VI. Wetland Future: Ongoing and Emerging Issues in Wetland Policy

Even if achieving "no net loss" in wetland acreage is attainable in the near future, once achieved, can it be sustained? Challenges to Section 404 regulation and the Swampbuster program during the 104th Congress, uncertainty about the future of Federal farm policy, and continuing budget constraints bring into question how sustainable "no net loss" would be if conservation and restoration programs were substantially weakened. Voluntary, compensatory programs have been proposed to replace or supplant the existing framework of regulatory and quasi-regulatory programs, but will they be affordable? And, can these programs be designed to prevent perverse claims for compensation (ERP, 1995, p. 149; Innes, 1995)? More broadly, if "no net loss" of wetland acreage is sustainable, is it a sufficient goal? What threats to the *quality* of the wetland resource base go beyond issues of wetland *acreage* gained and lost?

The Outlook for Wetland Conversion

The 104th Congress proposed changes in wetland policy for both Section 404 regulation and the Swampbuster provisions. A focal point was wetland delineation; that is, the extent of wetlands subject to these programs. The so-called *21-day exemption* was included in the House-passed legislation reauthorizing the Clean Water Act (H.R. 961) and was discussed in the context of the 1996 farm bill debate to make Swampbuster consistent with that legislation. Changes in either 404 or Swampbuster, without changes in the other legislation, would leave landowners subject to inconsistencies in policy jurisdiction. The 21-day exemption would restrict Food Security Act wetlands (that is, wetlands subject to Swampbuster) to areas that are typically inundated (ponded or flooded) for at least 21 consecutive days during the growing season. Under the current Swampbuster provision, wetland delineation requires the soil to be inundated for 15 days during the growing season, except for prairie pothole, playa, or pocosin wetlands, which must be inundated for 7 days (NRC, 1995). The 21-day language would have exempted roughly 85 percent of wetlands currently subject to Swampbuster (Wiebe, and others, 1996a). The 104th Congress did not enact these exemptions and other proposals to exempt farmed wetlands.

Previous farm legislation required producers to set aside some acreage from production to control commodity supplies and, since 1985, placed restrictions on adding highly erodible land and wetlands to their crop acreage base. The Federal Agricultural Improvement and Reform Act of 1996 allows agricultural producers to make cropping and land allocation decisions based on market signals without affecting eligibility for farm program payments. The new law continues Swampbuster, but also provides additional flexibility to landowners in complying with Swampbuster (Moore, 1996). Actions that result in minimal effects on wetlands are excluded from Swampbuster sanctions and wetland drainage is allowed where wetland losses are fully mitigated by wetland restoration. Sanctions triggered by inadvertent actions are waived so long as wetlands are fully restored within 1 year.

The payments authorized by the Federal Agricultural Improvement and Reform Act are scheduled to expire after the 2002 season. Subtitle G of the Act establishes a "Commission on 21st Century Production Agriculture" that is charged with "Identification of the appropriate future relationship of the Federal Government with production agriculture after 2002" (H.R. 2854, Subtitle G, Section 183(b)(2)). Unless Congress acts to suspend it, agricultural policy will revert back to the permanent law (the 1949 Agriculture Act) when the 1996 Federal Agricultural Improvement and Reform Act expires. Thus, ending farm program payments cannot be accomplished by simply allowing the 1996 Federal Agricultural Improvement and Reform Act to expire. If commodity prices are relatively high when the Act expires in 2002, however, the Commission could recommend that Congress reduce direct payment support to agriculture or actually end farm program payments. Although Swampbuster remains intact under the Act, an eventual end to farm program payments could render it meaningless for lack of an effective sanction.

Analyzing Wetland Conversion Without Swampbuster

To develop a sense of Swampbuster's role in maintaining “no net loss,” we estimate wetland conversion for crop production in the absence of the Swampbuster program and economic consequences associated with such conversion. As discussed above, previous research on agricultural wetland conversion used site-specific simulation models (Kramer and Shabman, 1986 and 1993; Heimlich and Langner, 1986; USDI,

1988). These models generally contained significant detail on local resource conditions (such as, productivity) and farm structure (such as, the size and crop mix for farms), providing conclusions regarding economic incentives affecting wetland conversion (with and without Swampbuster) for a generalized farm on a specific site.

In our model, we analyze data on wetland hydrology and potential agricultural productivity for nearly 50,000 wetland sample points, which are aggregated to make regional and national estimates of wetland area that may be profitably drained for crop production in the absence of Swampbuster. The site-specific nature of the data allows us to draw regional and national conclusions based on the potential agricultural productivity of a representative sample of actual wetlands rather than using county average productivity or other assumptions that may obscure important variations in resource quality. The national scope of our study allows us to (1) quantify potential wetland losses and assess policy proposals in terms of consequences for achieving and maintaining "no net loss" and (2) estimate potential equilibrium adjustments in crop acreage, commodity prices, farm income, and the regional distribution of farm income. Our methodology has two steps:

- First, we estimate wetland acreage that could be profitably farmed at expected (baseline) crop prices and production and conversion costs immediately after Swampbuster provisions end. We specify **high wetland conversion** and **low wetland conversion** scenarios to place upper and lower bounds on the range of conversion possibilities.[6] The wetland conversion decision depends partly on the expected profits from conversion, which we calculate as expected value of returns from conversion less expected costs of conversion, assuming no feedback effects on prices and costs from increased production due to the wetland conversion (Appendix III). For expected price in the profitability calculation, we assume commodity prices for 2001 from the *Agricultural Baseline Projections to 2005, Reflecting the 1996 Farm Act*, the latest long-term projection produced by USDA-WAOB (1997). Baseline commodity prices are expected to be strong, a relatively favorable situation for land conversion. The low conversion scenario assumes conversion of only those wetlands that Natural Resources Conservation Service field technicians judge have some likelihood of conversion and that are profitable to convert. The high conversion scenario expands on this by including lands that Natural Resources Conservation Service field technicians do not judge likely to convert based on physical features, evidence from similar land, and economic conditions at the time of the inventory, but which expected economic conditions indicate would be profitable if converted to crop production in the future.

- Second, we simulate the economic effects of wetland conversion including crop acreage planted, crop production, commodity prices, and farm income in the long run, after equilibrium adjustment to the shortrun wetland conversion. Wetland acreage expected to be converted from step one is used to augment land supply in the U.S. Agriculture Sector Mathematical Programming Model (USMP), a national/interregional model of U.S. agriculture (see Appendix III for details). Economic effects of wetland conversion on the farm sector depend on how much acreage is converted, which crops are planted on that acreage and consequent crop acreage shifts on other acreage, and the cost and net return effects of all these changes on farm income across the country. Producers respond to price changes due to increased production on the converted wetlands: If prices decline, then some land may subsequently be removed from crop production. Price effects are factored back into producer response and crop acreage decisions are allowed to equilibrate with reduced market prices.

[6]We did not include so-called "nuisance" wetlands in the conversion estimates presented here. "Nuisance" wetlands are cropped wetlands where improved drainage would not be profitable based on the yield effect for the wetland area itself but may be undertaken to avoid problems in the farming operation (Danielson and Leitch, 1986; Leitch, 1981). For example, a small wetland in the middle of a field may be drained to avoid driving around it or becoming mired in it in wet seasons. Some "nuisance" wetlands are likely to be drained if Swampbuster is ended, although how much cropped wetland falls in the "nuisance" category is difficult to predict.

Potential Wetland Conversion

In the **high conversion** case, wetland conversion or improved drainage for crop production would be profitable on an estimated 13.2 million acres (table 6). For the **low conversion** case, we are left with 5.8 million acres after screening out acreage judged by Natural Resources Conservation Service technicians as unlikely to be converted. Cropped wetlands account for 15 percent of low conversion wetlands, while forested wetlands make up more than 60 percent (fig. 4). In the high conversion case, forested wetlands increase to 75 percent of all convertible wetlands, while the proportion of cropped wetlands shrinks to 7 percent.

These results are consistent with simulation results reported earlier for periods in which commodity prices were strong enough to provide an incentive for wetland conversion, but government payments remained at levels high enough to make the Swampbuster sanction effective (Heimlich and Langner, 1986). During 1975-84, farm program payments were not high enough that their loss would provide a significant disincentive against wetland conversion. Because farm program payments continue regardless of commodity price levels under the 1996 FAIR Act, high prices and high payments can occur simultaneously, as they are projected to do in the baseline.

Longrun Effects

Longrun economic effects are reported as changes from the crop acreages, crop production, prices and farm income anticipated by the USDA baseline, after adjustment to the shortrun increase in acreage from wetland conversion (table 6). In terms of overall cropland acreage, the low conversion scenario would result in a 2.2-million-acre increase in cropland acreage, 0.7 percent higher than the baseline acreage of 328.3 million acres. In the high conversion scenario, total crop acreage would rise by 5.0 million acres from the baseline, a 1.5-percent increase. In both scenarios, the longrun acreage increase is about 38 percent of the potentially convertible wetland acreage provided to the USMP model.

Regionally, the largest differences in potential wetland conversion between the **low** and **high** conversion scenarios are for forested wetlands in Appalachia and the Southeast (table 6). There is little or no change in wetland acreage likely to convert in the Northern Plains, Mountain States, or Pacific Coast States. In the Southeast for the high conversion case, 4.1 million acres of wetland are estimated to be potentially profitable in crop production—a large pool of land when compared with a total cropland base of roughly 18 million acres (Daugherty, 1987). In the Appalachian farm production region, the high conversion estimate of 2.1 million acres of potentially convertible wetland is a

Table 6—Wetland acreage and farm income changes from USDA baseline levels by farm production region and low and high wetland conversion scenarios

Farm production region	Low wetland conversion			High wetland conversion		
	Potential wetland conversion	Longrun change in crop acreage	Longrun change in farm income	Potential wetland conversion	Longrun change in crop acreage	Longrun change in farm income
	----------Million acres----------		Million $	----------Million acres----------		Million $
Northeast	0.5	0.4	-17.9	0.9	0.6	-27.3
Lake States	0.6	0.1	-209.3	1.4	0.2	-402.5
Corn Belt	0.4	-0.3	-835.5	0.5	-1.3	-2,072.3
Northern Plains	0.8	0.0	-371.8	0.8	-0.7	-870.6
Appalachia	0.7	0.5	8.8	2.1	1.7	162.3
Southeast	1.0	0.8	150.6	4.1	3.3	722.7
Delta States	1.5	1.1	76.1	2.8	1.9	3.2
Southern Plains	0.2	-0.2	-236.4	0.4	-0.5	-452.8
Mountain States	**	0.0	-74.8	**	-0.1	-115.7
Pacific Coast	0.1	0.0	-104.8	0.1	-0.1	-153.1
U.S.	5.8	2.2	-1,614.9	13.2	5.0	-3,206.3

** Fewer than 50,000 acres.
Source: Economic Research Service, USDA.

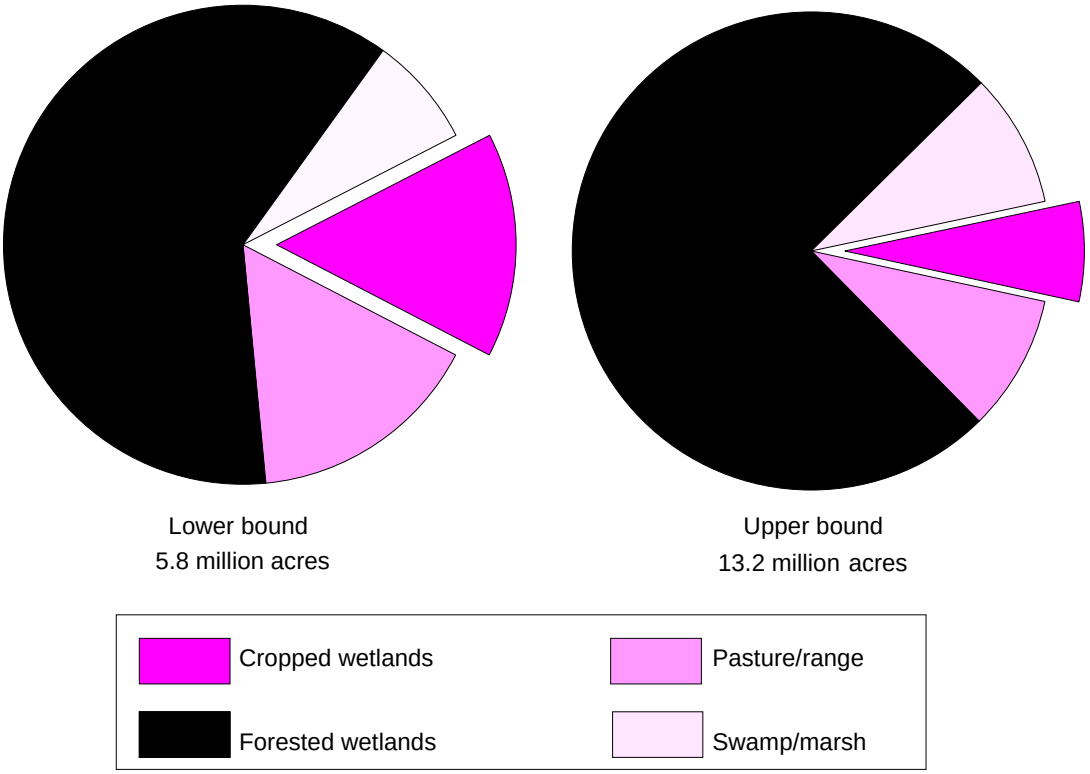
somewhat smaller proportion of the roughly 29-million-acre cropland base in that region.

