CHAPTER 4—Affected Environment

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Grasslands in the Millerdale Waterfowl Production Area.

The three wetland management districts manage thousands of noncontiguous tracts of Federal land totaling 1,136,965 acres: 100,094 acres of WPAs and 1,036,871 acres of conservation easements. This chapter describes the physical environment and biological resources of these district lands, as well as fire and grazing history, cultural resources, visitor services, socioeconomic environment, and district operations.

4.1 Physical Environment

The districts are located in central and eastern South Dakota from west of the Missouri River to the Minnesota state line, and from the North Dakota border roughly two-thirds of the way south to the state line of Nebraska.

The prairies of South Dakota have become an ecological treasure of biological importance for waterfowl and other migratory birds. The prairie potholes of the Dakotas support a wide diversity of wildlife, but they are most famous for their role in waterfowl production. Although the Prairie Pothole Region occupies only 10 percent of North America's waterfowl breeding range, it produces approximately 50 percent of the continent's waterfowl population. Complexes of wetlands scattered throughout the three districts attract breeding duck pairs. While semipermanent and permanent wetlands provide brood-rearing habitat and migratory stopover habitat, respectively, it is the smaller temporary and seasonal wetlands that draw breeding duck pairs to South Dakota and other parts of the Prairie Pothole Region.

Climate change

In January 2001, the Department of the Interior issued Order 3226, requiring its Federal agencies with land management responsibilities to consider potential climate change effects as part of long-range planning endeavors. The U.S. Department of Energy's report, "Carbon Sequestration Research and Development," concluded that ecosystem protection is important to carbon sequestration and may reduce or prevent loss of carbon currently stored in the terrestrial biosphere. The report defines carbon sequestration as "the capture and secure storage of carbon that would otherwise be emitted to or remain in the atmosphere." The increase of CO_2 (carbon dioxide) in the earth's atmosphere has been linked to the gradual rise in surface temperature commonly referred to as "global warming."

In the context of comprehensive conservation planning for the districts, the strategies that manage and increase grassland vegetation contribute to the sequestration of carbon, constituting a primary climate-related effect. Large, naturally occurring communities of plants and animals that occupy major landscapes (for example, grasslands, forests, wetlands, tundra, and desert) are effective both in preventing carbon emission and in acting as biological "scrubbers" of atmospheric CO_2.

One Service activity in particular—prescribed burning—releases CO_2 directly to the atmosphere from the biomass consumed during combustion; yet it results in no net loss of carbon sequestration capacity because new vegetation quickly germinates and sprouts to replace the consumed biomass. This vegetation sequesters an approximately equal amount of carbon as was lost through the prescribed burning (Dai et al. 2006).

Interestingly, EPA's (U.S. Environmental Protection Agency's) 1998 publication, "Climate Change in South Dakota" (EPA 236-F-98-007x) directly addressed Service interests in the State:

"Based on model projections, national wildlife refuges in South Dakota appear to be among the most vulnerable in the United States to changes in climate. The region's national wildlife refuges and prairie pothole systems appear to be especially sensitive to changes in precipitation and temperature. Sixty percent of the annual variation in the number of these wetlands can be explained by year-to-year changes in temperature and precipitation. Smaller wetlands may be particularly vulnerable to climate change. Projections show that warmer annual temperatures affect wetlands by reducing open water and increasing vegetation cover, independent of precipitation. Rising temperatures, if continued for several years, may decrease breeding bird density and diversity in this critically important waterfowl habitat. Major additional threats to ecosystems include habitat loss and species extinction, increased fire frequency, and increased vulnerability to invasive plant and insect species."

Climate

South Dakota's interior continental climate exhibits an extreme range of temperatures between summer and winter, common high winds, and cyclic wet/dry periods. Normal temperatures (1971–2000) vary surprisingly little between the northwest and southeast corners of the three-district area. January minimum temperatures average 3.4°F in Mobridge and 2.9°F in Sioux Falls, while July maximum temperatures average 85.4°F in Mobridge and 85.6°F in Sioux Falls. A bigger difference is evident comparing southwest to northeast. January minimum temperatures average 7.7°F in Pierre versus -0.5°F in Clear Lake, while July maximum temperatures average 89.2°F in Pierre compared to 81.6°F in Clear Lake. The record low temperature in the three-district area was –48°F at Miller on January 12, 1912, while the record high was 120°F at Gann Valley on July 5, 1936.

Normal annual precipitation (1971–2000) averaged 24.69 inches in Sioux Falls in the southeast, decreasing to 16.94 inches in Mobridge. Sioux Falls receives an average of 41 inches of snow per year.

Physiography, Geography, and Soils

Physiography

Because districts cover such a large geographic area, the physical environment and biological resources are described here in the context of level III and level IV physiographic regions (Bryce et al. 1996). Four physiographic regions (ecoregions) occur in the three-district area: Northwestern Glaciated Plains, Northwestern Great Plains, Northern Glaciated Plains, and Western Cornbelt Plains (figure 8).

Level III ecoregions are distinguished by patterns of biotic and abiotic phenomena: vegetation, climate, soils, land use, wildlife use, and hydrology. Local biotic and abiotic factors are used to further subdivide the level III ecoregions into level IV ecoregions—the finest level in the hierarchy (Bryce et al. 1996). The descriptions below of the ecoregions that constitute the three-district area are adapted from "Ecoregions of North Dakota and South Dakota" (USGS 2006).

Northwestern Glaciated Plains—Ecoregion 42 (Level III)

Portions of the Huron and Sand Lake WMDs are in this ecoregion. The Northwestern Glaciated Plains ecoregion marks the westernmost extent of continental glaciation. The youthful morainal (ridges of rock debris at the margins of glaciers) landscape has significant surface irregularity and high concentrations of wetlands. The rise in elevation along the eastern boundary defines the beginning of the Great Plains. Land use is transitional between the intensive dryland farming in the level IV Drift Plains ecoregion to the east and the predominance of cattle ranching and farming in the Northwestern Great Plains ecoregion to the west.

Missouri Coteau—Ecoregion 42a (Level IV)

Like closely spaced ocean swells, the rolling mounds of the Missouri Coteau enclose countless wetland depressions, or potholes. During its slow retreat, the Wisconsinan glacier stalled at the Missouri escarpment for thousands of years, melting slowly beneath a mantle of sediment to create the characteristic pothole topography of the coteau. The wetlands of the Missouri Coteau and the neighboring Prairie Pothole Region contain the majority of the WPAs in North America. Land use on the coteau is a mixture of tilled agriculture in flatter areas and grazing on steeper slopes.

Missouri Coteau Slope—Ecoregion 42c (Level IV)

The Missouri Coteau Slope ecoregion declines in elevation from the Missouri Coteau ecoregion to the Missouri River. Unlike the Missouri Coteau ecoregion, where there are few streams, the Missouri Coteau Slope has a simple drainage pattern and fewer wetland depressions. Because of the level to gently rolling topography, the Missouri Coteau Slope supports more cropland than the Missouri Coteau ecoregion. Cattle graze on the steeper land along drainages.

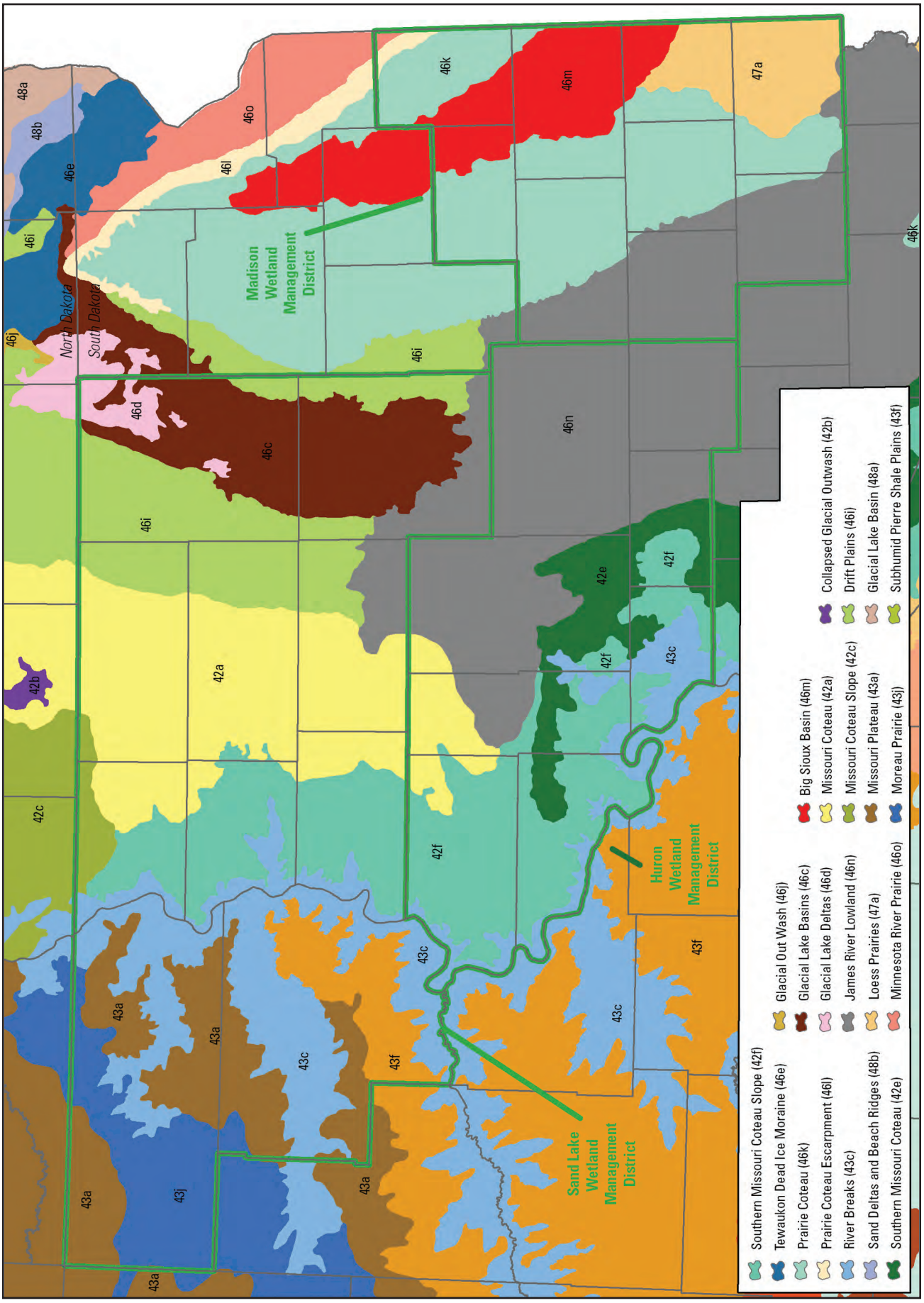

Figure 8. Draft Level III and IV Ecoregions of South Dakota.

Southern Missouri Coteau—Ecoregion 42e (Level IV)
The Southern Missouri Coteau ecoregion, on the southern fringe of continental glaciation, exhibits a muted coteau topography: gentle undulations rather than steep hummocks, smaller areas of high wetland density, and more stream erosion backcutting into areas of internal drainage. There is more tilled land on the Southern Missouri Coteau than on the Missouri Coteau because of its gentler topography. More soybeans and corn are planted on the Southern Missouri Coteau because of its milder climate and increased precipitation.

Southern Missouri Coteau Slope—Ecoregion 42f (Level IV)
The Southern Missouri Coteau Slope ecoregion differs from the Missouri Coteau Slope to the north; it has mesic rather than frigid soils and a substantial cap of rock-free loess. To the south, the coteau areas east of the Coteau Slope ecoregions become progressively narrower and more eroded. The level to rolling uplands of the Southern Missouri Coteau Slope are planted in sunflowers, wheat, millet, and barley. Corn is a marginal crop that does well in wet years. The stream drainages tend to be grazed. Willows, green ash, and elm grow in the riparian areas.

