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**NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC.
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**NORTH CENTRAL STATES
NONPOINT SOURCE PROGRAM REVIEW**

TECHNICAL BULLETIN NO. 710

FEBRUARY 1996



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NORTH CENTRAL STATES NONPOINT SOURCE PROGRAM REVIEW

This is the third in a series of four regional reviews of state programs for controlling nonpoint sources of water pollution associated with forest management operations. This report covers thirteen North Central states. Previous reports in the series are Technical Bulletin No. 706 (covering Western states) and Technical Bulletin No. 686 (covering southern states).

The review was prepared by Professor Paul Ellefson and Anthony Cheng at the University of Minnesota. They found that forestry is among the more modest sources of nonpoint pollution in the region. Nevertheless, all states in the region have programs to control forestry nonpoint sources. Seven states have developed well-documented Best Management Practices (BMPs) for silviculture. As might be expected, states with well-documented BMPs are generally those with the greatest levels of forestry activity. States in which forestry is a relatively minor land use generally have very modest programs for addressing forestry nonpoint sources. None of the states in the region have regulatory programs specifically targeted at forestry practices.

There have been only a few attempts to monitor the implementation and effectiveness of forestry BMPs in the North Central States. Surveys in Minnesota have found BMP implementation rates of about 80 percent. Most of the research supporting the effectiveness of BMPs has been conducted in other regions.

The project manager for this report was Dr. George Ice at the NCASI West Coast Regional Center. Questions or comments should be directed to Dr. Ice at (541) 752-8801.

Very truly yours,

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NORTH CENTRAL STATES NONPOINT SOURCE PROGRAM REVIEW

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ABSTRACT: This report reviews state nonpoint source (NPS) control programs in the thirteen North Central states. Agricultural land uses cover 69 percent of this region, with forests covering another 20 percent. State assessments show that forest practices are among the more modest sources of nonpoint source pollution. Every state in the region has some type of NPS control program, and seven of the thirteen states have developed Best Management Practices (BMPs) specifically for silviculture. There have been few attempts to monitor rates of BMP implementation in this region.

KEYWORDS: Nonpoint source, Best Management Practices, Forest Practices, Water Quality, Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin

RELATED TECHNICAL PUBLICATIONS:

- (1) "Western States Nonpoint Source Program Review," NCASI Technical Bulletin No. 706 (December 1995).
- (2) "Southern Regional Review of State Nonpoint Source Control Programs and Best Management Practices for Forest Management Operations," NCASI Technical Bulletin No. 686 (December 1994).
- (3) "Benefits and Costs of Programs for Forest Nonpoint Pollution Control in Washington and Virginia," NCASI Technical Bulletin No. 660 (April 1994).
- (4) "A Summary of Silvicultural Nonpoint Source Control Programs for the United States - 1982," NCASI Special Report No. 83-01 (January 1983).

NORTH CENTRAL STATES NONPOINT SOURCE PROGRAM REVIEW

I PROGRAM HIGHLIGHTS

A. Forestry as a Nonpoint Source

States in the North Central Region have a notable mixture of economic sectors, all of which are potential nonpoint sources of water pollutants. Documents prepared by state governments in response to requirements of the Clean Water Act of 1987 clearly indicate that forestry practices are among the more modest sources of nonpoint pollution in the region. Nonpoint sources associated with agriculture and urban areas have far more significant effects on water quality.

Where forestry practices are identified as serious sources of water pollutants, concern is often with the construction and maintenance of roads in and near bodies of water. Even where such impacts are considered locally severe, state assessments often conclude that such activities have a minimal impact on water quality within broader regional basins of a state.

B. Program Operational Status

State governments in the North Central Region have assumed a modest but sincere posture toward forestry nonpoint sources of water pollutants. Frequently implemented by a variety of agencies, all the region's states have some form of program (however modest) which is designed to address nonpoint source forestry sources of pollutants. States with very modest programs are generally those in which a state's responsible environmental or pollution control agency has determined that forestry practices are a very minor source of water pollutants (e.g., Iowa, Kansas, Nebraska).

The nonpoint forestry source programs in the North Central Region are most often implemented by a state's lead forestry agency (e.g., Division of Forestry, Bureau of Forestry, Department of Forestry). The latter typically coordinates program development and implementation with other responsible agencies (e.g., wildlife, water resources, pollution control). In some states, the lead forestry agency's authority is overlapped by authority of an agency having more generalized authority for pollution control (e.g., pollution control agency).

States in the North Central Region rely on the existence of voluntary best management practices and associated educational and technical assistance programs as the primary programmatic means for addressing nonpoint forest sources of water pollutants. Of the region's 13 states, 7 have developed well-documented and attractively published sets of best management practices. States

lacking such documents are either in the process of defining a set of best management practices, or they incorporate best management practices into the modest number of forest plans prepared for landowners seeking special forestry cost-share or tax incentive payments.

Although best management practices established by states in the North Central region were promoted as a result of concern over water quality emanating from forested watersheds, the scope of topics addressed by best management practices has broadened considerably, often including endangered species, scenic beauty, biological diversity, and wildlife generally.

The region does not have a state with a comprehensive regulatory program focused on the forestry practices of private landowners. Some states have, however, state agencies that regulate stream crossings and forestry practices in specially designated forest areas (state wild and scenic river systems). Michigan, Wisconsin and Minnesota are actively debating the merits of a comprehensive state forest practices law.

C. Compliance with Standards

Landowner and operator implementation of forestry practices considered necessary for the protection of water quality is an obvious necessity for successful accomplishment of state interests in water resources. A major concern to state governments is the selection of an appropriate program (or mix thereof) that will ensure such implementation.

State agencies have generally not monitored (in a comprehensive fashion) the rate at which forestry practices (best management practices) have been adopted by public land-owning agencies and owners of private forest. The exception is Minnesota (Michigan has a monitoring effort currently underway). In the Minnesota case, compliance rates among all landowners, and for most practices, is very high (often 80 percent or more). Noncompliance cases involved inappropriate activities in filter strips and improper drainage of skid trails and landings. Whether the existence of well publicized documents containing descriptions of best management practices is the cause of the generally high rates of compliance is unknown. Compliance rates prior to the distribution of manuals describing best management practices are not available for comparison purposes.

D. Effectiveness of Standards

Compliance with best management practices is no guarantee that state interest in water resources impacted by forestry practices will be met. The forestry practices implemented are, in essence, a means for accomplishing water quality goals that are of interest to state governments (e.g., reduced sediment, reduced trace elements, reduced water temperatures). To actually determine the usefulness of these forestry practices to

accomplish such goals, scientific monitoring is required. Programs to scientifically and comprehensively monitor the impact of forestry practices on water quality in North Central states have not been implemented.

Administrators of state forestry programs in the North Central Region are generally of the opinion that educational and technical assistance programs are the most effective means of influencing the forestry practices of private landowners, and consequently of achieving desired water quality standards. As for regulatory programs, most of these administrators are of the opinion that such programs are an ineffective means of achieving a variety of forestry objectives (e.g., reforestation, water quality) -- except for prevention and suppression of wildfire. Conversely, a significant number of these well-positioned administrators are distrustful of the ability of voluntary best management practices to effectively control nonpoint forestry sources of water pollutants.