However, gross conversion of wetlands to crop production may not be limited to the longrun increase in crop acreage. Wetlands may be initially converted and then removed from production as prices fall, or other marginal land that had been in production may be removed from production as prices fall. At lower longrun equilibrium prices, little of the wetland acreage estimated to be profitable to convert becomes unprofitable, suggesting that converted wetlands are likely to remain in production while other marginal land is pushed out. For the low conversion scenario, 5.1 million wetland acres are still profitable at longrun equilibrium prices, 88 percent of the 5.8 million acres profitable at baseline prices. For the high conversion scenario, 9.4 million acres remain profitable at longrun equilibrium prices, 71 percent of the 13.2 million acres profitable at shortrun baseline prices. Even if converted wetlands were removed from production, there is little reason to believe that they would be effectively restored to wetland condition.

Production increases for all major commodities except for sorghum[7] (table 7). The largest percentage increases in production are for cotton and rice, while the largest absolute increases are for corn and soybeans. Increased production leads to reduced crop prices for all eight commodities (table 7). In the low conversion scenario, percentage reductions are lowest for wheat (-0.6 percent) and barley (-0.8 percent) and largest for rice (-5.9 percent), soybeans (-3.2 percent), and cotton (-3.2 percent). These results are not surprising given that convertible wetlands are concentrat-

[7]Relatively few wetland acres are converted to sorghum production because there are few convertible wetlands in sorghum growing regions. However, increased production of other feed grains leads to lower feed grain prices, led by lower corn prices, reducing sorghum production.

Figure 4
Former use of wetlands potentially convertible after FAIR



Source: ERS analysis of 1992 National Resources Inventory data.

Table 7—Longrun production and price changes from USDA baseline, high and low wetland conversion scenarios

Crop	Baseline[1]		Low wetland conversion		High wetland conversion	
	Price	Production	Change in production	Change in price	Change in production	Change in price
	Dollars/ bushel	Million bushels	-Percent-			
Corn	2.80	10,010.9	0.8	-2.6	2.1	-7.4
Sorghum	2.50	659.9	-0.10	-2.9	-3.2	-7.7
Barley	2.60	455.0	0.5	-0.8	0.3	-2.3
Oats	1.70	318.2	1.3	-2.6	2.6	-10.6
Wheat	4.30	2,489.6	0.7	-0.6	1.6	-1.4
Soybeans	6.45	2,533.1	1.8	-3.2	4.5	-8.3
	Dollars/cwt	Million cwt				
Rice	10.31	173.7	6.6	-5.9	12.8	-11.5
	Dollars/pound	Million pounds				
Cotton	[2]	9,750.0	2.6	-3.2	6.2	-7.5

[1]Baseline production and prices for 2001 from *Long-term Agricultural Baseline Projections, 1998-2008,* February 1997.
[2]USDA is prohibited from publishing cotton price projections.
Source: Economic Research Service, USDA.

ed in the South, where rice, soybeans, and cotton are major crops. Wheat and barley are grown in regions with comparatively few convertible wetlands.

Nationally, reduced prices lead to declines in longrun aggregate net farm income of more than $1.6 billion in the low conversion scenario and $3.2 billion in the high conversion scenario, reductions of 2.2 percent and 4.9 percent, respectively (table 6). Note that deficiency payment, supply control, export promotion, and other features of pre-FAIR farm legislation, which served to mitigate the magnitude of income declines, are no longer authorized. The fact that farm income declines as production expands and prices fall reflects the relatively inelastic demand and supply responses in the model.

In both scenarios, aggregate farm income also declines in most farm production regions, as it does nationally. However, the Southeast, Delta, and Appalachian regions enjoy small increases in aggregate net farm income. These regions have large amounts of convertible wetland but have relatively small existing cropland bases on which to suffer losses due to the price effect. The largest aggregate reduction in income is in the Corn Belt, where few unconverted wetlands remain and the existing cropland base is large and highly productive. Farm income also declines substantially in the Northern Plains, Southern Plains, and Lake States.

Environmentally, even the longrun, low conversion case—in which 2.2 million wetland acres are converted—would be a serious blow to achieving and maintaining "no net loss" of wetlands. Between 1982 and 1992, gross conversion of wetlands for crop production was about 310,000 acres (USDA-NRCS, 1996, p. 52; Heimlich and Melanson, 1995). Conversion of 2.2 million acres over a 10-year period would represent a sevenfold increase in the rate of wetland conversion for agriculture, although it would be less than half of the 5.6 million acres converted each decade between the mid-1950's and mid-1970's. That level of conversion would also far exceed current efforts to restore wetlands previously converted to agricultural production. The Wetlands Reserve Program is capped at a maximum enrollment of 975,000 acres, with just over 400,000 acres enrolled as of January 1997. Thus, remaining Wetlands Reserve Program authority represents one-fourth of the 2.2 million acres expected to be converted without Swampbuster.

Ending Swampbuster would have the largest impact on bottomland hardwood forests in the Delta,

Appalachian, and the Southeast regions. These wetlands provide flood storage, water quality maintenance, and winter waterfowl habitat. In the lower Mississippi delta, about 80 percent of forested wetlands have already been lost, mostly to crop production (Dahl, 1990). Although the acreage of cropped wetland that would be converted is small, much of it is located in the Prairie Pothole region, North America's most valuable waterfowl breeding ground. In some years, the Prairie Pothole wetlands produce up to one-half of U.S. production of waterfowl (Kantrud, and others, 1989; Stewart, 1996). About 50 percent of these wetlands have already been lost, mostly to crop production (Dahl, 1990).

Phasing out commodity program payments would not end Conservation Reserve Program or Wetlands Reserve Program payments or other smaller programs from which benefits could be denied under Swampbuster. However, the level of payments from these programs is small (about 7 percent of total agricultural payments) compared with income support payments under the FAIR Act, and far less uniformly distributed across farms. Most farms likely would not receive payments under these programs and, hence, would not be subject to sanctions under Swampbuster provisions.

A potential decline in farm income of 2.5 to 4.9 percent demonstrates that farmers and landowners who do not drain wetlands have a significant economic stake in the fate of wetlands.[8] Farmers who actually drain wetlands for crop production are likely to see their incomes rise. However, these individuals are a minority of agricultural landowners. Other producers would suffer reduced incomes due to lower commodity prices. Although land use restrictions, whether as a pre-condition to receiving farm program payments or otherwise, have never been popular among farmers or landowners, our analysis shows that lifting Swampbuster restrictions would be contrary to the economic interests of most farmers and landowners. Farm-level analyses of the effects of wetland policies on farm income do not account for the restrictions faced by other farms. National analysis shows that wetland conservation policies can create increases in aggregate returns to producers because farms without wetlands to convert gain more than farms with wetlands to convert lose. Lichtenberg and Zilberman (1986) show why farm price support programs buffer farm income from price decreases caused by eliminating environmental programs.

Section 404's Post-Swampbuster Role

If Swampbuster provisions were eliminated or made ineffective through changes in farm legislation that remove the leverage provided by farm program payments, agricultural wetlands would still be subject to requirements for Section 404 permits. However, the Section 404 permit program has been criticized in the past as ineffective in reducing wetland conversion, including agricultural conversions (USGAO, 1988; Theis, 1991). In the past, Section 404 has had limited impact on agricultural wetland conversion because many activities are exempted under Section 404 (f) or covered under nationwide general permits, Section 404 did not explicitly regulate drainage, and Army Corps of Engineers offices are located far from agricultural areas, making enforcement difficult. According to the General Accounting Office (GAO, 1988, p. 4):

> Because neither the Corps nor EPA has systematic surveillance programs to detect unauthorized activities, undetected violations of Section 404 permit requirements may be occurring. Also, some suspected unauthorized activities reported to the Corps may not be investigated for months after they are reported, and many projects are not inspected by the Corps for compliance with permit conditions.

Whether Section 404 will be more effective in limiting future conversion of wetlands for agricultural production remains to be demonstrated. Recent changes to Nationwide General Permit 26, which formerly permitted substantial agricultural conversion, may indicate that Section 404 will more effectively deal with agricultural conversion.

Section 404 regulates discharge of dredge and fill material in wetlands, but does not specifically regulate wetland drainage or clearing. Regulation of wetland drainage under Section 404 has been incidental to discharge of dredged or fill materials into a wetland during drainage installation. As a result of a settlement to a lawsuit brought against the Army Corps of Engineers (*North Carolina Wildlife Federation v. Tulloch*, Civil number c90-713-CIV-5-BO, EDNC 1992), regulations expanding Section 404 to cover

[8]To put these declines in context, net farm income, excluding government payments, has increased 3.5 percent in real terms and 6.9 percent in nominal terms on average over the 1985-95 period.

activities, such as drainage, land clearing, and construction on pilings that damage wetlands but were previously exempted as *de minimis* fills were proposed in rule making on June 16, 1992 (33 C.F.R. 323.2(d), 40 C.F.R. 232.2(3)), and included in the Clinton wetland plan (White House, 1993, p. 22). In January 1997, the Tulloch ruling was invalidated in a decision allowing landowners to drain wetlands without a permit so long as any dredged material produced by drainage installation is removed from the wetland site (*American Mining Congress v. U.S. Army Corps of Engineers*, 951 F. Supp. 261). The court cited Congressional failure to expand Section 404's scope, which indicates that the issue is still alive legislatively. Most of the wetland regulatory reform bills considered in the 104th Congress, but not passed, included drainage provisions reflecting the Tulloch decision. The Army Corps of Engineers appealed to have the Tulloch decision restored, and won a stay of the District Court decision in June 1997. In July 1998, the Circuit Court issued an order that effectively vacated the stay, meaning that the injunction against enforcement of the Tulloch rule is in effect. The Corps of Engineers is expected to appeal.

Using general permits that provide blanket coverage for whole classes of activities streamlines much of the Army Corps of Engineers permit activity. Thus time-consuming individual permit review is avoided. The nationwide permit program has been controversial because regulators and landowners do not agree on what constitutes a "minimal impact." Nationwide Permit 26, used for small agricultural conversions, allowed fill of up to 10 acres of isolated and headwater wetlands with a pre-discharge notification to the Army Corps of Engineers, and up to 1 acre without notification (Davis, 1997, p. 14; *Federal Register* 1996). In FY 1995, 13,837 activities were conducted under Nationwide General Permit 26, accounting for 5,020 acres of wetland loss, which were offset by 5,809 acres of wetland mitigation (*National Wetlands Newsletter*, 1997). During FY 1995, a total of 43,775 activities were authorized by nationwide general permits (including Nationwide General Permit 26), adversely affecting 6,500 acres for which the Army Corps of Engineers received approximately 7,800 acres of mitigation in return (*Federal Register*, 1996). Environmentalists viewed Nationwide General Permit 26 as a major threat to protection of small, isolated wetlands, which, they argue, provide important wildlife habitat and other important ecological services (National Audubon Society, 1996).

In response to these concerns, the Army Corps of Engineers is phasing out Nationwide General Permit 26 over a period of 2 years (beginning February 11, 1997), replacing it with multiple, activity-specific, nationwide general permits to be proposed during 1998. In the meantime, the size of activities authorized under Nationwide General Permit 26 is reduced from 10 to 3 acres. Only those activities which affect one-third acre or less may proceed without pre-discharge notification to the Army Corps of Engineers (*Federal Register*, 1996).

State Wetland Responsibilities

States have had a major role in wetland conversion since colonial times. For example, South Carolina authorized drainage in the Cacaw Swamp in 1754, and Virginia surveyed areas of the Great Dismal Swamp for drainage in 1763 (Dahl and Allord, 1996). Moreover, the Swampland Acts of 1849, 1850, and 1860 allowed States to reclaim overflow lands in the Federal domain.

State policies concerning wetlands evolved similar to those of Federal policies, moving from exploitation to conservation as remaining wetlands disappeared and wetland functions and values became appreciated. In 1963, Massachusetts was the first State to pass regulations governing the circumstances under which wetlands could be drained, dredged, or otherwise converted (Council on Environmental Quality, 1978, p. 53). Other States followed, particularly after Section 404 was passed in 1972. By 1978, 15 States had legislation specifically regulating wetlands. As of 1984, the Office of Technology Assessment found that all 30 coastal States (including the Great Lakes) had programs that directly or indirectly regulated coastal wetlands, although usually not inland wetlands (OTA, 1984, chapter 9).

