South Dakota
Wetland Resources

Although wetlands cover only 3.6 percent of South Dakota (Dahl, 1990), they are of substantial ecological and economic importance to the State and Nation. Depressional wetlands in the glaciated eastern part of South Dakota, commonly referred to as prairie potholes, and wetlands associated with reservoirs provide important breeding and resting habitat for migratory and resident waterfowl (fig. 1). South Dakota wetlands also provide important habitat to many other nongame and game wildlife species, including pheasants (Sather-Blair and Linder, 1980; Soil Conservation Service, 1985) and whitetail deer (Kramlich, 1985), which are economically valuable to the State.

Hydrologic functions of wetlands include water retention and flood attenuation (Hubbard and Linder, 1986) and, on a local basis, ground-water recharge (Hubbard, 1988a). Hunting, trapping, fishing, bird watching, nature photography, camping, hiking, and boating are some of the recreational opportunities provided by wetlands, and the South Dakota tourist industry relies heavily on the recreational and esthetic value of the State's wetlands. Other important benefits of wetlands in South Dakota include livestock forage (Hubbard, 1988b), bait-fish production (Carlson and Berry, 1990), and mineral mining. These benefits are provided by diverse wetlands distributed across South Dakota's plains and the Black Hills.

TYPES AND DISTRIBUTION

Wetlands are lands transitional between terrestrial and deepwater habitats where the water table usually is at or near the land surface or the land is covered by shallow water (Cowardin and others, 1979). The distribution of wetlands and deepwater habitats in South Dakota is shown in figure 2*A*; only wetlands are discussed herein.

Wetlands can be vegetated or nonvegetated and are classified on the basis of their hydrology, vegetation, and substrate. In this summary, wetlands are classified according to the system proposed by Cowardin and others (1979), which is used by the U.S. Fish and Wildlife Service (FWS) to map and inventory the Nation's wetlands. At the most general level of the classification system, wetlands are grouped into five ecological systems: Palustrine, Lacustrine, Riverine, Estuarine, and Marine. The Palustrine System includes only wetlands, whereas the other systems comprise wetlands and deepwater habitats. Wetlands of the systems that occur in South Dakota are described below.

System	Wetland description
Palustrine	Wetlands in which vegetation is predominantly trees (forested wetlands); shrubs (scrub-shrub wetlands); persistent or nonpersistent emergent, erect, rooted, herbaceous plants (persistent- and nonpersistent-emergent wetlands); or submersed and (or) floating plants (aquatic beds). Also, intermittently to permanently flooded open-water bodies of less than 20 acres in which water is less than 6.6 feet deep.
Lacustrine	Wetlands within an intermittently to permanently flooded lake or reservoir. Vegetation, when present, is predominantly nonpersistent emergent plants (nonpersistent-emergent wetlands), or submersed and (or) floating plants (aquatic beds), or both.
Riverine	Wetlands within a channel. Vegetation, when present, is same as in the Lacustrine System.

There is no current (1993) estimate of statewide wetland acreage in each of the systems. Final mapping and digitizing for the FWS National Wetlands Inventory has been completed for eastern South Dakota, but only preliminary draft mapping has been completed for the remainder of the State (Chuck Elliot, U.S. Fish and Wildlife Service, oral commun., 1993). Final mapping and digitizing for the entire State may be completed within a few years.

An inventory of wetland and open-water areas conducted in 1973–74 estimated that 71 percent of South Dakota's wetlands were palustrine (Ruwaldt and others, 1979); 19 percent were mixed lacustrine and palustrine associated with prairie ponds and lakes and manmade stock ponds and dugouts; and 10 percent were riverine. Stock ponds are impoundments constructed by damming deep draws; dugouts are constructed by excavating a depression and do not have dams (Ruwaldt and others, 1979). Palustrine wetlands in South Dakota primarily include emergent wetlands such as marshes and sloughs, in which coarse, herbaceous vegetation like cattails and bulrushes are predominant; wet meadows, in which low, herbaceous vegetation like grasses and sedges are predominant; and vegetated, shallow-water zones of stock ponds and dugouts (Stewart and Kantrud, 1971). Lacustrine wetland areas occur in the numerous glacial lakes in the eastern part of the State and in artificial impoundments throughout the State. Submersed vegetation like widgeongrass and pondweed are common in lacustrine wetlands. Prairie potholes (a palustrine emergent wetland) that contain erect, rooted, herbaceous hydrophytes are by far the most common wetland type in South Dakota (Kantrud, Krapu, and Swanson, 1989).