Northwestern Great Plains—Ecoregion 43 (Level III)
Roughly the western third of the Sand Lake WMD and small portions of the south-central Huron WMD are within this ecoregion. The Northwestern Great Plains ecoregion encompasses the Missouri Plateau section of the Great Plains. It is a semiarid rolling plain of shale, siltstone, and sandstone punctuated by occasional buttes and badlands. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Agriculture is limited by erratic precipitation patterns and limited opportunities for irrigation.

Missouri Plateau—Ecoregion 43a (Level IV)
The Missouri Plateau typifies the "wide open spaces" of the American West. The topography was largely unaffected by glaciations, retaining its original soils and complex stream drainage pattern. The historic shortgrass prairie is now a mosaic of wheat, alfalfa, and grazing land.

River Breaks—Ecoregion 43c (Level IV)
The River Breaks form broken terraces and uplands that descend to the Missouri River and its major tributaries. They have formed in soft, easily erodible strata such as Pierre shale. The dissected topography, wooded draws, and uncultivated areas provide a haven for wildlife. Riparian gallery forests of cottonwood and green ash persist along major tributaries such as the Grand, Moreau, Cheyenne, Bad, and White rivers, but such habitats have been largely eliminated along the Missouri River by impoundments.

Subhumid Pierre Shale Plains—Ecoregion 43f (Level IV)
Continues vegetative cover is essential to keep the soft, black shale soils intact. Tilling the hillsides risks wind and water erosion; stream channels are deeply incised and slumping is common along exposed banks.

Moreau Prairie—Ecoregion 43j (Level IV)
This ecoregion is characterized by occasional buttes, areas of badlands, and numerous salt pans. The soils tend to be alkaline, making the Moreau Prairie less agriculturally productive than surrounding areas (ecoregion 43a). Most of the region is grazed by cattle, sheep, and antelope.

Northern Glaciated Plains—Ecoregion 46 (Level III)
Portions of all three districts are in this ecoregion. Also commonly referred to as the Drift Prairie, this area was subject to scouring and deposition during prolonged glacial activity between 70,000 and 10,000 years ago. A flat to gently rolling landscape of glacial drift characterizes the Northern Glaciated Plains ecoregion. The subhumid conditions foster a grassland transition between the tall- and mixed-grass prairies. High concentrations of temporary and seasonal wetlands create favorable conditions for duck nesting and migration. Although the tilled soil is very fertile, agricultural success is subject to annual climatic fluctuations.

Glacial Lake Basins—Ecoregion 46c (Level IV)
Lake Dakota once occupied the Glacial Lake Basins. Proglacial (adjacent to a glacier) lakes were formed when major stream or river drainages were blocked by glacial ice during the Pleistocene. The smooth topography of the Glacial Lake Basins, even flatter than the surrounding Drift Plains, resulted from the slow buildup of water-laid sediments. The level, deep soils in the lake plains are intensively cultivated with a prevalence of corn and soybeans.

Glacial Lake Deltas—Ecoregion 46d (Level IV)
The Glacial Lake Deltas were deposited by rivers entering glacial lake basins (see above). The heaviest sediments, mostly sand and fine gravel, formed delta fans at the river inlets. As the lake floors were exposed during withdrawal of the glacial ice, wind reworked the sand in some areas into dunes. In contrast to the highly productive, intensively tilled glacial lake plains, the dunes in the delta areas have a thin vegetative cover and a high risk for wind erosion. These areas are used mainly for grazing or irrigated agriculture.

Drift Plains—Ecoregion 46i (Level IV)
On the Drift Plains, the retreating Wisconsinan glaciers left a subtle, rolling topography and a thick mantle of glacial till (mixture of clay, sand, and rocks).

A greater proportion of temporary and seasonal wetlands are found in the Drift Plains than in the coteau areas, where semipermanent wetlands are numerous. Because of the productive soil and level topography, this ecoregion is almost entirely cultivated, with many wetlands drained or simply tilled and planted. However, valuable waterfowl habitat still remains, concentrated in State- and federally sponsored duck production areas. The historical grassland in the Drift Plains was a transitional mix of tall- and mixed-grass prairie. The prairie grasses have been largely replaced by fields of spring wheat, barley, sunflowers, and alfalfa.

Prairie Coteau—Ecoregion 46k (Level IV)
The Prairie Coteau ecoregion, like the Missouri Coteau, is the result of stagnant glacial ice melting beneath a sediment layer. The tightly undulating, hummocky landscape has no drainage pattern; it is perforated with closely spaced semipermanent and seasonal wetlands. However, the Prairie Coteau differs from the Missouri Coteau in two ways. It supports a chain of large lakes that were formed where there was little ice shear, and its higher precipitation levels support widespread burr oak woodlands near wetland margins.

Prairie Coteau Escarpment—Ecoregion 46l (Level IV)
The Prairie Coteau Escarpment ecoregion, though small, is a distinctive ecosystem, rising 300–600 feet from the Minnesota River valley to the brow of the Prairie Coteau. The elevation, broken topography, and sufficient precipitation favor dense deciduous forest growth in riparian areas. Cool, perennial streams flow off the escarpment, providing habitats and oxygenated water not found elsewhere in eastern South Dakota.

Big Sioux Basin—Ecoregion 46m (Level IV)
The Big Sioux Basin is a trough penetrating the core of the Prairie Coteau. Its topography was affected by pre-Wisconsinan glaciation; later advances of the Wisconsin glacier diverged around the basin. In contrast to the neighboring Prairie Coteau, the basin has a well-developed drainage network. There is more tilled land in the Big Sioux basin due to the relative paucity of wetlands and the gentler topography.

James River Lowland—Ecoregion 46n (Level IV)
The boundary between the James River Lowland and the Drift Plains to the north is a broad phenological and climatic transition zone. The James River Lowland ecoregion is characterized by mesic soils, warmer temperatures, and a longer growing season than the Drift Plains. These differences are reflected in the crop types of the region. Winter wheat, corn, and soybeans are more prevalent in this ecoregion's milder climate.

Minnesota River Prairie—Ecoregion 46o (Level IV)
This ecoregion is present only in the extreme northeast corner of the Madison WMD. Thick glacial drift composes the level terrain of the Minnesota River Prairie. Wetlands are common, though they are fewer and less persistent than those in the neighboring stagnation moraines. The desiccating winds and historic fire regime promoted the prairie ecosystem in this region; however, it is transitional to woodland that occurs to the north and east in Minnesota. Today, the original tallgrass prairie has been replaced by intensive agriculture for grain, corn, and soybeans.

Western Corn Belt Plains—Ecoregion 47 (Level III)
This ecoregion is present in the southeastern corner of the Madison WMD. Once covered with tallgrass prairie, more than 75 percent of the Western Corn Belt Plains is now used for cropland agriculture, and much of the remainder is in forage for livestock. A combination of nearly level to gently rolling glaciated till plains and hilly loess plains; an average annual precipitation of 25–35 inches, which occurs mainly in the growing season; and fertile, warm, moist soils make this one of the most productive areas of corn and soybeans in the world. Major environmental concerns in the region include surface and groundwater contamination from fertilizer and pesticide applications as well as from the effects of concentrated livestock production.

Loess Prairies—Ecoregion 47a (Level IV)
The Loess Prairies of Iowa and South Dakota surround the perimeter of the Des Moines lobe of the Late Wisconsinan glaciation. Of the two areas of this ecoregion in South Dakota, the northern is distinguished from neighboring regions by its rock-free soil and a paucity of wetlands. The southern area is more highly dissected, with deciduous woodland and brush on the steeper slopes and in the draws.

Geography

Much of the current topography reflects the sculpting of the land by continental ice sheets during the last major glaciation, the Wisconsin Glacial Episode. This episode, the most recent in a cycle of glacial advances and retreats over the last 1.5 million years, began approximately 110,000 years ago and ended about 12,000 years ago. The Wisconsin ice sheets covered large portions of Canada and much of the upper Midwest, including all of eastern South Dakota. The accumulation of hundreds of feet of ice caused the ice to slowly move under its own weight, collecting everything from fine sediments to large boulders on the retreating side and depositing them along the advancing edge. These erosional and depositional events created many of the elements that characterize the landscape of eastern South Dakota.

The slow but constant movement of the glaciers scoured the broad river valleys, and the melting ice at the front of the glaciers carved many of the river channels that now flow through the area. The rolling hills that typify much of the region are also the result

of thousands of years of glaciers repeatedly advancing and retreating, as are the thousands of shallow prairie pothole depressions that dot the region. These potholes are generally shallow wetlands that retain water for at least part of the year, although many have been drained in the last 75 years for use as agricultural fields. Most of the protected areas in the three districts are centered around or next to one or more of these potholes.

Soils

Three of the twelve dominant soil orders of the United States—mollisols, entisols, and vertisols—occur in eastern South Dakota. Mollisols cover more than 95 percent of the landbase, with the other two orders occurring exclusively along the Missouri River. The following descriptions, adapted from "Soil Taxonomy—A Basic System of Soil Classification for Making and Interpreting Soil Surveys" (NRCS 1999), summarize the taxonomy of these orders and their suborders.

- Mollisols commonly are the very dark colored, base-rich, mineral soils of the steppes. Mollisols are extensive in subhumid to semiarid areas on the plains of North America and recognized as the dominant soil type in all three districts. Many of these soils developed under grass at some time, although many were apparently forested at an earlier time. Mollisols may have any of the defined temperature regimes but do not have permafrost. Mollisols can have any moisture regime, but enough available moisture to support perennial grasses seems to be essential. Where slopes are not too steep, Mollisols are used mainly for small grain in the drier regions and corn or soybeans in the warmer, humid regions.
  - Udolls are the more or less freely drained Mollisols of humid climates. In the United States, their vegetation at the time of settlement was dominantly a tallgrass prairie, but some of the soils on Pleistocene surfaces appear to have supported at some time a boreal forest that was supplanted by grasses several thousand years ago. Most of the Udolls are in the eastern part of the Great Plains or are east of the Great Plains. Udolls dominance is prevalent throughout eastern portions of Madison and Sand Lake WMDs. Where slopes are not too steep, nearly all of these soils are cultivated. Corn and soybeans are the major crops.
  - Ustolls are the more or less freely drained Mollisols of subhumid to semiarid climates. Rainfall occurs mainly during a growing season, often in heavy showers, but it is erratic. Drought is frequent and may be severe. During a drought, soil blowing becomes a problem. Ustolls are extensive soils on the western Great Plains in the United States and the dominant form in all three districts. Most of the Ustolls on the Great Plains in the United States had grass vegetation when the country was settled. The Aridic subgroups supported mostly short grasses, and the others supported mixtures of short and tall grasses.
- The central concept of Entisols is that of soils that have little or no evidence of the development of pedogenic horizons. On many landscapes the soil material is not in place long enough for pedogenic processes to form distinctive horizons. Some of these soils are on steep, actively eroding slopes, and others are on flood plains or glacial outwash plains that receive new deposits of alluvium at frequent intervals. Entisols may have any mineral parent material, vegetation, age, or moisture regime and any temperature regime, but they do not have permafrost. The only features common to all soils of the order are the virtual absence of diagnostic horizons and the mineral nature of the soils.
  - Fluvents are mostly brownish to reddish soils that formed in recent water-deposited sediments, mainly on floodplains, fans, and deltas of rivers and small streams but not in backswamps where drainage is poor. Many Fluvents are frequently flooded unless they are protected by dams or levees. Stratification of the materials is normal. Most of the alluvial sediments are derived from eroding soils or streambanks and contain an appreciable amount of organic carbon, which is mainly in the clay fraction.
  - Orthents are primarily Entisols on recent erosional surfaces. The erosion may be geologic or may have been induced by cultivation, mining, or other factors. Any former soil that was on the landscape has been completely removed or so truncated that the diagnostic horizons for all other orders do not occur. Orthents occur in any climate and under any vegetation.
- The central concept of Vertisols is that of clayey soils that have deep, wide cracks for some time during the year. They shrink when dry and swell when moistened. Before the advent of modern classification systems, these soils were already well known for their characteristic color, the cracks they produce during the dry season, and the difficulty of their engineering properties. These soils are generally sticky in the wet season and hard in the dry season, so they require special cultivation practices regardless of whether modern equipment or traditional implements, such as a hoe or bullock-drawn plow, are used. Shrink-swell processes in soils are related to the total content of clay, the content of fine clay, and mineralogy. Vertisols generally have a high clay content (50–70 percent) and a relatively large proportion of fine clay in the clay fraction.

