expected. Although some of these expenditures will occur within Teton County, irrigation equipment will, out of necessity, not be purchased locally.

An average of 20,000 visitors annually experience a winter interpretive program from horse drawn sleighs through a concessionaire agreement between the Refuge and the Grand Teton Association. This hour-long activity commences at and returns to the west boundary of the Nowlin Management Unit. Winter supplemental feeding at the Nowlin feedground sustains up to 2,000 elk in this vicinity which are viewed from the sleighs. Winter elk numbers on this unit may decline during years when supplemental feeding is not required to sustain the bison and elk herds. However, the production of high quality forage on the Nowlin Management Unit is expected to be adequate to attract and sustain elk in sufficient numbers to maintain an informative and high quality interpretive experience. Observing natural, elk grazing behavior will enhance the quality of this experience for some visitors.

Tourism will not be adversely affected and Teton County will continue to benefit from visitation related to and generated by the refuge and its resources. Overall, economic impacts from irrigation construction will be positive but short-lived. Long-term positive benefits could occur from reduced disease impacts and tourism supported by a healthy elk population. Tourist sport fishing in Flat

Creek could also be enhanced and sustained through increased water flows resulting from reduced water consumption through the use of an efficient irrigation system.

Alternative B (preferred alternative)
Positive long and short term economic impacts will be similar to those described in Alternative A, but likely increase due to the increased size of Alternative B and the greater prospects of disease mitigation. No new adverse impacts to the Teton County economy will occur from the addition of irrigation acreage or the use of a sprinkler system.

Labor
Impacts of the Alternatives
Alternative A (no action)
Labor estimates were obtained from the 2007 Plan/EIS and the 1998 Irrigation System Rehabilitation Plan EA. Four full-time, permanent employees would be hired to operate, maintain and complete the long-term biological monitoring associated with this irrigation alternative. An additional three full-time employees would be hired for the first five year setup phase to oversee construction and irrigation activities, farming, crop selection, forage production and system maintenance.

These new Refuge jobs will be full-time year-round positions and are expected to make a minor contribution to the overall stability of the local economy.

Alternative B (preferred alternative)
Three full-time employees will be hired for the first five year setup phase to oversee construction and irrigation activities, farming, crop selection, forage production and system maintenance. Only two of these three permanent staff will be retained after the five year setup phase has been completed. Five temporary seasonal employees will be hired to operate and provide maintenance support during the five month irrigation season.

The full-time year-round positions and the temporary seasonal positions are expected to provide a minor positive economic stimulus and make a minor contribution to the overall stability of the local economy. The Refuge provides seasonal housing for the temporary workers which will eliminate any additional pressure to the local seasonal housing market.

Recreation
Impacts of the Alternatives
Alternative A (no action)
Implementing this alternative is not expected to deter visitation to the Refuge and no recreational activities currently occurring on Refuge lands will be prohibited or restricted as a result of the project. Wildlife viewing opportunities may in fact increase throughout the refuge as a result of greater dispersion of elk during the winter months. On the other hand, the recreational experiences of some people may be affected by the presence of irrigation systems within the project areas. First-time visitors and those who consistently use the refuge for recreation may find installed irrigation structures displeasing to the eye and the presence of these structures may qualitatively diminish their recreational experience some unknown degree.

Alternative B (preferred alternative)
Recreational impacts will be similar to those described in Alternative A. No new adverse impacts to the Teton County economy will occur from the addition of irrigation acreage or the use of a sprinkler system.

Negative visual impacts to visitor experiences caused by metal sprinkler hardware used in Alternative A, will be reduced by the replacement of elevated sprinkler hardware with the ground-level, plastic K-Line pod system.

CHAPTER 5: CONSULTATION AND COORDINATION

LIST OF PREPARERS

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PUBLIC INVOLVEMENT

The U.S. Fish and Wildlife Service engaged in public outreach as well as consultation with others. This outreach focused on the identification of issues, information sharing, and receiving input into the potential for expanding the irrigation system that was approved in the 2007 Plan/EIS.

A public scoping meeting was held on Thursday, March 12, 2009 from 4:00 – 7:00pm in the Town Council Chambers, located in the Town Hall building in Jackson, Wyoming. Refuge staff outlined plans for a proposed irrigation expansion as well as requesting and receiving comments from the public. Five people attended this meeting.

