

5 Environmental Consequences

The environmental consequences, or impacts, discussed in this chapter are the potential effects on a resource as a result of carrying out the actions of an alternative.

For a better understanding of why these effects may occur, refer to the descriptions of resource conditions and interactions in chapter 3 (affected environment).

Chapter 4 (alternatives) presents the management scenario for each alternative, which could create the consequences described here.

This chapter presents the following:

- Summary of environmental consequences (table 7)
- Environmental consequences by alternative
- Socioeconomic impacts
- Cumulative impacts



Tim McCabe/USFWS

Male Wood Duck

The public scoping meetings, issues workbooks, and refuge information indicated that there are four major issues of concern regarding refuge management. These issues are used to describe expected environmental consequences of the alternatives.

Table 7. Comparison of impacts and benefits of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ISSUE	ALTERNATIVE 1 <i>Current management—no action</i>	ALTERNATIVE 2 <i>Maximize biological potential for grassland-nesting birds</i>	ALTERNATIVE 3 <i>Integrated management—proposed action</i>
Wildlife and Habitats	<i>Habitat diversity:</i> greater diversity of habitat by providing a variety of habitats	<i>Habitat diversity:</i> increased for grassland-nesting birds	<i>Habitat diversity:</i> enhanced vegetative diversity of grasslands
	<i>Waterfowl:</i> dominant focus; grasslands managed for upland nesting at current level	<i>Waterfowl:</i> dominant focus; reduced waterfowl numbers during spring and fall migrations due to lack of open water	<i>Waterfowl:</i> dominant focus, with localized increase in habitat
	<i>Deer and pheasant:</i> winter food requirements would be supplemented	<i>Deer and pheasant:</i> deer and pheasants may rely more on crops outside the refuge	<i>Deer and pheasant:</i> same as alternative 1
	<i>Woodland-dependent species:</i> winter shelter (in shelterbelts) maintained for deer and pheasant	<i>Woodland-dependent species:</i> less habitat due to removal of all shelterbelts	<i>Woodland-dependent species:</i> less habitat due to removal of some shelterbelts
	<i>Grassland-dependent species:</i> benefit from reduction in woodland	<i>Grassland-dependent species:</i> more; increased nesting success of grassland birds	<i>Grassland-dependent species:</i> localized increase of habitat
	<i>Overwater species:</i> maintained at current levels	<i>Overwater species:</i> decline due to breached dike and fewer years of adequate pool depth from natural flows	<i>Overwater species:</i> same as alternative 1

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ISSUE	ALTERNATIVE 1 <i>Current management— no action</i>	ALTERNATIVE 2 <i>Maximize biological potential for grassland-nesting birds</i>	ALTERNATIVE 3 <i>Integrated management— proposed action</i>
Water Management	<i>Water levels:</i> relatively stable, benefiting overwater nesters	<i>Water levels:</i> fluctuate naturally with flows in the James River due to breaching of dikes; significant decrease in size and depth of riverine wetlands, changing the vegetation of the wetlands and adjacent uplands	<i>Water levels:</i> same as alternative 1
	<i>Siltation:</i> wetlands for migratory birds slowly lost as silt carried by the James River is deposited in impoundments	<i>Siltation:</i> reduced siltation rates within the refuge	<i>Siltation:</i> same as alternative 1
	<i>Fish habitat:</i> decline in fish production in Mud Lake	<i>Fish habitat:</i> diminished; pool capacity greatly reduced	<i>Fish habitat:</i> same as alternative 1
	<i>Fish habitat:</i> unknown effect on the water table on nearby private lands	<i>Fish habitat:</i> same as alternative 1	<i>Fish habitat:</i> same as alternative 1
Public Use	<i>Hunting:</i> current levels, seasons, and locations	<i>Hunting:</i> possible reduced quality of hunting as harvest opportunities decrease because of less accessibility of game to hunters due to grassland restoration	<i>Hunting:</i> current levels, seasons, and locations
	<i>Fishing:</i> current levels, seasons, and locations; limited parking adjacent to fishing sites	<i>Fishing:</i> less opportunity and angler use due to only fall and winter fishing to avoid conflicts with nesting migratory birds; limited parking adjacent to fishing sites	<i>Fishing:</i> same as alternative 1
	<i>Trapping:</i> allowed only as a management tool	<i>Trapping:</i> same as alternative 1	<i>Trapping:</i> same as alternative 1
	<i>Wildlife observation and wildlife photography:</i> current levels of viewing opportunities	<i>Wildlife observation and wildlife photography:</i> decreased viewing opportunities due to access restrictions	<i>Wildlife observation and wildlife photography:</i> increased viewing opportunities
	<i>Environmental education and interpretation:</i> remain at current levels	<i>Environmental education and interpretation:</i> more environmental education, interpretation, and partnerships, with subsequent increased support of the refuge; enhanced on-site visitor opportunities	<i>Environmental education and interpretation:</i> same as alternative 2

