Oklahoma
Wetland Resources

Wetlands cover about 950,000 acres (2 percent) of Oklahoma—a decrease of about 67 percent over the last 200 years (Dahl, 1990). Oklahoma's wetland acreage places the State twenty-third in total wetland acreage among the 48 conterminous States.

Wetlands are environmentally and economically valuable to the State. They reduce flood peaks by dispersing water over a large area and releasing it gradually to downstream areas, thus reducing the severity of floods. Wetlands in flood plains (fig. 1) improve the quality of water in rivers and streams by trapping or absorbing sediment, nutrients, and toxins. Wetland vegetation helps stabilize streambanks and provides food for wildlife. The vegetation also reduces wind and water erosion.

Wetlands provide important wildlife habitat. Most of the State's fish and wildlife, during some part of their life cycle, depend on riparian (streamside) habitats that include wetlands. Wetlands also provide important stopover, feeding, overwintering, and breeding grounds for migratory waterfowl, wading birds, and shore birds. The tourist industry benefits from the scenic beauty of the State's diverse wetlands, which afford opportunities for recreational activities such as hunting, fishing, birdwatching, nature photography, camping, hiking, and boating.

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 Oklahoma 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 Oklahoma 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.

Palustrine wetlands constitute most of Oklahoma's wetland acreage. Palustrine wetlands in the State include forested wetlands such as bottom-land hardwood forests and swamps; emergent wetlands such as marshes and wet meadows; aquatic-bed wetlands characterized by submersed or floating plants in ponds, lakes, rivers, and sloughs; and sparsely vegetated wetlands such as small, intermittently flooded playa lakes.

Palustrine forested wetlands are most common on river flood plains and along some streams in the moist, eastern part of Oklahoma in the Ozark Plateaus, Ouachita, Coastal Plain, and eastern Central Lowland physiographic provinces (fig. 2*B*). A survey conducted in the early 1980's indicated that forested wetlands covered about 240,000 acres of the eastern one-third of the State at that time (Brabander and others, 1985). The degree and duration of river flooding generally influence which tree species predominate in a forested wetland and what common name is applied to the wetland. Commonly, forested wetlands that are deeply flooded for much of the year are termed "swamps," whereas those that are flooded intermittently or only during the wettest parts of the year are termed "bottom-land hardwood forests."

Riparian wetlands are palustrine wetlands that form along the banks of streams, rivers, and lakes. These wetlands can be dominated by herbaceous emergent plants (emergent wetland), shrubs and saplings (scrub-shrub wetland), or trees (forested wetland). Riparian wetlands are especially important to fish and wildlife in the grasslands of the plains and prairie regions because they provide shelter and moisture in a landscape that is otherwise sparsely vegetated by trees or shrubs and lacks year-round sources of water.

In Oklahoma, riparian wetlands range in area from about 10 to 2,000 acres (Oklahoma Tourism and Recreation Department, 1987). The largest expanses of riparian wetland are along the Cimarron, Canadian, Washita, and Red Rivers and their tributaries. Examples of these wetland are the numerous small marshes on river terraces along the Cimarron River. A recent study of riparian lands in western Oklahoma (Stinnett and others, 1987) indicated that riparian areas that are frequently flooded cover about 621,000 acres along 5,200 miles of streams west of about the longitude of Oklahoma City. Forests cover from 22 to 28 percent of the riparian flood plains.