Wetlands occupy about 1.8 million acres (3.6 percent) of South Dakota (Dahl, 1990). In the Great Plains (fig. 2*B*), the natural drainage system generally is well developed, and there are few natural wetlands. Wetlands in the Great Plains generally are associated with manmade stock ponds. The Central Lowland is entirely within the glaciated part of South Dakota (fig. 2*C*), and most wetlands are in depressions among ground moraines deposited by the glaciers.

HYDROLOGIC SETTING

Wetlands form where there is a persistent water supply at or near the land surface. The location and persistence of the supply is a function of interdependent climatic, physiographic, geologic, and

Figure 1. Palustrine wetland in the Sand Lake National Wildlife Refuge. This refuge encompasses about 22,000 acres (mostly palustrine and lacustrine wetlands) and is an important nesting and staging area for migratory waterfowl. *(Photograph by Bill Schultze, U.S. Fish and Wildlife Service.)*

hydrologic factors such as precipitation and runoff patterns, evaporation, topography, and configuration of the water table. In South Dakota, the dominant factors influencing the distribution of wetlands are moisture deficit, topography, and composition of surficial materials.

Precipitation and runoff rates in South Dakota differ annually and with season and location. The normal annual precipitation in South Dakota ranges from about 16 inches in the northwest to about 24 inches in the Black Hills and the southeast (Benson, 1986). About 70 percent of annual precipitation occurs during the growing sea-