The Association of State Wetland Managers polled States in 1992 to learn more about State laws applying to wetlands. In 1996, the States were surveyed again about changes to their wetland laws and 16 of the 50 States responded. Table 8 summarizes the results. Forty-four States have wetland statutes or laws, including 18 that regulate both coastal and freshwater wetlands, 7 that regulate only coastal wetlands, and 4 that regulate coastal and part of their freshwater wetlands. Forty-six States relate wetland policies to water quality policies, such as Clean Water Act Section 401 water quality certification programs or

Table 8—State wetland laws and programs, 1996

Item	Number of State laws with provision			
	Yes	No	Not listed	Total
1. State Wetland laws	44	4	2	50
2. Wetlands and water quality	46	4	0	50
Regulates only coastal wetlands	7	0	43	50
Regulates coastal and some freshwater wetlands	4	0	46	50
Regulates both coastal and freshwater wetlands	18	0	32	50
3. Staffing	40	0	10	50
4. Definitions/delineation comparable with Federal definitions	46	2	2	50
5. Regulated and exempted activities	44	0	6	50
6. Special provisions (if any) for agriculture and forestry	25	9	16	50
7. Wetland classification (if any)	28	9	13	50
8. Mapping	44	1	5	50
9. Mitigation policy (if any)	39	6	5	50
10. Mitigation banks (if any)	37	9	4	50
11. Role of local governments	34	5	11	50
12. Evaluation methodology (if any)	21	9	20	50
13. State general permit (if any) for 404	17	12	21	50
14. Investigated assumption of Section 404 powers	21	21	8	50
15. Joint permitting	30	6	14	50
16. Penalties	26	5	19	50
17. Permit tracking and enforcement	33	5	12	50
18. Special area management and advanced identification	32	5	13	50
19. State wetland conservation plan	30	6	14	50
20. No net loss goal	33	8	9	50
21. Wetland training and education	31	5	14	50
22. Nonregulatory incentives for private landowners	29	4	17	50
23. Special problem	23	3	24	50
24. Contacts	50	0	0	50
25. Guidebooks, brochures, other educational materials	37	0	13	50

Source: Kusler, and others (1994) and personal communication for 1996 update.

other State water quality standards. Forty-six States have wetland definitions that are comparable with those used in Federal programs. However, enforcement of these policies is less widespread: 40 States staff their programs, 33 States track and enforce wetland permits, and only 26 States penalize violators of their wetland laws.

The Association of State Wetland Managers identified key issues and trends in State wetland program adoption (Kusler, and others, 1994). The following issues are important for agricultural wetlands:

- States are shifting attention from coastal wetlands that are now well-protected to freshwater wetlands, including those subject to agricultural conversion.
- States are recognizing a need to move beyond dredge and fill to regulate drainage and removal of vegetation, activities related to agricultural conversion.
- States are recognizing needs for special standards applying to altered and managed wetlands, including those used in agricultural production.
- States recognize that wetland regulation must be carried out in the context of broad State wetland plans and in a watershed context.
- States see a need to establish minimum, uniform standards, such as the "no net loss" goal.
- States seek better definition and coordination of Federal, State, and local roles in wetland protection.
- Twenty-one States have investigated assumption of direct Section 404 permitting authority under the Clean Water Act, although only two have actually assumed full responsibility for the program.

A U.S. Geological Survey (USGS) report shows important Federal, State, and private organizational ties in State programs (USDI-USGS, 1996). Participation by State agencies in wetland-related management, regulation, restoration and creation, and delineation and inventory is detailed. More difficult to obtain is insight as to what powers of coordination are exercised and what financial resources are available to carry out concerted programs with Federal agencies and, within the State, with local governments. One of the most important avenues for State involvement in wetlands policy is through joint participation with Federal agencies, particularly through programmatic general permits developed in conjunction with the Army Corps of Engineers based on strong State, local, or regional programs (Studt, 1995, p. 77).

State Participation in Administering the Section 404 Permit Program

Sections 404(g) and (h) give States the authority to assume administration of the Section 404 program in lieu of the Army Corps of Engineers where the States have, among other things, instituted wetland permitting programs that are at least as stringent as the Federal wetlands program. Many of the tensions that develop in administering a wetland regulatory program would likely be ameliorated if States assumed the program, returning control to more local authority. To date, only two States—Michigan and New Jersey—have assumed responsibility for the Section 404 program. States may take responsibility for parts of the Section 404 program without assuming complete responsibility. Twenty-one States have investigated assuming some Section 404 powers in operating their own regulatory programs, and 13 have carried out detailed technical reviews (Kusler, 1994).

States can also participate in Federal wetlands permitting by exercising their authority under Clean Water Act Section 401 to grant or deny water quality certification for individual or general Federal Section 404 permits (Kusler, 1994, p. 45; Studt, 1995). States adopt surface water quality standards and wetlands water quality standards to protect their waters, and are free to make these standards as stringent as they wish. States can review and approve, deny, or put conditions on all Federal permits or licenses that might result in discharges to State waters, including wetlands under any Section 404 permit, that would fail to meet State water quality standards (USEPA, 1993).

Finally, some States participate in Federal wetlands regulation through State program general permits (SPGP's; Kusler, 1994, p. 50). The Clean Water Act does not specifically authorize the Army Corps of Engineers to issue SPGP's. However, the Army Corps of Engineers relies upon its general permit authority in Section 404(e) to issue statewide permits that are "piggy-backed" onto the existing State wetlands permitting programs. The Army Corps of Engineers has also issued programmatic permits on a local basis. At present, the Army Corps of Engineers has issued approximately 60 SPGP's and local programmatic permits, including permits in New Hampshire, Maine, Wisconsin, North Carolina, and Maryland.

Determining the appropriate roles of Federal, State and local governments in regulating wetlands and water resources is difficult (Kusler, 1994, p. i). Federal, State, and local governments, acting in concert, have the potential to articulate the ideal market for public goods demanded of wetlands in a "no net loss" environment.

The Outlook for Wetland Restoration

In the last decade, wetland restoration has become as important as wetland conservation. While controlling wetland conversion to other uses is essential to attaining the "no net loss" goal, not all existing wetlands can be conserved. Weighing the costs and benefits of a particular wetland conversion may show that society is better off because of the conversion. Wetland restoration programs are needed to replace wetland functions and values lost at the margin through these kinds of conversions.

There are four aspects of wetland restoration. First, one of the most important restoration programs for agriculture is the Wetlands Reserve Program, which was considerably revised in the 1996 FAIR Act. Second, mitigation for permitted wetland conversion under Section 404 of the Clean Water Act attempts to replace lost wetlands. Mitigation can be done either through creating or restoring similar wetlands on the development site, carried out by the permit applicant, or through granting wetland mitigation banking credits for wetland restoration done in advance of development at another location. Third, private groups are restoring wetlands, either on their own or in partnership with Federal or State programs. Finally, floodplain management questions raised by the major

floods in 1993 have raised issues of wetland restoration.

Completing the Wetlands Reserve Program

Begun as a nine-State pilot program, the Wetlands Reserve and Emergency Wetlands Reserve Programs have mounted the largest wetland restoration effort in history. By the middle of 1997, 533,026 acres of wetlands were enrolled in 3,200 contracts under the Wetlands Reserve and Emergency Wetlands Reserve Programs (table 9). Wetlands Reserve Program enrollment is highest in the Delta and Gulf regions (40 percent) and the Midwest region (21percent).

The 1996 FAIR Act included several changes for the Wetlands Reserve Program. The Act requires that, to the extent practicable, new enrollments in the Wetlands Reserve Program will consist equally of permanent easements, 30-year easements, and restoration cost-share agreements without easements. Payments for 30-year easements will be limited to 50-75 percent of the amount that would have been paid for permanent easements. Furthermore, the Federal share of restoration costs will be 75-100 percent in the case of permanent easements, and 50-75 percent in the case of 30-year easements or cost-share agreements without easements. The 1996 Act also capped Wetlands Reserve Program enrollment at 975,000 acres.

These changes reflect three sets of pressures that will affect any Federal wetland restoration program. First, the cost of acquiring property rights is high, even the rights for a limited easement. In the prevailing era of budget austerity, many interests compete for the dollars that must be allocated to acquire cropping rights and restore wetlands. Second, environmental critics charge that restoring prior converted wetlands is needlessly expensive, and may not be effective because of the limitations of restoration science (Kusler and Kentula, 1990). Efficiency and equity issues are also raised by restoration programs that reward landowners who previously converted wetlands for crop production, while not providing sufficient regulatory or compensatory incentives to current wetland owners for conserving wetlands. Finally, other critics warn that permanent easements on wetlands are not acceptable to landowners because they remove land from crop production, limit flexibility for future land use changes, and reduce the U.S. competitive advantage in international commodity markets. These arguments helped motivate 1996 changes to the Wetlands Reserve Program, despite the widespread acceptance of permanent easements by Wetlands Reserve Program landowners and a relatively successful restoration track record for the program. By mid-July 1997, permanent and 30-year easements had been fully enrolled at more than 50,000 acres each, but cost-share agreement acreage lagged at about 13,000 acres.

Mitigating Conversion and Wetland Mitigation Banking

Mitigation involves the compensatory creation or restoration of substitute land with particular environmental characteristics, such as wetlands, to make up for unavoidable conversion of environmentally sensitive land. Some regulatory programs, such as Section 404 of the Clean Water Act, require compensatory mitigation if wetland conversion cannot be avoided or sufficiently minimized. The Swampbuster provisions of the 1985 Food Security Act did not allow wetland mitigation. Gradually, pressure from producers who wanted to find some way to accommodate necessary conversions, and pressure for consistency with Section 404 brought amendments in 1990 and 1996 farm legislation to allow continued program participation if the wetland conversion is mitigated through restoration of a prior-converted wetland in the same general area of the local watershed (16 U.S.C. 3822).

Compensatory wetland mitigation has historically required creation, restoration, or enhancement of replacement wetlands of the same type on or adjacent to the site of the wetland conversion (ELI, 1993). This onsite, project-specific focus has resulted in small-scale, high-cost compensatory wetlands yielding poor ecological benefits in areas that may not reflect broader wetland priorities. For example, a one-quarter acre wetland restoration enclosed by chain-link fence, and surrounded by a shopping mall parking lot clearly does not provide the wetland functions and values, including nonmarket values, that the undeveloped wetland site provided, even if "no net loss" of acreage goals are met. Concern about these results has led to an alternative mitigation approach over the last decade: wetland mitigation banking (USACE, 1994).

Wetland mitigation banking attempts to provide greater flexibility in meeting the wetland mitigation requirements of the Section 404 permit program. Rather than creating or restoring wetlands at the site of wetland losses, public works agencies, private developers, or other parties involved in wetland con-

version can mitigate those losses by purchasing "compensation credits" in larger, centralized wetland mitigation projects. Credits are issued to those who seek to convert wetlands based on the acreage of wetlands they pay to create or restore. Mitigation ratios typically require more than 1 acre of wetlands to be created or restored for each wetland acre converted, and may be further adjusted to account for differences in the type and timing of wetland restoration. The wetland mitigation bank itself may be operated for the exclusive use of a particular developer or public agency, or it may also serve other parties, or it may be altogether independent of conversion activities (ELI, 1993).

In a traditional mitigation scenario, for example, Developer A might be required to create a 2-acre wetland near the site of a 1-acre wetland that is being converted for development. Under mitigation banking, by contrast, Developer A might pay Mitigation Bank B to create or restore 2 acres of wetlands at an offsite location providing greater wetland benefits. Bank B would then issue Developer A a mitigation credit that could be used to permit the planned wetland conversion and development to proceed.

The Environmental Law Institute identified 46 existing wetland mitigation banks in the United States as of July 31, 1992 (ELI, 1993). Banks were located in 17 States, but concentrated in California (with 11 banks) and Florida (with 8). State highway departments, port authorities, or local governments operated nearly 75 percent of the 46 banks to provide mitigation for public works projects. Private developers controlled six more banks for advance mitigation of their own projects. Only four banks offered compensation credits for commercial sale to the general public—one of them a privately owned bank and the other three owned by public agencies or nonprofit organizations.

The Environmental Law Institute also identified 64 proposed mitigation banks at various stages of review and authorization. Of the 64, 32 proposed to offer credits for commercial sale to the general public, in contrast with 9 percent of existing banks. By 1995, private sector entrepreneurs had established 12 banks for sale of credits to the general public (Scodari and Brumbaugh, 1996). By February 1997, another U.S. Army Corps of Engineers survey identified 108 operating wetland mitigation banks, with 43 established for general sale of credits. The latest survey identified 100 more banks in various stages of development (Brumbaugh, 1997).

On November 28, 1995, USDA's Natural Resources Conservation Service and other Federal agencies published final policy guidance for the establishment, use, and operation of mitigation banks to satisfy the wetland mitigation requirements of the Clean Water Act's Section 404 permit program and the "Swampbuster" provisions of the 1985 Food Security Act (*Federal Register*, 1995a). The guidelines state that banks may be sited on public or private lands, but that mitigation credits may not be generated by federally funded wetland conservation projects, such as the Wetlands Reserve Program or the Fish and Wildlife Service's Partners for Wildlife Program. Mitigation requires restoring or creating wetlands; preservation of existing wetlands may not generally be used as the sole basis for generating credits, except under unusual circumstances. The guidelines express the agencies' preference for mitigation within the same geographic area and of the same kind of wetland as that being degraded or lost. The guidelines require that wetlands be restored, or that restoration be contracted for, prior to any debiting of mitigation credits from the bank, with preference for advance restoration. Finally, wetlands created, restored, or enhanced by the mitigation bank are to be protected in perpetuity with appropriate real estate arrangements, such as conservation easements or transfer of title to an appropriate Federal or State agency or to a nonprofit conservation organization. Wetlands and other aquatic resources restored under the Conservation Reserve Program or similar programs requiring only temporary conservation easements may be eligible for banking credit upon termination of the original easement if the wetlands are provided permanent protection and it would otherwise be expected that the resources would be converted upon termination of the easement (*Federal Register*, 1995a).