Figure 1. Stinchcomb Wildlife Refuge above Lake Overholser, Oklahoma. *(Photograph courtesy of U.S. Fish and Wildlife Service.)*

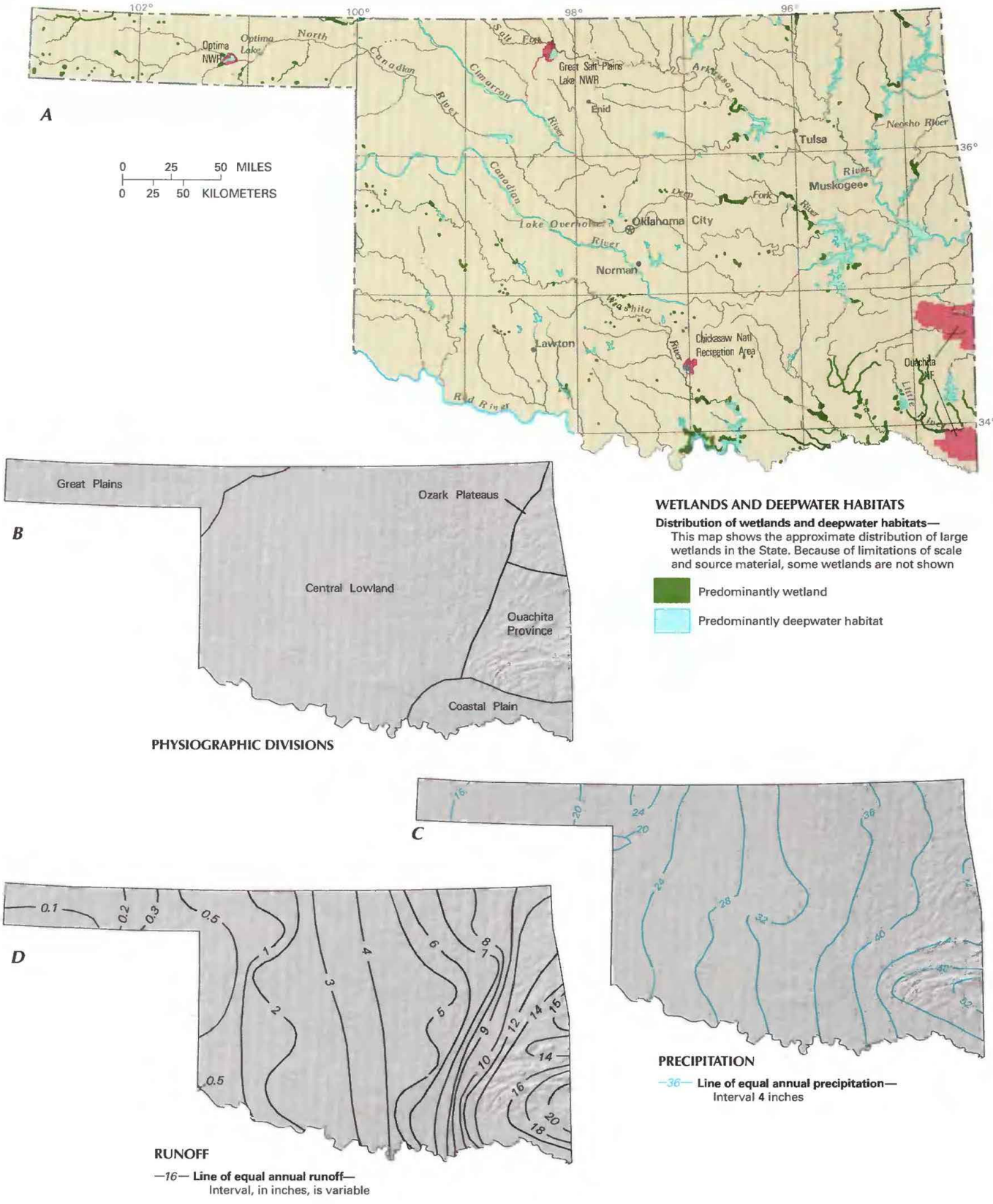

Figure 2. Wetland distribution in Oklahoma and physical and climatological features that control wetland distribution in the State. ***A***, Distribution of wetlands and deepwater habitats. ***B***, Physiography. ***C***, Average annual precipitation. ***D***, Average annual runoff. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center. C and D, Blumer, 1986).*