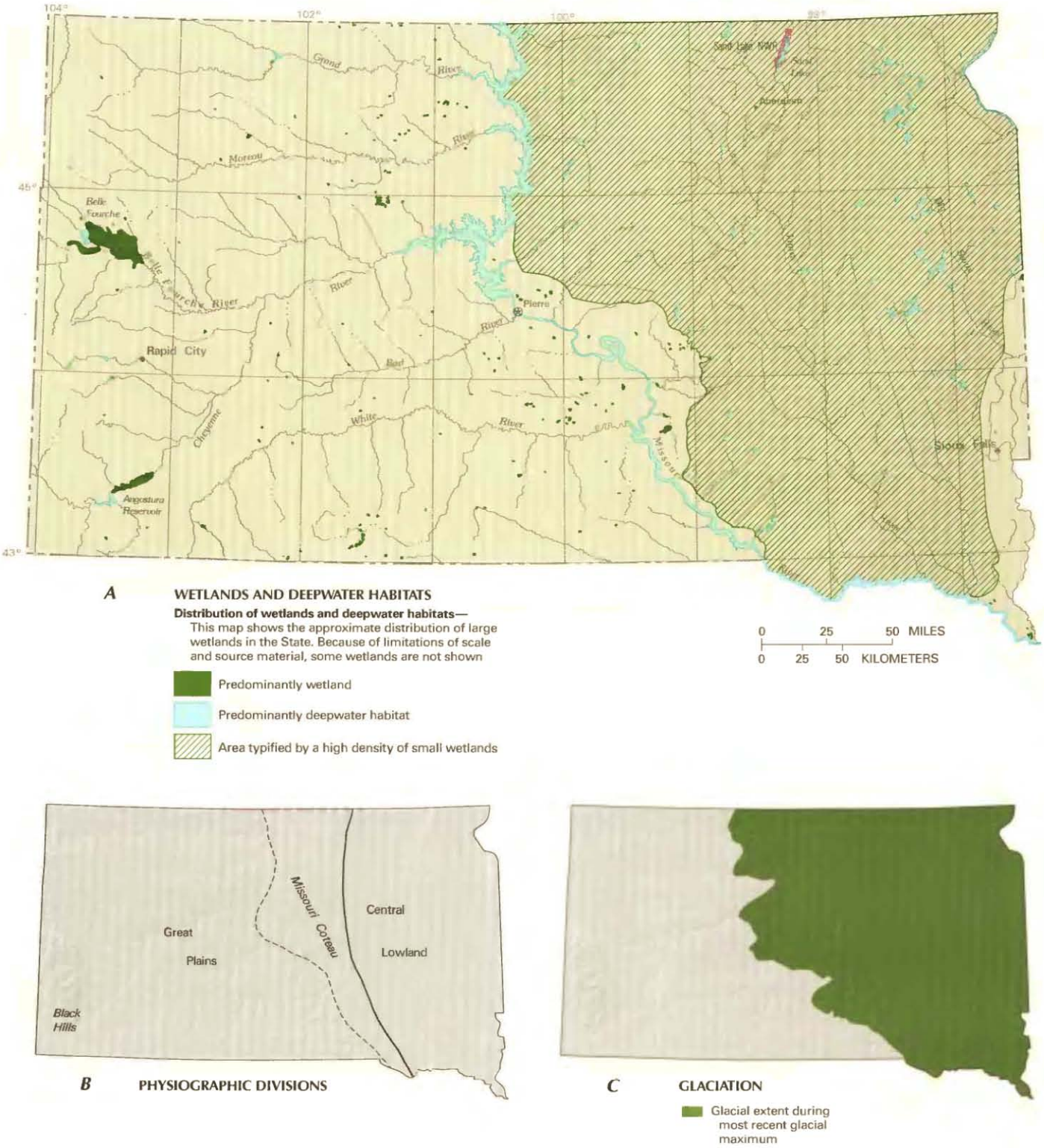

Figure 2. Wetland distribution in South Dakota and physical features that control wetland distribution in the State. ***A***, Distribution of wetlands and deepwater habitats. ***B***, Physiography. ***C***, Extent of most recent glaciation. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Physiographic divisions from Fenneman, 1946; landform data from EROS Data Center. C, South Dakota Geological Survey, 1971).*

son (May through October). The average annual runoff ranges from about 0.2 inch in the northwest to about 2 inches in the Black Hills. A large percentage of runoff occurs as a result of snowmelt and rainfall in the spring and early summer. Precipitation and snowmelt runoff are the principal water sources for prairie pothole wetlands (Shjeflo, 1968).

Annual lake evaporation in South Dakota ranges from about 38 inches in the northeast to about 48 inches in the southwest (Benson, 1986). About 75 percent of the annual evaporation occurs during the growing season. In South Dakota, evaporation exceeds precipitation in most years, and there is a net statewide annual moisture deficit that ranges from about 20 inches along the eastern border of the State to about 32 inches in the southwest. Evaporation is the principal source of water loss from prairie pothole wetlands (Shjeflo, 1968).

Climatic, topographic, and hydrologic characteristics differ among and sometimes within physiographic provinces. The two major physiographic provinces in South Dakota (fig. 2*B*), the Great Plains and the Central Lowland, generally have very different hydrologic settings for wetland formation.

The Great Plains physiographic province generally is unglaciated, and the natural drainage system is well developed. Steeper topography, a better developed drainage system, and a generally more arid climate are factors that result in substantially fewer wetlands in the Great Plains than in the Central Lowland in eastern South Dakota. Wetlands in the Great Plains occur primarily in association with manmade stock ponds and perennial and ephemeral streams (Brewster and others, 1976; Ruwaldt and others, 1979). Most of the wetland areas associated with perennial streams are classified as riverine, whereas those associated with ephemeral streams generally are palustrine because of the presence of emergent plants (Hubbard, 1988a). Wetlands associated with stock ponds and dugouts generally are classified as palustrine or lacustrine. About 60 percent of the wetlands in the unglaciated western part of South Dakota occur in association with stock ponds. Although several studies have indicated that stock ponds do not equal natural wetlands in habitat quality, the stock ponds provide valuable habitat for plants and animals, especially during drought (Duebbert, 1972; Flake, 1979). A small part of the Great Plains lies east of the Missouri River in a glaciated region known as the Missouri Coteau. Prairie pothole wetlands are common in this region.