Table 7. Comparison of impacts and benefits of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

ISSUE	ALTERNATIVE 1 <i>Current management—no action</i>	ALTERNATIVE 2 <i>Maximize biological potential for grassland-nesting birds</i>	ALTERNATIVE 3 <i>Integrated management—proposed action</i>
Public Use	<i>Camping: not allowed</i>	<i>Camping: same as alternative 1</i>	<i>Camping: same as alternative 1</i>
	<i>Wildlife: current levels of disturbance to wildlife</i>	<i>Wildlife: less disturbance of wildlife due to road closures and elimination of recreation areas; some increase in wildlife habitat due to elimination of recreation areas and some roads</i>	<i>Wildlife: additional disturbance to wildlife due to new recreational trail</i>
Invasive Plants	<i>Infestations: major problem in grasslands and wetland edges</i>	<i>Infestations: increased opportunities for invasion in the short term due to elimination of croplands and shelterbelts; reduction of invasive plants would prevent their tendency to take over and create monotypic stands</i>	<i>Infestations: reduction of invasive plants would prevent their tendency to take over and create monotypic stands</i>
	<i>Vegetation: reduced forbs and vigor of the grassland community due to chemical control of invasive plants</i>	<i>Vegetation: increased grassland habitat through removal of Russian olive trees and shelterbelts</i>	<i>Vegetation: increased grassland habitat and native riparian vegetation through selective removal of shelterbelts and Russian olive trees</i>
	<i>Wildlife: reduced habitats due to loss of grassland quality (i.e., invasive plants)</i>	<i>Wildlife: elimination of a food source for some species of winter wildlife due to aggressive removal of shelterbelts and Russian-olive trees</i>	<i>Wildlife: same as alternative 2</i>

ALTERNATIVE 1

CURRENT MANAGEMENT—NO ACTION

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

WILDLIFE AND HABITATS

Alternative 1 would maintain the current habitat management program at approximately the same intensity. The grasslands would be managed to provide habitat for upland-nesting waterfowl.

Planted woodlands would continue to deteriorate with age and would naturally die out. Grassland-nesting birds would benefit as a result. Species of migratory birds that use fringes would decrease, resulting in a decrease in local species diversity of migratory birds.

Hunters that recreate on and around the refuge place a high value on the large number of waterfowl, pheasants, and deer that use the refuge.

Approximately 800–1,000 acres of cropland would be maintained to provide food for resident wildlife species. In addition, the farming program would be used to control invasive plants for the restoration of grassland.

Maintaining the existing crop production program would sustain deer and pheasant populations and maintain the recreational hunting and viewing opportunities for these species at a high level. Snow geese would continue to have the tendency to use the refuge crop fields very little and fly off-refuge to forage.

Neighbors adjacent to some of the refuge's best deer habitat annually lose some of their crops of corn and alfalfa to foraging deer. Planting cropland on the refuge has attempted to lessen this impact; however,

planting cropland does little to contribute to the production of grassland-nesting birds. Interspersed cropland reduces the size of contiguous blocks of grass, which makes it easier for predators to find bird nests. Cropland management results in the increased use of pesticides, some of which may be harmful and persist in the environment. Farming also increases soil erosion.

WATER MANAGEMENT

The water cycle affects the fishery and wildlife use of the refuge. Under alternative 1, the current system of dikes and water control structures would be used to implement conventional water strategies when emergent vegetation is in optimal condition. This would consist of passing the spring runoff through the refuge as quickly as possible until water levels have fallen to full-pool elevation. Full-pool elevation would be maintained and any activity upstream that would result in a rise of pool elevations through the nesting season would be discouraged (May 15–August 1).