Oklahoma's playa lakes are mostly in the panhandle region. They provide overwintering and resting habitat for waterfowl migrating along the Central Flyway (U.S. Fish and Wildlife Service, 1990). The number of playa lakes in the State is about 1,200, totaling about 9,000 acres, and the lakes range in area from less than 1 acre to more than 200 acres (Oklahoma Department of Wildlife Conservation, unpub. data, 1990). Playa lakes are sand- or mud-bottomed lakes that receive most of their moisture from precipitation runoff and have little external drainage. They range from dry lakebeds to shallow lakes that can be freshwater or saline. Freshwater playas are numerous, small to medium in size, and serve as zones of recharge to the underlying aquifer (Osterkamp and Wood, 1987). Saline playas are larger in size and fewer in number than the freshwater playas and are areas of discharge from the underlying aquifer.

Playa lakes smaller than 20 acres typically are intermittently flooded, whereas larger playa lakes generally are continuously flooded. Small playas are classified as palustrine wetlands; the larger, more permanent playa lakes are lacustrine wetlands and bordered by palustrine emergent wetlands. Flooded playa lakes, especially those containing vegetation, provide optimum wildlife habitat.

Most lacustrine wetlands in Oklahoma are in the larger playa lakes and in the shallows of the many reservoirs on rivers statewide. Because of their depth, reservoirs typically contain more deepwater habitat than wetland; however, wetlands in the shallow margins of reservoirs can be extensive in areas of low relief. Siltation (as in Great Salt Plains Lake on the Arkansas River) or declining water levels caused by low streamflow in dry years or reservoir leakage (as in Optima Lake) can create additional wetland acreage in reservoirs. Lacustrine wetlands in reservoirs and large playa lakes and the adjacent palustrine marshes provide valuable habitat for resident and migratory waterfowl. Both Great Salt Plains Lake and Optima Lake are National Wildlife Refuges.

Riverine wetlands include beds of small streams and the shallows of rivers. Riverine wetlands are restricted to the channels of streams and undammed rivers and do not include wetlands in their flood plains. Because of the many miles of streams and rivers in Oklahoma, the State has extensive riverine wetlands. However, reservoir construction converted many formerly riverine wetlands into lacustrine wetlands or deepwater habitat.

HYDROLOGIC SETTING

Wetlands form where a persistent water supply is at or near the land surface. The location, abundance, and persistence of the water supply is a function of physiographic, climatic, and hydrologic factors, such as topography, precipitation and runoff patterns, evapotranspiration rate, and configuration of the water table.

Precipitation and runoff rates differ annually, with the seasons, and geographically. The average annual precipitation in Oklahoma ranges from about 16 inches in the western panhandle to more than 52 inches in southeastern Oklahoma (fig. 2*C*). Spring is the wettest season, and May is the wettest month. Runoff ranges widely across the State. The average annual runoff ranges from about 0.1 inch in the western panhandle to more than 20 inches in the southeastern corner of the State (fig. 2*D*). Evaporation is greatest in western Oklahoma and least in the eastern part of the State.

The forested wetlands (bottom-land hardwood forests) of eastern Oklahoma are primarily on flood plains in alluvial river valleys. Flood-plain wetlands generally depend on river flooding in spring for much of their moisture. Annual flooding of the rivers generally is confined to the main channel or lowlands that border a river, but floods of 5- to 100-year recurrence intervals typically overflow the banks, leaving residual water in backswamps, pools, sloughs, oxbows, and depressions. Rainfall is also a source of moisture to these wetlands. Flood-plain forests and swamps delay runoff and provide surface-water storage. Organic soils in the forested wetlands function somewhat like sponges, increasing water-storage capacity and retarding evapotranspiration (Wilkinson and others, 1987).