In the glaciated Central Lowland, several factors result in retention of water on the land surface and the occurrence of numerous prairie pothole wetlands: (1) the generally flat topography results in a poorly developed drainage system and low runoff velocities, (2) depressions in the glaciated topography result in retention of water on the surface and extensive ponding, (3) low permeability of the geologic materials (soils and fine-grained glacial till) results in minimal infiltration of water, and (4) in the spring, when most of the annual precipitation and runoff occurs, frozen soils further restrict infiltration of water and cause the water to pond (Winter, 1989). About 90 percent of the wetland area of the glaciated eastern part of South Dakota is associated with prairie ponds and lakes (primarily palustrine emergent wetlands); the remaining 10 percent is divided between riverine wetlands and those associated with stock ponds or dugouts (Ruwaldt and others, 1979).

Ground-water interactions with palustrine wetlands in the prairie region can be complex (Winter, 1989). The flat topography provides opportunity for infiltration, but the impermeable substrate inhibits infiltration. Because the glacial till in eastern South Dakota generally is composed of fine-grained materials and has a high smectite-clay content, it expands greatly on wetting and becomes impermeable (Hubbard and others, 1988). Water can flow through fractures in the till; but even where fractures occur, permeability is low (Winter, 1989; Grisak, 1975). Greater interaction between wetlands and ground water can exist in areas of glacial outwash where lenses of coarser grained, more permeable materials exist (Lewis Howells, U.S. Geological Survey, oral commun., 1993). However, interaction between wetlands and ground water in eastern South Dakota generally is small and typically accounts for about 5 to 25 percent of water exchange (Winter and Woo, 1990).

Hubbard (1988a) and Winter (1989) have discussed a general model of ground-water flow systems underlying prairie wetlands (fig. 3). A local flow system (of which most shallow ground water is a part) occurs where ground water moves from an adjacent upland into a wetland or between adjacent wetlands. Intermediate flow systems generally underlie local flow systems, and water flowing in intermediate flow systems may pass under some streams and wetlands. Regional flow systems underlie both local and intermediate systems and discharge at major topographic lows such as large rivers, lakes, and wetlands. Factors that determine which ground-water flow systems a prairie pothole wetland is interacting with include the topographic setting, position of the water table, thickness and hydraulic characteristics of the aquifer material, and the configuration of the underlying bedrock (Hubbard and others, 1988).

Depending on their location within the local, intermediate, and regional ground-water flow systems, individual wetlands can serve as discharge areas, recharge areas, or both (flow-through wetlands). In the prairie pothole region, wetland water quality is affected by the interaction between wetlands and ground water: recharge wetlands tend to have low dissolved-solids concentrations, discharge