Mitigation banking essentially makes transferable a developer's obligation to mitigate when wetland losses are unavoidable. In so doing, it offers potential advantages of a wider market in conservation interests. Specifically, mitigation banking offers economies of scale in wetland creation, restoration, or enhancement, as well as flexibility in locating compensatory wetlands in sites that offer greater or higher priority ecological benefits. Given the relatively recent emergence of wetland mitigation banking, whether the bank concept will prove a viable market

Table 9—Acreage under the Wetlands Reserve Program (WRP) and Emergency Wetlands Reserve Program (EWRP), 1992-97[1]

State/wetland region	1992 WRP	1993 EWRP	1994 WRP	1995 WRP	1995 EWRP	1996 WRP	1996 EWRP	1997 WRP Permanent	1997 WRP 30-Year	1997 WRP Cost-share	1997 EWRP	Total
						Acres						
Kansas	0	142	1,166	2,243	0	1,770	0	1,578	0	0	0	6,899
Nebraska	0	55	1,408	5,634	0	0	0	1,076	64	0	0	8,237
Oklahoma	0	0	0	12,590	0	0	0	2,344	1,184	0	0	16,118
Central Plains	**0**	**197**	**2,574**	**20,467**	**0**	**1,770**	**0**	**4,998**	**1,248**	**0**	**0**	**31,254**
Arkansas	0	0	16,081	15,424	0	3,867	0	6,014	5,199	1,856	0	48,441
Louisiana	12,663	0	28,183	25,705	0	0	0	6,934	5,467	125	0	79,077
Mississippi	11,751	0	26,705	20,451	0	0	0	3,732	5,621	0	0	68,260
Tennessee	0	0	1,876	4,166	0	0	0	576	200	0	0	6,818
Texas	0	0	2,440	6,731	0	0	0	447	409	500	0	10,527
Delta and Gulf	**24,414**	**0**	**75,285**	**72,477**	**0**	**3,867**	**0**	**17,703**	**16,896**	**2,481**	**0**	**213,123**
Arizona	0	0	0	0	0	0	0	0	0	0	0	0
Colorado	0	0	0	503	0	0	0	838	203	0	0	1,544
Idaho	0	0	0	102	0	0	0	972	787	0	0	1,861
Nevada	0	0	0	0	0	0	0	0	0	0	0	0
New Mexico	0	0	0	0	0	0	0	0	0	0	0	0
Utah	0	0	0	0	0	0	0	0	0	0	0	0
Wyoming	0	0	0	37	0	0	0	0	0	100	0	137
Mountain	**0**	**0**	**0**	**642**	**0**	**0**	**0**	**1,810**	**990**	**100**	**0**	**3,542**
Illinois	0	197	2,470	2,473	4,453	2,643	3,326	2,394	847	0	0	18,803
Indiana	0	0	1,675	476	0	1,306	0	1,096	2,548	500	0	7,601
Kentucky	0	0	0	1,905	0	0	0	836	0	99	0	2,840
Michigan	0	0	0	1,460	0	535	0	2,948	836	0	0	5,779
Minnesota	453	672	1,751	2,125	1,569	535	0	1,856	66	0	0	9,027
Missouri	1,696	11,172	4,699	1,869	7,067	12,206	0	2,779	1,420	0	5,900	48,808
Ohio	0	0	0	2,450	0	652	0	2,677	714	8	0	6,501
Wisconsin	1,560	0	1,465	3,917	0	1,750	0	1,649	165	1,104	0	11,610
Midwest	**3,709**	**12,041**	**12,060**	**16,675**	**13,089**	**19,627**	**3,326**	**16,235**	**6,596**	**1,711**	**5,900**	**110,969**
Connecticut	0	0	0	112	0	0	0	0	0	0	0	112
Delaware	0	0	0	52	0	0	0	0	0	0	0	52
Maine	0	0	0	500	0	0	0	189	0	3,428	0	4,117
Maryland	0	0	0	1,177	0	0	0	105	0	0	0	1,282
Massachusetts	0	0	0	30	0	0	0	0	0	0	0	30

See notes at end of table.

—Continued

Table 9—Acreage under the Wetlands Reserve Program (WRP) and Emergency Wetlands Reserve Program (EWRP), 1992-97[1]—Continued

State/wetland region	1992 WRP	1993 EWRP	1994 WRP	1995 WRP	1995 EWRP	1996 WRP	1996 EWRP	1997 WRP Permanent	1997 WRP 30-Year	1997 WRP Cost-share	1997 EWRP	Total
						Acres						
New Hampshire	0	0	0	103	0	0	0	0	0	70	0	173
New Jersey	0	0	0	195	0	0	0	198	0	0	0	393
New York	45	0	401	951	0	1,528	0	4,217	2,892	75	0	10,109
Pennsylvania	0	0	0	485	0	0	0	552	0	0	0	1,037
Rhode Island	0	0	0	0	0	0	0	0	0	0	0	0
Vermont	0	0	0	200	0	0	0	0	0	0	0	200
West Virginia	0	0	0	0	0	0	0	190	0	66	0	256
Northeast	**45**	**0**	**401**	**3,805**	**0**	**1,528**	**0**	**5,451**	**2,892**	**3,639**	**0**	**17,761**
California	4,410	0	2,556	5,495	0	4,674	0	4,057	1,787	2,356	0	25,335
Oregon	0	0	0	770	0	0	0	1,081	646	6	0	2,503
Washington	0	0	626	2,289	0	0	0	1,982	1,033	35	0	5,965
Pacific	**4,410**	**0**	**3,182**	**8,554**	**0**	**4,674**	**0**	**7,120**	**3,466**	**2,397**	**0**	**33,803**
Iowa	5,073	29,759	5,858	928	5,733	4,039	9,811	2,653	208	0	0	64,062
Montana	0	0	0	859	0	0	0	615	480	40	0	1,994
North Dakota	0	0	0	0	0	0	215	0	2,910	0	0	3,125
South Dakota	0	4,260	3,411	2,394	5,139	0	0	1,330	1,295	0	0	17,829
Prairie Pothole	**5,073**	**34,019**	**9,269**	**4,181**	**10,872**	**4,039**	**10,026**	**4,598**	**4,893**	**40**	**0**	**87,010**
Alabama	0	0	0	858	0	0	0	0	381	0	0	1,239
Florida	0	0	0	0	0	0	0	0	13,000	2,800	0	15,800
Georgia	0	0	0	2,005	0	0	0	0	0	0	0	2,005
North Carolina	5,703	0	2,802	1,340	0	0	0	131	455	0	0	10,431
South Carolina	0	0	0	4,142	0	0	0	442	602	18	0	5,204
Virginia	0	0	161	462	0	0	0	160	102	0	0	885
Southeast	**5,703**	**0**	**2,963**	**8,807**	**0**	**0**	**0**	**733**	**14,540**	**2,818**	**0**	**35,564**
Alaska	0	0	0	0	0	0	0	0	0	0	0	0
Hawaii	0	0	0	0	0	0	0	0	0	0	0	0
United States	**43,354**	**46,257**	**105,734**	**135,608**	**23,961**	**35,505**	**13,352**	**58,648**	**51,521**	**13,186**	**5,900**	**533,026**

[1]Data current as of July 14, 1997.
Source: WRP and EWRP program data, Natural Resources Conservation Service, USDA.

institution over time, and whether it might eventually prove promising in other conservation contexts remains to be seen.

Although embracing mitigation banking as a "market-based" solution to replacing wetlands lost to conversion is fashionable, regulatory agencies need to recognize the extent to which they create the market for mitigation banks (see fig. 5). The supply of wetland "commodities" created by banks must satisfy two customers, the ultimate demand from permit seekers who want to acquire credits to offset wetland conversion (shown in the right column), and the regulatory authority that must approve the credits (shown in the center column). Abrupt changes in standards or practices by the regulatory authority will likely upset investment decisions made by the bank on the basis of previous rules and can be a source of disruption with which other markets do not have to contend. Key trading rules set by the regulators include standards for design and construction, performance, monitoring and maintenance, long-term management, time to market, and liability for failure. For example, if the regulatory authority abruptly changes a previously established standard mitigation ratio from 3 acres of wetland restoration to 1 acre of wetland conversion permitted to 2:1, the mitigation bank's market is arbitrarily cut by a third with no other underlying change in development demand.

The mitigation bank's supply of mitigation credits is subject to risky investment decisions. These include risks in anticipating the kind and location of wetlands that will be in demand and that will provide acceptable credits for wetlands converted; risks in producing successful restorations that are of sufficiently high quality to garner low mitigation ratios, thus reducing fixed costs (land); and the normal financial risks attending any long-term capital investment. Regulatory agencies must recognize that their rules for mitigation banking can increase or lower many of these risks, raising or lowering the potential return for mitigation banks, and increasing or decreasing the supply of bank credits developed (USACE, 1994-c, p. 18). The interagency guidance on mitigation banking issued in 1995 provides a good basis for creating mitigation banking markets (*Federal Register*, 1995a).

Private Efforts to Protect Wetlands

In addition to public programs to protect remaining wetlands and restore converted wetlands, private nonprofit conservation organizations have similar goals. A 1994 survey found that 73 percent of nearly 1,100 land trusts nationwide reported wetland protection among their priorities (Doran, 1997). The National Wildlife Federation's Wildlife Habitat Enhancement Council, founded in 1988, now includes 80 corporate members and 15 national conservation groups, which have enhanced and restored over 200,000 acres of wetlands at 225 sites (USACE, 1994-e). Since its establishment in 1951, The Nature Conservancy (TNC) has purchased nearly 475,000 acres of wetlands from willing landowners in the United States. Ownership of most of this acreage has since been transferred to other public and private conservation organizations. As of August 1996, TNC owned about 170,000 wetland acres, and protected another 210,000 wetland acres through management agreements, conservation easements, and leases (TNC, 1996). Because of difficulties in accounting for these activities, there is likely considerable overlap in the reported achievements and acreage from these efforts.