Public comments to identify issues of concern were accepted through March 28, 2009. The only written comments received were submitted by the Jackson Hole Conservation Alliance in consultation with the Greater Yellowstone Coalition and Defenders of Wildlife. These organizations expressed concerns about the benefits of an expanded irrigation system. They are also plaintiffs in a lawsuit challenging the 2007 Plan/EIS.
Issues of concern were obtained during the public scoping process and through consultation with public agencies and private consultants. These issues were used to help frame the analysis of this environmental assessment.

The Service followed up its initial scoping meeting with a public review of the Draft Environmental Assessment: National Elk Refuge Irrigation Expansion Project. The draft document was released to the public on April 27, 2009 for a 30-day review period. Service staff met with a variety of individuals and organizations during the review period. Written comments were received from . A public open house was held on May 19, 2009 at the Teton County Commissioners" Chambers from 5:00pm to 7:00pm. The meeting was attended by seven people. (Please refer to Appendix A for a discussion of review comments and the Service's response).

Consultation contacts were made with the following individuals and agencies: .
Ann Harvey, Board Member, National Wildlife Refuge Association

Tim Fuchs, Regional Wildlife Supervisor, Wyoming Game and Fish Department
Hamilton Smith, Senior Ecologist/Wildlife Biologist, Biota Research and Consulting
John Money, Biologist, Grand Teton National Park
Jim Kline, Engineer, Harwood Irrigation
Jim Gerrish, American Grazing Lands Services LLC
Mike Balboni, Deputy Forest Supervisor, Bridger-Teton National Forest
Deidre Witsen, Special Uses Permit Administrator, Bridger-Teton National Forest
Lloyd Dorsey, Wyoming Representative, Greater Yellowstone Coalition, Jackson, WY
Louise Lasley, Public Lands Director, Jackson Hole Conservation Alliance, Jackson, WY
Sportsmen For Fish and Wildlife, Board of Directors, Jackson, WY
Brad Bunderson, Rancher & K-Line User, Utah
Marty Manasco, Dunn's Irrigation, Riverton, WY
Chad Ridgway, Consultant, Cowboy Homestead Services, Alpine, WY
John Patton, General Manager, Asset Environmental Services II, LLC, Wilson, WY
E. Ann Patton, Manager, Asset Environmental Services II, LLC, Wilson, WY
Andy Seiller, Territory Manager, Rosco Culvert, Green River, WY
Phil Wilson, Owner, 3-B Construction, Wilson, WY
Tom Toman, Rocky Mountain Elk Foundation, Missoula, MT
Jill Tonn, Rocky Mountain Elk Foundation, Thermopolis, WY
Paul Hansen, Rocky Mountain Field Representative, The Nature Conservancy, Jackson, WY
Tom Seigerstrom, Jackson Hole Land Trust, Jackson, WY

LITERATURE CITED

Please refer to the 2007 Plan/EIS for a more complete listing of literature cited.

Cole, E. K., and P.E. Farnes. 2007. Estimating forage Production and Winter Severity on the National Elk Refuge, Jackson, WY Proceedings 75th Western Snow Conference, Kailua-Kona, Hawaii, April 16-19, 2007. pp137-140

Dechant, J., M. Sondreal, D. Johnson, L. Igl, C. Goldade, P. Rabie and B. Euliss. 1999 (revised 2002). Effects of management practices on grassland birds: Long-billed curlew. Northern Prairie Wildlife Research Center, Jamestown, ND. 19 p.

Galbraith, A. F., T. L. Salberg, and D. L. Tart. 1998. The Flat Creek Riparian Survey. USDA Forest Service, Bridger-Teton National Forest, Jackson, Wyoming. Unpublished report.

Johnson CJ, Phillips KE, Schramm PT, McKenzie D, Aiken JM, et al. (2006) Prions Adhere to Soil Minerals and Remain Infectious. PLoS Pathog 2(4): e32. doi:10.1371/journal.ppat.0020032

Rodenhouse, N., L. Best, R. O'Connor and E. Bollinger. 1995. Effects of agricultural practices and farmland structures *in* Ecology and management of neotropical migratory birds. Oxford University Press, New York.