- Vertisols generally have gentle slopes, although a few are strongly sloping. The natural vegetation is predominantly grass, savanna, open forest, or desert shrub. Most Vertisols are well suited to mechanized farming if there is plenty of rainfall or irrigation water and if suitable management practices are followed. Large areas of Vertisols in the world are not farmed, however, because their cultivation would require too much energy, especially where traditional, low-input methods are used. This constraint is a major limiting land use characteristic of Vertisols.
- Usterts are the Vertisols in temperate areas that do not receive high amounts of rainfall during the summer. Usterts are extensive in Texas, Montana, and western portions of South Dakota. They receive low amounts of rainfall during the summer, and cracks open and close once or twice during normal years. The native vegetation is mostly grasses and forbs. Usterts are used mainly as rangeland or cropland. Because the permeability of these soils is so slow, irrigation may result in waterlogging and a buildup of salinity.

Water Resources

The area encompassed by the three districts is drained by three rivers: the Big Sioux on the east, the James in the middle, and the Missouri on the west. The Big Sioux and the James are tributaries of the Missouri, flowing toward it from the north. The Big Sioux River is the only one of the three to originate in South Dakota; its headwaters are in the Madison WMD. It exits from the southeast corner of the district to form the southeastern boundary of South Dakota upstream of its confluence with the Missouri. The James has the flattest gradient of any river its length in North America. Water takes about 1 month to travel through South Dakota. The Missouri River is the largest river system in the United States. Near Pierre, it was impounded by the Oahe Dam in 1952 to create a storage facility of more than 23 million acre-feet.

Hydrology

Wetlands exist because specific geologic conditions and hydrologic processes favor pooling of water or soil saturation. A unique combination of glaciation and climatic conditions in the Prairie Pothole Region has produced a large number of dynamic aquatic ecosystems that have a tendency neither to receive nor contribute to channelized surface flow. These basins have the potential to impound large volumes of water and undergo long-term, extreme changes in water depth and biotic conditions in response to climatic and seasonal trends.

Prairie pothole wetlands are dynamic, relatively small, shallow basins that vary greatly in their ability

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American white pelicans breed in freshwater areas in the interior of North America.

to retain surface water, and in their water chemistry, which varies from fresh to hypersaline. In an area where annual and seasonal precipitation varies greatly in form and amount, these wetlands occur in a wide variety of hydrological settings. Consequently, the presence of surface water in these wetlands is largely unpredictable. Superimposed on these characteristics are the effects of a variety of land uses including pasture, cultivation, mechanical forage removal, idle conditions, and burning. All these factors exert profound influences on the plant and animal communities found in these basins (Kantrud et al. 1989).

These wetlands, described as lacustrine basins and palustrine basins (wetlands that lack flowing water), have water regimes that include temporary, seasonal, and semipermanent flooding. Basins with these water regimes constitute about 90 percent of the basins in the Dakotas' Prairie Pothole Region. Heavy spring rainfall and snowmelt followed by periods of low rainfall contribute to dynamic water level fluctuation throughout the region. Temporary and seasonal wetlands are typically smaller than semipermanent wetlands and generally contain water for only a portion of the year. In drought periods, these short-term wetlands may stay dry for as long as 10–20 years. Because they usually contain water in the spring when farmers are planting crops and dry during the summer, they are often looked upon as having no ecological value and are consequently drained (Leitch 1989). However, it is the small, shallow, and frequently dry characteristics that make these wetlands a preferred habitat for many species of wetland-dependent wildlife (Kantrud and Stewart 1984; Niemuth et al. 2006). Because they are among the earliest wetlands to warm in the spring and contain an abundance of flooded vegetation, these early wetlands provide an abundance of breeding and foraging habitat for wildlife and breeding duck pairs (Swanson and Duebbert 1989; van der Valk 2005). Abundance of temporary and seasonal wetlands throughout the

Prairie Pothole Region is looked upon as one of the primary draws to the area for waterfowl. According to Ron Reynolds of the Service's HAPET (Habitat and Population Evaluation Team), it is estimated that every ten 1-acre wetlands can predictably support 20 duck pairs; in contrast, one 10-acre wetland likely supports only seven duck pairs. The dense populations of aquatic invertebrates in these wetlands have evolved to adapt to annual and long-term changes in the water quality of these microhabitats; other hydrophilic species, such as fish, are precluded by the periods of desiccation from inhabiting these wetlands.

Those aquatic features that are stable in depth typically support some fish species and rarely freeze to the bottom. The few deeper lakes, typically known as "kettle lakes," were formed when subsurface glacial ice blocks were left as the glaciers retreated. When the ice blocks melted, the surrounding glacial debris collapsed, leaving distinctive, steep-sided lakes. Plant life and fish populations that normally fluctuate in Prairie Pothole Region wetlands are stable in this lake type. Cowardin et al. (1979) defines the wetland subsystems, classes, and subclasses that occur in these basins and provides a useful reference to their geology, climate, hydrology, and soils.

The original density of wetlands in the Prairie Pothole Region is thought to have been about 80 wetlands per square mile before European settlement. Since that time, about 37 percent of South Dakota's wetlands have been drained for agriculture or development, with 20,000 acres being lost each year in the Prairie Pothole Region (Dahl 2000). Because the Prairie Pothole Region is a major world supplier of cereal grains, wetlands in the region are often drained for crop production or otherwise cropped when water conditions permit.

Water Quality

Some wetland basins function as groundwater recharge areas; such basins tend to be temporarily or seasonally flooded. These basins hold water for only a few months each year, and the water is generally low in dissolved solids. Some basins are through-flow systems with respect to groundwater; that is, groundwater flows in through parts of their bed while other parts recharge groundwater. Through-flow basins hold water over longer periods, and the water tends to have higher concentrations of dissolved solids. Some basins serve only as discharge areas for groundwater. Lakes that receive discharge from both regional and local groundwater flow systems and do not lose water to seepage or surface outflow are highly saline (Kantrud et al. 1989).

Human-related disturbance such as drainage and cultivation are the most extreme disturbances in most prairie wetlands in North and South Dakota. In some instances, fill (earth or rocks) or use for solid-waste disposal has destroyed the basins (Kantrud et al. 1989).

Water Rights

The Western States tend to be semiarid to arid, while the Eastern States are typically wetter. This change in precipitation patterns falls along the 100th meridian, and South Dakota offers a vivid snapshot of the differences between the western and eastern United States. Anyone driving across South Dakota can see a striking difference between the eastern and western parts of the State.

Like other resources, water becomes more valuable as its availability decreases. Consequently, as is often the case where agriculture is an important component of the economic base, water rights assume tremendous importance. Thus, climate played a major role in shaping South Dakota's water rights laws.

South Dakota, like many of the Western States, needed a water management system that would equitably distribute often scarce water resources. In the eastern United States, where water is more plentiful, a riparian water use system developed. Under such a system, users have the right to make reasonable use of the water accessible to them. However, in the Western States, a system developed based on the "Doctrine of Prior Appropriation." This prior appropriation system allows water users to construct works to move water over long distances to where the water is needed and provides for assignment of a water use priority date. "First in time, first in right" became a common identifier for this priority date–based system, since the most senior water right holders have first claim on any water available. Because of the considerable investment involved in constructing works to move water long distances, protecting that investment has been a priority since the advent of such projects. The doctrine of prior appropriation became the means to protect water users and continues to be South Dakota's method of managing its water resources.

In 1889 South Dakota became the 40th State, but the doctrine of prior appropriation actually predates South Dakota's statehood. The Dakota territorial legislature enacted legislation in 1881 establishing a procedure to "locate" surface water rights. In 1955, legislation was enacted to make ground water, as well as surface water, subject to the doctrine of prior appropriation.

In 1972 another important provision concerning management of ground water was added to the State's water right laws. This provision prevents withdrawals of ground water in excess of the average estimated annual recharge to the ground water source. In other words, users cannot draw more water out of the aquifer than the average amount needed to refill the aquifer each year. This provision ensures that ground water supplies will be available in perpetuity to all domestic water users and everyone with a water right permit.

Many Western States do not provide this protection and, consequently, ground water supplies are being depleted.

Through the years many other changes to the water rights laws have been made to protect and improve management of water resources. However, even with these changes, the same underlying principles implemented at the beginning of the 20th century are still in place in the 21st century.

The South Dakota Department of Environment and Natural Resources requires a water right license for every impoundment or wetland restoration having more than 25 acre-feet of storage. Individual licenses are detailed below. If the impounded storage is less than 25 acre-feet, a location notice is required. Location notices for all three districts are provided in appendix E.

Huron WMD

The Huron WMD holds four water licenses issued by the South Dakota Department of Environment and Natural Resources for impoundments of more than 25 acre-feet at the primary spillway elevation.

- Water Right License No. 5794-3 allows 560 acre-feet of water storage from runoff. The license also allows a sufficient amount of water to maintain the water level to the outlet elevation of 1,346 feet for fish and wildlife production purposes at Bauer WPA. The priority date is October 18, 1993.
- Water Right License No. 6130-3 is a vested water right that allows storage of 11 acre-feet of water storage from Cain Creek and runoff. The license also allows a sufficient amount of water to maintain the water level to the outlet elevation of 1,288 feet for fish and wildlife propagation. The priority date is December 31, 1939.
- Water Right License No. 6854-3 is for the Cowan Project in Hyde County. The permit allows 260 acre-feet of water storage from runoff for fish and wildlife propagation as well as for stock water purposes. The priority date is March 30, 2007.
- Water Right License No. 6855-3 is for the Harter Pond Project in Hyde County. The permit allows 181 acre-feet of water storage from runoff for fish and wildlife propagation as well as stock water purposes. The priority date is March 30, 2007.

Madison WMD

The Madison WMD holds water right licenses for several WPAs and private property with Service Easements issued by the South Dakota Department of Environment and Natural Resources.