Riparian wetlands in south-central Oklahoma are in areas classified as rolling to gently rolling prairie and savannah. These wetlands have formed on flood plains of permanent streams and are maintained by frequent or seasonal flooding or by a high water table. Riparian-wetland vegetation typically consists of emergent herbaceous plants, shrubs, or trees. Soil types range from sandy loam to clay loam underlain by sandstone and shale. Average annual precipitation in the region ranges from 30 to 34 inches. Lake evaporation is about 63 inches annually (Barclay, 1980). Because of the extensive channelization of streams, which has lowered the water table, and the many impoundments, which have reduced flooding, a large percentage of the riparian wetlands once present in this part of the State have been lost (Barclay, 1980).

A study by Taylor and others (1984) describes the riparian wetlands along the north side of the Cimarron River in north-central Oklahoma as marshes and ponded water in surface depressions of terrace deposits along the river. The terrace surface is generally level to gently sloping, and sand dunes line the river. The wetlands began to appear in formerly dry depressions in 1975 because of a rise in the water table. The depressions have flat bottoms and are assumed to be formed by wind. The areal extent of these wetlands has increased since 1975, owing to a further rise in ground-water levels. The terrace and associated deposits consist of dune sands and alluvial and wind-blown sediments overlying bedrock. Soils in the nonwetland areas of the terrace are sandy loam or loamy sand, whereas soils in the wetlands are clayey with some characteristics of hydric soils.

The riparian wetlands in western Oklahoma are on the flood plains of perennial streams in an area of the State that is transitional between the arid lands of the west and the humid, temperate forests of the east (Stinnett and others, 1987). These wetlands are maintained by periodic flooding, ground water, and local precipitation. During drought, the wetlands can dry up, causing the riparian vegetation to disappear. Soil types in the area range from loamy fine sand to sandy clay loam. Average annual precipitation in this region ranges from 18 to 34 inches. Annual lake evaporation in western Oklahoma ranges from 56 to 64 inches. Evaporation is greatest in the panhandle (Stinnett and others, 1987).

The major perennial streams that have riparian wetlands in west-central Oklahoma are the Canadian and Washita Rivers, which flow southeasterly through rolling hills of mixed-grass and tall-grass prairie. The major perennial stream that has riparian wetlands in the southwestern part of the State is the Red River, which flows easterly through level to gently rolling topography that supports mixed-grass vegetative cover (Stinnett and others, 1987).

Historically, the area of playa lakes in the panhandle was short-grass and mixed-grass prairie. However, much of the area of playa lakes is now under cultivation. The physiography of the playa lake area is characterized by relatively flat terrain. Because of the flatness of the terrain, there is generally little stream drainage; consequently, playa lakes collect most of the surface runoff. The playa lakes are shallow depressions that have large surface area relative to the total volume of water contained in them. Consequently, most playa lakes have small storage capacities. Osterkamp and Wood (1987) indicate that freshwater playa lakes in the Great Plains originate wherever surface depressions collect precipitation. The lakes enlarge as a result of dissolution of carbonates by water infiltrating the unsaturated zone above the underlying aquifer and subsequent subsidence of the lakebed. Over time, the older, central lakebeds acquire a layer of clay-rich deposits that largely restricts movement of water between the playa lake and the underlying aquifer. Water probably is removed from freshwater playa lakes primarily by re-

charge to the underlying aquifer from the outer areas of the lake, where lakebed sediments have not yet accumulated (Osterkamp and Wood, 1987) and by evaporation (Nelson and others, 1983). There is no general agreement on the origin of saline playa lakes; however, Wood and Jones (1990) propose that the source of the salinity is the concentration by evaporation of runoff and shallow, fresh ground water that discharges from the underlying aquifer.

TRENDS

The FWS has estimated that from the 1780's to the 1980's, the wetland area in Oklahoma decreased from about 2,840,000 acres to about 950,000 acres (Dahl, 1990). This decrease represents a change in wetland acreage from 6.4 percent of the State's surface area to 2.1 percent.