The ability to hold water levels stable is essential to the success of colonial overwater-nesting birds, which require consistent water levels in their colonies throughout nesting efforts. The current ability to influence wetland conditions through water management provides a broad range of critical habitats that support an array of plant and wildlife species.

The five subimpoundments have some water management capability. Under alternative 1, the subimpoundments are managed as dynamic wetland systems that cycle between drawdown and flood events. Prairie wetlands have evolved under these fluctuating conditions—cycling between wet and dry periods makes prairie wetlands very productive.

By managing the subimpoundments for maximum productivity, the subimpoundments would provide for the greatest production of hydrophytic plants and aquatic invertebrates possible. As an important food resource, these aquatic macroinvertebrates would encourage the use of the subimpoundments by waterfowl, shorebirds, wading birds, amphibians, and other marsh birds, as well as positively influence the early growth of ducklings. Drawdowns of the subimpoundments would be accomplished in different years to provide a diversity of habitat conditions during any given year.

When stands of emergent vegetation need to be reestablished, managed drawdowns of the refuge, Mud Lake, or the subimpoundments would be conducted. Winterkill of game fish is sometimes an unintentional result of late-season drawdowns, with detrimental impacts on fish production in those years.

Currently, no mitigation is occurring to compensate for accelerated sedimentation near the Mud Lake dike. Sedimentation rates are expected to remain elevated near current levels (0.5 inch per year) and continue to degrade the wetland functions of Mud Lake. The refuge's ability to cycle vegetation and create an interspersed cover and water to meet current wildlife objectives in Mud Lake through current water level manipulations would be hindered.

Production of aquatic macrophytes and algae is expected to decrease, resulting in lower invertebrate production. Reduced invertebrate production may retard nutrient cycling and overall wetland productivity, as well as limit a major food source for waterfowl and other wildlife. Species richness, emergence, and germination of wetland macrophytes may be significantly reduced, thereby reducing the ability of the wetlands to provide water quality functions.

Winterkill of game fish may occur more often and, to a larger extent, as Mud Lake becomes shallower. Fishery production in Mud Lake would also be reduced as deepwater habitats become scarcer. Acceleration of sediment accretion rates in the refuge is not expected to occur until Mud Lake fills with sediment. Therefore, game fish would be able to find protection in the refuge during years when managed drawdowns are not occurring. Fish would still be able to traverse the refuge through the James River channel.

It is unknown whether water levels on the refuge affect the water tables on neighboring lands. Water should be moved quickly through the system to keep water tables on adjacent private lands low for agricultural purposes. The extent to which sediment accretion in Mud Lake would impact the water table on private land is unknown.

PUBLIC USE

Since alternative 1 calls for no change in management strategies, public use would continue at the present level. The refuge would provide quality, universally accessible, recreational opportunities to visitors of all ages and abilities.

Recreational opportunities on the James River are very important to local residents. Opportunities on the refuge include wildlife-dependent and wildlife-compatible uses legislated by Congress and outlined in the National Wildlife Refuge System Improvement Act of 1997—hunting, fishing, wildlife observation, wildlife photography, environmental education, and interpretation. Hiking has also been deemed a compatible use during limited times of the year.

HUNTING

Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge. Hunting also has a long-standing history on national wildlife refuges.



John Stehm/USFWS

White-tailed Deer

Under alternative 1, management practices would not change and all seasons would continue as presently managed. The refuge would continue to provide hunting seasons for white-tailed deer, waterfowl, and upland game, in accordance with state and federal laws and regulations.

- Deer seasons and harvests would continue to be set annually in agreement with the SDGFP to meet herd management needs for the refuge.
- Waterfowl hunting would continue to be boundary hunting only. However, the option of eliminating all or some of the spaced blinds has been discussed with the SDGFP, Brown County Sportsmen's Club, and other interested parties.
- An upland game season would continue as a late-season hunt during the last three weeks of December.

No new parking areas for additional hunting access are proposed.

FISHING

Although there is a high demand for ice fishing, there is no active fisheries management. Due to

annual water fluctuation, low water depths, and practices that prioritize migratory birds over fish, the refuge does not support a reliable game fishery.