- Water License No. 856-3 is a vested water right for Buffalo Lake WPA in Minnehaha County that allows 310 acre-feet of storage from runoff. It also allows a sufficient amount of water to maintain the water level to the outlet elevation of 1,648 feet for public recreation purposes. The priority date is November 2, 1889.
- Water Right License No. 5707-3 increased the outlet elevation of Buffalo Lake to 1,650 feet, increasing the storage by 641 acre-feet to 951 acre-feet for fish and wildlife propagation purposes; it also allows maintenance of the water level at the new elevation. The priority date for the increased amount is September 2, 1992.
- Water Right License No. 5961-3 allows 145 acre-feet of water storage plus 55 acre-feet of seasonal use at the North Unit of Minnehaha County Easement 92X, and 8 acre-feet of water storage plus 4 acre-feet of seasonal use at the South Unit for fish and wildlife purposes. The priority date is October 15, 1996.
- Water Right License No. 5714-3 allows storage of 64 acre-feet plus 108 acre-feet of seasonal use at Hamlin County Easement 171X. Sufficient water also needs to be allowed to maintain the outlet elevation of 1,781.6 feet for fish and wildlife as well as stock water purposes. The priority date is September 28, 1992.
- Water Right License No. 6369-3 allows storage of 82.12 acre-feet at Hamlin County Easement 190X for fish and wildlife purposes. The priority date is October 25, 2002.
- Water Right License No. 6279-3 allows storage of 110 acre-feet of water at Moody County Easement 70X for fish and wildlife purposes. It also allows sufficient water to maintain the outlet elevation at its fullest capacity. The priority date is August 9, 2001.
- Water Right License No. 5945-3 allows storage of 477 acre-feet of water plus 1,078 acre-feet of seasonal use at Dry Lake WPA in Brookings County to maintain the outlet elevation of 1,721 feet for fish and wildlife purposes. The priority date is June 24, 1996.
- Water Right License No. 5882-3 allows storage of 37.1 acre-feet of water plus 33.9 acre-feet seasonal use at Eriksrud WPA to maintain the outlet elevation of 1,749.5 feet for fish and wildlife purposes. The priority date is August 30, 1995.
- Water Right License No. 5855-3 allows storage of 49.5 acre-feet of water plus 54 acre-feet of seasonal use at Dry Lake WPA to maintain the outlet elevation of 1,736 for fish and wildlife purposes. The priority date is March 13, 1995.
- Water Right License No. 5531-3 allows storage of 106.3 acre-feet of water plus 93.4 acre-feet of seasonal use at Pickering WPA to maintain the outlet elevation of 1,717 feet for fish and wildlife purposes. The priority date is March 29, 1991.

Table 4. Prairie decline in South Dakota.

Prairie type	*Historical area (acres)*	*Present area (acres)*	*Percent Decline*
Mixed-grass	3,954,000	1,186,000	70
Tallgrass	6,425,000	42,420	99

Source: USGS, Northern Prairie Wildlife Research Center

- Water Right License No. 5432-3 allows storage of 125 acre-feet of water plus 65 acre-feet of seasonal use at Kingsbury County Easement 429X to maintain the outlet elevation of 1,703.5 feet for fish and wildlife purposes. The priority date is February 27, 1990.
- Water Right License No. 5938-3 allows storage of 85 acre-feet of water plus 201 acre-feet of seasonal use at Kingsbury County Easement 434X to maintain the outlet elevation of 1,693 feet for fish and wildlife purposes. The priority date is May 23, 1996.
- Water Right License No. 5224-3 allows storage of 257 acre-feet of water at Eilen WPA for fish and wildlife purposes. The priority date is August 24, 1988.

Sand Lake WMD

- The Sand Lake WMD holds two water licenses issued by the South Dakota Department of Environment and Natural Resources for impoundments of more than 25 acre feet at the primary spillway elevation.
- Water License No. 6052-3 is a vested water right that allows 267 acre-feet of storage from runoff and Dove Creek. It also allows a sufficient amount of water to maintain the water level to the spillway elevation of the dam to provide habitat for fish and wildlife propagation at Zell Lake WPA. The priority date is January 1, 1936.
- Water License No. 5472-3 allows local water runoff to be stored up to 60 acre-feet plus 110 acre-feet of seasonal use for fish and wildlife production on Spink County WPA. The priority date is September 11, 1990.

Air Quality

Air quality is regulated pursuant to several provisions of the Clean Air Act, including the NAAQS (National Ambient Air Quality Standards) and the Prevention of Significant Deterioration program. The NAAQS establish maximum allowable pollution levels for "criteria pollutants": particulate matter, ozone, sulfur dioxide, nitrogen dioxide, lead, and carbon dioxide.

South Dakota, a generally rural State, is one of only a handful of States that meets all the NAAQS, or is "in attainment." Attainment status is based on data collected through an ambient air monitoring network, comprising various sites throughout the State. Although the data are not collected on a county-by-county basis, data collected in one county is representative of other, similar areas. Despite the operation of energy facilities along South Dakota's eastern edge of the State, the State boasts some of the cleanest air in the nation.

Prescribed burning and wildfires are the two events with the greatest effect on air quality. These activities produce numerous gases, including CO_2 and H_2O as well as particulate matter. Wildfires are generally exempt from provisions of the Clean Air Act because they are unplanned events. Prescribed fires are planned activities and must therefore comply with the Clean Air Act State Implementation Plan (SIP) requirements. Planning for the use of prescribed fire incorporates management of smoke. The Service will work with the State of South Dakota Department of Environmental and Natural Resources in meeting the SIP for smoke management and will follow any smoke permitting process. The Service identifies sensitive areas and takes precautions to safeguard visitors and local residents. Smoke dispersal is a consideration in determining whether a controlled burn is within prescription. Generally, the fine-grass fuels and small burn size (80–600 acres) generate low volumes of smoke for short durations (4–5 hours).

4.2 Biological Resources

Vegetation Communities

Prairie habitats in South Dakota and throughout the Great Plains have been gaining public interest over the last few years as more people become aware of their decline (table 4). Before the 1870s, prairies covered more than a third of the United States and almost all of South Dakota. What was once a mosaic of grasses and forbs (flowering plants) where bison roamed is now predominantly agricultural land. With the arrival of increasing numbers of settlers in the late 1800s, the landscape started to change and continued to change at such a rate that now only one-half of one percent of historic prairie habitats in the United States remain. The historical distribution of prairie zones in the three-district area is shown in figure 9.

In addition to its importance to wildlife, prairie is crucial for soil and water conservation. Prairie provides a reminder of the nation's rural and pioneer heritage; it provides recreational activities such as hunting, hiking,

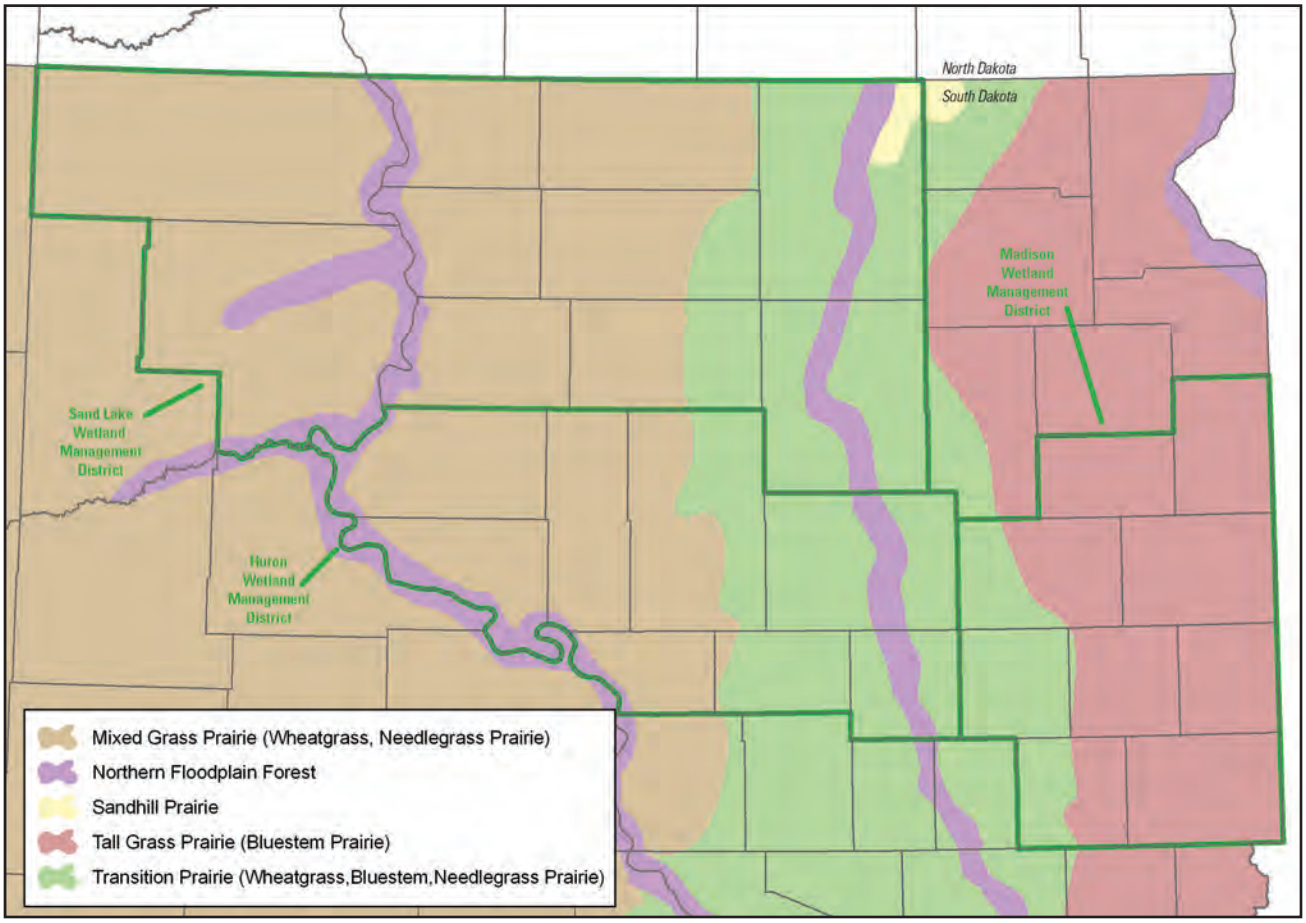

Figure 9. Distribution of vegetation communities in the three districts, South Dakota.

and bird watching; and it offers living laboratories for scientific research. Prairie also provides economic benefits through cattle grazing, haying, and native seed harvesting. When prairie is lost, the nation's natural heritage is lost along with a valuable resource (North Dakota Parks and Recreation Department, no date).

Mixed-Grass Prairie

Mixed-grass prairie is one of the largest ecosystems in North America, with significant areas preserved for natural values in national wildlife refuges, WPAs, State game management areas, and nature preserves (Johnson 2006a). The dominant grass species in the mixed-grass prairie are prairie Junegrass, little bluestem, needle and thread, blue grama, green needlegrass, porcupine grass, prairie cordgrass, northern reedgrass, plains muhly, western wheatgrass, and Kentucky bluegrass (NDGF 2005). The short- and tallgrass prairies intergrade just east of an irregular line that runs from northern Texas through Oklahoma, Kansas, and Nebraska, and then northwest into west-central South Dakota and North Dakota. The perimeter is not well defined because of the array of short-stature, intermediate, and tallgrass species that make up an ecotone between the short- and tallgrass prairies (Bragg and Steuter 1996). In general, mixed-grass prairie is characterized by the warm-season grasses of the shortgrass prairie to the west and the cool- and warm-season grasses (which grow much taller) to the east. Because of this ecotonal mixing, the number of plant species found in mixed-grass prairies exceeds that in other prairie types. Estimated declines in the areal extent of native mixed-grass prairie range from 30.5 percent in Texas to more than 99.9 percent in Manitoba (Austin 1998).

Mixed-grass prairie in the three-district area is closely associated with the Northwestern Glaciated Plains (ecoregion 42). The hummocky, rolling hills of the Missouri Coteau rise dramatically 150–500 feet above the Drift Plains (ecoregion 46i) and James River Lowlands (ecoregions 46n) to the east. Here, the mixed-grass prairie community supports a high concentration of wetlands—roughly 800,000 basin acres. Alkaline lakes are also more prevalent here. Streams and rivers are nearly absent, as are upland deciduous forests. A considerable amount of native prairie remains, and this area is used primarily for cattle grazing. Areas of reduced slope have been converted to cropland for small grains, sunflowers, corn,

and alfalfa. The mixed-grass prairie of the Missouri Coteau (ecoregion 42a) is known for supporting some of the highest numbers of breeding ducks in North America. Due to the large amount of grassland and wetland that remains or has been restored, this area is especially crucial to many other grassland-endemic species. Much of the Coteau is classified as "good" to "outstanding" for wind energy potential, the development of which could lead to habitat fragmentation. Irrigation and new advances in agricultural production, such as no-till farming in combination with Roundup-Ready corn and soybeans, makes farming of native prairie possible even where it was previously impractical due to rugged terrain.