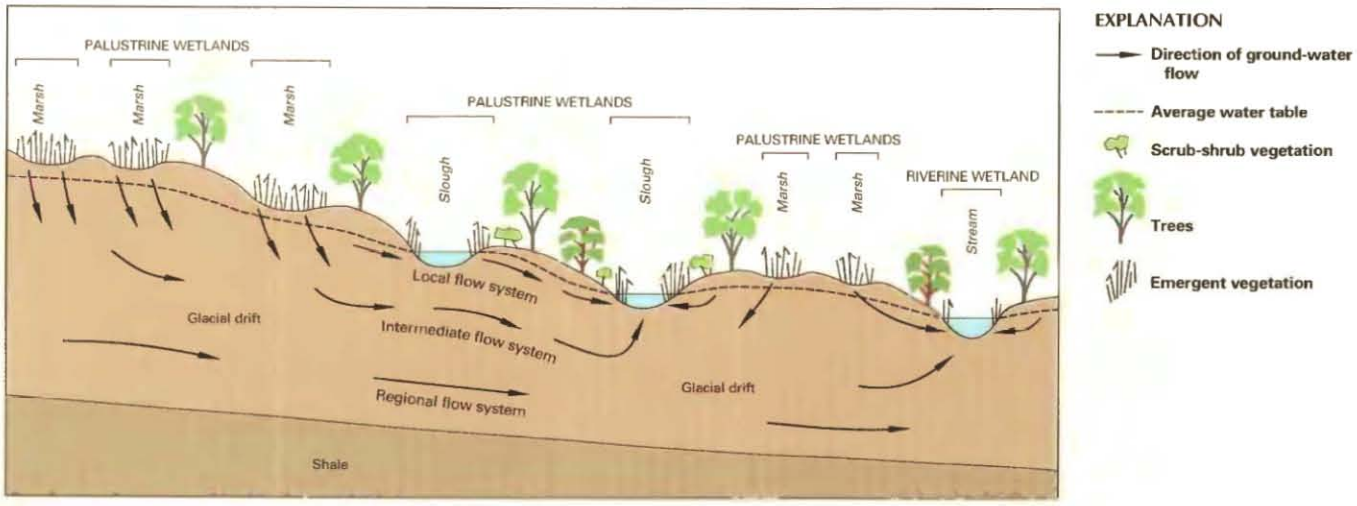

Figure 3. Generalized hydrologic setting of South Dakota wetlands. *(Source: Hydrologic concepts from Winter, 1989.)*

wetlands tend to have high dissolved-solids concentrations, and flow-through wetlands tend to have intermediate dissolved-solids concentrations (LaBaugh and others, 1987; Hubbard and others, 1988). There can be seasonal reversals in the direction of water exchange between a wetland and the ground water (Winter, 1989). In spring, water can seep from a wetland to the ground water when wetland water levels are high and can then reverse later in summer as evapotranspiration creates a discharge point for ground water. Although recharge of water from individual wetlands to the intermediate and regional ground-water flow system generally is small, on a regional basis the total contribution of recharge from prairie pothole wetlands to deep aquifers might be substantial (Winter, 1989).

Wetlands also significantly affect the surface-water hydrology of eastern South Dakota. The glacial depressions retain runoff, effectively reduce the contributing drainage area of a drainage basin, and result in attenuation of flood peaks (Hubbard, 1988a; Hubbard and Linder, 1986). Antecedent moisture conditions affect the capacity of prairie pothole wetlands to retain runoff.

TRENDS

The FWS has estimated that, from the 1780's to the 1980's, wetland area in South Dakota decreased by about 35 percent—from about 2.7 million to about 1.8 million acres (Dahl, 1990). Historically, agricultural conversions have accounted for most wetland losses in South Dakota. Kantrud, Millar, and van der Valk (1989) discussed the effects of agricultural disturbances in wetlands in the prairie pothole region. In cropland areas, wetland losses have resulted from tilling for crop production and from draining and filling to increase crop-producing land area and to avoid the inconvenience of maneuvering farm machinery around wet spots. High erosion rates in agricultural areas due to exposed soils in cropland areas and overgrazed parts of range and pastureland areas also have contributed to wetland degradation and loss.

Other practices that have had an adverse effect on South Dakota wetlands include inundation of wetlands during reservoir filling, timber harvesting, dugout construction (for livestock watering) in existing wetlands, and contamination from inadequately treated sewage and industrial waste. In urban areas, wetlands have been drained and filled for residential and commercial expansion. Stream channelization and road construction have adversely affected wetlands directly by draining wetlands within construction areas and indirectly by providing convenient drainage outlets that encourage unauthorized wetland drainage by adjacent landowners (Erickson and others, 1979; Smith and others, 1989).