The refuge would continue with the present fishing program of providing opportunistic fishing at the current five locations. Limited fishing access at these five right-of-way locations, during both winter and summer seasons, has produced a high density of users in limited areas. Fishing would continue to be provided only in these five areas, where it has been determined that disturbance to breeding, nesting, brooding, and wintering wildlife would be minimal.

Boating, which would decrease the density of users in one area, is not allowed to avoid disturbance to nesting and brooding birds.

Insufficient parking near the five designated fishing areas creates traffic congestion when anglers use road rights-of-way for fishing. Within a short walking distance of the fishing areas are parking areas at Hecla Day use Area and Weismantel Grade/117th Street. The parking area near the Highway 16/Columbia Dam location is especially problematic, as it is located more than 0.5 mile south of the fishing area. All designated parking areas would continue to be marked and maintained and would provide information and brochures for fishing and hunting.

There are no plans to provide parking at the other two fishing areas, located on Highway 10 and north of Brown County 5, because no space is available for parking areas.

TRAPPING

Trapping is currently only used as a management tool. Its application is based on a year-by-year assessment of needs. Reduction of depredation on ground-nesting birds and minimizing damage to dikes and road grades are the two primary goals.

WILDLIFE OBSERVATION, WILDLIFE PHOTOGRAPHY, ENVIRONMENTAL EDUCATION, AND INTERPRETATION

Current on- and off-refuge opportunities for wildlife viewing, education, and interpretation would be retained. This includes informational kiosks, an auto tour, hiking trails, day use areas, an observation tower and a viewing platform, and educational programs.

CAMPING

Camping is not allowed and is not a priority use on national wildlife refuges. Camping on the refuge is not wildlife-compatible or wildlife-dependent. Because of the modest size of the refuge, camping is not necessary for reasonable access. A variety of camping opportunities exists within short distances (8–25 miles), including Columbia, Aberdeen, and various sites around Brown County.

INVASIVE PLANTS

Invasive plants, especially Canada thistle, are colonizing habitats and dominating the vegetation in some areas. Invasive plants on the refuge are particularly troublesome for adjacent landowners who are required by state and local laws to control invasive plants on their lands. These landowners see the refuge as a source of invasive plants colonizing their lands.

The chemicals used to control invasive plants are of concern from the standpoint of environmental contamination and negative impacts on desirable plant species. Using pesticides reduces diversity and the subsequent quality of grasslands.

The diversified program of integrated pest management to control invasive plants would not change. In addition to herbicides, management tools such as grazing, burning, mowing, and farming would be used to maintain the quality of upland habitat. Control may be conducted on up to 1,500 acres of grasslands annually. Infestations may increase or decrease, depending on environmental conditions.

ALTERNATIVE 2

MAXIMIZE BIOLOGICAL POTENTIAL
FOR GRASSLAND-NESTING BIRDS

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

WILDLIFE AND HABITATS

The number of acres of grassland habitat would be maximized by the following:

- Elimination of the farm program
- Decline in wetland acreage with the removal or breaching of the two dikes
- Elimination of shelterbelts

There would be a benefit to grassland-dependent bird species by providing larger blocks of nesting habitat and eliminating predator travel corridors and den sites. Since many grassland-dependent birds are in decline, the changes would help increase biodiversity on a landscape scale, but species diversity on the local (refuge) scale would decline. The numbers and diversity of tree-nesting species and edge species would be reduced.

The grasslands would be managed to provide habitat for upland-nesting waterfowl. Management would be limited to grazing, mowing, haying, and burning. There would be a lack of forbs in much of the grassland due to extensive control of Canada thistle using haying and herbicide application.



Neil Powers/USFWS

Prescribed fire is used to rejuvenate grassland.

The diversity of wetland-dependent species using the refuge would decline, due to the decreased wetland acreage of all wetland types and the lack of any water control ability.

Game species, especially waterfowl, geese, pheasant, and deer, are important recreational resources. Use of the refuge by geese would decline due to the drastic decline of wetland acres. White-tailed deer use would be sustained, as in alternative 1, depending on cattail response to the change of water levels from the dike removal and breaching.