Transition Prairie

Transition prairie is found between the more xeric mixed-grass prairie and the mesic tallgrass prairie. Transition prairie is characterized by western wheatgrass, big bluestem, and needlegrasses, representing a mix of influences from both tallgrass and mixed-grass prairies. Transition prairie in the three-district area is closely associated with the Drift Plains, James River Lowlands, Glacial Lake Basins, and Glacial Lake Deltas (ecoregions 46i, 46n, 46c, and 46d, respectively).

Grass species that dominate the tallgrass prairie continue to be present in transition prairie. However, the vegetation is reduced in height, becomes less dense, and takes on a distinctly more xeric impress. More mesic species do not extend as far up the slopes. These changes result from gradually increasing unfavorable water relations as the vegetation of true gives way to that of mixed-grass prairie. Big bluestem and switchgrass are much less widely distributed, indicating less favorable conditions for growth.

Tallgrass Prairie

Tallgrass prairie is the wettest of the grassland types and is largely characterized by sod-forming bunchgrasses. Like other grasslands, species composition of tallgrass prairie varies geographically (Sims 1988). Grassland groupings of the tallgrass prairie are (1) bluestem prairie from southern Manitoba through eastern North Dakota and western Minnesota south to eastern Oklahoma, and (2) wheatgrass, bluestem, and needlegrass prairie from south-central Canada through east-central North Dakota and South Dakota to southern Nebraska. The dominant grass species in these areas are big bluestem, little bluestem, switchgrass, Indiangrass, prairie dropseed, slender wheatgrass, porcupine grass, mat muhly, fescue sedge, and meadow sedge.

Since 1830, there have been estimated declines of 82.6–99 percent in tallgrass prairie in specific States and provinces. These declines exceed those reported for any other major ecological community in North America (Samson et al. 1998). Less than 15 percent of the tallgrass prairie in South Dakota remains intact, and the nationwide rate is no better (Samson and Knopf 1994). No other major ecosystem on the North American continent has been so fully altered by human activities (Domek 1998).

Prairie landscapes are shaped by disturbance regimes such as drought, fire, and grazing. Prior to European settlement, the agents of those regimes were wildland fire and bison. Fire probably played a larger role than did bison in shaping the mosaic of vegetation communities. Fire swept through the area every 3–5 years, burning plant material, recycling nutrients into the soil, and stimulating diverse, healthy plant growth (Domek 1998). Tallgrass prairie and associated wetlands in the three-district area were historically found predominantly in the eastern portion of South Dakota. By the 20th century, much of the tallgrass prairie had been converted to farmland; few tracts of native vegetation remain. Farmland with woodlots and shelterbelt plantings is now prevalent.

Wetland Habitat

A wide variety of aquatic plants occur in prairie wetlands. However, the vegetative communities of prairie wetlands are determined by the fluctuating hydrologic

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A male bobolink surveys its grassland habitat.

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A sora forages in wetland habitat.

Mason Sieges/USFWS

Canada thistle is a widespread invasive on district lands.

regime, which creates a wet-dry cycle in wetlands (Kantrud et al. 1989). As wetlands pass through the four stages of the wet-dry cycle—dry marsh, regenerating marsh, lake marsh, and degenerating marsh—various environmental conditions cause specific vegetation expression to occur. Each stage is determined by the amount of water present, ranging from drought to full pool conditions. As the wetlands cycle through these stages, a variety of diverse aquatic plant life expresses due to the environmental factors triggering germination in the seed bank. Different aquatic plants occur at the various stages of the wetland cycle.

Several basic zones in prairie wetlands—wet meadow, shallow marsh, deep marsh, open water, and alkali—also affect the species of aquatic plants that are expressed. Wet meadow is the transition of upland into wetland and is characterized by grasses, fine sedges, and forbs. Shallow marsh is characterized by mid-height grasses and coarse sedges. Deep marsh is characterized by tall coarse herbaceous plants (such as cattail and bulrush species). The open water zone can be occupied by submergent or floating aquatic plants. Alkali zones are often devoid of vegetation or contain salt-tolerant species such as widgeongrass.

Most of South Dakota's wetlands are prairie potholes, which provide nesting and feeding habitat for migratory waterfowl and wading birds. About one-half the nation's duck population originates in the Prairie Pothole Region of South Dakota and other prairie States. Prairie potholes, or sloughs, are water-holding depressions of glacial origin that occur in 300,000 square miles of prairies in north-central United States and south-central Canada. These potholes provide the most productive wetland habitat for waterfowl in North America. Although comprising only 10% of the continental waterfowl breeding, the Prairie Pothole Region produces about 50% of the duck crop in an average year and much more in bumper years. Potholes also furnish water for other wildlife and livestock (USGS 2007).

Invasive plants

The South Dakota Weed and Pest Control Commission has designated certain weeds as noxious because of their difficulty to control and the costs associated with the loss of agricultural production (table 5). All the State-listed noxious weeds were introduced from other ecosystems and have flourished in the absence of natural controls. Control of State-listed noxious weeds—whether chemical, mechanical, biological, or fire—is a priority for the Service. However, many other invasive plants also threaten wildlife habitat and interfere with the Service's management objectives. Weeds may be designated as locally noxious upon request from counties and with approval from the South Dakota Weed and Pest Control Commission. Local noxious weeds have the following characteristics:

- The weed is biennial, perennial, or a pernicious annual.
- The weed is capable of spreading rapidly.
- The weed is not controllable without special preventative or management practices.

Table 5. State-listed and local noxious weeds and their distribution in the South Dakota Wetland.

State noxious weeds	*Scientific name*	*Distribution by county*
Canada thistle	*Cirsium arvense*	Widespread
Leafy spurge	*Euphorbia esula*	Widespread
Perennial sow thistle	*Sonchus arvensis*	Widespread
Hoary cress	*Cardaria draba*	Hand, Hyde, Minnehaha
Russian knapweed	*Centaurea repens*	Jerauld, Minnehaha, Spink
Purple loosestrife	*Lythrum salicaria*	Edmunds, Lake, Minnehaha, Sanborn, Spink
Salt Cedar	*Tamarix aphylla, T. chinensis, T. gallica, T. parviflora and T. ramosissima*	Edmunds, Faulk, Spink
Local noxious weeds	*Scientific name*	*Distribution by county*
Absinth wormwood	*Artemisia absinthium*	Widespread
Musk thistle	*Carduus nutans*	Widespread
Plumeless thistle	*Carduus acanthoides*	Widespread
Bull thistle	*Cirsium vulgare*	McCook
Field bindweed	*Convolvulus arvensis*	Beadle, Buffalo, Campbell, Edmunds, Hamlin, Hughes, Kingsbury, Lake, McPherson, Potter, Sanborn
Common mullein	*Verbascum thapsus*	Beadle, Hyde
Yellow toadflax	*Linaria vulgaris*	Brown, Edmunds, Hyde, Lake, McPherson, Moody
Houndstongue	*Cynoglossum officinale*	Hyde

- The weed is capable of materially reducing production of crops and livestock.
- The weed is capable of decreasing the value of the land.

District staff addresses these species on a case-by-case basis, depending on available money, time, and resources.

Invasive plants on Service lands have reduced wildlife habitat and biodiversity. The presence of invasive plants can alter the functioning of ecosystems by degrading wildlife habitat; displacing native species; and changing carrying capacity through reduced forage production, lower plant diversity, and increased soil erosion and sedimentation. Such plants are not only problematic on the Service's fee-title lands; they also infest rangelands and croplands across South Dakota. The spread of invasive plants occurs by root spread or by seed dispersal, with wind, water, humans, equipment, and animals acting as transport mechanisms.

Fire

Prior to European settlement, wildfires and grazing (primarily by bison, prairie dogs, and insects) were the primary ecological disturbances that revitalized grasslands. Lightning and Native Americans caused ignitions , with most wildfires likely occurring during summer and fall. Depending on weather conditions, a single wildfire might burn thousands of acres, creating a mosaic of burned, unburned, and grazed areas. Historical fire frequency was probably highly variable but has decreased since settlement (Umbanhowar 1996); however, little information is available on the presettlement occurrence of fire in the three districts. Evidence of fire return intervals in the mixed-grass prairie suggests about every 5–10 years in the moist portions and around 25 years on dry portions (Wright and Bailey 1980; Frost 1998). In general, during dry periods in areas where precipitation is limited, such as the western and central grasslands, a long-term decline in grass production occurs when burning is more frequent than every 5–10 years. This fire frequency may be best for natural fire management of grasslands, such as the short- or mixed-grass prairies, although

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Prescribed fire is an important tool to manage the health of grassland ecosystems.

fire exclusion may be best for other purposes (Bragg 1995). Tallgrass prairie tends to have a shorter fire return interval than mixed-grass prairie. Evidence suggests roughly a 3–7 year fire return interval for most of the tallgrass prairie.

After settlement by Europeans, wildfires were suppressed. Today, most local fire departments and area ranchers still aggressively suppress wildfires. It is also the districts' policy to suppress all wildfires or, when appropriate, to manage wildfires for multiple objectives on Service lands. The fire management program for the three districts will follow applicable laws; DOI and Service policies; and guidance established at national, regional, and local levels.

The National Wildfire Coordinating Group currently recognizes two forms of wildland fire: wildfire and prescribed fire. A wildfire is an unplanned ignition, and a prescribed fire is a planned ignition. Wildfires are further divided into two categories based on ignition source: natural (typically lightning) and human. The management response for naturally occurring wildfires can include multiple objectives, whereas human-caused wildfires must be suppressed. Managing for multiple objectives means that different portions of a naturally occurring wildfire can be managed differently. For example, one portion of the wildfire may be suppressed while another portion, providing a benefit that contributes to attainment of refuge goals, is allowed to burn. However, the districts have chosen suppression as the management response to all wildfires. Suppression tactics chosen for each wildfire are at the discretion of the incident commander and the refuge manager, and can range from aggressive direct attack to surveillance or monitoring.

District staff utilizes prescribed fire to simulate the historical influence fire had on plant communities. Burning removes layers of residual cover that can reduce plant species diversity and increase a wildfire's resistance to control. Prescribed fire is currently used in all habitat types found within the districts.

Even though prescribed burning can occur at any time of year, most prescribed fires are currently applied in spring, early summer, and into fall, depending on the prescribed fire's objectives and the associated effects on flora and fauna. Spring burning is often preferred because it presents opportunities to manage invasive cool-season grasses, open up shorelines and vegetation-choked wetlands, and provide areas of green browse attractive to migratory waterfowl. Prescribed fire has been increasingly implemented during the last 15 years; since 2001, the districts have treated about 28,900 acres.

Prescribed burning and grazing can be used in concert to reduce the accumulation of organic litter. Burning creates a "flush" growth of new vegetation, which is then grazed to extend treatment of problem plants such as Kentucky bluegrass and smooth brome. Invasive plants such as Canada thistle, absinth wormwood, and leafy spurge can be similarly managed. The districts have occasionally used this management strategy, which shows promise for more frequent use in the future. Overall guidance for use of prescribed fire and management of wildfires in the three districts is presented in chapter 6 as well as in the fire management plans for the districts.

Grazing

Grazing is an important agent in shaping the structure and composition of grassland communities. Herbivores such as bison, elk, deer, pronghorn, and black-tailed prairie dog interact with soils, plants, other animals, and other processes to produce distinctive successional patterns in the northern Great Plains landscape at multiple scales.

Plants on the prairie evolved with some form of herbivory. Most plant species have growing points at or near the ground surface, allowing the plant to be grazed without killing it. Some contain bitter or toxic substances that cause animals to avoid grazing on them. Others have spines to cause injury to grazing animals' mouths. Consequently, to maintain native plant associations, it is essential to maintain the processes—such as grazing—under which the plants evolved.