Some land-use practices have created new wetlands or enlarged existing ones. Seepage associated with distribution and application of irrigation water has increased wetland acreage, especially on the large Bureau of Reclamation (BOR) irrigation projects in western South Dakota (primarily Belle Fourche and Angostura Reservoirs). In many parts of South Dakota, flowing artesian wells constructed for livestock watering or fish production have increased wetland area. Stock ponds and dugouts constructed for livestock watering constitute an important part of South Dakota wetlands, especially in the unglaciated western part of the State. Reservoir construction has undoubtedly increased the acreage of lacustrine wetlands.

CONSERVATION

Many government agencies and private organizations participate in wetland conservation in South Dakota. The most active agencies and organizations and some of their activities are listed in table 1.

Federal wetland activities.—Development activities in South Dakota wetlands are regulated by several Federal statutory prohibitions and incentives that are intended to slow wetland losses. Some of the more important of these are contained in the 1899 Rivers and Harbors Act; the 1972 Clean Water Act and amendments; the 1985 Food Security Act; the 1990 Food, Agriculture, Conservation, and Trade Act; and the 1986 Emergency Wetlands Resources Act.

Section 10 of the Rivers and Harbors Act gives the U.S. Army Corps of Engineers (Corps) authority to regulate certain activities in navigable waters. Regulated activities include diking, deepening, filling, excavating, and placing of structures. The related section 404 of the Clean Water Act is the most often-used Federal legislation protecting wetlands. Under section 404 provisions, the Corps issues permits regulating the discharge of dredged or fill material into wetlands. Permits are subject to review and possible veto by the U.S. Environmental Protection Agency (EPA), and the FWS has review and advisory roles. Section 401 of the Clean Water Act grants to States and eligible Indian Tribes the authority to approve, apply conditions to, or deny section 404 permit applications on the basis of a proposed activity's probable effects on the water quality of a wetland.

Most farming, ranching, and silviculture activities are not subject to section 404 regulation. However, the "Swampbuster" provision of the 1985 Food Security Act and amendments in the 1990 Food, Agriculture, Conservation, and Trade Act discourages

Table 1. Selected wetland-related activities of government agencies and private organizations in South Dakota, 1993

[Source: Classification of activities is generalized from information provided by agencies and organizations. •, agency or organization participates in wetland-related activity; ..., agency or organization does not participate in wetland-related activity. MAN, management; REG, regulation; R&C, restoration and creation; LAN, land acquisition; R&D, research and data collection; D&I, delineation and inventory]

Agency or organization	MAN	REG	R&C	LAN	R&D	D&I
FEDERAL						
Department of Agriculture						
Consolidated Farm Service Agency	...	•	...	...	...	...
Forest Service	•	...	•	...	•	•
Natural Resources Conservation Service	...	•	•	...	•	•
Department of Commerce						
National Oceanic and Atmospheric Administration	...	...	...	...	•	...
Department of Defense						
Army Corps of Engineers	•	•	•	...	•	•
Military reservations	•	...	...	...	...	...
Department of the Interior						
Bureau of Land Management	•	...	•	...	•	•
Bureau of Reclamation	...	...	•	...	•	•
Fish and Wildlife Service	•	...	•	•	•	•
Geological Survey	...	...	...	...	•	...
National Biological Service	...	...	...	...	•	...
National Park Service	•	...	•	•	•	•
Environmental Protection Agency	...	•	...	...	...	•
TRIBAL						
Cheyenne River Sioux Tribe	•	...	•	...	•	...
Crow Creek Sioux Tribe	•	...	•	...	•	...
Lower Brule Sioux Tribe	•	...	•	...	•	...
Oglala Sioux Tribe	•	...	...	...	•	...
Rosebud Sioux Tribe	•	...	...	...	•	...
Sisseton–Wahpeton Sioux Tribe	•	...	...	...	•	...
Standing Rock Sioux Tribe	•	...	•	...	•	...
Yankton Sioux Tribe	•	•	•	•	•	...
STATE						
Department of Agriculture	...	...	•	...	•	...
Department of Environment and Natural Resources	...	•	•	...	•	...
Department of Game, Fish and Parks	•	•	•	•	•	...
Department of Transportation	•	•	•	•	...	...
State universities	...	...	...	...	•	•
PRIVATE ORGANIZATIONS						
Ducks Unlimited	•	...	•	•	•	...
The National Wildlife Federation	...	...	•	•	...	...
The Nature Conservancy	•	...	•	•	•	...