Smith, B.L., E.K. Cole, and D.S. Dobkin. 2004 *Imperfect Pasture: A Century of change at the National Elk Refuge in Jackson Hole, Wyoming. Jackson, WY*: Grand Teton National Park Natural History Association

Upper Snake River Basin Sage-Grouse Local Working Group (USRBWG). 2008. Upper Snake River Basin Sage-Grouse Conservation Plan. 160 p.

Wyoming Game and Fish Department (WGFD). 2006. Threatened, endangered, and nongame Bird and mammal investigations, Annual Completion Report, ed. A. Cerovski. Cheyenne, WY. 252 p.

PERSONAL COMMUNICATIONS

Cole, E. Biologist, National Elk Refuge
2009 Personal communication regarding effects of Refuge tilling practices on ground nesting birds.

Money, J., Botanist, Grand Teton National Park
2009 Personal communication regarding effects of irrigation on plants.

Wallen, R., Resource Management Biologist, Grand Teton National Park. 1994 Personal communication. Cited in the National Elk Refuge's *Irrigation System Rehabilitation Plan Environmental Assessment* (USFWS 1998)

APPENDIX A: RESPONSE TO PUBLIC COMMENTS

The Service received a variety of comments from individuals and organizations during the official 30-day review period for the Draft Environmental Assessment: National Elk Refuge Irrigation Expansion Project. There was both support and opposition/concern expressed. What follows are responses to comments received during the review period.

1. Impacts to amphibians.

Response:
Amphibians play an important role as biological indicators to the ecological health of their surrounding environment. The expansion of the irrigation under the Preferred Alternative is not anticipated to adversely affect amphibians in the proximity of the project area.

Amphibian breeding habitat on the NER is located primarily in and adjacent to two man-made ponds, Nowlin Ponds #1 & #4. These ponds support boreal chorus frogs and breeding populations of boreal toads and Columbia spotted frogs. The Nowlin Ponds are fed by and connected to Nowlin Creek which may also provide some seasonal amphibian habitat.

Water in the Nowlin Ponds should remain similar to historic levels. Nowlin Ponds #1 & #2 are currently used as a source of water to flood and sprinkler irrigate up to 505 acres of uplands in the Nowlin Management Unit. The proposed conversion to sprinkler irrigation using Flat Creek water transported via pipeline to irrigate the Nowlin Unit uplands, will eliminate the need to use Nowlin Ponds # 1 & #2 as irrigation water sources. Historically, Twin Creek is the surface water source for the Nowlin System. The NER is exploring the possibility of re-establishing the upstream, off-refuge flow of Twin Creek which would increase the surface water supplying Nowlin Creek and Ponds. The possibility of adding Flat Creek water to the Nowlin Ponds from the irrigation pipeline will also be explored, and if feasible, used if water levels drop significantly below historic levels. Also, the addition of water control structures to Nowlin Ponds #2, #3, and #4 would also facilitate the manipulation of water levels for the benefit of amphibian populations.

Disturbance to amphibian habitat in and adjacent to the Nowlin Creek and Ponds will be reduced under the preferred alternative. In the past, farming activities have occurred within 100 feet of Nowlin ponds #2 & #4. As a result of public comment, the expanded irrigation project will maintain a standard buffer zone of 200 feet from the Nowlin Creek and Ponds #1 & #4. Farming and irrigation will be eliminated in these buffer zones to prevent disturbance to foraging and dispersing amphibians.

Water quality for the Nowlin Creek System should not change under the Preferred Alternative. Agricultural chemicals and fertilizers could be used at the same level as the current irrigation program. However, removal of most flood irrigation ditches will eliminate a surface water route that may have transported chemicals and fertilizers to the Nowlin Creek System. Most flood irrigation ditches will be closed under the Preferred Alternative, thus reducing the potential of transporting agricultural chemicals to the Nowlin Creek System.

Flood irrigation ditches do not provide quality amphibian habitat. These small, shallow, steep-sided ditches are dry except during the irrigation season when swift, near-capacity flows occur which can serve as an impediment to amphibian dispersal. Within hours of terminating irrigation flows,

porous soils cause rapid water infiltration which eliminates water retention and the corresponding benefits of water ponding to amphibians. Removal of flood irrigation ditches will not adversely affect amphibian populations.

Amphibian population monitoring will continue on the NER to help identify any unanticipated effects to amphibians in the Nowlin System.