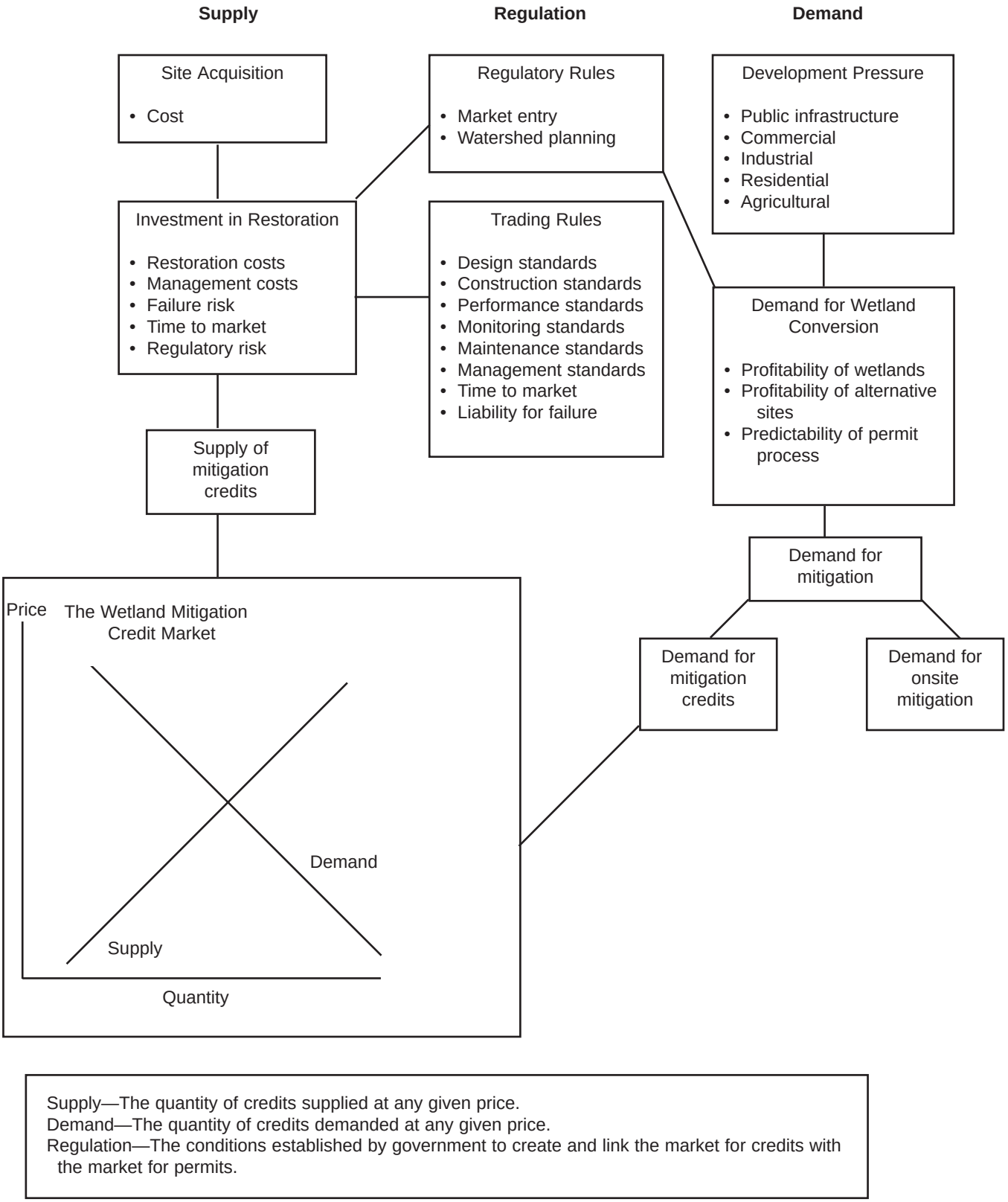
Public-private Partnerships

Federal, State, and local government agencies may be able to reduce the transaction costs associated with wetland preservation by enlisting nonprofit conservation groups as partners in acquiring, managing, and monitoring easements. (As specified in Wetlands Reserve Program regulations, however, the responsibilities and costs of enforcing easements must remain with delegated Federal or State agencies (7 C.F.R. 720 and 1467, Section 1467.2(f)).) Nonprofit groups, such as land trusts, offer flexibility and agility, the ability to mobilize private financial and political support, and the capacity to provide local knowledge and insights (Wiebe, and others, 1996b). Local knowledge and support may also be acquired through participating organizations, such as soil and water conservation districts. A survey found 20 Federal wetland enhancement and restoration efforts that invite varying degrees of partnership, 34 programs in 24 States, and 14 nonprofit organization programs (USACE, 1994-e).

Public and private nonprofit organizations working in partnership also offer access to a larger pool of landowners potentially willing to convey conservation easements. Public easement-acquisition programs reach a wide range of landowners, but such programs are limited by the availability of public funding. Although qualified nonprofit organizations can offer

Figure 5

Regulatory policies influence wetland mitigation credit markets



Source: USACE, 1994-c.

tax advantages in exchange for easement donations, public programs generally require that easements be acquired at fair market value (or at least, as in the case of the Wetlands Reserve Program, that landowners be *offered* fair market value). For example, the implementing regulations (49 C.F.R. 14.102(2)(d)) of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 require Federal agencies to offer not less than fair market value when they seek to acquire land (USGAO, 1994a, p. 4). Neither the Conservation Reserve Program nor the Wetlands Reserve Program is required to *pay* full fair market value for the partial interests they acquire, however, and landowners may increase their chances of selection by offering to accept less than fair market value (USDA, 1997). Nonprofit programs surmount the funding constraint by emphasizing the tax advantages of easement donation or bargain sale, but may be unable to attract landowners for whom tax benefits are insufficient. Public and private approaches together may attract a larger pool of interested landowners than either approach can alone.

These two potential advantages—cost savings and an expanded pool of interested landowners—justify a closer look at the role of partnerships between Federal agencies and nonprofit organizations in resource conservation policy. Nonprofit organizations play an active role in acquiring land and partial interests in land for the Forest Service, Bureau of Land Management, Fish and Wildlife Service, and National Park Service. Land trusts and other nonprofit groups increasingly perform a brokerage function with regard to conservation easements, both in transactions between private parties and in transactions involving private parties and government agencies. The Forest Service and the Fish and Wildlife Service, for example, often rely on nonprofit organizations to help negotiate or acquire and transfer interests in land for conservation purposes. In the Wetlands Reserve Program, land trusts may participate in easement monitoring and management, and landowners may sell other partial interests, such as easements beyond the 10-year term and hunting, fishing, and timber rights allowed under the Wetlands Reserve Program easement agreement, to private conservation organizations (7 C.F.R. 720 and 1467, Section 1467.2(f)).

Partnerships between Federal agencies and conservation organizations have also been successful in a variety of other contexts. For example, partnerships under the North American Wetlands Conservation Fund include projects totaling 940,723 acres of wetlands acquired, restored, and/or enhanced as of September 1996, at a combined Federal and non-Federal cost of $359 million ($382 per acre). The Fish and Wildlife Service Partners for Wildlife program has initiated voluntary restoration projects totaling approximately 400,000 acres for little more than the cost of the restoration work. No property interests are acquired, but the landowner agrees to maintain the restoration for some years or repay the cost of the work. Wetlands Reserve Program regulations provide that USDA's Natural Resources Conservation Service can delegate specified administrative functions, including wetland management, and monitoring responsibilities (but not enforcement), to qualified Federal or State agencies or private organizations (Arnold, 1993; *Federal Register*, 1995b). To date, such delegation has occurred only in cases where residual interests (that is, the owner sold residual fee simple title to a Federal agency) in Wetlands Reserve Program land have subsequently been acquired by other State or Federal agencies—as in the case of the Iowa River Corridor Project discussed below—but not in cases where the land has remained in private ownership (Misso, 1997). The Farm Service Agency (FSA) seeks land trusts' help in educating farmers about FmHA's program to reduce debts in exchange for conservation easements, and in monitoring those easements (Land Trust Alliance, 1994). The White House noted the achievements of land trusts in the *1996 Economic Report of the President* (Council of Economic Advisers, 1996). The Forest Service and the Bureau of Land Management are also seeking to work more closely with land trusts in activities relating to land acquisition and management (USDA-FS, 1994; Land Trust Alliance, 1993).

Federal officials caution that land trusts must be well-informed of Federal standards and practices regarding appraisal and land acquisition, such as the guidelines in *Uniform Appraisal Standards for Federal Land Acquisitions* (Interagency Land Acquisition Conference, 1992), and must work closely with the Federal Government from the beginning of any easement acquisition process if such partnerships are to be successful (Sherman, 1995). In addition, as mentioned above, although Federal agencies can pay less to landowners willing to accept it, they are required to offer not less than fair market value when they seek to acquire land (USGAO, 1994a).

Two recent reports have examined the role of nonprofit organizations in Federal land acquisition. An audit in May 1992 by the Office of Inspector General at the U.S. Department of the Interior found that between 1986 and 1991 the Fish and Wildlife Service, National Park Service, and Bureau of Land Management spent $222 million (about 22 percent of their land acquisition expenditures) on properties involving nonprofit organizations (USDI, 1992, as summarized in GAO, 1994a). That report found that U.S. Department of the Interior agencies generally paid nonprofit organizations the appraised fair market value of the land acquired, resulting in financial gains to the nonprofit organizations in some cases (for example, when the latter had originally acquired the land for less than fair market value through bargain sale with tax deductions under Section 170(h)). U.S. Department of the Interior's Assistant Secretaries for Land and Minerals Management and for Fish and Wildlife and Parks disagreed with the Office of Inspector General's conclusion that these gains were unduly large, prompting debate about the appropriate role of nonprofit organizations in Federal land acquisition.

In 1994, the General Accounting Office issued a second report on the role of nonprofit organizations, which focused on land acquisitions by the Forest Service and the Department of Energy (USGAO, 1994a). In contrast to the U.S. Department of the Interior study, the General Accounting Office found that the Government's interests were adequately safeguarded in both cases. Between 1988 and 1992, the Forest Service's land acquisitions totaled about $337 million, of which about 41 percent was spent on acquisitions involving nonprofit organizations (USGAO, 1994a). In most transactions, the Federal agencies based their offers on fair market value as determined by timely appraisals, as required. Even in cases where nonprofit organizations sold land to the Government for more than they paid for it (as when nonprofit organizations acquired land at less than fair market value), the nonprofit organizations were found to incur net losses when all direct and indirect costs associated with land acquisition and transfer were considered. The General Accounting Office report concluded that Forest Service and Department of Energy relationships with nonprofit organizations have been positive, allowing the Federal Government to take advantage of opportunities to acquire desirable properties that might otherwise have been missed due to landowner unwillingness to deal directly with Federal agencies or to agencies' inability to act quickly.

Restoring Wetlands To Manage Floodplains

Rainfall that was unusual in both extent and duration resulted in ground saturation and flooding in the Midwest in 1993, causing widespread damage and raising questions about the appropriate use of watersheds and floodplains. Subsequent flooding in Georgia (in 1994), California (in 1995), and the mid-Atlantic States and Pacific Northwest (1996) further demonstrated the importance of floodplain management. The White House Interagency Floodplain Management Review Committee (IFMRC, 1994) found that loss of wetlands and upland cover (primarily to agricultural uses) had significantly increased runoff over the past century and a half, but that restoring converted wetlands along the floodplain to provide additional out-of-bank storage would have had little impact on conditions in 1993 (IFMRC, 1994). Economic damage estimates ranged from $12 to $16 billion, of which agriculture accounted for over half. As of June 1994, USDA emergency assistance paid to the nine Midwestern States most severely affected totaled $2.9 billion, most of it for disaster assistance and crop insurance (USDA Flood Information Center, 1994).

Despite the magnitude of damages in 1993, the IFMRC found that reservoirs and levees built by the Army Corps of Engineers worked essentially as designed, preventing more than $19 billion in potential damages. Watershed projects built by the Natural Resources Conservation Service were estimated to have prevented potential damages totaling an additional $400 million. However, they also found that nonstructural solutions, such as permanent evacuation of floodprone areas, flood warning, flood proofing of structures, and creation of additional natural and artificial flood storage, need greater emphasis. The IFMRC concluded that, although wetland conversion dramatically increased runoff, wetland restoration would have had only a minimal effect on the 1993 flood's unprecedented magnitude (IFMRC, 1994). Floodplain wetland restoration under the Wetlands Reserve and Emergency Wetlands Reserve Programs since 1993 will likely reduce future flood damages from more typical floods.

Based on its findings, the IFMRC recommended a variety of administrative and legislative steps, improved coordination of Federal acquisition of envi-

ronmentally related interests in land from willing sellers, and recommended reforms to enhance the efficiency and effectiveness of the National Flood Insurance Program. The National Flood Insurance Reform Act of 1994 (Title V of P.L. 103-325, 42 U.S.C. 4001) restricts lending secured by uninsured or underinsured property located in floodplains, extends the waiting period before new flood insurance policies become effective from 5 to 30 days, and denies Federal disaster assistance to individuals who failed to obtain and maintain flood insurance when required to do so as a condition for receiving disaster assistance.

Wetland's role in floodplain management remains relevant today. Not just the Midwest is affected; California, the Ohio Valley, and the Upper Mississippi, Missouri, and Red River basins had flooding in 1996 and 1997. A variety of public and private efforts are conserving and restoring wetlands in floodplains. Nonprofit conservation organizations played a significant role in acquiring land interests after the Midwestern floods of 1993 (IFMRC, 1994). The Nature Conservancy, for example, helped negotiate floodplain easements and even acquired residual rights from Missouri farmers who had placed their farms in the Wetlands Reserve Program (Tenenbaum, 1994).

Examples of how public-private partnerships can accomplish floodplain management are the Iowa River Corridor Project (IRCP) and the Levee District 8. Numerous Federal, State, local, and private organizations are working together to restore wetlands and encourage a mix of floodplain-sensitive land uses in these areas. The IRCP focuses on a 50-mile stretch of the Iowa River's floodplain above the Coralville Reservoir in eastern Iowa (IRCP, undated; USDI-FWS, 1995). Of a total of about 50,000 acres within the project area, about 30,000 acres were cropland at the time of the 1993 floods, much of it on prior-converted wetlands. Since 1993, about one-third of project-area landowners have enrolled nearly 12,000 acres of this cropland in the Wetlands Reserve Program or the Emergency Wetlands Reserve Program. In addition, many participating landowners have agreed to sell their remaining interests in about 8,000 acres of enrolled land to the Fish and Wildlife Service, which will turn over management responsibilities on that acreage to the Iowa Department of Natural Resources. In addition to these property acquisition activities, numerous other public and private agencies are working in the project area to monitor water quality and other ecological changes, and to help landowners explore new floodplain-sensitive uses for lands not enrolled in the Wetlands Reserve Program or the Emergency Wetlands Reserve Program.

Partnerships in floodplain wetland restoration and preservation are also evident in Levee District 8, which covers 3,000 acres of Iowa River floodplain in southeastern Iowa's Louisa County. Prior to 1993, the district had received Federal funds to repair flood-damaged levees 14 times, at a cost of nearly $4 million (in 1993 dollars). The 1993 floods caused a further $757,000 in levee damage (Dettman, 1994). Rather than repair the levees again, the district's Board voted in March 1994 to discontinue agricultural operations and disband the district, returning riparian land to wetland condition.