It is likely that bison herds historically spent a considerable amount of time grazing native prairie in the three-district area. Their grazing, trampling, trailing, and related activities likely had a significant effect on the development and maintenance of certain plant communities. Free-ranging bison and elk are no longer present in the districts. Instead, district staff works with local ranchers to mimic natural disturbances through livestock grazing.

Grazing can be prescribed during periods when specific targeted plants are most palatable to livestock. Seasonal grazing of the uplands stresses the invasive cool-season grasses and favors native grasses and forbs. Grazing in wetland habitats reduces accumulations of

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The burrowing owl is a South Dakota Priority Species and a Region 6 Bird of Conservation Concern.

organic litter at the surface; excessive organic litter often favors invasive plants such as Canada thistle. Grazing can also be used as part of an IPM (integrated pest management) program. Follow-up treatments tend to be easier to complete and are more effective when they follow grazing.

Wildlife

This section describes the birds and mammals that are common in district lands, strategic planning for waterfowl, and threatened and endangered species that have the potential to occur in the districts.

Birds

Grasslands and wetlands dominated by a rich assortment of native grasses, sedges, and forbs occur throughout the districts. This diverse grassland landscape supports an impressive concentration of waterfowl, shorebirds, and other open-water bird species. Many species of raptors and songbirds breed and are widely distributed on protected district lands, making South Dakota a primary destination for outdoor enthusiasts. Bird species that occur in the districts are listed in appendix G.

The 1988 amendment to the Fish and Wildlife Conservation Act mandates that the Service "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973." BCC (Birds of Conservation Concern) is the most recent effort to carry out this mandate (USFWS 2008a). The overall goal of this report is to accurately identify the migratory and nonmigratory bird species (beyond those federally listed as threatened or endangered) that represent our highest conservation priorities. Several categories of bird species are considered for inclusion on lists in this report: nongame birds; gamebirds without hunting seasons; subsistence-hunted nongame birds in Alaska; and ESA candidate, proposed, and recently delisted species. Bird species are included on the lists on the basis of several factors; these include population trends, threats, distribution, abundance, and relative density.

The goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions among Federal, State, tribal, and private partners. BCC lists should be consulted in accordance with Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." The 2008 BCC report should also be used to develop research, monitoring, and management initiatives. By focusing attention on the highest priority species, the report is intended to promote greater study and protection of the habitats and ecological communities upon which these species depend, thereby contributing to healthy avian populations and communities. Table 6 lists the species that have been identified as birds of conservation concern or priority species for this region. The districts have developed a list of focal species—distilled from the larger list of species shown in table 6—that they are best positioned to help protect and maintain on the basis of the species' geographic ranges and specialized habitats (table 7).

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A badger relaxes in the sun.

Mammals

There can be little doubt that the activities of wild American bison, which were extirpated from the Prairie Pothole Region of South Dakota in the 19th century, had a major influence on prairie uplands and wetlands in presettlement times. Unfortunately, there is no documentation of how wetlands were affected by the feeding, drinking, dusting, or other activities of millions of bison as they roamed the prairies. Other grassland mammals extirpated from the area are grizzly bear, kit fox, and plains wolf. Currently, the suite of mammal species occurring in the districts includes coyote, red fox, badger, raccoon, striped skunk, mink, long-tailed weasel, white-tailed deer, mule deer, white-tailed jackrabbit, eastern cottontail, muskrat, thirteen-lined ground squirrel, deer mouse, prairie vole, and meadow vole. In addition to these common species, moose, elk, and pronghorn are occasionally sighted on or adjacent to district lands.

Threatened and Endangered Species

Laws passed in the late 1960s gave some attention to endangered species; however, it was not until ESA was passed in 1973 that significant protection was granted to rare species. This landmark law, considered by some the most significant environmental law ever passed, has been amended and reauthorized by Congress on numerous occasions, most recently in 1988. The Service administers the law for all inland species and certain marine species. When Congress authorized ESA, it declared that species of "fish, wildlife, and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the nation and its

Table 6. Birds of Conservation Concern or Priority Species.

Species	*Range*	*Prairie Potholes Birds of Conservation Concern (USFWS 2008a)*	*Region 6 Birds of Conservation Concern (USFWS 2008a)*	*South Dakota Priority Species (Bakker 2005)*	*Threatened or Endangered Species*
American bittern	All three districts	X	X	X	
Bald eagle	All three districts	X	X		
Baird's sparrow	Sand Lake	X	X	X	
Bell's vireo	All three districts		X		
Black tern	All three districts	X		X	
Black-billed cuckoo	Sand Lake/Madison	X	X	X	
Black-crowned night heron	All three districts			X	
Bobolink	All three districts				
Burrowing owl	All three districts		X	X	
Chestnut-collared longspur	All three districts	X	X	X	
Dickcissel	All three districts	X			
Ferruginous hawk	Huron/Sand Lake		X	X	
Franklin's gull	All three districts			X	
Golden eagle	Huron/Sand Lake		X		
Grasshopper sparrow	All three districts	X	X	X	
Greater prairie-chicken	All three districts			X	
Horned grebe	Sand Lake	X	X	X	
Lark bunting	Huron/Sand Lake			X	
Le Conte's sparrow	Sand Lake			X	
Least bittern	All three districts	X	X		
Least tern	Huron/Sand Lake				X
Loggerhead shrike	All three districts		X		
Long-billed curlew	Huron/Sand Lake	X	X		
Marbled godwit	All three districts	X	X	X	
Nelson's sharp-tailed sparrow	Sand Lake	X		X	
Northern harrier	All three districts			X	
Piping plover	All three districts				X
Red-headed woodpecker	All three districts	X	X		
Savannah sparrow	All three districts			X	
Sedge wren	All three districts				
Sharp-tailed grouse	Huron/Sand Lake			X	
Short-eared owl	All three districts	X	X	X	
Sprague's pipit	Sand Lake	X	X		
Swainson's hawk	All three districts	X		X	
Upland sandpiper	All three districts	X	X	X	
Virginia rail	All three districts			X	
Western meadowlark	All three districts			X	
Willet	All three districts			X	
Willow flycatcher	All three districts		X		
Wilson's phalarope	All three districts			X	

Table 7. Selected focal grassland bird species by wetland management district.

Species	*Huron*	*Madison*	*Sand Lake*
Baird's sparrow			X
Blue-winged teal	X	X	X
Bobolink		X	X
Chestnut-collared longspur	X		X
Gadwall	X	X	X
Grasshopper sparrow	X	X	X
Greater prairie-chicken	X		
Mallard	X	X	X
Marbled godwit	X	X	X
Northern harrier		X	
Northern pintail	X	X	X
Northern shoveler	X	X	X
Short-eared owl	X		
Upland sandpiper	X	X	X
Willet			X
Wilson's phalarope		X	

people." The purpose of ESA is to provide a means whereby endangered species and their ecosystems may be conserved. The intent of the act is not merely to list species as endangered or threatened, but rather to recover the populations of these species to a point where they can be removed from the list.

Occurrences of eight federally listed species and two candidate species (Dakota skipper and Sprague's pipit) have been documented within at least one of the three districts. These species are listed in table 8 and described below.

American Burying Beetle

Although the Service lists South Dakota as a State where burying beetle is known to occur, the last documented occurrence in the districts was in Brookings County in 1945. Habitat associations with historical collections of burying beetle are not well defined. It is thought that carrion availability is more important than vegetation or soils to the species' occurrence.

Dakota Skipper

Dakota skippers occur in the Sand and Lake Madison WMDs. Dakota skipper is a small butterfly with a 1-inch wingspan. It has a thick body and a faster and more powerful flight than most butterflies. Skippers are likely to occur only in scattered remnants of high-quality native prairie across a vast area of grassland in the north-central United States and south-central Canada. The most significant remaining populations of Dakota skipper are in western Minnesota, northeastern South Dakota, north-central North Dakota, and southern Manitoba. The species' current distribution straddles the border between tallgrass and mixed-grass prairie; it occurs in two types of habitat (USFWS 2002a):

- Flat, moist native bluestem prairie in which three species of wildflowers are usually present— stagewood lily, harebell, and smooth camas.
- Upland (dry) prairie that is often on ridges and hillsides; bluestem grasses and needlegrasses dominate these habitats and three wildflowers are typically present in quality sites—pale purple, upright coneflowers, and blanketflower.

Dakota skipper populations have declined due to widespread conversion of native prairie for agricultural and other uses. This has left the remaining skipper populations isolated from one another in relatively small areas of remnant native prairie. In addition, many of the habitats where the species persists are threatened by overgrazing, conversion to cultivated agriculture, inappropriate fire management and herbicide use, woody plant invasion, road construction, gravel mining, invasive plant species, and flooding.

Topeka Shiner

Topeka shiner habitat is characterized as small to mid-sized streams of the central prairie regions of the United States with relatively high water quality and cool to moderate temperatures. Many of these streams exhibit perennial flow, although some become intermittent during summer or periods of prolonged drought.

Few historical data are available regarding the distribution of Topeka shiner in South Dakota; at the time this species was proposed for listing in 1997, only five locations were known. Since then, several

Table 8. Listed species (based on published population data).

Status	*Species/listing name*
E	American burying beetle (*Nicrophorus americanus*)
C	Dakota skipper (*Hesperia dacotae*)
E	Topeka shiner (*Notropis topeka* [=*tristis*])
E	Whooping crane (*Grus americana*)—except where EXPN
E	Eskimo curlew (*Numenius borealis*)
T	Piping plover (*Charadrius melodus*)—except Great Lakes watershed
E	Least tern (*Sterna antillarum*)—interior DPS
C	Sprague's pipit (*Anthus spragueii*)
E	Black-footed ferret (*Mustela nigripes*)—entire population, except where EXPN
E	Gray wolf (*Canis lupus*)—lower 48 States, except where delisted or EXPN. Mexico.

E = listed as endangered under ESA
T = listed as threatened under ESA
C = candidate for listing under ESA
EXPN = experimental nonessential population
DPS = distinct population segment

surveys conducted throughout South Dakota found that the species was more widespread than previously thought. In its Final Ruling on Topeka shiner critical habitat (69 Federal Register 44736, July 27, 2004), the Service elected to exclude from designation all previously proposed critical habitat in South Dakota under authority of ESA section 4(b)(2). As a result, several agencies partnered to develop a plan for the shiner's recovery in South Dakota. Current measures to protect the species defer to this plan.

Whooping Crane

Whooping crane is one of the most endangered birds in North America. According to Tom Stehn, Service Whooping Crane Coordinator, as of 2010 the only naturally occurring wild, migratory population in the world numbered approximately 290 individuals. Each spring and fall, whooping cranes use wetlands and agricultural fields in the Huron and Sand Lake WMDs as migratory stopover areas en route to their summer and winter grounds.

Eskimo Curlew

Although the Service lists South Dakota as a State where Eskimo curlew is known to occur, no specific location information is available.

Piping Plover

Designated critical habitat for this threatened species is defined as prairie alkali wetlands and surrounding shoreline, extending into upland habitat to 200 feet outside the high water mark; river channels and associated sandbars and islands; reservoirs and their sparsely vegetated shorelines, peninsulas, and islands; and inland lakes and their sparsely vegetated shorelines and peninsulas.

Historic data on the distribution of northern Great Plains piping plovers are scarce, with regular surveying efforts beginning after 1980. More recent breeding records exist for counties along the Missouri River, as well as Codington, Day, and Miner Counties in South Dakota (South Dakota Ornithologists' Union 1991).

