West Virginia
Wetland Resources

Wetlands constitute less than 1 percent of West Virginia's surface area but contribute significantly to the State's economic development and ecological diversity (Tiner, 1987). Most of the State's wetlands are in highlands that extend along a north-south axis near the eastern State boundary and in the lower elevations of the Potomac River drainage basin to the east and the Ohio River drainage basin to the west. The plants and animals of upland West Virginia bogs and marshes include species that are distinctly northern in range and distribution (Fortney, 1977). Some of these species may be ice age relicts that migrated southward during the last glacial period and became established in the cool, moist environment of the central Appalachian Mountains when the glaciers retreated. Wetlands that contain this unusually diverse assemblage of plants and wildlife draw large numbers of tourists to the State and provide educational and recreational opportunities.

The State's two largest wetlands and other wetlands associated with river main stems provide habitat for waterfowl and other game and nongame animals and support many rare and endangered plant species. Natural and constructed wetlands in West Virginia have been used to mitigate the effects of road construction, to increase habitat of nongame animals, and to treat both active- and abandoned-mine drainage and municipal wastewater.

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 West Virginia 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 West Virginia 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.

Figure 1. Canaan Valley, West Virginia. The valley's extensive upland bogs and marshes were designated a National Natural Landmark by the Secretary of the Interior in 1974. *(Photograph by Stephen J. Shaluta, Jr., West Virginia Department of Commerce, Labor and Environmental Resources, Division of Tourism and Parks.)*

West Virginia's wetlands were inventoried by the West Virginia Division of Natural Resources (formerly the West Virginia Department of Natural Resources) as part of a State survey initiated in 1975 and more recently by FWS as part of the National Wetlands Inventory. The Division surveyed all wetlands larger than 5 acres and listed them by class, location, size, source, and vulnerability to destruction. A total of 22,490 stream miles and 45,542 acres of wetlands were identified from ground and map searches. Palustrine and lacustrine wetlands constituted 0.3 percent of the State's total land and water surface area (West Virginia Department of Natural Resources, 1988).

The FWS National Wetlands Inventory identified West Virginia wetlands on high-resolution aerial photographs and listed location, type, and distribution of all wetlands 1 acre or larger. The results of the inventory indicated that West Virginia has about 102,000 acres of wetlands, including 42,000 acres of forested wetlands, 24,000 acres of scrub-shrub wetlands, 20,000 acres of emergent wetlands, and 16,000 acres of ponds (Tiner, 1987). The difference in acreage reported by the two surveys reflects the large number of wetlands in the State that are smaller than 5 acres and the inventory techniques used.

The Canaan Valley and Meadow River wetland complexes contain about 14 percent of the State's wetlands. The Canaan Valley wetland complex includes palustrine forested, scrub-shrub, and emergent wetlands and, with an area of 6,740 acres, is the largest wetland complex in the central Appalachian Mountains. The Meadow River wetland complex is the second-largest wetland complex in the State and, in terms of acreage, contains about one-fourth of the State's swamps (forested and scrub-shrub wetlands) and one-third of the State's wet meadows (emergent wetlands).

Other wetlands, commonly located along streams and rivers, are mostly of small to moderate size and are distributed widely across the State (West Virginia Department of Natural Resources, 1988). Forested wetlands are the most common type, with interspersed scrub-shrub, emergent, and open-water wetlands (ponds).

West Virginia also has many small wetlands located on islands

and flood plains and along embayments adjacent to large rivers. Embayments are backwater zones that form at the mouths of tributaries where main-stem navigation dams raise upstream pool levels. The FWS is inventorying the flora and fauna of Ohio River island wetlands and 79 West Virginia embayments between Ohio River miles 47.5 and 312. Embayments and wetlands on islands are important stopover areas for migrating waterfowl, nurseries for riverine fish, and habitat for beaver, bald eagles, herons, sandpipers, and ospreys (Patti Morrison, U.S. Fish and Wildlife Service, oral commun., 1993). Ely (1993) surveyed the vascular plants in eight Ohio River embayments and identified 259 species in 169 genera and 76 families. Thirteen plant species are on the State Endangered Species list.