Landowners, State and Federal agencies, and private conservation organizations agreed to return the land to wetlands. As a result, most of the land formerly protected by the district's levees is being reclaimed as part of the Iowa River's natural floodplain and restored to bottomland hardwood forest. Most of the district's landowners sold permanent easements to the Federal Government under the Emergency Wetlands Reserve Program. Private conservation organizations are purchasing interests in other land not enrolled in WRP. In all, more than a dozen Federal, State, local, and private agencies contributed to the effort, including the Natural Resources Conservation Service, the Fish and Wildlife Service, the Environmental Protection Agency, the Federal Emergency Management Agency, the Iowa Department of Natural Resources, the Iowa Natural Heritage Foundation, the Conservation Fund, The Nature Conservancy, Pheasants Forever, Ducks Unlimited, the Fish and Wildlife Foundation, and the Louisa County Soil and Water Conservation District (Mountain, 1995). The Fish and Wildlife Service will maintain the area as part of its Mark Twain Wildlife Refuge. In addition to providing wildlife habitat, recreation, and educational opportunities, the restoration will ease flooding downstream.

These public and private approaches to restoring wetlands formerly converted to other uses are thus beginning to make headway toward the long-term goal of

increasing wetland resources. However, continued appropriations are needed because all of the restoration programs are voluntary and landowners must be compensated for the loss of income foregone when the wetland is restored. Compensation for restoring wetlands, along with concerns about regulatory and quasi-regulatory wetland conservation programs, has led to interest in compensating landowners for conserving wetlands. This is a more expensive task because of the large acreage of existing wetlands, lack of a way to ration compensation among claimants, and the higher cost of some wetlands subject to pressure for conversion to developed uses.

The Outlook for Wetland Compensation

Property rights have received unprecedented attention in recent years. When the Government takes property for public use, called a "taking," the Constitution requires that it pay the owner just compensation. Legislation considered in the 104th Congress would have required the Federal Government to compensate landowners whenever Federal agency actions diminished the value of even a portion of a property by a threshold percentage varying from 20 to 33 percent (H.R. 961 passed in the House on May 16, 1995; H.R. 925, S. 352). Federal agency actions included the Endangered Species Act, the Clean Water Act, the Swampbuster provisions of the 1985 Food Security Act, and others. This requirement would have established diminution in value as a sufficient criterion by which takings could be determined, regardless of other economic and legal criteria (see section I). However, the proposal was not enacted into law. Takings-related activity has fallen off considerably in the 105th Congress.

Most States have also considered takings legislation in recent years, and 20 States have now enacted takings laws. Most of the State laws require takings impact assessments rather than compensation for diminished property values, but four States have enacted compensation laws. Florida authorizes compensation for real property owners whose property has been "inordinately burdened" by government actions, Louisiana and Mississippi provide for compensation when government actions diminish the value of agricultural or timber land by 20 percent and 40 percent, respectively, and Texas has a takings threshold of 25 percent diminution in property value, including water rights (American Resources Information Network, 1997).

Strictly voluntary public and private programs such as the Conservation Reserve Program, the Wetlands Reserve Program, and State and local farmland protection efforts provide insights into the difficulties inherent in identifying and valuing partial interests in land—difficulties that public agencies will confront when conducting takings impact assessments. Experience with existing voluntary programs suggests that the analysis necessary to determine whether takings resulted from government actions and what compensation is due will ultimately have to be conducted on a costly, case-by-case basis (Wiebe, and others 1996b; USDA-ASCS, 1993). Ironically, this is an objection critics raise with reference to the approach traditionally employed by the courts (Goldstein, 1996; Innes, 1995; Hunt and VandenBerg, 1998).

Estimating Compensation Costs for Wetlands

Even though local appraisal will have to determine actual compensation amounts, if required compensation measures are enacted, the Federal Government's potential liability under proposed compensation requirements for some restrictions on the use of privately owned wetlands can be estimated (Zinn, 1992). These estimates are useful in illustrating the size of the fiscal commitment implied by compensation requirements, and to show how the total cost varies depending on the scope and timing of compensation. Estimated compensation liability will vary depending on the location of land affected (metropolitan versus nonmetro), the prevented use claimed (for example, urban development versus agriculture), and degree of conversion potential that will be compensated (for example, compensating all wetlands affected versus wetlands for which a *bone fide* development proposal is pending). Although estimates derived from varying these assumptions vary widely, they all imply significant public outlays.

One estimate of the total value of wetlands subject to Swampbuster and Section 404 provisions is based on recent State-average cropland values from Economic Research Service surveys, differentiated by metro and nonmetro location (table 10). The cropland values reflect both potential for agricultural production and an expectation of future development value. Metropolitan values are more than twice those in nonmetropolitan areas, where development is less likely and land is less valuable. The estimate of $181.6 billion is probably high for three reasons. First, the

value implicitly assumed for the wetland in its natural state, before clearing and drainage to make it equivalent to average agricultural land, is zero. Natural wetlands do have some intrinsic market value for hunters, groups concerned with preserving natural areas, and people who just want natural surroundings in rural settings. These values, however low, should be subtracted from the gross agricultural valuation. Second, many wetlands are already used for crop production or grazing, and thus have some intrinsic agricultural value in their undrained or partially drained state. These values should also be subtracted. More fundamentally, it is unlikely that any compensation scheme would offer to compensate all wetland owners, regardless of how remote the expectation of conversion.

A second estimate is based on market values actually paid by public and private organizations that currently acquire easements or fee title rights to wetlands. Examples include The Nature Conservancy, the North American Waterfowl and Wetlands Office of the U.S. Fish and Wildlife Service, and USDA's Wetlands Reserve Program. As an illustration, the second estimate in table 10 values all wetlands in metro and nonmetro areas based on the average market value of wetland parcels acquired in such areas by The Nature Conservancy between 1955 and 1996, adjusted to 1996 constant dollars. Average wetlands market values are only slightly lower than average agricultural land values ($1,459 versus $1,629 per acre), resulting in similar aggregate estimates of compensation costs ($162.6 billion versus $181.6 billion).

A third estimate was developed by modifying the first approach based on expected rates of wetland conversion to different uses and using estimates of values for land that is ready to develop, rather than values for raw land with expectations for future development. As we saw in Chapter III, rates of wetland conversion

Table 10—Alternative estimates of compensation for wetland regulation

Item	Wetlands	Value per acre	Total value
	Million acres	Dollars	Billion dollars
Valuing all wetlands at agricultural land prices:[1]			
Metro	31.7	2,676	84.7
Nonmetro	79.8	1,214	96.8
Total	111.5	1,629	181.6
Valuing all wetlands at wetland market prices:[2]			
Metro	31.7	2,611	82.7
Nonmetro	79.8	1,002	79.9
Total	111.5	1,459	162.6
Valuing wetlands converted at 1982-92 rates, by converted use:[3]			
Urban	0.9	100,000	89.0
Agriculture	0.3	1,200	0.4
Total	1.2	74,477	89.4
Valuing wetlands converted at 1954-74 rates, by converted use:[3]			
Urban	0.5	100,000	54.0
Agriculture	5.9	1,200	7.1
Total	6.4	9,446	61.1
Valuing wetlands profitable to convert to agricultural use:[4]			
Preconversion use	13.2	145	1.9
Agricultural use	13.2	2,360	31.1
Total	13.2	2,215	29.2

[1]Raw agricultural land values are from National Agricultural Statistics Service/Economic Research Service cropland value survey data for 1996.
[2]Market values for wetlands acquired by The Nature Conservancy, 1955-96, in 1996 constant dollars, Christen Comstock, personal communication, 1997.
[3]Urban land values are from Urban Land Institute *Market Profiles, 1993* housing, retail, and office prices for selected cities.
[4]Values are for agricultural use and preconversion use of wetlands from profitability analysis in Section VI.
Source: Economic Research Service compilation of 1992 National Resources Inventory and Fish and Wildlife Service Status and Trends data.

for all uses have declined since the mid-1950's due to enactment of regulatory programs, and have shifted from primarily agricultural conversion to primarily urban conversion (table 2). If these regulatory programs are eliminated in favor of a compensation program, landowners will face few restrictions on conversion and will have additional economic incentives to pursue development projects (ERP, 1995, p. 149; Innes, 1995). Thus, compensation cost estimates can vary from $89.3 billion, assuming the current (1982-92) rates and mix of conversions, to $61.1 billion, assuming reversion to the higher conversion rates and agricultural emphasis of the 1950's to 1970's (table 10). Returning to the older pattern of conversion in which five times more wetland acres were lost would cost less than more recent patterns of wetland conversion because of the higher proportion of lower cost agricultural land converted in earlier periods.

A fourth estimate of compensation for agricultural conversion foregone was constructed based on an assessment of the potential profitability of wetland conversion. The estimate of $29.2 billion is solely for agricultural land, but it has the virtues of focusing directly on wetlands profitable to convert, accounting for the production potential of those wetlands and the cost of converting the wetlands to production, and subtracting an estimate of the market value of the wetlands in the absence of conversion. This estimate does not account for the price effects caused by regulation, or by removing regulation. For a complete estimate of wetland compensation required, a similar effort would have to be undertaken for wetland conversion for urban development, which would likely result in much higher values.

Achieving "No Net Loss"

Progress toward the "no net loss" goal has been more rapid than many anticipated when it was first enunciated in the late 1980's. The achievement is partly illusory because high net conversion rates debated in the late 1980's were based on trend data from 1954-74, the latest available at the time. Since then, estimates from 1974-84 and 1982-92 show that wetland conversions, particularly to agricultural uses, have been reduced. While wetland conversion is lower, since 1990 wetlands that had been drained are also now being restored by Federal, State, and private programs. On the basis of partial data, Tolman (1995; 1997) claims that wetland restoration in 1994 exceeded the rate of wetland conversion. Problems in accounting for restoration activity make confirming Tolman's hypothesis difficult, but there is little doubt that the United States is moving closer towards "no net loss," at least in acreage terms (Smith, 1997; Wilen, 1995).

In table 11, the most recent estimates of gross wetland losses and gains are compared with estimates of restoration activity. If the rate of gross wetland conversion to all uses observed over 1982-92 continued during the first half of the 1990's, 156,000 acres of wetlands would have been converted, requiring double the rate of restoration or replacement observed in 1982-92. Based on available data, restoration activity in 1992-96 accomplished that doubling, rising from 77,000 acres per year in 1982-92 to an average of 187,343 acres per year in 1992-96. When adjustments for upland acres, restoration versus enhancement, and double counting between the Partners for Wildlife and North American Waterfowl Management Plan are made, it appears that the United States is within 47,000 acres per year of achieving "no net loss" of wetland acreage. None of these estimates include purely private efforts at restoration, such as those of Ducks Unlimited, the Izaak Walton League, The Nature Conservancy, and other groups and individuals, nor efforts by State and local governments.

Whether the low rate of gross wetland conversion, the high rate of wetland restoration, or both, can be sustained over the long term remains unclear. Improvements in the agricultural and nonagricultural economy, proposals to exempt wetlands from current conservation and regulatory programs, phasing out of farm program benefits that motivate the Swampbuster provisions, and continuing budgeting issues could increase wetland conversion from the low rates observed in 1982-92, reduce restoration activity, or both, moving us away from the "no net loss" target.

Costs and Benefits of "No Net Loss"

Based on the analyses and data presented above, a rough picture of the costs incurred in preventing wetland conversion and conserving or restoring wetlands to achieve "no net loss" emerges. Mean costs of acquiring property rights in wetlands range from several hundred dollars per acre for wetlands in their natural state that have little potential for conversion up to hundreds of thousands of dollars per acre for wetlands with potential value for urban development sites (table 12). Acquiring rights to former wetlands and restor-

Table 11—Average annual wetland losses and gains compared with recent restoration activity, 1992-96

Program	1982-92 average annual gross wetland								Average annual restoration	
	Losses	Gains	1992	1993	1994	1995	1996	Total	1992-96	Adjusted[1]
					Acres					
USDA-WRP/EWRP[2]	na	na	43,438	0	159,634		197,313	400,385	80,077	76,073
FWS-PFP[3]	na	na	38,000	34,528	54,739	54,146	51,407	232,820	46,564	2,328
FWS-NAWMP[4]	na	na	88,000	51,000	50,000			189,000	37,800	9,450
ACE-Section 404[5]	na	na	na	na	15,000	45,925	47,864	108,789	21,758	20,670
Mitigation banks[6]	na	na	1,144	1,144	1,144	1,144	1,144	5,720	1,144	1,087
Total	156,000	77,000	170,582	86,672	280,517	101,215	297,728	936,714	187,343	109,608

na = not available.

[1]Adjusted for the proportion of wetland versus upland acres, restoration versus enhancement, and for double counting.

[2]Wetland Reserve and Emergency Wetlands Reserve Programs, assumes 95 percent is actual restoration.

[3]Fish and Wildlife Service-Partners for Wildlife Program, assumes 20 percent not reported in North American Waterfowl Management Plan and 25 percent is actual restoration.

[4]Fish and Wildlife Service-North American Waterfowl Management Plan, assumes 25 percent is actual restoration.

[5]Robertson (1997), assumes 95 percent is restoration.

[6]Forty-six existing wetland mitigation banks inventoried in 1992, assumes 95 percent is restoration.