Some neighbors of the refuge are losing a portion of their crops of corn and alfalfa to foraging deer. With the elimination of all crops on the refuge, white-tailed deer and pheasants may have to rely more on neighboring crops as a food source. Depredation on neighboring crops may increase throughout the growing season.

WATER MANAGEMENT

Water management on the refuge affects the fishery and wildlife use of the refuge. With the removal or breaching of the Mud Lake and Columbia Road dikes, water levels on the refuge would fluctuate naturally with flows in the James River. Size and depth of the riverine wetlands would decrease significantly, changing the vegetation regime of the wetlands and the adjacent uplands.

The number of migrating waterfowl, including breeding pairs and broods, using the refuge would probably decline. However, it is not known how a decrease in numbers, combined with an improvement in nest success (due to reduced nest depredation and increased grassland acreage), would affect waterfowl production.

Use of the refuge by overwater-nesting colonial birds would decline.

Sedimentation rates in wetlands would decline with the removal or breaching of the dikes, with long-term benefits to water quality expected to occur.

The five subimpoundments have some water management capability. Under alternative 2, the subimpoundments would be managed similarly to alternative 1, but opportunities to fill the subimpoundments would be less frequent due to lower water levels.

Water management used to enhance waterfowl habitat may have a detrimental impact on the fishery, because drawdowns to winterkill rough fish also kill game fish. Under alternative 2, there would be no water management capabilities, except for the subimpoundments. Winterkill of fish would be more frequent due to lower water levels.

Lower water levels within the wetlands on the refuge could result in a lower water table on adjacent lands, especially in the sandy soils east of the James River. This could negatively affect crop yields on these areas during dry years.

PUBLIC USE

Under alternative 2, public use would be restricted to maximize the biological potential of grassland-nesting birds. The restrictions would limit public use to specific locations by season. Access to the James River would be reduced.

While providing for upland, ground-nesting, migratory birds (focus of alternative 2), the desire of some of those who recreate on the refuge for a great diversity of habitats and wildlife would not be met.

HUNTING

Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge. The refuge would continue to allow deer and upland game hunting. Waterfowl hunting would be allowed along the perimeter of the refuge. These seasons do not interfere with nesting, brooding, or foraging migratory birds.

The removal of all shelterbelts and cropland, and subsequent restoration of native grassland, would adversely affect the quality of hunting, as many game species are dependent on shelterbelts and croplands for food and shelter. Accessibility of deer and upland game to hunters would likely decrease, which in turn would likely reduce harvest success.

Waterfowl-hunting success may also be affected. Without the impoundments, migrating waterfowl may pass through the refuge more quickly during the fall; opportunities for hunters to harvest waterfowl would be reduced. Overall hunter satisfaction may decrease as the quality of hunting and harvest opportunities decreases.

FISHING

Limited fishing access has produced a high density of users in limited areas. There is also a high demand

for ice fishing. Spring and summer fishing opportunities would be eliminated to avoid direct conflicts with nesting and brooding migratory birds. This would limit anglers' use of the refuge. Fall and winter fishing would still be allowed at the five designated fishing areas.

The refuge does not support a reliable game fishery. Fish populations on the refuge are likely to drop even lower with the removal or breaching of the dikes, as deeper water areas found in the impoundments would be eliminated. Without this critical fish habitat, fish populations would be more likely to suffer winterkill. As a result, it is likely angler use would decrease due to limited harvest opportunities.

Insufficient fishing access creates traffic congestion when anglers use road rights-of-way for fishing. There would be no change in fishing access, as in alternative 1.

TRAPPING

Trapping would only be used as a management tool, as in alternative 1.

WILDLIFE OBSERVATION, WILDLIFE PHOTOGRAPHY, ENVIRONMENTAL EDUCATION, AND INTERPRETATION

Public access to wildlife observation, wildlife photography, environmental education, and interpretation would be greatly reduced, which could result in decreased visitation.



Bob Savannah/USFWS

Nearly all spring and summer recreational use and some fall recreational use of the James River through the refuge would either be eliminated or restricted to avoid conflicts with nesting, brooding, and foraging birds.

General public use would be restricted to the headquarters area during breeding and brooding seasons.

CAMPING

Camping would not be allowed, as in alternative 1.