E. State Enforcement Authority

State governments in the North Central Region have general authority to address water pollutants originating from forestry practices. Such authority originates either from water quality laws generally (usually implemented by a state's water quality or pollution control agency) or from state authority specifically focused on forestry activities generally (usually implemented by a state's lead forestry agency).

States also have considerable authority to implement technical assistance, cost-share, and educational programs focused on forestry in general. None of the states in the region have used this authority to develop programs that specifically address water quality problems that may emanate from the forestry practices of private landowners.

States in the region do not have regulatory programs of a comprehensive nature that focus on forestry practices. Whether they should depends on the severity of water quality problems emanating from forestry practices within a state, and the state's inclination toward government intrusion into activities traditionally considered to be private in nature. At least three states in the region are actively considering the possibility of developing forest practice regulatory laws.

F. Extension-Education Programs

Extension-education programs used as a means of informing landowners about best management practices in general, or about legally-mandated forestry practice standards specifically, are for the most part poorly organized in their focus on water quality issues in most North Central states. Such is not to deny the existence of programs that are being effectively implemented

by a state's lead forestry agency or Extension Service. Needed, however, is a careful review of the status of such programs generally and the development of strategic options that will enable them to more directly focus on water quality matters.

G. Information Sources

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II REGIONAL LAND USE PATTERNS

Of the region's more than 516 million acres, 69 percent is devoted to agricultural land uses (Table 1). This includes cropland, pastureland, and rangeland. States with land use most heavily oriented toward agriculture are Illinois, Indiana, Ohio and states located in the Great Plains (Table 2). Cropland occupies nearly half of the region's land use, while urban development accounts for approximately five percent, namely 26 million acres.

Forests occupy over 100 million acres of land in the nation's 13 north central states -- 20 percent of the region's total land area (includes federal land from Table 1)¹ (Powell et al., 1993). If sparsely forested great plains states are excluded (North Dakota, South Dakota, Kansas, Nebraska, and Iowa), forests cover 36 percent of states remaining in the region. Approximately 94 percent (94 million acres) of the region's forest area is classified as timberland (unreserved forest areas capable of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands).

TABLE 1 LAND USE IN THE NORTH CENTRAL REGION,
BY TYPE OF USE - 1987

Land Use	Area (thousand acres)	Percent of Total Surface Area
Rural Cropland	239,273	46
Pastureland	46,673	9
Forestland	81,697	16
Rangeland	71,859	14
Minor Uses	19,642	4
SUBTOTAL RURAL LAND	459,144	89
Developed (urban)	25,013	5
Water Area	13,133	2
Federal Land	19,052	4
SUBTOTAL OTHER	57,198	11
TOTAL SURFACE AREA	516,342	100

Source: Summary Report: 1987 National Resources Inventory. USDA-Soil Conservation Service. Statistical Bulletin Number 790. 1989. Washington, D.C.

¹ States included in the North Central Region are: Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin.

TABLE 2 RURAL LAND USE, NORTH CENTRAL REGION,
BY STATE AND TYPE OF USE - 1987

State	Percent of Total Rural Land				
	Cropland	Pastureland	Rangeland	Forestland	Minor Uses
Illinois	79	8	0	11	2
Indiana	68	10	0	18	4
Kentucky	26	26	0	44	4
Michigan	32	9	0	51	8
Minnesota	51	8	0	31	10
Missouri	38	32	0	28	2
Ohio	55	11	0	28	6
Wisconsin	38	10	0	44	8
SUBREGION AVERAGE	48	14	0	32	6
Iowa	80	12	0	5	3
Kansas	9	5	34	1	1
Nebraska	44	4	49	1	2
North Dakota	68	3	24	1	4
South Dakota	40	5	50	1	4
SUBREGION AVERAGE	58	6	31	2	3
REGION AVERAGE	52	11	12	20	5

Source: Summary Report: 1987 National Resources Inventory. USDA-Soil Conservation Service. Statistical Bulletin Number 790. 1989. Washington, D.C.

III FOREST RESOURCES

A. Forest Type Groups

Forests of the region are diverse in character in that they are composed of vast areas of central hardwoods, northern hardwoods, and boreal conifers (Table 3). The oak-hickory, maple-beech-birch, and aspen-birch dominate the region's forested landscape. Combined, these forest types occupy 68 percent of the land use devoted to forests within the region. Land form and climatic conditions make clear boundaries between forest types difficult to identify. In general, however, conifers appear across the Northern portion of the region's Lake States, with an array of mixed hardwoods occurring as one proceeds toward the region's southern boundaries. Some formerly dominate species now exist in isolated pockets (e.g., hemlock, white pine).

Oak-hickory forests (26 million acres) stretch in a band along the southern portion of the region, extending through Ohio, Kentucky, Indiana, Illinois, Iowa, Missouri, southern Michigan, central Wisconsin, and central Minnesota. Tree species typically found in oak-hickory forests are white oak, black oak, northern red oak, and bur oak. Hickory forests are a small component of the region's oak-hickory type, occupying only the southern portions of the region. Oak-pine forests are found in portions of Kentucky where the northern range of southern pines extends.

Maple-beech-birch forests are the second most extensive forest type in the North Central region -- accounting for 16 percent of the region's unreserved forested area. Pioneer forests in transition provide the necessary conditions for the shade-tolerant species which comprise this group, namely sugar maple, yellow birch, and basswood.

Aspen-birch, a fast-growing pioneer forest type, occupies large tracts of land in northern Minnesota, Wisconsin, and Michigan -- nearly 13 million acres. Previously regarded as a noncommercial species, waferboard and oriented-strand board technologies have opened up large new markets for utilization of aspen. Through root-sprouting, aspen forests regenerate quickly and, once established, are very fast growers.

TABLE 3 UNRESERVED FOREST LAND, NORTH CENTRAL REGION,
FOREST TYPE GROUP, 1992

Forest Type Group	Area (thousand acres)	Percent
White-Red-Jack Pine	5,584	7
Spruce-Fir	9,799	12
Loblolly-Shortleaf Pine	798	1
Oak Pine	1,194	1
Oak-Hickory	26,022	31
Oak-Gum-Cypress	384	- ^a
Elm-Ash-Cottonwood	8,958	11
Maple-Beech-Birch	17,985	21
Aspen-Birch	13,307	16
Other Groups	33	- ^a
All Forest Type Groups	84,064	100

^a Less than one percent.

Note: Excludes Kentucky and non-stocked forest land.

Source: Forest Resources of the United States, 1992 by D. S. Powell, J. L. Faulkner, D. R. Darr, Z. Zhu, and D. W. MacCleery. General Technical Report RM-234. 1993. Rocky Mountain Forest and Range Experiment Station. USDA-Forest Service. Fort Collins, CO.