2. Affects on Ground Nesting Bird Populations

Response:
The NER is committed to minimizing the impacts of disturbance to ground nesting birds. Strategies have been identified to mitigate the effects of the Preferred Alternative to this segment of the bird population. It is anticipated that these efforts will successfully prevent significant adverse affects to ground nesting bird populations.

Pre-irrigation season bird surveys will be conducted to identify the location of ground nesting birds of special interest such as the long-billed curlew, short-eared owl and northern harriers. Areas surrounding these active nests will be avoided and irrigation activities will commence after the nesting season has ended.

NER irrigation workers will be trained to identify and report observations of the ground nesting bird species of special interest listed above. Irrigation activities will be delayed in these areas until after the nesting season.

Flood irrigation can adversely affect the success of ground nesting birds. Under the Preferred Alternative, flood irrigation will be eliminated which will benefit ground nesting birds.

All Greater sage-grouse nesting habitat has been eliminated from the Preferred Alternative to avoid disturbance during the nesting season.

3. Will the Preferred Alternative increase the use of Refuge water rights or change its natural Hydrology?

Response:
It is anticipated that the Preferred Alternative, which eliminates flood irrigation and replaces it with sprinkler irrigation, will result in Refuge hydrology which more closely matches its pre-settlement condition. Settlers constructed an extensive network of small, flood irrigation ditches which were used to diverted and disperse Flat, Twin and Cache Creek waters across the Refuge for agricultural purposes. These ditches were used to transport adjudicated water rights of up to 74.4 cfs of Flat Creek water. The sprinkler irrigation system under the Preferred Alternative will be designed to divert a maximum of 22 cfs of water from Flat Creek.

Reduced use of Flat Creek water for irrigation will allow more water to stay in the Flat Creek channel, making it available for riparian habitat growth and the native cutthroat trout fishery. This may result in a minor increase in flow for Flat Creek during the month of June.

Hydrologist Alan Galbraith conducted the "Flat Creek Riparian Survey" in 1998 and concluded the following: "*It appears that in all months of the year except June, Flat Creek in the meadow (reach between the Refuge/National Forest boundary and the confluence of Flat and Cache Creeks;*

description added) receives anywhere from 50% to 90% of its flow from groundwater upwelling. For most of the year groundwater contributes about three quarters of the flow to Flat Creek as opposed to surface water flows from the streams and Boyle ditch."

Hydrologist Galbraith explains the groundwater flow results from an impervious granite substrate which serves as the base for the Gros Ventre Mountain Range. He describes this process in the following manner:

"This sequence of porous carbonate rocks lying over the more impervious granite sets up conditions where snow melt and long duration rainfall will percolate through the porous rock layers and flow along the granite contact generally downslope toward the Flat Creek valley. This portion of the watershed is responsible for most of the flows in Flat Creek and lies to the east of the valley with the famous "sleeping Indian" the most conspicuous feature."

Water infiltration through existing irrigation ditches likely contributes to groundwater recharge during the irrigation season. However, based on Hydrologist Galbraith's survey, this contribution is probably minor.

4. Will the NER introduce non-native, cultivated plants to replace native plants?

Response:
Non-native, cultivated acreage will not increase under the Preferred Alternative. Currently, Alternative A (no action) is approved to actively cultivate and intensively manage up to 2,400 acres of non-native grasses for forage production. The Preferred Alternative does not increase this acreage.

Non-native grasses and forbs were introduced to the Refuge by the early settlers. Those areas that have been cultivated or intensively grazed by livestock show significant but varying levels of introduced grasses. Native plants are still present in many of these areas in varying levels of prevalence. Its possible that increase irrigation may benefit non-native plants and increase their prevalence.

If determined necessary, restoration of native plant communities is possible where non-native plants have, or may become the dominant species. The installation of an irrigation system increases the chance of successfully re-establishing a native plant community by planting native seeds. These planted areas can be irrigated when seedlings are small and at their most vulnerable to desiccation.

Existing non-native noxious weeds are controlled on the Refuge through a cooperative arrangement with the Teton County Weed and Pest Department. Weed control will continue to be conducted and will be intensified as necessary should undesirable non-native plants increase in frequency.