HYDROLOGIC SETTING

The distribution of wetlands in West Virginia is determined by the interaction of climatic and orographic factors, local topography, and geologic setting. The State is in three physiographic provinces—the Appalachian Plateaus, Valley and Ridge, and Blue Ridge (fig. 2*B*). Eastern West Virginia is in the Valley and Ridge Province and contains a small section of the Blue Ridge Province. The region is drained by Potomac River tributaries to the north and by Kanawha River tributaries to the south. The Appalachian Plateaus physiographic province of southern and western West Virginia contains the Allegheny Mountain and Kanawha Sections.

Most of the State's wetlands are located in the Allegheny Mountain Section and along the Eastern Divide. The Eastern Divide is located along the boundary between the Appalachian Plateaus and the Valley and Ridge Province and separates the Ohio River drainage basin to the west from the Potomac River drainage basin to the east. The highest point on the Eastern Divide has an altitude of 4,860 feet. Predominantly westerly winds carry gulf, subtropical Atlantic, and land-recycled moisture across the State. Air masses rise and cool in the higher altitudes of the Eastern Divide, releasing moisture on the western slope. After crossing the Eastern Divide, the air masses sink and warm and release little moisture, creating a "rain shadow" to the east. Consequently, annual precipitation increases eastward from about 40 inches along the State's western boundary to about 60 inches in the higher altitudes of the Eastern Divide and then decreases to about 36 inches in the eastern panhandle. The abundance of precipitation along the western slopes of the Eastern Divide supplies moisture needed to support wetlands and is the most important determinant of wetland formation and maintenance in West Virginia.

Where ample water is available, wetland formation depends primarily on local topography and geologic setting. Diehl and Behling (1982) examined 49 wetlands in the Appalachian Plateaus and identified geologic settings that affect wetland formation and maintenance. Stream valleys with low gradients (less than 5 feet per