The North Central region is home to two major conifer forest types. Prominent in the northern portions of Michigan and Minnesota are Spruce-fir forests, commonly composed of black spruce and balsam fir. Also significant in the region is the white-red-jack pine forest type. The latter is commonly composed of jack pine (fire species most often found on sandy and dry forest sites), and red and white pine. The latter two species are frequently intensively managed as small pure stands.

Elm-ash-cottonwood is also common in the North Central region (nearly 9 million acres). Especially prominent in the plains states, these species are typically found on the lower terraces and flood plains of the Mississippi, Minnesota, Missouri, Platte, Kansas, and Ohio rivers.

B. Forest Ownership

Timberland ownership in the Region is largely private, namely 75 percent (Table 4). Over 9 of 10 acres of the latter is controlled by a diversity of owners commonly identified as nonindustrial private owners (e.g., farmers, absentee owners, recreational interests). Industrial holdings are concentrated in Michigan, Minnesota, and Wisconsin.

TABLE 4 TIMBERLAND OWNERSHIP, NORTH CENTRAL REGION, BY OWNERSHIP, 1992

Ownership Category	Area (thousand acres)	Percent
Private		
Forest Industry	4,569	6
Nonindustrial	65,940	94
Private Total	70,509	100
		75
Public		
County and Municipal	5,164	22
State	8,379	35
Federal	10,189	43
Public Total	23,732	100
		25
All Owners	94,241	100

Source: Forest Resources of the United States, 1992 by D. S. Powell, J. L. Faulkner, D. R. Darr, Z. Zhu, and D. W. MacCleery. General Technical Report RM-234. 1993. Rocky Mountain Forest and Range Experiment Station. USDA-Forest Service. Fort Collins, CO.

C. Landform and Soil Geography

The North Central region is composed primarily of central lowland plains which are bounded on the east by the Appalachian Highlands, north by the Canadian Shield, south by the interior highlands (Ozark Province), and west by the interior or high plains Figure 1. The Central Lowland Plains region is dominated by sedimentary parent material and is especially characterized by its gentle to moderate slopes. Exceptions to the latter occur in the Wisconsin Driftless area and in areas that are adjacent to the Ohio, Mississippi, and Missouri rivers. Dominating the

Plains region are soils with subsurface horizons of clay that are usually moist for at least 90 consecutive days during the growing season (Alfisol soils). Also present in the Central Lowland Plains are nearly black, organically rich soils (Mollisol soils) that support the intensive production of various agricultural products (Foth 1990, Thornbury 1965).

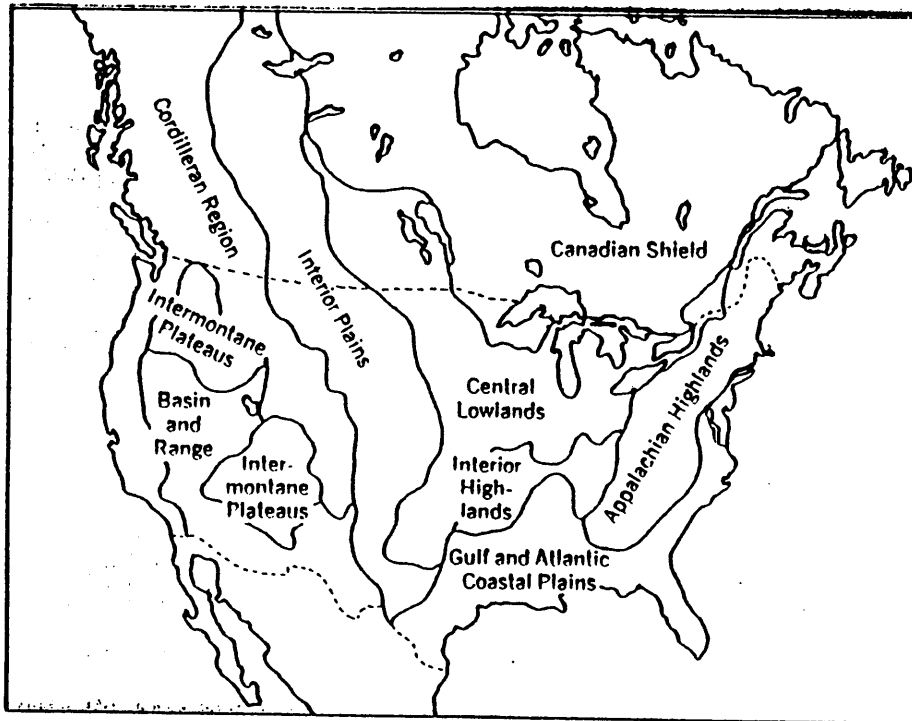


FIGURE 1 PHYSIOGRAPHIC REGIONS OF NORTH AMERICA

The North Central Region also includes a portion of the Canadian Shield (northern Minnesota, northern Wisconsin, upper peninsula of Michigan) which is composed of ancient rocks that have been subject to extensive geologic processes. The Southern portion of the Shield contains soils of modest depth (18 to 24 inches) which become progressively shallower to the north. The Shield includes areas that have modest to notable gradients, especially in northeastern Minnesota, the Upper Peninsula of Michigan and portions of northern Wisconsin.

Although modestly forested, the Interior Plains region (Mollisol soils) is also a part of the North Central Region (notably encompassing North Dakota and South Dakota). The Interior Plains region was formed from erosion and subsequent sedimentation along the eastern side of the Rocky Mountains;

soils are usually dry. Within the Interior Plains region, forests cover a significant portion of South Dakota's Blackhills, which are characterized by soils that are usually dry (seldom moist for more than 90 days) (Aridisol soils), with steep slopes and numerous rock outcrops.

D. Erosion Sources

Erosion and sedimentation from forested lands in the North Central Region are generally associated with activities that involve road construction and harvesting near bodies of water (including stream crossings). However, relative to other sources in the region, sediment from forest land is very low (Table 5).

TABLE 5 ESTIMATED ANNUAL SEDIMENT YIELDS FROM RURAL LAND (NON-FEDERAL), NORTH CENTRAL REGION, BY STATE AND TYPE OF USE, 1987

State	Tons of Sediment Per Acre Per Year					
	Cropland	Pastureland	Rangeland	Forestland	Minor Uses	All Rural Land
Illinois	5.2	2.3	0.0	2.3	3.3	4.6
Indiana	4.2	1.6	0.0	1.5	5.2	3.5
Kentucky	8.5	3.0	0.0	1.5	43.2	5.5
Michigan	2.2	0.4	0.0	0.1	0.8	0.8
Minnesota	2.5	0.3	0.1	0.2	0.2	1.4
Missouri	7.0	1.9	0.6	1.6	4.5	3.8
Ohio	3.5	2.2	0.0	1.8	9.8	3.3
Wisconsin	3.6	0.8	0.0	0.2	0.4	1.6
SUBREGION AVERAGE	4.6	1.6	0.1	1.2	8.4	3.1
Iowa	6.5	1.5	0.0	1.3	1.6	5.5
Kansas	2.6	1.0	1.4	1.5	1.3	2.1
Nebraska	4.7	1.3	1.1	1.6	1.9	2.7
North Dakota	1.9	0.5	0.9	0.3	0.1	0.1
South Dakota	2.3	0.8	0.9	0.2	41.1	2.8
SUBREGION AVERAGE	3.6	1.0	0.9	1.0	9.2	2.6
REGION AVERAGE	4.2	1.4	0.4	1.1	8.7	2.9

Source: Summary Report: 1987 National Resources Inventory. USDA-Soil Conservation Service. Statistical Bulletin Number 790. 1989. Washington, DC.