According to C. D. Kruse of the U.S. Army Corps of Engineers, nesting in South Dakota has generally been limited to the Missouri River, primarily below the Gavins Point and Fort Randall Dams and on Lake Oahe. Piping plovers have occasionally nested on Lake Sharpe (Missouri River); they have been sighted on Lake Francis Case (Missouri River) during the nesting season, but nesting has not been documented. Along these rivers, plovers often nest near interior least terns (federally listed as endangered).

Of the roughly 6,000 piping plovers left in the world, about half breed in the northern Great Plains. This population is declining between 6 and 12 percent annually (Larson et al. 2002; Plissner and Haig 2000; Ryan et al. 1993), and is expected to become extinct in 50–100 years unless significant conservation activities are initiated. The decline and poor prognosis led to the listing of this population in the 1980s as threatened in the United States and endangered in Canada.

Interior Least Tern

The Service lists the Sand Lake WMD as an area where the least tern is known to occur. This tern, the smallest member of its family, arrives on its breeding grounds in early May. Interior least terns nest in small, loosely defined groups on barren beaches of sand, gravel, or shells; on dry mudflats and salt-encrusted soils (salt flats); and at sand and gravel pits along rivers. Nesting success depends on the presence of bare or nearly barren sandbars, favorable water levels during nesting, and abundant food. The chicks leave the nest only a few days after hatching, but the adults continue to care for them, leading them to shelter in

Ryan Hagerty/USFWS

The whooping crane is a listed species.

nearby grasses and bringing them food. Terns hover over and dive into standing or flowing water to catch small fish. The interior least tern was federally listed as endangered in 1985, primarily due to the loss of nesting habitat as a result of dramatic alterations (channelization and impoundment) of important river systems. Water level fluctuations, vegetation of nesting habitat, and disturbance (from people, pets, predators, and livestock) continue to jeopardize nesting success.

Sprague's Pipit

Once common, the Sprague's pipit has now declined drastically. Surveys have found a long-term (approximately 40-year) population decline of approximately 3.9 percent annually. Conversion of native grasslands to agriculture probably significantly reduced the total global population of Sprague's pipit to current levels. Populations are still threatened by the loss and conversion of breeding habitat to agriculture and human development. Overgrazing by cattle and the invasion by exotic grasses have further reduced the quality of much of the species' breeding habitat. In addition, loss, conversion, fragmentation, and degradation of grasslands on the pipit's wintering grounds are continuing threats.

The Sprague's pipit is one of the few endemic species to the North American grasslands, requiring grassland habitat for both breeding and wintering. The species' breeding range includes parts of Montana, North Dakota, South Dakota, and Minnesota. During the breeding season, Sprague's pipits are most common in relatively large patches of prairie for nesting (estimated at between 170–776 acres), and thus may be area sensitive. Although they use exotic vegetation, they are significantly more abundant in, and prefer, native prairie. They avoid non-prairie features in the landscape, so the impact of an object (for example, an oil and gas well or a wind turbine) is much larger than the actual footprint of the feature. Energy development is increasing rapidly throughout the breeding range of the Sprague's pipit, a trend that is expected to continue.

The male has a high breeding flight display that can last up to 3 hours. On the ground, Sprague's pipits have very secretive behavior, landing several meters away from the nest and approaching on foot. Sprague's Pipits are one of the least-studied birds in North America, in part due to their elusive behavior and habit of singing high above the ground.

The Service has determined that the Sprague's pipit, a small grassland bird, warrants protection under the ESA, but that listing the species is precluded by the need to address other listing actions of higher priority. The Sprague's pipit will be classified as a candidate species until a listing proposal can be prepared. The Service has completed a comprehensive status review—known as a 12-month finding—and determined that there is sufficient scientific and commercial data to propose listing the species as threatened or endangered throughout its range due to loss of habitat and the inadequacy of existing regulations to protect the habitat. However, the districts have chosen to postpone developing a species-specific objective for the Sprague's pipit until a formal conservation strategy and guidelines for Sprague's pipit management can be developed.

Black-Footed Ferret

It is assumed that ferrets occurred in association with prairie dog colonies—likely including portions of the three-district area. However, the most recent documented observation of wild black-footed ferrets in the vicinity was west of the Missouri River in 1974.

Gray Wolf

Gray wolves once lived in much of the contiguous United States. They were only absent from a portion of California, the southwest corner of Arizona, and the red wolf range in the southeastern United States. By 1974, when gray wolf was listed as an endangered species, the species' breeding range had been reduced to a small corner of northeastern Minnesota and Isle Royale, Michigan. Individual wolves were periodically observed in the West, but there were no breeding packs. Recovery efforts have since restored the species to some areas of its historic range, including portions of the Southwest, the Rocky Mountains, and the western Great Lakes Region. No records exist for South Dakota.

The Western Great Lakes DPS (Distinct Population Segment) has been proposed for delisting.

4.3 Cultural Resources

Humans have occupied central North America for more than 12,000 years and have left a diverse cultural material legacy on the landscape. Several researchers have summarized our understanding of the prehistory and history of the region (Bonnichsen et al. 1987; Gregg et al. 1996; Schneider 1982; SHSND 1990; Winham and Hannus 1989; Wood 1998), and only a brief review will be provided here. The following summary is adapted from Michael A. Jackson and Dennis L. Toom's 1999 report, "Cultural Resources Overview Studies of the Tewaukon National Wildlife Refuge, Sargent County, North Dakota, and the Waubay National Wildlife Refuge, Day County, South Dakota" (Jackson and Toom 1999).

The Northeastern Plains cultural chronology can be divided into five basic periods:

1. Paleoindian (9500–5500 B.C.)
2. Plains Archaic (ca. 5500–500 B.C.)
3. Plains Woodland (500 B.C.–A.D. 1000)
4. Plains Village (A.D. 1000–1780)
5. Historic (A.D. 1780–1890)

The names of the first four periods also refer to mainly prehistoric Native American cultural traditions, with the Plains Village tradition extending into early historic times. The Historic period encompasses the decline of the Plains Village tradition and the rise of the Plains Equestrian tradition, which developed as a consequence of the introduction of the domestic horse, European manufactured trade goods, and epidemic diseases. It subsumes Native American lifeways during protohistoric and early historic times in the Northern Plains from about A.D. 1780 to A.D. 1880. Later in the Historic period, at the end of the Plains Equestrian tradition at ca. A.D. 1880, the Euroamerican tradition becomes dominant.

PALEOINDIAN PERIOD (9500–5500 B.C.)

The Paleoindian period has been provisionally dated to approximately 9500–5500 years B.C. The age range of this period is based mainly on Paleoindian finds elsewhere in the Great Plains because the amount of Paleoindian artifacts identified in the Northeastern Plains subarea is minimal. This period began with the initial entry of humans into the Northeastern Plains following the retreat of the last Pleistocene glaciers. These Paleoindian peoples exhibited nomadic settlement patterns and subsistence economies based on hunting and gathering that were adapted to late Pleistocene and early Holocene climates, animals, and plants.

Paleoindian artifacts have rarely been identified in the eastern Dakotas, but they are more common farther west. In the eastern Dakotas, including the Glaciated Plains and Prairie Coteau, erosion has been limited (in comparison to the western Dakotas); consequently, most of the upland land surfaces have been relatively stable since the last glacial retreat. The modern ground surface is therefore essentially the same surface as that on which Paleoindian peoples lived, so cultural remains of those peoples should be present at or near the surface. If Paleoindian materials are present, they are likely in poor context because of the cumulative effects of thousands of years of bioturbation and approximately 100 years of agricultural plowing.

PLAINS ARCHAIC PERIOD (5500–500 B.C.)

The Plains Archaic period followed the Paleoindian period from approximately 5500 B.C. to 500 B.C. Relatively few Plains Archaic sites have been identified in the Northeastern Plains, and even fewer have been extensively investigated. This period is characterized as an extension of the nomadic hunting and gathering adaptation from the preceding period, but it was adapted to essentially modern (Holocene) climate, fauna, and flora. Bison remained the principal quarry of these people, although deer, elk, and moose were exploited along the prairie/woodland transition. There is also evidence of intensified seed and plant gathering and processing during the Plains Archaic period. Other changes included the adoption of the atlatl and dart, and an overall decline in the quality of flintknapping.

PLAINS WOODLAND PERIOD (500 B.C.–A.D. 1000)

Plains Woodland lifeways are thought to have shared many similarities with those of the Plains Archaic period, particularly subsistence economies based on hunting and gathering. However, the practice of

mound burial, possibly indicative of more complex ceremonialism; the production and use of ceramic vessels; and the first use of the bow and arrow all appear to have been developments that distinguish the Plains Woodland period. It is also possible that horticulture made its first appearance during Plains Woodland times, but direct evidence of this is lacking in the Northern Plains. It also has been suggested that Plains Woodland peoples enjoyed a somewhat more settled lifeway, shifting from the fully nomadic settlement pattern of the Plains Archaic period to a seminomadic pattern.

Artifact assemblages of the Plains Woodland tradition reflect the introduction of ceramic technology and the acquisition of exotic trade materials. Late in the tradition, the transition from dart or spear points to arrow points can be seen in weapons technology. The lifeway is characterized by increased sedentism, population growth, and the construction of earthen burial mounds. The appearance of the Plains Woodland tradition in the eastern Dakotas is an extension of the general Woodland lifeway that flourished throughout the Midwest (to the east and southeast) during this period. Again, adaptation to the plains/prairie environment resulted in a distinctive subsistence pattern that relied heavily on bison hunting. Plains Woodland campsites are generally identified where river and stream valleys extended into the Plains proper, affording a riparian setting for the establishment of base camps.

Plains Village Period (A.D. 1000–1780)

In the Northern Plains, the Plains Village tradition is best known from its many village sites that have been found in the Middle Missouri subarea, a region consisting essentially of the Missouri River trench in the Dakotas. The Plains Village tradition first appeared in the Middle Missouri at about A.D. 1000. It flourished there throughout most of the late prehistoric period and persisted in attenuated form well into historic times. The period is brought to a close at A.D. 1780 following the decimation of the Plains Village population base along the Missouri River by a smallpox epidemic that originated in the American Southwest.

Plains Village culture was distinctly different from its Plains Woodland antecedent. It was characterized by the construction of substantial, permanent dwellings, known as earthlodges, that were arranged into villages of various sizes and configurations, some of which were fortified and some not. Subsistence was based on a mixed strategy of horticulture, or garden agriculture, including the cultivation of maize, beans, squash, and sunflowers; bison hunting; and general hunting and gathering, or foraging. Continued elaboration and sophistication in ceramic manufacture also typify the period, with well-made, globular-shaped and shouldered pots exhibiting a wide variety of stylistic variability typifying most village collections.

The Plains Village settlement pattern is interpreted as semi-sedentary, with people residing in their villages at various times of the year, especially during times of important horticultural activity, and leaving their villages at other times to go on extended hunts. A key element in the Plains Village adaptation was the production of a dependable, storable, surplus food supply. This surplus consisted of both meat and garden produce that was usually stored in subterranean storage pits, commonly called cache pits, another identifying attribute of the tradition. Considerable archeological and ethnohistorical evidence indicates direct connections between the prehistoric Plains Village tradition; the related Coalescent Tradition in the Northern Plains; and the historically known Mandan, Hidatsa, Arikara, and Cheyenne peoples.

Protohistoric and Early Historic Period (A.D. 1780–1890)

The Plains Equestrian tradition, also referred to as the Equestrian Nomadic tradition, evolved during protohistoric and early historic times following the introduction of the domestic horse via trade networks extending into the Spanish Southwest. In the Northern Plains, acquisition of the horse by Native American peoples was well underway by about A.D. 1750. The Plains Equestrian tradition represents the well-known nomadic bison hunters of early historic times who spent much of the year in tipi camps. During this period, there was greater cultural interaction among native groups as a consequence of improved transportation (i.e., the horse) and ever increasing Euro-American influence.