(through financial disincentives) the draining, filling, or other alteration of wetlands for agricultural use. The law allows exemptions from penalties in some cases, especially if the farmer agrees to restore the altered wetland or other wetlands that have been converted to agricultural use. The Wetlands Reserve Program of the 1990 Food, Agriculture, Conservation, and Trade Act authorizes the Federal Government to purchase conservation easements from landowners who agree to protect or restore wetlands. The Consolidated Farm Service Agency (formerly the Agricultural Stabilization and Conservation Service) administers the Swampbuster provisions and Wet-lands Reserve Program. The Natural Resources Conservation Service (formerly the Soil Conservation Service) determines compliance with Swampbuster provisions and assists farmers in the identification of wetlands and in the development of wetland protection, restoration, or creation plans.

The 1986 Emergency Wetlands Resources Act encourages wetland protection through funding incentives. The act requires States to address wetland protection in their Statewide Comprehensive Outdoor Recreation Plans to qualify for Federal funding for State recreational land; the National Park Service (NPS) provides guidance to States in developing the wetland component of their plans.

Federal agencies are responsible for the proper management of wetlands on public land under their jurisdiction and also are involved in other wetland-enhancement and protection activities. With the mission to conserve, protect, and enhance fish and wildlife populations and their habitats, the FWS is perhaps the most active Federal agency in wetlands management and protection in South Dakota. The FWS manages about 47,000 acres in six National Wildlife Refuges that are predominantly wetlands, and about 146,000 acres in numerous waterfowl-production areas in the eastern part of the State. The FWS protects wetlands on private lands through its Wetlands Easement Program, in which private landowners agree not to drain, burn, level, or fill specified wetlands in exchange for monetary payment. About 500,000 acres of wetlands are protected by this program. The FWS also is involved in a program to construct 3,000 acres of new wetlands on private and Indian-reservation lands in South Dakota (Carl Madsen, U.S. Fish and Wildlife Service, written commun., 1993).

The U.S. Forest Service (FS) manages about 2.1 million acres in three National Forests and three National Grasslands in South Dakota. The FS is in the process of compiling estimates of wetlands and other riparian areas on their jurisdictional lands in South Dakota. A preliminary estimate is that about 1 percent of FS lands are wetlands or other riparian areas (Barry Parrish, U.S. Forest Service, oral commun., 1993). The FS also is involved in wetland-creation activities on their land.

The Bureau of Land Management (BLM) manages about 273,000 acres in South Dakota, of which about 1,560 acres are in riparian areas (Eric Luse, Bureau of Land Management, oral commun., 1993). The FS and the BLM have riparian-area management plans whose goals include restoring, maintaining, and protecting riparian areas; educating the public concerning the importance of healthy riparian areas; and cooperating with private landowners, resource users, and other Federal agencies in the protection of riparian areas (Bureau of Land Management, 1991). The NPS manages about 274,000 acres in two National Parks, one National Monument, and one National Memorial in South Dakota, but currently there are no estimates of wetland acreage on those lands.

The BOR has jurisdiction over about 63,500 acres in South Dakota, including land in existing irrigation projects and land in proposed, but not yet constructed, projects (Loren Hindbjorgen, Bureau of Reclamation, oral commun., 1993). Currently, there are no estimates of wetland acreage on BOR lands in the State. The BOR does not have a specific wetland-management plan, but a wetland and riparian-habitat element is being included in an initiative being developed by the BOR (Rick Nelson, Bureau of Reclamation, oral commun., 1993). The BOR has been involved in wetlands creation on its jurisdictional land, but there are no estimates of total acres involved.