INVASIVE PLANTS

Invasive plants, especially Canada thistle, are colonizing habitats and dominating the vegetation in some areas. Invasive plants on the refuge are particularly troublesome for adjacent landowners who are required by state and local laws to control invasive plants on their lands. These landowners see the refuge as a source of invasive plants colonizing their lands.

Infestations of invasive plants may increase or decrease, depending on environmental conditions, as in alternative 1. However, the number of acres of invasive plants might increase due to the lower water levels in this alternative. In this case, an increase in the use of haying and herbicide application to control invasive plants may be necessary.

ALTERNATIVE 3

INTEGRATED MANAGEMENT—
PROPOSED ACTION AND DRAFT CCP

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

WILDLIFE AND HABITATS

The vegetative diversity of the grassland habitats would be greatly enhanced by reseeding all habitat blocks dominated by smooth brome or decadent DNC to native vegetation or rejuvenated DNC. Invasions of Canada thistle, which can decrease the abundance of desirable plants when it exists in a monoculture, would be reduced.



These healthier grasslands would provide higher quality food and cover than Canada thistle monocultures. Limited areas of diverse, native grasses already exist; therefore, the diversity of species using the grasslands is not expected to increase because of increased vegetative diversity. However, grassland-dependent birds and small mammals that require grasslands with vertical habitat complexity and diverse seed sources to feed or reproduce are expected to become more abundant as the grasslands are restored.

Native forbs are expected to become more prevalent as grasslands are restored. These broadleaf plant species provide excellent habitat for many insect species; therefore, the diversity and abundance of insect species is expected to increase. This increase should contribute to an increase in the abundance of grassland-dependent birds and small mammals that rely heavily on insects as a food source.

Increases in habitat complexity, seed source diversity, insect diversity, and insect abundance may result in an overall increase in the carrying capacity of the grasslands—the total number of grassland-dependent birds and small mammals capable of feeding and reproducing on the refuge may increase.

Game species, especially waterfowl, geese, and deer, are important resources of the refuge. Use of the refuge by geese and white-tailed deer would likely be unchanged.

Neighbors to the refuge are losing some of their crops of corn and alfalfa to foraging deer. In an effort to minimize this impact under current management, cropland blocks on the refuge were placed adjacent to areas of high depredation on private land. Total cropland acreage would ultimately be reduced to 800 acres. Farmed acreage would be rotated as a management tool for controlling Canada thistle to restore degraded grasslands. Benefits for white-tailed deer would be provided indirectly.

WATER MANAGEMENT

The system of dikes and water control structures on the refuge would be preserved. Water management would have the same impacts as under alternative 1, with the notable exception that accelerated sediment accretion rates within Mud Lake would attempt to be addressed via watershed-level conservation efforts.

Sedimentation rates near the Mud Lake dike are expected to remain elevated near current levels over the next 15 years, thereby continuing to degrade the wetland functions of Mud Lake. The fishery and wildlife would be impacted similar to that under alternative 1 during the next 15 years.

Watershed-level conservation efforts that target sustained agricultural production and long-term wetland management can be quite effective. However, creating the partnerships necessary to develop and carry out such broad-scale conservation efforts throughout the upper James River basin would be very time consuming. A cumulative reduction in sediment entering the James River because of such a massive effort could take decades to materialize.

Long-term benefits of broad-scale conservation efforts should be evident once conservation programs protecting the upper James River basin are firmly established on the landscape. The life span of Mud Lake would be extended if watershed-level conservation efforts were successful in the short term. In addition, long-term benefits to water quality functions, nutrient cycling, and overall wetland productivity on the James River and the refuge are expected to occur once the desired conservation efforts are in place.

PUBLIC USE

Recreational opportunities on the James River are very important to local residents. Wildlife-dependent and wildlife-compatible recreational uses along the James River, within the refuge, would continue to be allowed and would be enhanced.

HUNTING

Hunting, especially of deer, waterfowl, and pheasant, is very popular on the refuge. Hunting programs for white-tailed deer, waterfowl, and upland game would continue to be the same as under alternative 1. Parking areas would be improved, marked, and maintained. Kiosks in parking areas would provide hunter information and brochures.