5. Monitoring to Determine Project Success and Impacts

Response:
Several comments identified the need for pre- and post- project monitoring. The NER is committed to conducting monitoring to help evaluate project success and impacts to Refuge resources. Monitoring will be an annual and integral part of project operations. Surveys established prior to project implementation will be continued and additional surveys will be added to help evaluate

project success. Below is a list of existing surveys which will be continued and additional surveys which will be initiated.

Existing Surveys:
-Forage Production Sampling
-Forage Utilization Sampling
-Bison & Elk Herd Health Monitoring
-Elk Movement and Habitat Selection Study (GPS collars)
-Hunter Harvest CWD Sampling
-Flat Creek "redd" counts
-Periodic Flat Creek Electro-fishing to determine species and abundance
-Long-billed curlew survey
-Greater sage grouse surveys
-Amphibian surveys

Additional Surveys:
-Enhanced vegetation monitoring (to detect species composition changes)
-Flat Creek water flow monitoring (water gauge)
-Enhanced, pre-irrigation ground nesting bird survey (to identify nesting areas for species of special concern)
will be was identified as an important component of this project. suggested by several commenters.
-Monitoring will become a standard annual procdure

-Pre & post project evaluations
- Water flows
-Long-billed curlews
-Sage grouse
-Fish
-Amphibians
-Herd Health; Prevalence of disease in elk and bison
- CWD Monitoring

6. NEPA Compliance

Response:
Prior to initiation of NEPA (National Environmental Protection Act) compliance, the Service conducted an overview of this project and determined it did not constitute a major federal action which would require an Environmental Impact Statement (EIS). The Service decided an Environmental Assessment (EA) would be the appropriate NEPA process for this proposed Irrigation Expansion Project.

7. Irrigation Expansion Support

Response:
Significant support was expressed for the Preferred Alternative by agencies, individuals and a sportsmen's organization. Those supporting this Irrigation Expansion Project include:
- Grand Teton National Park (with suggestions)

- Wyoming Game and Fish Department (with suggestions and concerns)
- Sportsmen For Fish and Wildlife Organization
-Chris Warburton, National Elk Refuge Sleighride Concessionaire
- Five additional interested individuals

Opposition was expressed by the Greater Yellowstone Coalition, Jackson Hole Conservation Alliance, and the Defenders of Wildlife.

8. Concern That Expanded Irrigation will not Reduce Elk and Bison Concentrations.

Response:
Expanded irrigation, the Preferred Alternative is one part of a two pronged strategy to reduce the reliance on winter supplemental feeding and reduce elk and bison concentrations on the Refuge. Population reductions through expanded sport hunting are identified in the Bison and Elk Management Plan as the technique to reduce populations to objective levels. This population reduction strategy is designed to complement increased irrigation and is described in the Bison and Elk Management Plan.

Years of bison and elk observation experience have lead Refuge staff to conclude that concentration levels are highest during the winter supplemental feeding operation. Bison and elk are artificially concentrated in a "nose to nose" orientation along a narrow band of alfalfa pellets during supplemental feeding. Competition for pellets during this process, regularly results in the displacement of less dominant animals by more aggressive animals. A constant shifting of animals and positions occurs on the feedlines.

Various bison and elk diseases are transmitted through saliva or nasal discharge. It is assumed that sick animals can deposit saliva or nasal discharge on the feedline pellets before they are displaced by more aggressive animals. This greatly increases the probability that a healthy, uninfected animal could consume disease contaminated pellets. This greatly increases the risk of transmitting diseases to non-infected animals.

The Preferred Alternative should result in a reduction of in the annual frequency of supplemental feeding, and shorter supplemental feeding seasons. Reducing the annual frequency and duration of supplemental feeding activities will reduce areas contaminated with high concentrations of manure and likely reduce the incidence of diseases linked to environmental contamination such as necrotizing pododermatitis (hoof rot).

The Preferred Alternative is designed to produce more natural standing vegetation, allow bison and elk to disperse over the 5,035 irrigated acres while grazing, and thereby reduce the need for winter supplemental feeding. Each day bison and elk herds are not artificially concentrated on feedlines reduces the potential for disease transmission that would exist during supplemental feeding. The NER believes it better, and ultimately healthier for bison and elk herds to graze on naturally standing forage, than to feed in a "nose to nose" orientation on alfalfa feedlines.