Tribal wetland activities.—There are eight Indian reservations in South Dakota, and the different tribes have varying levels of involvement in wetland management and enhancement on their lands. Most of the tribes are developing wetland-management plans for their reservations, and four tribes are participating financially with the FWS in wetland-creation programs on tribal lands.

State wetland activities.—Although South Dakota currently (1993) has no comprehensive wetland-protection program, the State is developing a wetland policy. The State, with the assistance of an EPA grant, has created a wetlands-coordinator position whose responsibility it is to develop a wetland-protection program. The position is within the South Dakota Department of Agriculture under the oversight of a committee that has members from four State agencies: the Department of Agriculture; the Department of Game, Fish and Parks; the Department of Environment and Natural Resources; and the Department of Transportation.

Several State agencies participate in aspects of Federal programs, and wetlands are enhanced or protected under some State programs. The Department of Game, Fish and Parks has diverse wetland responsibilities under the mission statement of the Division of Wildlife: to manage South Dakota's wildlife and fisheries resources and their associated habitats for their sustained and equitable use and for the benefit, welfare, and enjoyment of the citizens of South Dakota and its visitors. Specific activities of the agency include providing technical advice regarding effects on fish, wildlife, and habitat for section 404 permit applications; providing technical expertise to the Department of Transportation to mitigate wetland impacts from road-construction activities; being actively involved in educational programs to teach landowners and school-age children the importance of wetland habitats; managing State-owned recreational and wildlife-production lands to protect and maintain wetland areas; and acquiring new land for wetland protection.

The Department of Environment and Natural Resources' Division of Environmental Regulation reviews section 404 permit applications to ensure compliance with State water-quality laws. A permit is not issued by the Corps without a Clean Water Act section 401 certification of such compliance. Pursuant to section 305(b) of the Clean Water Act, the Department's Division of Water Resources Management submits to the EPA and the U.S. Congress a biennial assessment of the State's surface-water quality, including that of wetlands. The Department's Division of Geological Survey and Division of Water Resources collects wetland hydrologic and water-quality data.

The Department of Transportation attempts to mitigate and minimize impacts to wetlands that result from its road-construction activities. The Department is the most frequent applicant for section 404 permits and avoids wetland alteration unless there is no feasible alternative. When wetland alteration is considerable, new wetland areas equal to or greater than the size of the losses typically are created within the project area. When onsite mitigation is not possible, a Wetlands Bank program is used to create new wetlands outside the project area that are equal to or greater than the size of the altered wetland.

State universities in South Dakota, including South Dakota State University, Northern State University, and the South Dakota School of Mines and Technology, are active in wetlands research. South Dakota State University participates in the National Wetlands Inventory program of the FWS and is coordinating an EPA-funded study of the effects of global climate change on wetlands in the United States (Carter Johnson, South Dakota State University, written commun., 1993).

Private wetland activities.—Ducks Unlimited owns about 2,000 acres and manages those lands for wetlands enhancement (Rick Warhurst, Ducks Unlimited, oral commun., 1993). The organization also has participated in cost-shared purchases of about 2,100 wetland acres with the Department of Game, Fish and Parks and has implemented wetland creation, restoration, and enhancement projects on about 9,500 acres of State or federally owned lands. The National Wildlife Federation is active in educating the public concerning wetland issues and has shared costs of land purchases with the Department of Game, Fish and Parks and the FWS (Dan Limmer, National Wildlife Federation, oral commun., 1993). The Nature Conservancy owns about 8,000 acres of wetlands in South Dakota and is active in monitoring and protecting endangered species on those lands (Joe Satrom, The Nature Conservancy, oral commun., 1993). Other organizations that participate in wetland-protection activities in the State include the Izaak Walton League, the National Audubon Society, and the Sierra Club. The South Dakota Association of Conservation Districts (an organization closely associated with the South Dakota Department of Agriculture) also has been involved in wetlands enhancement, with most of the 69 conservation districts in the State participating financially in wetland-creation programs of the FWS.

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