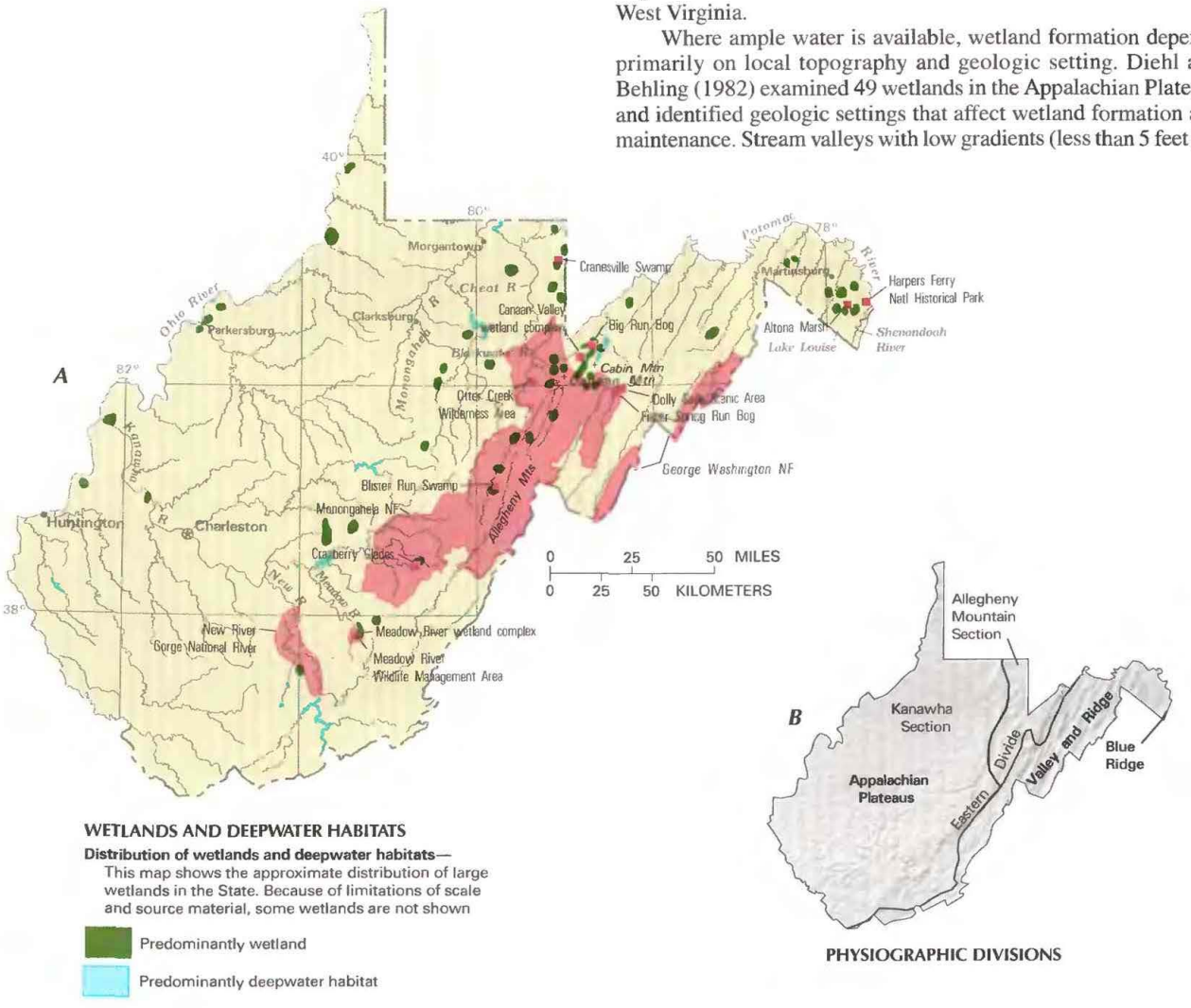

Figure 2. Wetland distribution in West Virginia and physiography of the State. ***A***, Distribution of wetlands and deepwater habitats. ***B***, Physiography. *(Sources: A, T.E. Dahl, U.S. Fish and Wildlife Service, unpub. data, 1991. B, Physiographic divisions from Fenneman, 1946; landforms data from EROS Data Center.)*

mile) and poorly drained alluvial plains were found to be conducive to wetland formation. Wetlands develop on the alluvial plain, but because the stream channel typically has cut into the alluvial material, the water table can be several feet beneath the alluvial plain; the wetlands are thus highly dependent on seasonal flooding. In mountain valleys, where streams have steeper gradients and rapid rates of flow, wetlands form near the slopes and receive abundant ground-water discharge (Winter, 1992).

Most wetlands in the Allegheny Mountain Section are upstream from where layers of erosion-resistant sedimentary rock intersect streambeds at an acute angle (Diehl and Behling, 1982). Erosion of less resistant rock layers upstream and downstream from the point of intersection causes a widening of the stream channel upstream and an increase in stream gradient downstream. Ponding and settling-out of fine sediments in the upstream area reduce permeability and favor formation of wetlands. Cranesville Swamp on the West Virginia–Maryland border is an example of a wetland formed in this type of geologic setting.

Anticlines are formed when stratified rock is folded downward in opposite directions from a crest. Erosion of the crest produces a valley (a "breached" anticline) surrounded by mountains and exited by a water gap at the downstream end. Canaan Valley (fig. 3) is an example of a breached anticline in which weathering of the valley floor is proceeding at a faster rate than that of the downstream water gap (Diehl and Behling, 1982). Ponding of water over poorly drained erosional sediments has produced conditions favorable to wetland formation.

Highlands consisting of flat, or nearly flat, rock layers that have been dissected by streams occur throughout the Allegheny Mountain Section. These settings are conducive to wetland formation because water ponds on the flat topography. An example of a wetland in this type of geologic setting is Big Run Bog, near Canaan Valley in north-central West Virginia.

Embayments have formed in the mouths of many small tributaries of the Ohio and Kanawha Rivers because of higher pool levels upstream from main-stem navigation dams. These embayments support wetland communities that did not exist along the rivers before construction of the dams. Although embayment-wetland communities have not been studied in detail, plant-species diversity in some is high (Koryak, 1978; Ely, 1993).

West Virginia wetlands of special interest include marl wetlands in the eastern panhandle and sphagnum-dominated peatlands situated along the Eastern Divide. Marl is a calcium carbonate precipitate combined with lesser amounts of clay and organic material. The precipitate forms when carbon dioxide is removed from shallow bodies of water by photosynthesis. Marl wetlands in the Shenandoah and Potomac River valleys of eastern West Virginia have near-neutral pH (6.8–7.2), widely fluctuating amounts of surface water, and a 16- to 28-inch-thick bottom layer of organic material underlain by about 10 feet of marl (Bartgis and Lang, 1984). West Virginia marl wetlands contain unique assemblages of calciphilic plants (plants adapted to alkaline conditions). Bartgis and Lang (1984) inventoried the flora of 10 marl wetlands in eastern West Virginia and recorded 12 vascular-plant species that are restricted to eastern West Virginia marl wetlands and 15 vascular-plant species that are found in only a few sites other than marl wetlands. Five marl wetlands in eastern West Virginia, including Lake Louise and Altona Marsh, have been designated as National Natural Landmarks and are listed on the National Registry of Natural Landmarks (National Park Service, 1992).