Forest land in the North Central Region is a source of 1.1 tons of sediment per acre per year. This is less than half the average 2.9 tons of sediment per acre per year that originates from rural land generally, and substantially below the 4.2 tons that occurs from an acre of cropland each year. In 1987, agricultural sources in the region were adversely affecting 39,960 miles of river (forestry affected 288 miles) and 213,627 acres of lake area (forestry affected 66 acres). This disparity between agricultural and forestry sources of water pollutants becomes even more significant given the 239 million acres of cropland in the region (versus 100 million acres of forest land).

Product-wise, the region is a major source of sawlogs (over 3.8 million MBF), pulpwood (nearly 10 million cords), and veneer (over 126 thousand MBF). Kentucky, Michigan and Missouri are major contributors to the region's sawlog production (over half), while Wisconsin, Michigan and Minnesota are leaders in pulpwood production (over 80 percent of total). Veneer production is most significant in the states of Michigan and Wisconsin.

Employees in the region's lumber and wood products, and the paper and allied products manufacturing groups, totaled over 300,000 in 1987. Of the latter, 57 percent were employed in some facet of logging and lumber manufacture, while the remainder were employed in pulp, paper and particleboard industries. The employees were located on one of the region's 8,300 manufacturing establishments which, in total, produced wood products having a 1987 value added of \$18.5 billion. Over 71 percent of this value added was contributed by the paper and allied products group. The wood-based industry of the region also has a significant wood furniture and fixtures component, especially in Michigan, Ohio and Indiana.

E. Timber Products Economy

Removals from the region's timber growing stock are significant -- more than 1.6 billion cubic feet annually (Table 6). Of this total, approximately 79 percent is produced by five states, namely Michigan, Minnesota, Missouri, Ohio and Wisconsin. Michigan, Minnesota, and Wisconsin contribute per state an annual average of 344 million cubic feet to the region's annual growing stock removals.

**TABLE 6 REMOVALS FROM GROWING STOCK IN THE NORTH
CENTRAL REGION, 1991**

State	Growth (thousand cubic feet)	Removals (thousand cubic feet)	Removals as Percent of Growth
Illinois	132,398	68,123	51
Indiana	150,630	92,730	62
Kentucky	388,110	100,145	26
Michigan	619,637	382,930	62
Minnesota	368,641	287,979	78
Missouri	244,800	135,928	46
Ohio	290,711	113,139	39
Wisconsin	421,377	360,685	86
SUBREGION TOTAL	2,616,304	1,541,659	59
Iowa	41,155	26,157	64
Kansas	32,300	8,327	26
Nebraska	13,268	5,383	40
North Dakota	9,152	1,687	18
South Dakota	43,419	35,533	82
SUBREGION TOTAL	139,294	77,087	55
REGION TOTAL	2,755,598	1,618,746	59

Source: Forest Resources of the United States: 1992 by D.S.Powell, J. L. Faulkner, D. R. Darr, Z. Zhu, and D. W. MacCleery. 1993. General Technical Report RM-234. Rocky Mountain Forest and Range Experiment Station. USDA-Forest Service. Fort Collins, CO.

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IV STATE NONPOINT SOURCE PROGRAMS - REGIONAL SUMMARY

State governments can initiate a wide variety of programs to influence forestry practices that impact the range of benefits that are produced by private forests. Regulatory programs are one obvious example. Other approaches include education extension programs, technical assistance programs, voluntary guidelines, tax incentives and cost-share programs. From a state agency's perspective, interest often focuses on the relative merits of such programs and the program mixture that will most effectively accomplish desired objectives.

A. Program Types

For the most part, regional physical conditions, importance of forestry in state economies, and past traditions of state involvement in the forestry activities of private landowners are primary variables affecting the type of programs each state uses to influence such activities. In 1992, key administrators of state forestry programs in North Central states were asked to identify the type of programs used to encourage owners of private forestland to:

- protect water quality (e.g., streamside buffer strips, road and skid trail layout, stream crossing structures).
- reforest after timber harvesting (e.g., minimum stocking levels, site preparation, seed trees).
- use appropriate timber harvesting procedures (e.g., clearcut size, logging systems and equipment).
- protect forest from fire, insects and diseases (e.g., slash treatment, smoke management, removal of infected trees).
- protect wildlife and rare plant species (e.g., limiting public access, wildlife habitat management, discouraging plant and animal removal).
- enhance recreation and aesthetic values (e.g., vegetative buffers along roadways, limits on size of timber harvests).

Educational and technical assistance programs were the most common types of programs used to influence the forestry activities of private landowners in North Central Region Table 7. Second most common were programs that provided financial support to private landowners, especially for activities involving protection of water quality, reforestation after timber harvest, and wildlife management and protection. Relatively few states implemented tax incentive or voluntary guideline programs for any of the purposes identified. Regulatory programs were the least used means of influencing the forestry practices of private landowners in the North Central Region. Combining technical assistance and voluntary guidelines, water quality protection was the most common focus for state programs.

B. Program Effectiveness

The ability of various public forestry programs to influence forestry practices applied on private forestland is often a major focus of debate among program administrators, owners of private forestland and interested citizens. The experiences of program managers who are (or have been) actively involved in the administration of a forestry program (or combination of programs) can provide a very useful perspective on the ability of different types of programs to accomplish agreed-to objectives. Future

program directions and emphases generally can be influenced by such experiences (Cheng and Ellefson, 1993).

TABLE 7 STATE PROGRAMS FOCUSED ON MAJOR PRIVATE FORESTRY ACTIVITIES IN THE NORTH CENTRAL REGION

Forest Resource Activity and Type of Program	Number of States With Program
Water Quality Protection	
Educational Programs	13
Technical Assistance	13
Voluntary Guidelines	8
Tax Incentives	7
Fiscal Incentives	11
Legal Regulations	2
Reforestation after Harvest	
Educational Programs	12
Technical Assistance	13
Voluntary Guidelines	4
Tax Incentives	6
Fiscal Incentives	10
Legal Regulations	0
Timber Harvesting Methods	
Educational Programs	13
Technical Assistance	13
Voluntary Guidelines	5
Tax Incentives	3
Fiscal Incentives	2
Legal Regulations	0
Forest Protection	
Educational Programs	13
Technical Assistance	11
Voluntary Guidelines	3
Tax Incentives	3
Fiscal Incentives	5
Legal Regulations	4
Wildlife Management & Protection	
Educational Programs	12
Technical Assistance	13
Voluntary Guidelines	4
Tax Incentives	2
Fiscal Incentives	10
Legal Regulations	3
Recreation and Aesthetics	
Educational Programs	11
Technical Assistance	13
Voluntary Guidelines	4
Tax Incentives	3
Fiscal Incentives	5
Legal Regulations	0
Total Number of States in Region	13

Source: State Programs Directed at the Forestry Practices of Private Forest Landowners: Program Administrators' Assessment of Effectiveness by A. S. Cheng and P. V. Ellefson. Staff Paper Series No. 87. Department of Forest Resources. University of Minnesota. St. Paul, MN. 1993.