Source: Economic Research Service, USDA, analysis of U.S. Fish and Wildlife Service, Army Corps of Engineers and other data.

ing them to wetland condition can be less expensive than wetland conservation because there is a large supply of former wetlands that are marginally suited to economic uses and relatively easily restored. Wetlands that are profitable to develop have good agricultural productivity, or are well located with respect to urban development, increasing their market value. For both conservation and restoration purposes, costs range widely depending on the potential for economic uses, location, and the difficulty of converting from or restoring to wetland condition.

Summarizing the wetland valuation studies presented in Chapter III, mean values per acre generally match or exceed conservation or restoration costs (table 12). Nonuse benefits may greatly exceed wetland costs because relatively low values per acre are shared by millions of individuals who appreciate the environmental values represented in wetlands. However, the extremely wide range of benefit estimates causes some concern. Such variation can be caused by flaws in estimation methods (Anderson and Rockel, 1991; Shaman and Batie, 1985; Scodari, 1997), by instability in respondents underlying perceptions of the functions, services, and values of wetlands (Novitski, and others, 1996), or by real variation in the physical attributes and locational characteristics of wetlands that underlie the valuations. Whatever the cause, wetland benefits could justify the costs of forgoing conversion and/or restoring wetlands in a "no net loss" policy. Because both the costs and the benefits vary to such a large degree and on such a site-specific basis, however, it is not possible to make an aggregate assessment based on the current information.

Present policy combines an overarching goal of "no net loss" with a regulatory review process that deals with minimal impacts through general permits and conducts more thorough, qualitative reviews of the environmental costs and private benefits of major proposals impacting wetlands. Unnecessary impacts are avoided, minimized, and, as a last resort, mitigated through wetland restoration or creation to replace lost values. Although greater use of economics could improve estimates of private benefits subject to wetland regulation, it is unlikely that economic valuation estimates could be deployed rapidly enough and with sufficient sensitivity to usefully inform cost/benefit considerations for any but the largest wetland conversion proposals.

Wetlands After "No Net Loss"

Once "no net loss" of wetland acreage is achieved, what remains? The "no net loss" goal is often thought of solely in terms of reducing acres of wetland converted and increasing acres restored. However, the National Wetlands Policy Forum concluded that the balance must be struck in terms of wetland functions and values, not merely acreage (The Conservation Foundation, 1988; NRC, 1992; NRC, 1995). Attention will now focus on ensuring that the quality

Table 12—Costs and benefits of wetlands

Program	Costs of conserving or restoring wetlands: Number	Acres	Cost	Range of values
			Dollars per acre	
Acquisition of property rights for wetland conservation:				
Water bank (capitalized @ 6%)	6,000 (contracts)	671,446	250	na
The Nature Conservancy	1,343	501,504	1,306	1-968,423
Swampbuster	na	13,165,800	2,215	519-4,136
Acquisition of property rights for wetland restoration:				
North American Wetlands Conservation Fund	202 (projects)	940,723	382	40-422
Wetlands Reserve Program	2,139	341,259	620	97-2,313
Emergency Wetlands Reserve Program	719	94,181	799	598-1,283

Economic values of wetland functions: Wetland function valued	Number of studies	Mean	Range of values
		Dollars per acre	
Marketed goods:			
Fish and shellfish support	8	6,132	7-43,928
Fur bearing animals	2	137	13-261
Nonmarketed goods:			
General-nonusers	12	83,159	115-347,548
General-users	6	2,512	105-9,859
Fishing-users	7	6,571	95-28,845
Hunting-users	11	1,019	18-3,101
Recreation-users	8	1,139	91-4,287
Ecological functions	17	32,149	1-200,994
Amenity and cultural	4	2,722	83-9,910

na = not available.
Sources: Table 1 and Appendix I, Table 10, Table 9 and unpublished FSA data, North American Wetlands Conservation Fund data.

of wetland resources is protected and restored, as well as their quantity.

Wetland quality issues concern the level of function that conserved and restored areas can attain and the ecological and human values they generate. Wetland conservation requires attention to quality because activities surrounding wetlands can degrade or improve wetland functioning, even when no direct conversion of wetland acreage occurs. Changing hydrologic regimes, altering sediment and nutrient flows, and changing surrounding vegetation can harm or help the level of functioning in an existing wetland and there are many human activities that can affect these watershed characteristics that are not affected by existing wetland protection programs.

Wetland quality or function is determined by the hydrologic functions, nutrient supply functions, plant community characteristics and dynamics, and faunal community characteristics discussed in Chapter III, relative to optimal levels in a fully functioning wetland of each type (NRC, 1992). Methods have been developed to analyze wetland function, but they have not been systematically employed to indicate trends in wetland quality (Brinson, 1993; Adamus and Stockwell, 1983). However, four factors can be used as indicators of potential change in wetland quality: soil erosion, irrigation, forest cover, and urbanization. All four indicators are related to important causes of wetland degradation (NRC, 1992; Kusler and Kentula, 1990) and are assessed here with data available in the 1992 National Resources Inventory. If watersheds surrounding wetlands are experiencing changes in these indicators, wetland quality is likely changing as well. Indicators of other factors that potentially affect wetland quality, such as livestock grazing, confined animal concentrations, and nutrient and pesticide use, may be significant, but data are not consistently available at the national level to construct indicators of these factors.

We examined watersheds that have at least 5 percent of their land area in wetlands, the same percentage as for the United States overall. There are 677 such wetland watersheds, encompassing 95.5 million acres of wetlands, about 85 percent of total non-Federal wetlands in the United States outside of Alaska. Findings of this national-scale analysis should be viewed as providing information on targeting regional- or local-scale efforts to monitor wetland quality changes, but cannot determine whether some or all wetlands in the indicated watersheds are actually being degraded or improved by changes in the activities taking place in those watersheds. In 1982-92, net reductions in sheet and rill erosion and irrigation in wetland watersheds probably contributed to improvements in wetland quality, while deforestation and urbanization had negative effects (table 13).

Sediment from Soil Erosion

Sediment can clog wetland vegetation and impair water holding capacity. In 1982-92, decreases in all sources of sheet and rill erosion were widespread, occurring in one-third of all watersheds and 63 percent of wetland watersheds (watersheds with at least 5 percent of area in wetlands, fig. 6). Erosion declines in wetland watersheds were 98 million tons, 29 percent of the total decline in U.S. sheet and rill erosion. Watersheds with erosion decreases contained 61 million wetland acres in 1992, while those with erosion increases contained 14.4 million wetland acres. Widespread changes in agricultural production practices caused by less intensive rotations, adoption of conservation tillage, and implementation of conservation compliance provisions in the 1985 Food Security Act accounted for the erosion reductions. NRI data show that the Conservation Reserve Program was responsible for 28 percent of the decrease in erosion in wetland watersheds.

Irrigation

Irrigation can degrade wetlands, where diversions from natural watercourses rob wetlands and other instream uses of water or where groundwater pumping lowers water tables and dries out wetlands. Thus, increases in irrigated acreage could impair wetlands, while decreases could improve wetlands. More wetland watersheds experienced net decreases in irrigated acreage between 1982 and 1992 than had net increases (fig. 7). Decreased irrigated acres in central Nebraska, and southern Georgia and Florida mitigated long-term problems for wetlands. Wetland watersheds with net declines lost 800,000 irrigated acres between 1982 and 1992, while irrigated acreage increased 1.3 million acres in watersheds with net gains. Some 23 million acres of wetlands were located in watersheds that had decreases in irrigated acres, and 15.8 million acres of wetlands were in watersheds where irrigated acreage increased. These changes mirror decreases in irrigated acreage in the Northern and Southern Plains States, Mountain region, and the Pacific region during

this period (USDA-ERS, 1994, p. 50). Watersheds with increases in irrigated acres are largely in humid areas where irrigation supplements natural precipitation. Supplemental irrigation may cause short-term stress on affected wetlands, but long-term damage is less likely.

Loss of Tree Cover

Deforestation, both from permanent land use change and from normal harvesting of mature tree crops, can stress wetlands. Tree canopy protects watersheds from runoff and erosion and shades watercourses, lowering water temperatures for sensitive aquatic species. Although some areas were planted to trees in 1982-92, development of tree canopy in a decade is usually insufficient to replace loss of mature tree cover. Watersheds with more than 5-percent wetlands lost 5.3 million forested acres between 1982 and 1992. These watersheds contained 87.1 million acres of wetlands (fig. 8). Deforestation in wetland watersheds represented about 36 percent of deforestation in the United States. Some 90 wetland watersheds, containing 8.4 million acres of wetlands, did not suffer deforestation. The loss of tree cover reflects both purposeful harvest and incidental clearing of trees associated with changes such as urban and agricultural development. Forest harvest is likely the major cause of deforestation in the Southeast, northern New England, Minnesota and Wisconsin, and the Pacific.

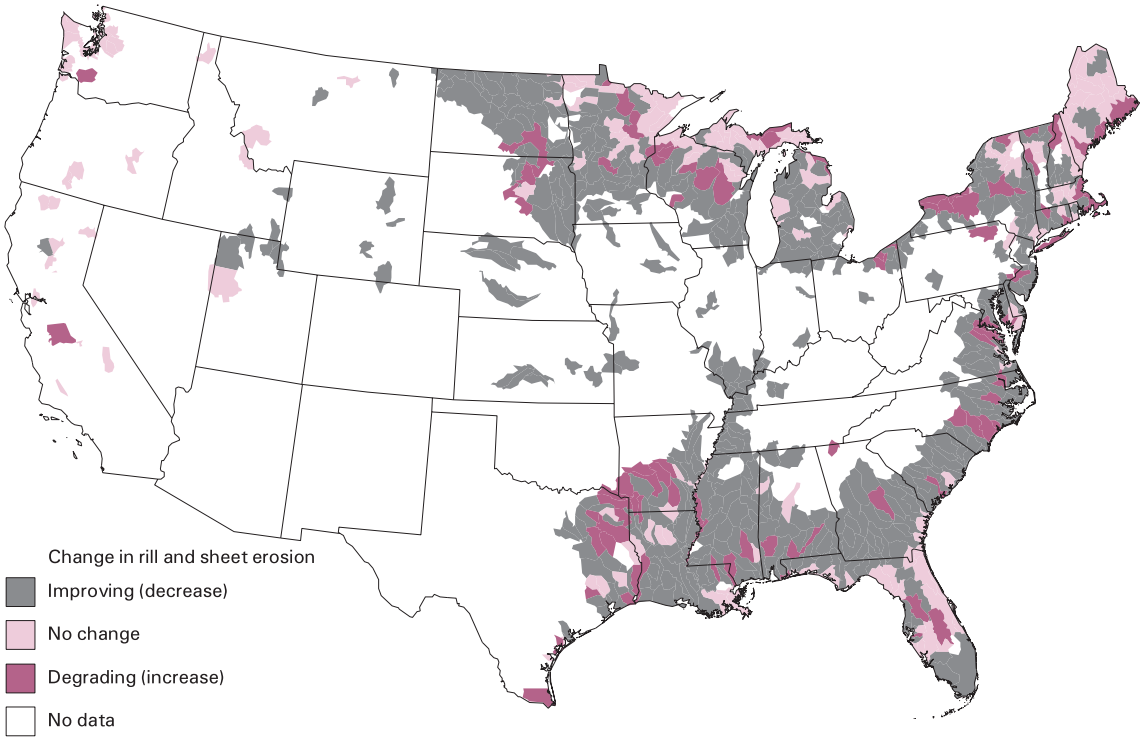
Table 13—Indicators of change in wetland quality, contiguous States, 1982-92

Indicator (impact on wetland quality)	Wetland watersheds[1]		Wetland area		Change in Erosion	Change in Irrigated area	Change in Forest cover	Change in Urbanization
	Number	Percent	1,000 acres	Percent	Million tons	--------Million acres--------		
Water erosion:								
Degrading (increase)	88	13	14.4	15	3.8	0.1	-1.0	-1.0
Improving (decrease)	429	63	61.0	64	-98.0	0.3	-3.1	-4.9
No change	160	24	20.1	21	0.0	0.1	-1.2	-1.1
Irrigated area:								
Degrading (increase)	93	14	15.8	17	-17.6	1.3	-1.0	-1.4
Improving (decrease)	149	22	23.0	24	-21.4	-0.8	-1.3	-2.4
No change	435	64	56.7	59	-55.2	0.0	-2.9	-3.1
Forest cover:								
Degrading (decrease)	587	87	87.1	91	-86.9	0.5	-5.3	-6.7
No change	90	13	8.4	9	-7.3	0.0	0.0	-0.3
Urbanization:								
Degrading (increase)	647	96	92.3	97	-92.8	0.4	-5.2	-7.0
No change	30	4	3.2	3	-1.4	0.0	0.0	0.0
All indicators degrading	19	3	3.6	4	0.6	0.2	-0.3	-0.4
Most indicators degrading/ some with no change	187	28	25.0	26	2.1	0.2	-1.5	-1.2
Most indicators degrading/ some improving	300	44	42.8	45	-68.8	0.7	-2.5	-3.3
No change in indicators	9	1	1.0	1	0.0	0.0	0.0	0.0
Indicators degrading = indicators improving	142	21	21.1	22	-25.5	-0.6	-0.9	-2.0
Most indicators improving/ some degrading	18	3	1.8	2	-2.5	-0.1	0.0	-0.1
All indicators improving	2	0	0.1	0	-0.1	0.0	0.0	0.0
Total wetland watersheds	677	100	95.5	100	-94.1	0.5	-5.3	-7.0

[1]Watersheds with 5 percent or more of total area in wetlands.
Source: USDA, Economic Research Service, based on 1992 National Resources Inventory data.