FISHING

Limited fishing access has produced a high density of users in limited areas. There is also a high demand for ice fishing. Insufficient fishing access creates traffic congestion when anglers use road rights-of-way for fishing. Opportunistic fishing and limited fishing access would be the same as under alternative 1.

WILDLIFE OBSERVATION, WILDLIFE PHOTOGRAPHY, ENVIRONMENTAL EDUCATION, AND INTERPRETATION

Additional opportunities for wildlife observation, wildlife photography, and hiking, along with improved signing, updated brochures, and restored information kiosks would provide visitors with a higher quality visitor experience.

Enhanced management of grasslands would offer visitors a greater chance of viewing grassland-dependent bird species.

CAMPING

Camping would not be allowed, as in alternative 1.

TRAPPING

Trapping would only be used as a management tool, as in alternative 1.

INVASIVE PLANTS

Invasive plants, especially Canada thistle, are colonizing habitats and dominating the vegetation in some areas. Invasive plants on the refuge are particularly troublesome for adjacent landowners who are required by state and local laws to control invasive plants on their lands. These landowners see the refuge as a source of invasive plants colonizing their lands.

Reduction of Canada thistle would be accomplished by tilling cropland infested with Canada thistle. Cropland would be planted with native vegetation seed or DNC several years later, after the area was considered clear of viable Canada thistle seed. If successful, there would be less reliance on farming as a habitat management tool. Canada thistle will not grow in fields planted with genetically-modified varieties of “Roundup-ready” corn or soybeans that are sprayed with the nonselective herbicide, Roundup. By maintaining these no-till crops in production for several years, the percentage of viable invasive-plant seed in the upper soil layer should be significantly depleted.

Such a strategy holds promise in reducing the germination potential of Canada thistle. Averaged across the next 15 years, a rotation of 800 acres of cropland is expected to improve control of Canada thistle on an estimated 3,000 acres of upland. As a result, Canada thistle should be much more contained than it is currently, reducing the potential for Canada thistle to serve as a seed source invading adjacent or downstream private lands.

Using cropland on a rotational basis is a reasonable alternative to large-scale chemical application. Application of chemicals would likely only need to be used on small infestations within newly seeded areas. This approach should provide for reestablishment of a more diverse plant community and higher quality habitat for migratory birds.

In addition, chemical use is thought to reduce the vigor of any plant community, resulting in an increased opportunity for Canada thistle to dominate. Current chemical use is degrading the plant diversity within established DNC, seeded native grass areas, and native prairie. The forb component is disappearing and habitat blocks are becoming dominated by chemical-tolerant, monotypic grasses.

SOCIOECONOMIC IMPACTS

The economic impact analysis for implementation of the draft CCP is summarized in this section. This analysis describes how management activities of the refuge affect the local economy. The analysis provides two critical pieces of information:

- Illustrates the refuge's true value to the local community
- Helps determine whether local economic effects are, or are not, a real concern in choosing among management alternatives

For the purposes of an economic impact analysis, a region and its economy is typically defined as all counties within a 30- to 60-mile radius of the impact area. Only spending that takes place within this local area is included as stimulating the changes in economic activity. The size of the region influences both the amount of spending captured and the multiplier effects. Based on the relative self-containment in terms of retail trade and distance to other communities, Brown County was assumed to comprise the economic region for the analysis.

Economic impacts are typically measured in terms of number of jobs lost or gained, and the associated result on income. Economic input-output models are commonly used to determine how economic sectors will and will not be affected by demographic, economic, and policy changes.

Management activities of economic concern in the analysis included the following:

- Refuge staffing
- Refuge spending within the local community
- Recreational activities on the refuge
- Spending in the local community by refuge visitors

The full economic report produced by the USGS (appendix H) looks in depth at the economic effects of the management alternatives for the Sand Lake National Wildlife Refuge.

Table 8 summarizes the direct and total economic impacts for all refuge management activities by alternative.

ALTERNATIVE 1

Current refuge staffing and budgeting generates 13 permanent and 4 temporary or seasonal employees. The current staff accounted for an annual payroll (including salaries and benefits) of \$910,600 in 2003.

In addition to providing salaries and benefits, the refuge purchased goods and services totaling \$165,200 in 2003, approximately 65 percent of which was spent locally in the Brown County economy.