The major causes of bottom-land hardwood-forest loss in eastern Oklahoma have been the cutting of virgin timber and the conversion of flood plains to cropland and pasture. These practices have resulted in the loss of about 1,653,000 acres of bottom-land hardwood forest (Wilkinson and others, 1987), or about 75 percent of the original forested area, much of which contained wetlands. An area in east-central Oklahoma that has had considerable losses of bottom-land hardwood-forest wetlands is the flood plain of the Deep Fork River. In this river basin, the flood plain on the upper one-third of the river lost most of its wetlands because of channelization between 1912 and 1923. The flood plain on the lower two-thirds of the river was altered or degraded in some parts; however, much of the unchannelized area in the lower two-thirds of the river represents one of the few areas in the State where extensive strands of bottom-land hardwood forest remain (Alan Stacey, Oklahoma Department of Wildlife Conservation, written commun., 1994).

Another major cause of wetland loss in eastern Oklahoma has been reservoir construction. Twenty-eight major reservoirs in eastern Oklahoma have inundated about 240,000 acres, or about 10 percent of the bottom-land hardwood forests. Nine additional major reservoirs have been proposed, the construction of which would result in inundation of an additional 50,000 acres of bottom-land hardwood forest (Wilkinson and others, 1987).

The Canadian, Washita, and Red Rivers and their tributaries have undergone extensive channelization and impoundment, resulting in loss of many riparian wetlands. A study by Barclay (1980) of two prairie streams that are tributaries to the Washita River in south-central Oklahoma showed that channelization of these streams resulted in an 86-percent reduction in bottom-land forest and the loss of all the wetlands, about 1,800 acres, or 6.2 percent of the flood plain of the two streams. Other losses of wetlands in this area are attributable to reservoir construction and conversion of wetlands to agricultural use.

A rise in water levels beginning in 1975 in the terrace deposits along the Cimarron River (Taylor and others, 1984) resulted in the restoring of some riparian wetlands in north-central Oklahoma. These wetlands have increased in area since 1975 owing to a continuing rise in water levels and surface pooling. Activities that lower the water levels, such as channelization or drainage of land for cropping or pasture, could cause the loss of wetlands. Terrace wetlands are at risk from petroleum-production activities, timber harvesting, and farming and grazing (Taylor and others, 1984). However, Taylor and others (1984) indicate that with proper management practices, the terrace marshes and other riparian wetlands can be retained as a wildlife habitat and a water resource without significantly affecting landowners.

From the mid-1950's to the mid-1980's, wetlands associated with the Canadian River in western Oklahoma decreased in area by about 45 percent (Stinnett and others, 1987). Additionally, wetland types changed substantially. Results of aerial-photograph analysis indicate an increase from 1,145 acres to 10,873 acres in forested wetlands, an increase from 12,975 acres to 24,210 acres in shrub wetland, an increase from 199 acres to 520 acres in open-water and mudflat wetlands, a decrease from 12,599 acres to 4,670 acres of emergent wetlands, and a decrease from 68,602 acres to 11,960 acres of river and sandbar wetlands during a 30-year period. Riverine wetlands decreased from 72 percent to 23 percent of the total wetland acreage and palustrine wetlands increased from 28 percent to 77 percent of the total wetland acreage. The changes probably were caused by lower streamflow resulting from the upstream construction of Lake Meredith Reservoir in the Texas panhandle.

The quality and number of playa lakes available to wetland wildlife in the Oklahoma panhandle has declined significantly. The decline has been attributed to cultivation of playa lake areas, field leveling, cattle grazing, and modification for irrigation and livestock watering (Oklahoma Department of Wildlife Conservation, unpub. data, 1990). About 61 percent of the playas are cultivated. The agricultural conversions in the playa lake area have resulted in a substantial change in land use from short-grass and mixed-grass prairie to cropland.