In the 13 states comprising the North Central Region, surveyed administrators appear most favorable toward technical

assistance and fiscal incentives as ways of influencing forestry practices that affect water quality, reforestation after harvest, and timber harvesting methods Table 8. Educational programs, technical assistance, voluntary guidelines, and legal regulations are not considered by a majority of administrators to be most effective for any of the three purposes identified here (the exception is educational programs to influence timber harvesting). Especially noteworthy is the intensity of least effective rankings given to voluntary guidelines and legal regulations. Given the focus of water quality protection in this report, administrators appear most enamored with technical assistance and fiscal incentives.

TABLE 8 PROGRAM ADMINISTRATOR'S RANKING OF PROGRAM ABILITY TO INFLUENCE SELECTED PRIVATE FORESTRY ACTIVITIES IN THE NORTH CENTRAL REGION -- BY ACTIVITY AND PROGRAM TYPE, 1992

Program and Ranking Category	Forestry Activity of Program's Focus (number of states)		
	Water Quality Protection	Reforestation After Harvest	Timber Harvesting Methods
Education Programs			
Most Effective	3	5	6
Effective or Neutral	6	7	3
Least Effective	4	1	4
Technical Assistance			
Most Effective	10	7	9
Effective or Neutral	3	3	2
Least Effective	0	1	2
Voluntary Guidelines			
Most Effective	2	1	1
Effective or Neutral	5	3	5
Least Effective	6	8	7
Tax Incentives			
Most Effective	2	4	4
Effective or Neutral	7	4	6
Least Effective	4	4	3
Fiscal Incentives			
Most Effective	6	6	4
Effective or Neutral	4	5	6
Least Effective	3	1	3
Legal Regulations			
Most Effective	3	1	2
Effective or Neutral	1	2	4
Least Effective	9	9	7

Note: One of the 13 states failed to rank programs focused on reforestation after harvest.
 Source: State Programs Directed at the Forestry Practices of Private Forest Landowners: Program Administrators' Assessment of Effectiveness by A. S. Cheng and P. V. Ellefson. Staff Paper Series No. 87. Department of Forest Resources. University of Minnesota. St. Paul, MN. 1993.

What follows is a state-by-state review of forest practice regulatory programs that are currently being implemented by state

governments in the North Central Region. Special focus is on practices that are undertaken to mitigate the adverse impacts of nonpoint forest sources of water pollutants. Programs in the following states are reviewed: Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

V ILLINOIS

A. Statutes, Regulations, and Programs

The Division of Forestry, Illinois Department of Conservation, administers a wide array of programs directed at private forestry. Administered primarily by the Division's Cooperative Forest Management Section, they include: education and training, technical assistance, voluntary guidelines, tax incentives, and fiscal incentives. Responsibility for administering water quality programs generally within the state rests with the Division of Water Pollution Control of the Illinois Department of Environmental Protection.

B. Nonpoint Assessment Report

The Division of Water Pollution Control assessed the impact of nonpoint sources of pollutants on water resources in Illinois. Of the nearly 184,000 lake acres assessed, silviculture was judged to have a moderate or minor impact on 258 lake acres; in no case were silvicultural sources judged to have a major impact on lake waters. Agricultural practices were a source of water pollutants for nearly 160,000 acres of lake. Of 14,000 miles of streams assessed by the Division, none were judged to be adversely impacted by silvicultural practices. Agricultural adversely impacted over 7,700 miles of the state's streams.

C. Nonpoint Management Plan

Detailed prescriptions for addressing nonpoint silvicultural sources of pollution have not been specified by the Division of Water Pollution Control (forestry is not among the Division's nine statewide initiatives). The Division does, however, identify Division of Forestry programs that are available for addressing such pollutant sources (if such is deemed necessary). Among the programs identified are forestry technical assistance, nursery plant material production, forestry development, and various federal programs administered cooperatively with state agencies (Conservation Reserve Programs, Forestry Incentives Program, Conservation Reserve Program).

D. Best Management Practices

The Division of Forestry has developed best management practices (BMPs) which are to be voluntarily applied by forest landowners and timber harvesters. The stated objective of the BMPs is to "help ensure that waters within or flowing out of Illinois' forests are of the highest quality consistent with natural processes and the need to prudently utilize Illinois' forest resources." Major categories are: forest management planning, road systems, drainage systems, logging systems, streamside management zones, site disturbance, pesticide use, fertilizer use, fire prevention and control, livestock use of forests, maintaining forested lands, and use of off-road recreational vehicles.

The Division of Forestry places special emphasis on long range planning of private forestland use and management, which has important consequences for the management of nonpoint forest sources of water pollutants. Planning solidifies landowner management objectives, identifies management activities necessary to accomplish such objectives, and anticipates and avoids practices that could adversely impact water quality. Specific categories of forestry practices that are addressed during the development of a long range plan include road systems, drainage systems, and timber harvesting activities. Examples of best management practices for road building are:

- Logging roads should be located to avoid, to the extent feasible, high hazard areas, especially those known to contain a potential for landslides, highly erodible soils, unstable stream channels, and wet areas.
- Where feasible, logging roads should be located on benches and ridges to minimize erosion and the potential for sediment reaching streams. Logging roads should be located to avoid paralleling stream channels in close proximity, to minimize the number of channel crossings, to avoid excessive excavation, to avoid adverse drainage patterns, and to minimize soil movement into streams.
- Road gradients should be kept low (generally under 10 percent) except where short, steeper, sections are needed to take advantage of favorable topography and to avoid excessive cut or fill.
- Permit requirements for Section 404 of PL-92-500 must be complied with whenever any stream modification is undertaken.

E. Forest Practice Rules

Illinois does not have rules pertaining to the application of water-quality impacting forestry practices that might be applied by private landowners or timber harvesters. However, administrators of state forestry programs indicate that forest practice regulation has been suggested and discussed in the immediate past.

F. Special Rules

Illinois does not have any special rules addressing forestry practices of private landowners. The state does, however, have laws governing the purchasing and transporting of timber (Timber Buyers License Act; Forest Products Transportation Act).

G. Compliance and Effectiveness

The Division of Forestry has not monitored compliance with forestry best management practices.

H. Information Sources

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State of Illinois. 1991. Environmental Protection Act. Illinois Rev. Statute Chapter 111 $\frac{1}{2}$, 1001 et seq. Springfield, IL.