In West Virginia, sphagnum-dominated peatlands occur mainly in the mountainous, higher altitudes of the Eastern Divide. Few peatlands occur south of West Virginia (Wieder, 1985). Southern peatlands, such as those in West Virginia, have higher annual net primary production (Wieder and Lang, 1983) and higher annual organic-matter decomposition (Lang and McDonald, 1982) than those to the north. In West Virginia, peatlands range in size from widely distributed bogs of less than 1 acre to large areas of the State's largest wetland, the Canaan Valley wetland complex. Several peatlands in the Monongahela National Forest—notably Cranberry Glades, Blister Run Swamp, Big Run Bog, and Fisher Spring Run Bog—contain unique plant associations such as cranberry glades interspaced with bog forests and shrub thickets, high-altitude balsam fir swamps, and sphagnum-red spruce bogs (National Park Service, 1992).

The sphagnum-dominated peatlands of the Canaan Valley wetland complex occupy the largest intermontane valley east of the Mississippi River. The valley floor is about 14 miles long and 5 miles wide. With an average altitude of 3,200 feet, it is the highest valley of its size east of the Rocky Mountains. The valley is flanked by Canaan and Cabin Mountains and is drained by the Blackwater River, a tributary of the Cheat River, through a narrow water gap at the northwest end (fig. 2A). Once densely forested, the area was logged and burned in the late 1800's and early 1900's. The valley now supports extensive wetlands resulting from abundant precipitation (53 inches per year) and a blanket of poorly drained soils derived from the erosion of underlying limestone. Water enters the wetland by discharge from the surrounding mountain slopes and by ground-water flow (fig. 3). Springs emanate from the contacts of alternating layers of shale and sandstone. The wetland complex in-

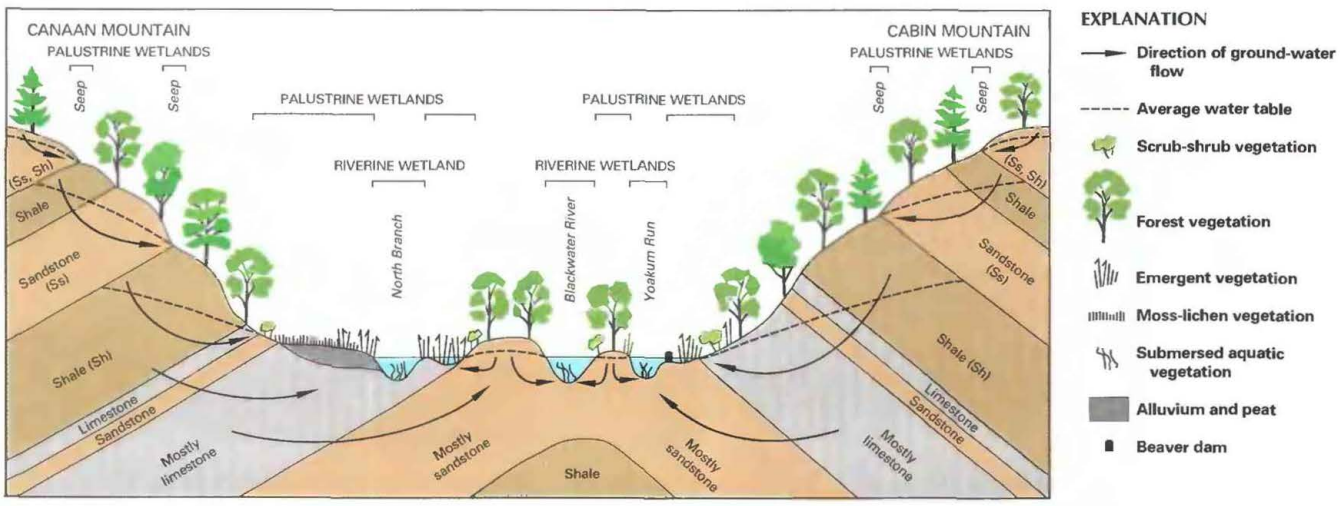

Figure 3. Geohydrologic setting of the Canaan Valley wetland complex in north-central West Virginia.

cludes wet meadows dominated by sedges and grasses, dense thickets of alder and spiraea (scrub-shrub wetlands), and extensive peat bogs (moss-lichen wetlands) consisting of sphagnum and haircap mosses, sedges, and heaths. Beavers have constructed dams on the Blackwater River and many of its tributaries, flooding stream margins and forming ponds and marshes.