CONSERVATION

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

Table 1. Selected wetland-related activities of government agencies and private organizations in Oklahoma, 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 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		•			•	•
STATE						
Oklahoma Conservation Commission	•	•			•	•
Oklahoma Water Resources Board	•	•			...	•
Oklahoma Department of Wildlife Conservation	•	•		•		•
SOME COUNTY AND LOCAL GOVERNMENTS		•				
PRIVATE ORGANIZATIONS						
Ducks Unlimited	•		•	...	•	•
The Nature Conservancy	•	...	•	•	•	•

Federal wetland activities.—Development activities in Oklahoma 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, 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 (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 Wetlands 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.

The wetland-related activities of the FWS in Oklahoma include acquiring bottom land along the Deep Fork River and along the Little River for the benefit of wetland-dependent wildlife (Oklahoma Conservation Commission, 1991). The FWS also has prepared an Oklahoma Wetlands Priority Plan that identifies 13 priority wetland areas in the State encompassing nearly 175,000 acres. The FWS, in 1990, enrolled 10 landowners in their program of providing technical and financial assistance for the restoration of wetlands on private lands in Oklahoma. Seven National Wildlife Refuges in Oklahoma are managed by the FWS.

The North American Waterfowl Management Plan is a joint effort by the U.S. and Canadian Governments to slow the rate of waterfowl-habitat loss. Mexico has signed an agreement to aid in the effort, which seeks to protect more then 6 million acres of wetlands. The FWS coordinates two joint venture projects of the North American Waterfowl Management Plan that includes two areas of Oklahoma. One is the Playa Lakes Joint Venture, which is intended to ensure the continual accommodation of waterfowl overwintering in, migrating through, and breeding in the panhandle region. A second is the Lower Mississippi Valley Joint Venture, which has the goal of protecting the bottom-land hardwood forests in eastern Oklahoma (Forsythe and Aldrich, 1989).

Other Federal Agencies in Oklahoma, such as the Bureau of Land Management (BLM), the Bureau of Reclamation (BOR), the U.S. Forest Service (FS), and the NPS, are charged with the responsible management of public lands, including wetlands, under their jurisdiction. The BLM's wetland-related goals are to protect, maintain, and restore riparian-wetland areas on lands administered by the BLM in Oklahoma. The acreage of riparian wetlands on lands administered by the BLM in Oklahoma, Kansas, and New Mexico is 27,600 acres (Bureau of Land Management, 1990). The BOR's jurisdiction extends over their project areas. The FS manages lands and resources in the two National Grasslands in western Oklahoma and the Ouachita National Forest in eastern Oklahoma. The NPS manages the Chickasaw National Recreation Area in south-central Oklahoma to preserve the natural and cultural resources of the area.

State wetland activities.—The State agencies most involved in wetland conservation are the Oklahoma Conservation Commission, the Oklahoma Water Resources Board, and the Oklahoma Department of Wildlife Conservation. The Conservation Commission develops the strategy for wetland management. The strategy includes defining wetlands, enumerating the beneficial uses of wetlands, inventorying wetlands, and recommending measures to mitigate losses and protect wetlands. The Water Resources Board prepares the State's water-quality standards, and certifies that permits issued by the Corps to dredge and fill will not violate the State water-quality standards. The Department of Wildlife Conservation protects, enhances, and restores wetlands in wildlife-management areas for the benefit of wildlife. The Department also provides technical assistances to owners of wetlands and works cooperatively with other organizations on wetland programs.

Private wetland activities.—The Nature Conservancy provides leadership in the acquisition of land for the preservation of wildlife. The Conservancy has established 14 preserves in Oklahoma. The organization also participates in a program that enlists landowners to voluntarily protect rare species on their property. Ducks Unlimited and many other organizations in Oklahoma advocate the preservation and restoration of wildlife habitats.

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FOR ADDITIONAL INFORMATION: District Chief, U.S. Geological Survey, Building 7, 202 W 66 St., Oklahoma City, OK 73116; Regional Wetland Coordinator, U.S. Fish and Wildlife, Fish and Wildlife Enhancement, 500 Gold Ave., SW, Albuquerque, NM 87102

Prepared by
B.D. Jones,
U.S. Geological Survey