VI INDIANA

A. Statutes, Regulations, and Programs

The Division of Forestry, Department of Natural Resources, is responsible for administering programs directed at private

forest management in Indiana. Such programs are focused primarily on technical assistance and education training programs. The state does have a flood control law which makes it unlawful to obstruct the capacity of a floodway, including leaving logging debris in stream channels. Responsibility for administering water quality programs in general within the state rests with the Indiana Department of Environmental Management.

B. Nonpoint Assessment Report

The Department of Environmental Management assessed various nonpoint sources of water pollutants, determining that forestry activities have a very modest adverse impact on the quality of water flowing from forested areas, and that such impacts can be controlled with relative ease. When erosion does occur during harvest, it is typically confined to a site-specific location and is very short lived. The Department acknowledged that such judgments are based on limited information and that additional research is needed to firmly determine the exact role that forestry practices play as a nonpoint polluter of waters.

C. Nonpoint Management Plan

The Department of Environmental Management makes a number of specific recommendations within three broad forestry subject areas, namely:

Forestry Activities: via an interdisciplinary process, develop (or refine) forest practices that can abate water pollutants originating from forestry activities; develop (and target to key audiences) educational programs that stress water quality management practices; secure funding for water quality programs that will provide technical assistance to landowners, timber harvesters, and professionals; and develop demonstration projects that focus on forestry and timber harvesting practices that curtail the incidence of water pollutants.

Forestry Research: determine the extent of nonpoint forestry sources of water pollutants; and utilize demonstration projects as sources of information on the water quality impacts of alternative forestry practices.

Forestry Education: enhance communication and coordination between agencies responsible for managing nonpoint forest sources of water pollutants; develop and publicize information programs that demonstrate to the public the appropriateness of certain forestry practices as means of curbing water pollution; and coordinate among appropriate agencies the development of demonstration projects.

D. Best Management Practices

Indiana has not developed a detailed comprehensive set of best management practices for forestry. Responsible officials indicate that a voluntary program suggesting best management practices is being developed. Such should be completed within 18 months. However, the nonpoint source management plan prepared by the Department of Environmental Management identifies, in very general terms, three major groups of best management practices focused on timber harvesting activities. They are: planning and construction (design and location of timber access system, drainage and slope stabilization, stream crossings, filter and buffer strips); use and maintenance (modifications for weather conditions, maintenance of structures, maintenance of roads); and close-out (revegetation measures, water control).

E. Forest Practice Rules

Indiana does not have rules pertaining to the application of water quality impacting forestry practices that might be applied by private landowners or timber harvesters. The state does, however, have a flood control law that prohibits the obstruction of the capacity of any floodway. Such prohibits the leaving of logging debris in stream channels or areas immediately accessible to such channels. The state also has a law requiring all timber buyers to be licensed and bonded.

F. Program or Rule Changes (Since 1980)

Voluntary forestry best management practices are being developed by the state's Division of Forestry.

G. Compliance and Effectiveness

The state Division of Forestry does not monitor compliance since there are no best management practices or directly applicable forest practice rules.

H. Special Issues

Conducting forest management activities in wetlands areas has gained prominence in Indiana. In 1991, a bill was introduced in the state Senate to regulate land management activities in wetlands areas. The bill would have defined regulated wetlands and subsequently required permits for activities conducted therein. Permits would have been issued by the state's soil conservation board. Practices to be included with the proposed law's jurisdiction are: "growing trees ... and other such practices associated with the production of ... forest products." The bill was defeated by a legislative committee. Despite failure at the state level, local ordinances regulating wetlands activities may grow in number. The issue of regulating forestry practices in wetlands areas is very likely to resurface in the future.

Also introduced to the 1991 Indiana legislature was a bill to limit the nature of forestry activities on state administered forests. Special focus would be on forest land located within designated forest preserves -- areas of at least 1,000 acres designated for purposes of protecting larger tracts of forest. Within such areas, "riparian protection areas" would be given special treatment. Such areas are zones that extend at least one-quarter mile from the edge of a major stream, river, or lake; are maintained in undisturbed condition; and are designed to protect water quality and aquatic habitats. All timber harvesting and road construction would be:

- prohibited within 150 feet of a permanent stream, 115 feet of an intermittent stream, 50 feet of an ephemeral stream, and 115 feet of a seep or spring.
- restricted within 600 feet of a permanent stream, 450 feet of a designated intermittent stream, and 115 feet of an ephemeral stream.

I. Information Sources

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State of Indiana. 1988. Timber Licensing Law. Public Law 190 (as amended). Indianapolis, IN.

State Nonpoint Source Task Force. 1989. Nonpoint Source Water Pollution Management Program: Indiana. June. Department of Environmental Management. Indianapolis, IN.

State Senate. 1991. Proposed Law to Regulate Practices in Wetlands. Senate Bill 568. March 6. Indiana State Legislature. Indianapolis, IN.

State Senate. 1991. Proposed Law to Regulate Practices on State Forests. Senate Bill 569. Indiana State Legislature. Indianapolis, IN.

VII IOWA

A. Statutes, Regulations, and Program

The Division of Forests and Forestry, Iowa Department of Natural Resources, administers a variety of programs directed at water quality protection on private forestlands, including education and training, technical assistance, voluntary guidelines, tax incentives, and fiscal incentives programs. Responsibility for administering water quality programs generally within the state rests with the Division of Environmental Protection of the Department of Natural Resources.

B. Nonpoint Assessment Report

The Environmental Protection Division of the state Department of Natural Resources assessed 8,235 miles of designated streams for nonpoint pollution impacts. The Division concluded that none of the streams were adversely impacted by forestry and silvicultural activities. In addition, of 48,549 acres of lake (236 lakes), none were found to be adversely impacted by forestry activities.

C. Nonpoint Management Plan

Iowa's Nonpoint Source Management Plan does not specifically suggest forestry programs to control nonpoint source of pollutants. Overall, the state suggests a wide array of education and training, demonstration projects, technical assistance, cost share incentives, monitoring, and special grant programs to manage nonpoint sources of pollutants as they occur.

D. Best Management Practices

Iowa does not have an established set of forestry best management practices nor does the state have special rules concerning forestry activities that may adversely impact water quality.

E. Compliance and Effectiveness

Since forestry best management practices have not been defined and set forth in Iowa, monitoring for compliance has not taken place.

F. Information Sources

Department of Natural Resources. 1992. State Nonpoint Source Management Report: Iowa. Des Moines, IA.

Environmental Protection Division. 1988. State Nonpoint Source Assessment Report: Iowa 1988. Department of Natural Resources. Des Moines, IA.

Environmental Protection Division. 1989. State Nonpoint Source Management Report: Iowa. Department of Natural Resources. Des Moines, IA.

VIII KANSAS

A. Statutes, Regulations, and Programs

State forestry programs directed at private forest landowners in Kansas are administered by the Cooperative Extension Service (Department of Forestry), Kansas State University. Programs administered by the Service include technical assistance, cost share fiscal incentives, education and training. The state Department of Health and Environment administers general rules focused on water pollutants; none are specific to forestry practices.