TRENDS

Of the wetlands present in West Virginia in the 1780's, about three-fourths remain today (Dahl, 1990). Most of the loss was caused by agricultural drainage of wetlands in flood plains of the Ohio, Kanawha, and Monongahela Rivers (West Virginia Department of Natural Resources, 1988). Agricultural drainage, channelization, pond construction, urbanization, and reservoir construction are the primary causes of wetland loss in West Virginia (Tiner, 1987). From 1957 to 1980, West Virginia gained 10,900 acres of forested and scrub-shrub wetlands and lost 5,800 acres of emergent wetlands (West Virginia Department of Natural Resources, 1988). Much of the increase in wetland acreage was caused either by beaver activity, which through flooding converted uplands into forested and scrub-shrub wetlands, or by plant succession.

Residential, commercial, industrial, and highway-development projects could threaten West Virginia wetlands (West Virginia Department of Natural Resources, 1988). These developments often are associated with inundation, filling, or drainage of large and small wetland areas. In 1990 the Canaan Valley Task Force, composed of Federal, State, and local government agencies, business concerns, and environmental groups, was organized to define and implement strategies to protect the unique natural resources of Canaan Valley while considering local community needs. Current activities of the task force include surveying and modeling water quality in the valley and producing materials designed to inform the public of the ecological and economic significance of the area (Canaan Valley Task Force, 1992).

A section of Interstate Highway 64 has been constructed through the Meadow River wetland complex. The West Virginia Department of Highways is mitigating the impact of construction by purchasing or developing additional wetlands. Because future urbanization associated with the highway might further threaten this wetland, the Division of Natural Resources has made long-term acquisition of Meadow River wetlands the State's foremost acquisition priority. A large section of this wetland that has been purchased comprises the Meadow River Wildlife Management Area (West Virginia Department of Natural Resources, 1988).

The West Virginia Department of Transportation, Division of Highways, and the U.S. Department of Transportation commissioned a study of wetlands created by or contiguous with 511 miles of limited-access highways. The area contained 96 wetlands, 60 of which were produced by highway construction. The Division mitigates wetland losses resulting from road construction by acquiring additional wetlands or enhancing existing wetlands with sandbags, dikes, and drainage structures (Ben Hark, West Virginia Department of Transportation, Division of Highways, oral commun., 1993). The Division is mitigating losses of wetlands from construction of limited-access highways and Federal facilities. The losses include about 48 acres of wetlands in the Meadow River Wildlife Management Area that have been disturbed by construction of secondary highways and about 10 acres of wetlands affected by construction of a Federal facility near Clarksburg. Effects of these activities on wetlands have been mitigated by purchase and enhancement of existing wetlands and by wetland construction (Ben Hark, West Virginia Department of Transportation, Division of Highways, oral commun., 1993).

Federal and State agencies and private organizations are working to preserve a diverse group of West Virginia wetlands. The FWS has purchased 8 Ohio River islands that contain important wetlands, is acquiring 38 additional islands, and is inventorying the flora and fauna of several islands and embayments. These wetlands would become part of the proposed Ohio River Islands National Wildlife Refuge (Patti Morrison, U.S. Fish and Wildlife Service, oral commun., 1993).

CONSERVATION

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

Federal wetland activities.—Development activities in West Virginia 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" provi-

Table 1. Selected wetland-related activities of government agencies and private organizations in West Virginia, 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	...	•		...	•	•
Department of the Interior						
Fish and Wildlife Service	•		•	•	•	•
Geological Survey	...		...		•	...
National Biological Service	...	...	...	...	•	...
National Park Service	•	...	•	•	•	•
Environmental Protection Agency	...	•		...	•	•
STATE						
Department of Labor, Commerce, and Environment						
Division of Natural Resources	•	•	•	•	•	•
Division of Environmental Protection		•	•	•	•	•
Department of Transportation						
Division of Highways	•		•	•	•	•
PRIVATE ORGANIZATIONS						
Ducks Unlimited	...		•	•	...	...
The Nature Conservancy	•	...	...	•	•	•

sion 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.