Currently, visitors to the refuge spend about \$655,500 annually in the Brown County economy. The current level of visitor spending directly generates more than \$152,000 in personal income and 9.4 jobs for local businesses accommodating visitors (hotels, restaurants, supply stores, and gas stations).

The associated indirect and induced effects generate an additional 4.3 jobs and more than \$102,000 in personal income throughout the Brown County economy for a total economic impact of 13.7 jobs and more than \$254,000 in personal income associated with the current level of refuge visitation.

Economic activity directly related to all refuge operations would generate an estimated 28.1 jobs and more than \$786,500 in personal income in Brown County. Including direct, indirect, and induced effects, all refuge activities would account for 41.3 jobs and \$1.09 million in personal income in Brown County. Current refuge management activities account for 0.15 percent of total county employment and 0.11 percent of county income.

ALTERNATIVE 2

The anticipated staffing and nonsalary expenditures are the same as for alternative 1, current conditions. Refuge visitation is estimated to decline by 30 percent as compared to alternative 1, resulting in lower (than current) spending and, subsequently, lower generation of personal income.

ALTERNATIVE 3

Staffing needs are expected to increase by 6.5 additional permanent employees (table 6). Refuge visitation is estimated to increase by 25 percent as compared to alternative 1. These increases would raise spending and personal income above current levels.

CUMULATIVE IMPACTS

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

The implementation of the draft CCP (alternative 3, integrated management–proposed action) would reduce the likelihood for cumulative impacts because

Table 8. Summary of economic effects of management alternatives for the comprehensive conservation plan, Sand Lake National Wildlife Refuge, South Dakota

<i>Brown County</i>	<i>Alternative 1 Current management— no action</i>	<i>Alternative 2 (Maximize biological potential for grassland-nesting birds)</i>	<i>Alternative 3 (Integrated management— proposed action)</i>
Total Refuge Staffing and Budgeting Impacts			
<i>Direct Effects</i>			
Annual Income	\$634,478	\$634,478	\$1,144,673
Jobs	18.7	18.7	35.3
<i>Total Effects</i>			
Annual Income	\$840,397	\$840,397	\$1,526,249
Jobs	27.6	27.6	51.6
Recreation Activities			
<i>Direct Effects</i>			
Annual Income	\$152,076	\$106,453	\$190,095
Jobs	9.4	6.6	11.8
<i>Total Effects</i>			
Annual Income	\$254,339	\$178,037	\$317,924
Jobs	13.7	9.6	17.1
Aggregate Impacts			
<i>Direct Effects</i>			
Annual Income	\$786,554	\$740,931	\$1,334,768
Jobs	28.1	25.3	47.1
<i>Total Effects</i>			
Annual Income	\$1,094,736	\$1,018,434	\$1,844,173
Jobs	41.3	37.2	68.7
Proportion of Total County Income	0.11%	0.10%	0.18%
Proportion of Total County Employment	0.15%	0.14%	0.26%

of the incremental approach in which habitats and other programs would be carried out.

The new approach of the proposed action would change the current waterfowl production scheme to a more ecologically oriented, habitat-based management. This approach would alleviate some of the impacts caused by target species management. For example, single species management such as primarily managing for waterfowl may impact nonpriority species.

The NEPA requires mitigation measures when the environmental analysis process detects possible significant impacts to habitats, wildlife, or the human environment. All the activities proposed under alternative 3 are not expected nor intended to produce significant levels of environmental impacts that would require mitigation measures. Nevertheless, the CCP will contain the following measures to preclude significant environmental impacts from occurring:

- Federally listed species will be protected from intentional or unintended impacts by having activities banned where these species occur
- Hunting safety regulations will be closely coordinated with and enforced by personnel from the refuge and SDGFP personnel
- All proposed activities will be regulated to reduce potential impacts to wildlife and plant species, especially during their sensitive reproductive cycles
- Monitoring protocols will be established to determine goal achievement levels and possible unforeseen impacts to resources for application of adaptive management to ensure wildlife and habitat resources, as well as the human environment, are preserved
- The CCP can be revised and amended after 5 years of implementation, for application of adaptive management to correct unforeseen impacts that occur during the first years of the plan.