APPENDIX B: SECTION 7 BIOLOGICAL EVALUATION

INTRA-SERVICE ENDANGERED SPECIES ACT SECTION 7 EVALUATION FORM

Originating Persons: John Esperance
Region 6, Division of Planning, NWRS

Telephone Number: 303-236-4369

Date: 3/23/09

I. Region: Region 6

II. Service Activity: Refuges, Division of Planning, Denver Regional Office

III. Pertinent Species and Habitat

A. Listed species and/or their critical habitat within the county / action area:

TETON COUNTY, WYOMING

Species	Scientific Name	Status
Black-footed Ferret	*Mustela nigripes*	E
Blowout Penstemon	*Penstemon haydenii*	E
Canada Lynx	*Lynx canadensis*	T
Gray Wolf	*Canis lupus*	X
Yellow-billed Cuckoo (Western)	*Coccyzus americanus*	C

T - Threatened
E - Endangered
X – Nonessential/Experimental Population
C - Candidate

B. Proposed species and/or their proposed critical habitat within the county / action area:
None

C. Candidate species within the county / action area:
Yellow-billed Cuckoo (Western)

IV. Geographic Area/Action

This Intra Section 7 covers the expansion of the irrigation system at the National Elk Refuge,

Jackson, Wyoming

V. Location

The site proposed boundary expansion and fee title acquisition (see attached map):

- State of Wyoming
- County: Teton
- Description of extent of project area:

Currently the Service manages approximately 24,778 acres of land at the National Elk Refuge. Per the 1998 *Irrigation System Rehabilitation Plan Environmental Assessment* (USFWS 1998) the Service has approval to covert from flood irrigation to sprinkler irrigation. As necessary, the Service would irrigate a minimum of 1,600 acres and increase sprinkler irrigation to 1,100 acres per year of the 1,590 acres that could be sprinkler irrigated and enhance the flood-irrigation delivery system to irrigate an additional 500 acres.

The Service proposes, to expand the total acreage of irrigated lands on the Refuge by 3,865 acres. The total area, covered by the sprinkler system, at the National Elk Refuge, would total 5,035 acres.

VI. Description of the Proposed Action

The Service is proposing to improve and expand the existing irrigation system. By expanding the irrigation system it is anticipated that there will be a reduction on the reliance for supplemental winter feeding and that water resources will be utilized more efficiently. In addition to increasing the production of grazing forage by expanding the use of irrigation, hunting is vital to decreasing the bison and elk herd size. Inadequate forage production has contributed to the need to artificially feed elk during the winter for 87 of the last 96 years.

The Service would expand the total acreage of irrigated lands on the Refuge by 3,865 acres. The proposed irrigated area would include those management units already irrigated. The total area, covered by the sprinkler system, at the National Elk Refuge, would total 5,035 acres.

This proposal would improve the bison and elk habitat through adaptive management with an emphasis on improving winter, summer, and transitional range, while at the same time ensuring that the biotic integrity and environmental health of the resources would be sustained over the long term.

VII. Determination of Effects

The proposed expansion of the irrigation system may affect, but is not likely to adversely affect species at the National Elk Refuge, listed in section III.

A 15 year Bison/Elk Management Plan/Environmental Impact Statement (Plan/EIS) was

completed in 2007 for the National Elk Refuge, the Grand Teton National Park and John D. Rockefeller, Jr. Memorial Parkway. The expansion of the irrigation system is a management tool to contribute the goals of the EIS. The four goals of the EIS are:

- Provide secure, sustainable ungulate grazing habitat that is characterized primarily by native composition and structure within and among plant communities and that also provides for the needs of other native species.

- Contribute to elk and bison populations that are healthy and able to adapt to changing conditions in the environment and that are at reduced risk from the adverse effect of non-endemic diseases.

- Contribute to the Wyoming Game and Fish Department (WGFD) herd objectives for the Jackson elk and bison herds to the extent compatible with Goals 1 and 2 and to the legal directives governing the management of the National Elk Refuge.

- Work cooperatively with the state of Wyoming and others to reduce the prevalence of brucellosis in the bison and elk populations in order to protect the economic interest and viability of the livestock industry, and reduce the risk of adverse effects of or from other non-endemic diseases not currently found in the Jackson bison and elk populations.