"Protohistoric" refers to the time of initial Euro-American cultural impact on native cultures prior to actual contact. European cultural influence may have come as early as A.D. 1650 with the introduction of trade goods filtering into the area from the north via native trade networks. As mentioned above, horses were introduced from the south by the mid-1700s. By the end of the eighteenth century and the beginning of early historic times, fur trade expansionism had profoundly influenced Native American lifeways in the Dakotas. Participation in the trading system brought changes in material culture and subsistence practices as interaction with Euro-Americans intensified.

Later in the Historic period—by about A.D. 1880—Euro-American domination of what was to become North and South Dakota was complete. Permanent non-Indian settlement of the States came about with the construction of railroads and the security of military protection. Military occupation of the Dakotas accelerated in response to the 1862 Sioux Uprising in Minnesota. The establishment of permanent forts in the Dakota Territory prepared the way for settlement. In addition to the military complement and their families, a civilian population was employed to supply goods and services to the army. Railroads penetrated

the territory in the 1870s, and homesteaders immigrated to the area partly because transportation and military protection were assured. Settlers acquired land from the railroads or from the government through the Homestead, Pre-emption, and Timber Culture acts in the 1870s and 1880s. Agricultural settlement followed a cyclical pattern of boom and decline, especially in the eastern part of the State. Settlement spread generally from east to west, and in 1889 the Dakotas achieved statehood.

4.4 Visitor Services

The Improvement Act emphasizes the importance of compatible, wildlife-dependent recreation. The act identifies six priority public uses: hunting, fishing, wildlife observation, photography, environmental education, and interpretation.

Hunting

Centuries ago, the coteau areas were considered a prominent landmark to the Plains Indians and early European settlers who camped and hunted waterfowl and other game species in the wetlands and potholes areas. With the settlement of the prairie States, certain hunting restrictions were established for the protection and propagation of wildlife.

Through Federal Duck Stamp sales, districts purchase and provide habitat for migratory and nesting waterfowl. Hunting of migratory waterfowl is allowed at WPAs, where only federally approved nontoxic shot is permitted. All other State regulations apply at WPAs.

Most of the WPAs are open to hunting for upland birds (ring-necked pheasant, sharp-tailed grouse, gray partridge). The districts also offer archery, rifle, and muzzleloader deer hunting.

Fishing

Fishing is allowed year-round at the districts; however, ice fishing during the winter months seems to be the most popular fishing activity. Restrictions on vehicle access into WPAs may be limited to designated trails. Permanent lakes at the districts offer fishing for northern pike, walleye, yellow perch, and a few other species.

Due to the abundance of aquatic life in the permanent wetlands, growth rates of fish are often very high. Fishing on WPAs, like all fishing on Service lands, requires the angler to follow both State fishing regulations and special refuge regulations.

Wildlife observation and photography

The districts provide outstanding opportunities for viewing wildlife. They offer optimal viewing for waterfowl, grassland birds, and shorebirds from April through early June and from late August through October. Seasonal highlights include the spring courtship dances of sharp-tailed grouse and western grebe, spring and fall shorebird migrations, daily fall movements of thousands of waterfowl, and winter activities of various bird and mammal species. Many wildlife species can be observed from public roads. In some areas, viewing blinds are available, and their locations on the districts change from time to time. Please contact individual district offices to obtain information on current viewing blind availability.

USFWS

District programs reach out to young hunters.

Environmental education and interpretation

Each district has a either a standalone headquarters or a headquarters co-located with a national wildlife refuge. Each headquarters office displays information in the visitor contact area.

The visitor centers offer exhibits and a variety of informational pamphlets about the Service, district, Refuge System, and other natural resources–related information. Strategically located kiosks contain information about prairie wetlands and wildlife species found throughout the districts. District staff provides educational talks and tours for schools and other groups, on request. The environmental education and outreach programs expand beyond the boundaries of the districts. District staff is involved in local, regional, and statewide programs.

Trapping

Recreational trapping is available at all WPAs, in accordance with State trapping regulations. Authorized by 50 CFR, part 31.16, recreational trapping is administered by the Service.

4.5 Partnerships

District staff has established partnerships with a wide variety of local, State, and national groups in efforts to achieve habitat objectives or expand environmental education. Most districts have local partnerships with weed boards, water resource boards, rural volunteer fire departments, law enforcement departments, Scouts, 4-H clubs, and private landowners. The districts have worked closely with SDGFP on projects such as hunting and fishing opportunities, disease issues, and management of habitat and invasive plants. District staff has developed partnerships with groups and agencies such as the U.S. Army Corps of Engineers, Ducks Unlimited, The Nature Conservancy, National Audubon Society, National Wild Turkey Federation, National Fish and Wildlife Foundation, USGS, and NRCS for habitat management, research, and environmental education.

4.6 Socioeconomic Environment

A socioeconomic study prepared by BBC Consulting (2009) is the source for information in this section.

Background

The three districts offer hunting, fishing, wildlife observation, photography, environmental education, and interpretation opportunities to the public. These recreational opportunities attract visitors, who spend money in the surrounding communities. Ancillary visitor activity, such as spending on food, gasoline, and overnight lodging, provides local businesses with supplemental income. Management decisions regarding public use, expansion of services, and habitat improvement measures at the districts affect recreation activity and, consequently, visitor expenditure.

Current socioeconomic, population, and employment conditions

The only large metropolitan area in the planning area is Sioux Falls in Minnehaha County. Other large communities in the planning area include Pierre, Huron, and Aberdeen. According to 2006 population estimates by the Bureau of Economic Analysis, the planning area is home to almost 347,000 individuals, or about 44 percent of the South Dakota population. Population growth in the planning area has been driven exclusively by growth in the metropolitan area south of Sioux Falls, the most populous city in South Dakota. The population of this city grew by more than 50 percent between 1980 and 2006, while the population in the rest of the planning area declined by more than 20 percent.

According to the Bureau of Economic Analysis, the planning area employs about 268,500 workers.

This same source discloses that most of the jobs in South Dakota are in government (13 percent), retail trade (12 percent), "other professional services" (12 percent), and health care and social assistance (11 percent). According to the Bureau of Labor Statistics, unemployment in the planning area ranged from 2.2 percent in Brookings County to 11.5 percent in Buffalo County in 2008. However, with the exception of Buffalo County, all counties in the planning area had unemployment rates below 5 percent. South Dakota's statewide unemployment rate of 4.6 percent was one of the lowest in the country during this period.

District Operations, Staffing Conditions, and Recreational Opportunities

Huron, Madison, and Sand Lake WMDs share contiguous boundaries in eastern South Dakota. Similarly, they share management activities such as controlling water quality and quantity, mitigating the presence of invasive species, disease control, restoration of native plant species, and ecological research.

Huron WMD currently employs 12 full-time, year-round employees, while Madison WMD employs 9 full-time, year-round employees. Sand Lake National Wildlife Refuge Complex, of which Sand Lake WMD is part, employs 11 full-time, year-round and 6 seasonal employees, but most of these employees are shared by the district and Sand Lake National Wildlife Refuge. Based on estimates of the relative amount of time spent by each employee on management at the district versus the refuge, and considering their full-time or seasonal status, the district supports the equivalent of about 6.25 FTEs (full-time equivalents).

Hunting, the principal activity driving the area's tourist industry, is by far the most popular visitor activity at all three districts, accounting for about 80 percent of visitation. The fall hunting season brings thousands of visitors by road and air into eastern South Dakota, and in many communities lodging is fully booked throughout this period. The majority of these hunters come to hunt pheasant, but some hunt migratory birds and a small portion pursue big game. The largest number of hunters visit Madison WMD due to its proximity to Sioux Falls, and hunting activity generally decreases along the Highway 14 corridor toward Huron WMD and the more remote Sand Lake WMD. Nevertheless, the cities of Huron and Aberdeen experience large influxes of hunters during the hunting season.

Fishing accounts for about 12 percent of visitation to the districts. It is most popular at Madison WMD, accounting about 14 percent of the visitation to this

district. Huron and Sand Lake WMDs report a combined total of fewer than 100 fishermen per year.

Non-consumptive recreational activities account for less than 8 percent of visitation to the districts and take place year-round, although they are most popular during the spring and summer months. Birding is the most popular non-consumptive activity at the districts, especially during the migration season.

Trapping is also permitted at the districts and accounts for about 19,800 visits per year to Madison WMD. Camping is not permitted on lands managed by the districts, although visitors often stay overnight in local commercial lodging establishments.

Annual visitation to the three districts in recent years has totaled more than 240,000 visitor-days, according to district staff. The majority of visitation (more 207,500 visitor-days) takes place at Madison WMD, due to its proximity to Sioux Falls. Huron WMD sees about 27,000 annual visitor-days and Sand Lake WMD only about 6,000.

District managers estimate that slightly less than a quarter of visitation (58,200 visitor-days) involves non-locals, but this proportion varies greatly by visitor type. More than 60 percent of pheasant hunters are from outside the planning area, compared to only 6 percent of big game hunters. District fisheries do not attract many trophy fishermen from outside the area, and fishing-related visitation to the districts is almost entirely local. An estimated 13 percent of non-consumptive recreational visitors to the districts are non-local. The proportion of visitation that is non-local also varies by district: almost 80 percent of visitation to Madison WMD is local due the presence of Sioux Falls; Huron WMD draws a somewhat higher proportion of non-locals (about one-third); and the more remote Sand Lake WMD has the highest proportion of non-local visitation (60 percent).

Offsite spending by visitors helps support local lodging and retail establishments in surrounding towns. Only non-resident visitor spending can be considered when calculating the socioeconomic impact of refuges on the local economy in the planning area in eastern South Dakota. The money spent by local residents on visitation to these districts would likely be spent on other local recreational activities if the complex did not exist, so it cannot be considered "new" expenditure in the local economy.

The Service's Banking on Nature 2006 study examines visitor expenditure by activity (hunting, fishing, or non-consumptive) for a sample of refuges and districts throughout the country. Huron WMD and Madison WMD are both profiled in this study; Sand Lake WMD is not. However, representations by district managers indicate that visitation to Sand Lake WMD is very similar to visitation to Huron WMD, and that spending levels are likely the same. Based on data reported in Banking on Nature, the average daily expenditure of non-local visitors to the districts is about $79 for hunters, $56 for anglers, and $25 for wildlife viewers and recreationists.

Baseline Economic Activity

The three districts affect the economy through the non-resident visitor spending they generate and the employment they support. The districts employ approximately 27.25 FTEs. A full-time year-round employee counts as one FTE, while seasonal and part-time employees, as well as those shared by districts and refuges, are counted as a fraction of an FTE. Payroll supported by the three districts totals $1,735,000, or nearly $64,000 per FTE. Using Bureau of Labor Statistics Consumer Expenditure Survey data for individuals in this income category, roughly 79 percent of annual income is spent locally. Under this assumption, the WMDs contribute $1,371,000 to the local economies in employee spending.

Visitor Spending

The three districts currently experience total visitation of approximately 58,200 non-resident visitor days per year. Of these, roughly 54,400 are for hunting, 1,500 for fishing ,and 2,300 for non-consumptive recreational activities. Combining these visitation numbers with nonresident spending averages from the Banking on Nature study, total visitor expenditure generated by the three districts is estimated to be $4,414,000 per year. Almost all expenditures (almost 97 percent) come from hunting and the remainder from fishing and non-consumptive recreation. Combining the effects of Service employment and visitor spending, the total direct economic activity generated by the Huron, Madison, and Sand Lake WMDs on the planning area is approximately $5.79 million annually.

4.7 Operations

Funding for operations at the districts supports the staff, facilities, and equipment needed to carry out management activities to meet the each districts' purposes, goals, and objectives. Each of the three stations that is not part of a complex has its own staff and facilities. Despite that, office working conditions are limited and can impose some constraints on conducting business.