Figure 6

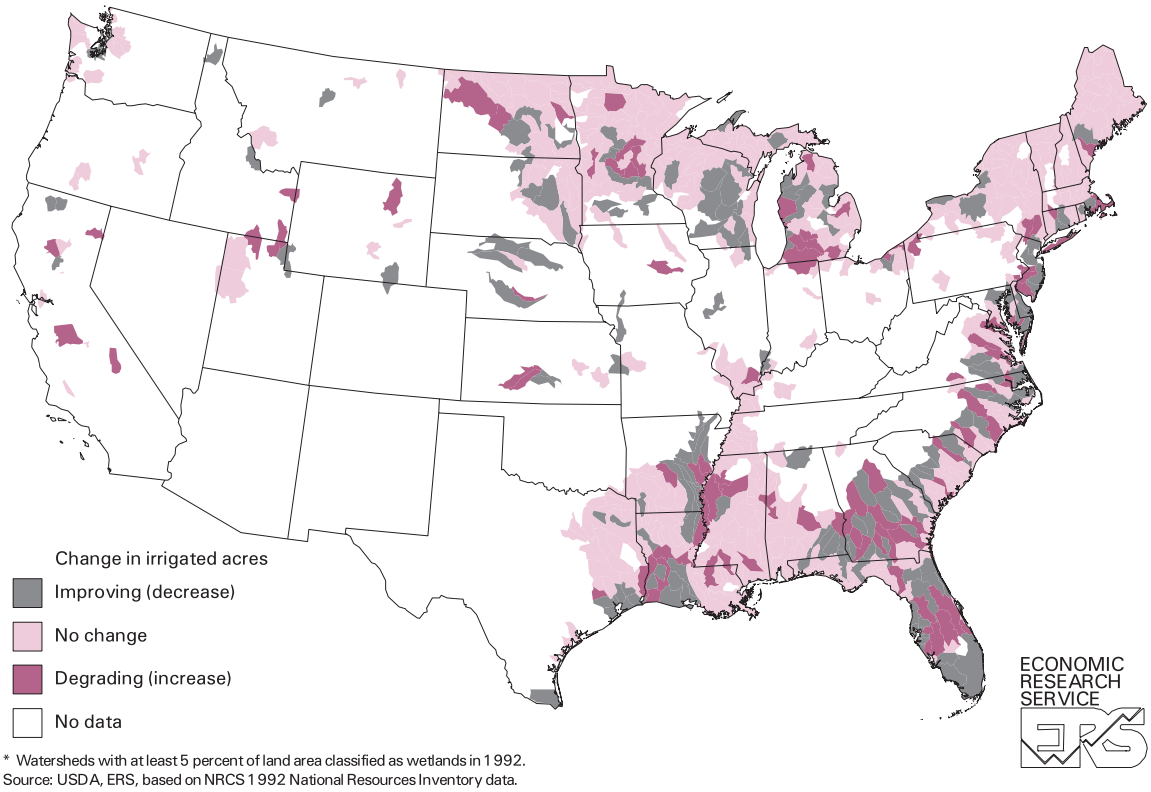
Change in sheet and rill erosion of wetland watersheds,* 1982-92



* Watersheds with at least 5 percent of land area classified as wetlands in 1992.
Source: USDA, ERS, based on NRCS 1992 National Resources Inventory data.

Figure 7

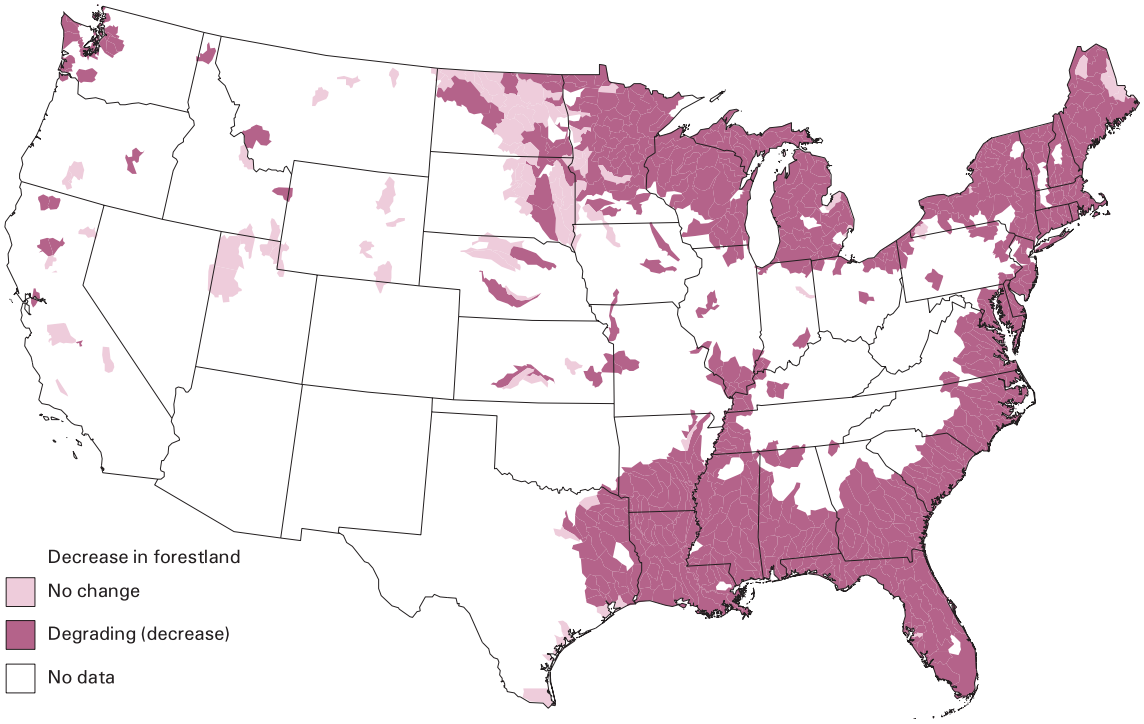
Change in irrigated acres of wetland watersheds,* 1982-92



* Watersheds with at least 5 percent of land area classified as wetlands in 1992.
Source: USDA, ERS, based on NRCS 1992 National Resources Inventory data.

Figure 8

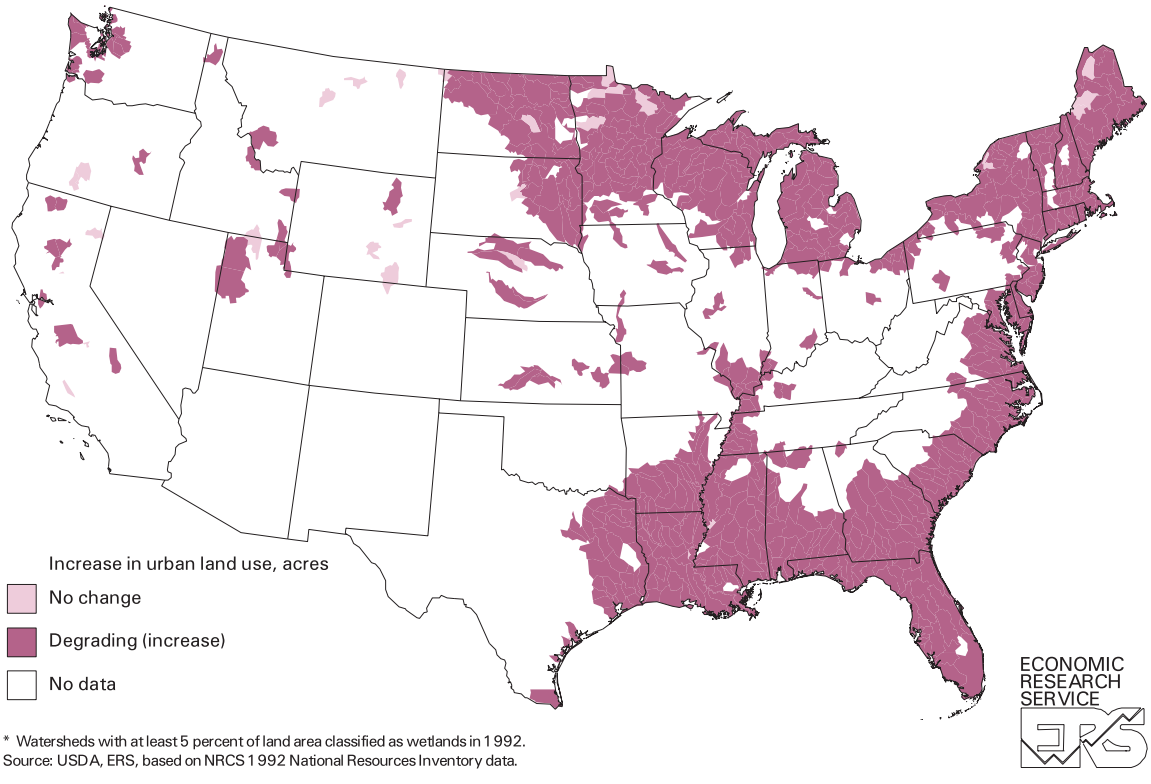
Loss of forestland and tree cover in wetland watersheds,* 1982-92



* Watersheds with at least 5 percent of land area classified as wetlands in 1992.
Source: USDA, ERS, based on NRCS 1992 National Resources Inventory data.

Figure 9

Increase of urban land use in wetland watersheds,* 1982-92



* Watersheds with at least 5 percent of land area classified as wetlands in 1992.
Source: USDA, ERS, based on NRCS 1992 National Resources Inventory data.

Tree clearing for urban development is likely a major cause in southern New England, the mid-Atlantic, and Florida.

Urban Development

Measured by the change in urban land uses between 1982 and 1992, urbanization can stress wetlands because of hydrologic modifications caused by increased runoff from paved areas, toxic runoff from industrial pollutants and chemicals and oils deposited on roadways, and from trash and garbage dumped in wetland areas. Nearly all watersheds (96 percent) with more than 5 percent wetlands had urban land increases, adding 7 million acres of developed land over the decade (fig. 9). Urbanization in wetland watersheds represented 48 percent of total U.S. urbanization. Wetland watersheds that experienced urban development include 92.3 million acres of wetlands (table 13). More extensive suburban development patterns may have less impact on wetlands than intensive development, particularly where zoning and floodplain management avoid wetlands and riparian areas. No increase in developed land was recorded in 30 wetland watersheds with 3.1 million acres of wetlands.

Overall, 19 watersheds experienced declines in all 4 indicators, while 9 watersheds experienced no change in any of the indicators. Most of the indicators were negative in 487 watersheds, although most of these did have decreased erosion. Decreases in erosion and irrigated acreage in 160 watersheds offset or equaled losses in forest cover and increases in urbanization. Only two watersheds (in Wyoming and Montana) experienced improvements in all four of the quality indicators.

The relative importance of these indicators on wetland quality is difficult to judge. Urbanization and sedimentation may have longer lasting effects on wetlands than irrigation and deforestation. However, if the trees are being removed in bottomland hardwood wetlands with no provision for reforestation, there may be long-term changes in the nature and quality of the wetlands affected. Urbanization within wetland watersheds, combined with increased wetland conversion for urban development, is emerging as an important force impacting wetlands.

Wetlands and Global Climate Change

Another future indirect threat to wetlands comes from sea level changes that may accompany global climate change (USDI-USGS, 1997a). The 1992 National Resources Inventory classifies just under 10 percent of U.S. wetlands as marine or estuarine. Including associated freshwater marshes and forested wetlands, the National Oceanic and Atmospheric Administration identifies a total of 26 million acres of coastal wetlands in the continental United States, most of them along the Gulf and Atlantic coasts (Watzin and Gosselink, 1992). Coastal wetland losses threaten these regions' commercial and recreational fisheries, tourism, and habitat for threatened and endangered species.

Through surface sediment deposition, subsurface accumulation of plant material, and inland "migration" to formerly upland sites, many coastal wetlands have maintained their relative elevation and persisted despite gradual increases in sea level of 1-2 mm per year over the past several centuries. Based on predictions by the Intergovernmental Panel on Climate Change (IPCC), however, these rates of sea-level rise are projected to increase two- to fourfold over the next century as global mean temperatures rise (USDI-USGS, 1997a). Simulation modeling of the St. Marks National Wildlife Refuge area in northwestern Florida indicates that projected sea-level rise would result in permanent inundation of large portions of that area’s coastal zone over the next century. Coastal marsh area would actually increase slightly in the study area, with losses to open water offset by inland migration of coastal marsh and resulting replacement of existing forest habitat (USDI-USGS, 1997b). In other areas, coastal development and population growth would be expected to play a greater role in constraining the natural processes by which coastal wetlands migrate inland in response to increases in sea level.