B. Nonpoint Assessment Report

The Division of the Environment assessed nonpoint sources of pollutants in Kansas. Of the 12 major river basins assessed by the Division, none were found to be adversely impacted by specifically identified silviculture or timber harvesting activities (harvesting, reforestation, residue management, forest management, road construction and maintenance). Agricultural practices were determined to contribute 99 percent of the total suspended pollutant load in the waters of Kansas.

C. Nonpoint Management Plan

The Division of the Environment identified certain forestry activities (silvicultural practices) as a means of reducing the incidence of water pollutants caused by agricultural practices occurring on certain highly erodible lands. Encouraged is reforestation and enhancement of riparian corridors. To be undertaken: identify prime lands for reforestation; encourage greater institutionalization of forestry within agricultural agencies; and develop reforestation plans in certain specified waters.

D. Best Management Practices

Kansas does not administer forestry best management practices in any form (voluntary or regulatory). Furthermore, the state does not have any special rules to curb forestry practices that could potentially impact the quality of water

flowing from private forest land. Private forests occupy only three percent of the state's land area; 96 percent of these forests are privately owned.

E. Compliance and Effectiveness

Since Kansas has not established best management practices, there has been not monitoring for compliance.

F. Information Sources

Division of Environment. 1989. Nonpoint Source Pollution: Assessment Report. Department of Health and Environment. Topeka, KA.

Division of Environment. 1989. Nonpoint Source Pollution: Management Plan. Department of Health and Environment. Topeka, KA.

Pinkerton, L. R. 1991. Personal Correspondence. Program Leader, Forest Management. September 30. Cooperative Extension Service. Kansas State University. Manhattan, KA.

IX KENTUCKY

A. Statutes, Regulations, and Programs

The Division of Forestry, Department of Natural Resources, has major responsibility for a variety of programs which address nonpoint forestry sources of water pollutants. These programs involve fiscal incentives (especially, Stewardship Incentives Program), technical assistance, broad educational efforts, and voluntary guideline programs. The Division does not have any specific unique legal authority or mandate to address nonpoint forest sources of water pollutants. Informed Division administrators are of the opinion that Kentucky is unlikely to ever enact a comprehensive law that regulates private forest practices. The most significant deterrent to such a law is potential infringement on private property rights. Responsibility for administering water quality programs generally within the state rests with the Division of Water Quality of the Kentucky Department of Environmental Protection.

B. Nonpoint Assessment Report

The most recent assessment of Kentucky's water quality conditions was undertaken in 1990 and 1991. Of the 55,300 miles of streams, approximately 10,671 miles (19 percent) were assessed. Of the assessed streams, 21 percent were found to be impaired, or not supporting stated water uses (e.g., domestic

water supply, recreation, aquatic life). An additional 10 percent were found to only partially support usage. The most prominent nonpoint sources of pollutants in streams were agriculture (46 percent of all sources), resource extraction such as surface mining (37 percent), and urban/storm runoff (11 percent). The remaining six percent of nonpoint pollutants were attributed to hydro-habitat modification and disposal systems.

The Kentucky assessment also surveyed 90 percent of the publicly-owned lake acreage. Of 102 lakes, nine percent did not support designated uses. Again, agriculture (29 percent), municipal runoff (21 percent), and surface mining (16 percent) were the dominant nonpoint sources of lake pollutants. Septic systems contributed an additional 10 percent and natural sedimentation processes accounted for 21 percent of the causes of pollutants.

Silvicultural and related forestry activities have had only moderate to minor affect on water quality in Kentucky. Of the 831 miles of streams impacted moderately, or in a minor way, by nonpoint sources, 34.3 miles (0.3 percent of all assessed stream mileage) were impacted by silviculture and related forestry sources.

C. Nonpoint Management Plan

Statewide programs to deal with nonpoint sources of water pollution generally involve significant attention to the advocacy of education, technical assistance, voluntary best management practices and cooperative local action. The only two nonpoint pollutant sources addressed by regulatory programs involve resource extraction (e.g., surface mining) and land disposal activities.

Programs recommended for control of nonpoint source pollution from forestry activities focus primarily on education and technical assistance to private landowners. The state Division of Forestry is charged with implementing such programs. A common Division approach to doing so involves assisting private landowners with the development of timber management plans. In 1988, the Division assisted in the development of plans that covered 82,000 acres of forest, resulting in over 8,000 acres of improved watershed.

Future plans for program actions focused on nonpoint forest sources of water pollutants include: intensification of educational programs aimed at private landowners and industry groups; updating best management practice (BMP) manuals; developing a comprehensive survey of BMP implementation; developing water quality monitoring stations for waters not fully supporting designated uses because of silvicultural activities; and providing reports on BMP effectiveness. These planned

activities were jointly developed by the Division of Forestry and the Kentucky Forest Industry Association.

D. Best Management Practices

Best management practices established for Kentucky focus on nonpoint pollutants from five different sources, namely sediments, nutrients, pesticides, organic debris, and water temperature. The best management practices suggested to control such pollutants are set forth in the following categories. Example practices are identified:

Access roads: Roads should be constructed so as to provide sufficient outslping; culverts (no drainage dips) should be installed to handle live running water. Distance between culverts or drainage dips varies according to road grade, road grade 2-5 percent every 300 to 500 feet, ... 16-20 percent every 100 feet. All road surfaces, road banks, and potential erosion sources should be revegetated upon completion of forestry activity.

Vegetative establishment of disturbed areas: Establish a vegetative cover to stabilize soil and reduce damage from sediment and runoff to downstream areas; grade area to be vegetated; scarify or otherwise roughen area before seeding; apply grass seed at rates specified (tall fescue -- 45 pounds per acre) during specified period (February 15 -- April 15).

Fire land construction: Avoid fire control lanes located at right angles to land contour, except during control activity on wildlife. Do not locate fire lanes so drainage occurs directly into streams; turn land 15 to 20 feet from stream so lane parallels stream; establish permanent vegetation on fire lanes.

Tree planting: Species selection and site applicability is suggested. A first year survival rate of 70 percent is considered satisfactory.

Site Preparation: Specification of acceptable preparation techniques for various types of forest (e.g., bottomland hardwood site preparation for plantations, converting poor growth hardwood sites to pine). Water quality should be considered when undertaking practices involving pesticides and scarification of land surfaces; leave filter strips along streams.

Pesticides: Pesticides must not be applied when danger of drift exists or when contamination of water is possible. Equipment must not be cleaned near ponds, streams or wells.

Filter strip: Filter strips should be established for purposes of trapping sediment from water runoff and maintaining water temperature. Silvicultural activities need not be

eliminated in filter strips, although the following are considered unacceptable: wheel or crawler vehicles, roads except at designated crossings, log landings and concentration yards, mechanical site preparation, and prescribed burning. Width of filter strip varies with slope of land: zero slope -- 25 feet; 10 percent slope -- 45 feet; ... 70 percent slope -- 165 feet.