VIII. Effects Determination and Response Requested

A. *Listed Species / designed critical habitat*

No Effect / no adverse modification	___ Concurrence
May affect, but is not likely to adversely affect species / modify critical habitat	_X_ Concurrence
May affect, and is likely to adversely affect species / modify critical habitat	___ Formal Consultation

B. Proposed Species / proposed critical habitat

No effect on proposed species / no adverse modification of proposed critical habitat (species: none)	_X_ Concurrence
Is likely to jeopardize proposed species or adversely modify proposed critical habitat (species: none)	___ Concurrence

John F. Esperance
Supervisory Fish and Wildlife Biologist
Division of Planning
National Wildlife Refuge System
Region 6

IX. Reviewing ESO Evaluation

_X_ Concurrence

___ Non-Concurrence

___ Formal Consultation Required

___ Conference Required

___ Informal Conference Required

Brain Kelly
Project Leader
Wyoming Ecological Services

APPENDIX C: 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 "Final Plan: National Elk Refuge Irrigation Expansion Project" is found not to have significant environmental effects, as determined by the attached "finding of no significant impact" and the environmental assessment.

Approved by:

Steve Guertin Date
Regional Director, Region 6
U.S. Fish and Wildlife Service
Lakewood, CO

Concurred with:

Richard A. Coleman, PhD Date
Assistant Regional Director, Region 6
National Wildlife Refuge System
U.S. Fish and Wildlife Service
Lakewood, CO

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

Submitted by:

Steve Kallin Date
Project Leader
National Elk Refuge
Jackson, WY

Finding of No Significant Impact

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

Two alternatives for expanding the irrigation system at the National Elk Refuge were assessed as to their effectiveness in achieving the refuge's purposes and their impacts on the human environment.

Alternative A, the "no-action" alternative would continue current management by implementing Alternative 4: Adaptively Manage Habitat and Populations (Preferred Alternative) from the 2007 Final Bison and Elk Management Plan and Environmental Impact Statement.

Alternative B, the proposed action would expand the total acreage of irrigated lands on the refuge by 3,435 acres. The total area, covered by the sprinkler system, at the National Elk refuge will be 5,035 acres. Though a larger acreage of land would be irrigated under the new proposed irrigation plan, water usage will likely decrease because of the efficiency of the water delivery methods. Total forage production for the expanded irrigation project would be an estimated 9,162,000 pounds or 4,581 tons on 5,035 acres. Implementation of this alternative would result in: 1) decreasing th3e cost of providing supplemental feed; 2) decreasing the potential for disease transmission; 3) improving the efficiency of water use; 4) reducing the level of elk browsing on woody plant communities; and 5) dispersing wintering elk and bison over a larger portion of the Refuge for a longer period during the winter.

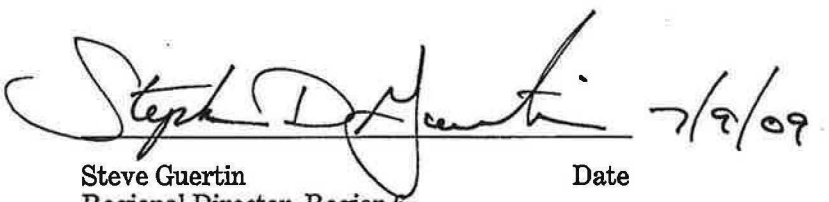
Based on this assessment and comments received, I have selected alternative B as the preferred alternative (final plan) for implementation. The preferred alternative was selected because it best meets the purposes for which the National Elk Refuge was established.

I find that the preferred alternative is not a major federal action 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 action is not required.

The following is a summary of anticipated environmental effects from implementation of the preferred alternative:

- The preferred alternative will not adversely impact endangered or threatened species as well as wintering elk or bison and grassland birds or their habitat.
- The preferred alternative will not adversely impact archaeological or historical resources.
- The preferred alternative will not adversely impact water resources; in fact, water usage will likely be improved.
- The preferred alternative will have minimal impact on visual resources as it is virtually invisible from a moderate distance. This sprinkler irrigation system will result in negligible adverse impacts on the foreground character and background views of the Refuge.

- The preferred alternative will not adversely impact marshland and open water habitats as well as cultivated fields and non-cultivated grasslands.
- The preferred alternative will not have a disproportionately high or adverse human health or environmental effect on minority or low-income populations.



7/9/09

Steve Guertin Date
Regional Director, Region 6
U.S. Fish and Wildlife Service
Lakewood, CO