In addition to the regulatory responsibilities described above, Federal agencies are involved in other conservation activities. The FWS surveys wetlands in and around the Ohio River, assists the Division of Natural Resources in the evaluation of applications for Clean Water Act Section 401 (water-quality) certification, and cooperates with other agencies in the mitigation of wetland losses. Through the Partners for Wildlife program, the FWS is cooperating with landowners to restore wetlands on privately owned land. The program provides total funding for wetland restoration. To be eligible for the program, landowners must agree to maintain restored wetlands in their natural state for 10 years. The FWS is using this program to restore wetlands in the Potomac and Ohio River drainages. In the Potomac River drainage, a 25- to 50-foot buffer strip of riparian (streamside) wetlands is being developed. These protected wetlands will prevent damage from grazing cattle and allow riparian vegetation to develop along streambanks (John Schmidt, U.S. Fish and Wildlife Service, written commun., 1993).

The U.S. Forest Service (FS) manages wetlands in the Monongahela and George Washington National Forests. The FS regulates access to important wetlands. These include four wetlands that are registered as National Natural Landmarks (Cranberry Glades, Blister Run Swamp, Big Run Bog, and Fisher Spring Run Bog) and small bogs in the Monongahela National Forest, particularly in the Dolly Sods Scenic and Otter Creek Wilderness Areas. The FS restricts activities that might directly affect or indirectly alter the water table near those wetlands. In addition, before any sale of timber resources in national forests, the FS requires an inventory of all affected wetlands.

The Abandoned Mine Lands Section of the Office of Surface Mining (OSM) has oversight over wetlands that have developed as a result of surface mining. Wetlands that have developed in and adjacent to mining impoundments commonly are liabilities to landowners, who might seek to drain and fill the wetland. The OSM enforces Clean Water Act Section 404 regulations, which require that new wetlands be constructed to mitigate wetland loss.

The NPS manages wetlands in Harpers Ferry National Historical Park and the New River Gorge National River. The NPS has recently completed an inventory of wetlands along the New River Gorge National River.

State wetland activities.—West Virginia State water-quality standards define wetlands as "***such areas as swamps, marshes, bogs, and other land subject to frequent saturation or inundation, and which normally support a prevalence of vegetation typically found where wet soil conditions prevail" (West Virginia Code, Chapter 20, Section 5A–2: Definitions). West Virginia does not have specific legislation protecting wetlands, but statutes under Chapter 20 of the West Virginia Code allow State involvement in section 404 permitting through section 401 of the Clean Water Act (West Virginia Department of Natural Resources, 1989). Presently, the State does not approve of all section 404 nationwide exemptions and requires application for section 401 certification to fill any wetland, regardless of size or location. Applications for section 401 certification are evaluated by the Division of Natural Resources and Division of Environmental Protection of the State Department of Labor, Commerce, and Environment. Applications are made directly to the Division of Environmental Protection, which has signatory authority for section 401 certification. However, through memoranda of understanding, the Division of Environmental Protection certifies wetland filling associated with coal mining, and the Division of Natural Resources certifies wetland filling for projects other than mining.

Private wetland activities.—Through the Matching Aid to Restore State Habitat (MARSH) program, Ducks Unlimited has provided funding for the purchase and restoration of West Virginia wetlands. Thirteen Ohio River islands that were purchased by Ducks Unlimited and deeded to the FWS contain wetlands. These wetlands will be managed by the FWS as part of the proposed Ohio River Islands National Wildlife Refuge (Jerry Thomas, Ducks Unlimited, oral commun., 1993). Ducks Unlimited also matches funds that the Division of Natural Resources obtains from the sale of Duck Stamps. These funds are used to restore wetland habitat. In West Virginia, The Nature Conservancy has established the preservation of plant and animal diversity in eastern West Virginia marl wetlands as its first priority. The Nature Conservancy has secured a conservation easement that is used to protect and manage large areas of Altona Marsh and Cranesville Swamp, an important peatland in the north-central part of the State. These easements restrict development in the area and guarantee public access for educational and scientific purposes.

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