Debris: Fell trees away from drainage along perennial streams. Remove logging debris (e.g., tops, limbs) from perennial streams, lakes or ponds to a distance to insure debris will not return to stream.

Other activities: Consideration must be given to appropriate water pollutants prevention practices that involve livestock, prescribed burning, and woodland improvement activities.

E. Forest Practice or Special Rules

Kentucky does not have any special rules pertaining to the application of water quality impacting forestry activities that might be undertaken by private landowners or timber operators.

F. Compliance and Effectiveness

Compliance with voluntary best management practices has not been comprehensively monitored in Kentucky. However, research is currently underway (University of Kentucky) to determine the impact of clearcut harvesting on stream water quality, with and without the application of voluntary best management practices. The parameters of interest include physical characteristics (e.g., suspended sediment, bedload, temperature), chemical (e.g., dissolved oxygen), bacterial (e.g., coliform), and biological (e.g., fish, macro-invertebrates).

G. Information Sources

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X MICHIGAN

A. Statutes, Regulations, and Programs

Nonpoint source pollution from forestry activities is addressed through a variety of programs administered by the Division of Forest Management, Department of Natural Resources. The programs managed by the Division include education and training, technical assistance, voluntary guidelines, and fiscal incentives.

Michigan's regulatory programs focused on nonpoint pollutant sources are not forestry specific. They may, however, impact the manner in which forest practices are applied. For example, the Soil Erosion and Sedimentation Act requires permits for all earth moving activities within 500 feet of a lake or stream, or which disturb an area of one acre or more. County agencies have the lead role in administering the law. The Sedimentation Control Unit, Division of Land and Water Management, is responsible for administering provisions of the act for the state Department of Natural Resources.

B. Nonpoint Assessment Report

The status of nonpoint sources of water pollutants was assessed by the Division of Surface Water Quality, Department of Natural Resources. Based on the perceptions of 20 types of natural resource, environmental and agricultural agencies, 69 percent of the state's 297 identified watersheds were being impacted by forest land erosion. The major pollutants resulting from forestry activities were sediments and, in a smaller part, pesticides, nutrients, fertilizers, and increased stream temperatures due to canopy removal. Silvicultural activities were acknowledged as sources of pollutants that could adversely

affect wetlands. However, the Division was unable to provide an estimate of the extent of such impacts.

The four leading nonpoint sources of water pollution identified by the Division were septic systems (81 percent of watersheds), stream-bank erosion (80 percent), agricultural erosion (75 percent), and construction site erosion (74 percent).

C. Nonpoint Management Plan

Strategies suggested as means for addressing nonpoint forest sources of pollutants are:

- support and expand existing education and technical assistance programs for forestland owners and users.
- support and expand existing stream bank erosion control programs (Soil Erosion and Sediment Control Act).

The plan sets forth directions for monitoring the application of best management practices. The Division of Forest Management is designated as the lead agency for implementing nonpoint forest source programs.

In 1991 and 1992, Michigan initiated statewide BMP training programs for purposes of complying with Section 319 of the Clean Water Act. As part of such an effort, a draft BMP manual has been prepared.

D. Best Management Practices

Best management practices have been developed by the Michigan Society of American Foresters in cooperation with the Michigan Chapter of The Wildlife Society. The guidelines address a variety of subjects, including development of forest plans, description of various silvicultural systems, forest protection, and recreational and visual resources. The following are examples from the wildlife and road construction sections.

Wildlife habitat: Retain several snags and den trees for wildlife purposes as well as some trees that are capable of producing seeds, acorns, and nuts; retain mature stands of northern white cedar and hemlock for purposes of winter cover for deer; provide for and maintain permanent forest openings for wildlife habitat; pile logging slash to provide cover for small mammals.

Road construction and maintenance: Carefully plan road and trail locations prior to construction. Roads over wet soils should be limited to or designed to be used only when frozen. Road slopes and ditches should be carefully located to prevent

sedimentation. Main access roads should be graveled under most conditions. Secondary roads should be reseeded in order to prevent erosion and to provide food for wildlife.

E. Forest Practices Rules

Michigan does not have a comprehensive statewide set of specific rules that apply to water quality impacting forestry practices that might be applied by private landowners and timber operators. However, certain permits are required by the state's Soil Erosion and Sedimentation Act. Furthermore, new regulations (Reg. 636, 637), promulgated under authority of the State Pesticide Control Act (Act 171, P.A., 1976), outline specific practices for minimizing nonpoint source pollution from pesticides used on forestlands.

F. Program or Rule Changes (Since 1980)

Forestry best management practices were formulated by the Michigan Society of American Foresters in 1987. Generally, there has been little significant change in programs or best management practices directed at forestry since the development of those BMPs.

G. Compliance and Effectiveness

Compliance with voluntary best management practices focused on water quality is currently being assessed in Michigan.

H. Special Issues

According to informed state forestry program administrators, there is increasing interest within the state legislature to enact a state forest practices act. Although recent introductions have failed, future proposals are most likely to be introduced.

I. Information Sources

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XI MINNESOTA

A. Statutes, Regulations, and Programs

Various state agencies have responsibility for implementing programs that affect the forestry practices of private landowners and operators in Minnesota. For example, the Division of Forestry, Minnesota Department of Natural Resources, implements several programs that are focused in some manner on the water quality impacts of forestry activities, including education and training programs, technical assistance programs, voluntary guidelines, and cost share incentive programs. Also important is the Department's Division of Waters, which administers general rules and standards with respect to shoreland areas and designated waterways in the state. Although forestry activities are not the primary focus of such regulations, forestry practices are impacted. At one time, the Minnesota Pollution Control Agency required stormwater discharge permits for timber harvesting activities. Forestry has been given an exemption from such permitting procedures.

B. Nonpoint Assessment Report

The Division of Waters of the state Pollution Control Agency assessed 42 percent of the state's 3.4 million acres of lakes and five percent of the state's 92,000 miles of streams and rivers (completed in 1988; 305(b) update currently in process). Of the many potential nonpoint sources of pollutants, silviculture and forestry related activities were judged to be inconsequential contributors. Agricultural activities (cited 56 percent of the time as a nonpoint pollution source), urban runoff (13 percent), land disposal activities (11 percent), and hydromodification (10 percent) were the most frequently cited nonpoint sources of water pollution in the state.

C. Nonpoint Management Plan

The state's approach to the management of nonpoint sources of water pollution involves two major strategies, namely:

- implementation of comprehensive water quality protection and improvement projects through the Clean Water Partnership Program (CWP).
- implementation of statewide best management practices (BMPs) through local, state and federal agencies and water quality related programs.

The Clean Water Partnership Program is focused on specific bodies of water and the polluting sources associated with them. The program involves the cooperative planning efforts of state and local governments. Based on the results of such efforts, funding is made available to address water quality problems associated with specific bodies of water.

The statewide best management practice strategy is supported by a structure that includes: ongoing monitoring and research to provide continuous information on water quality trends; information and education efforts which integrate all land management units; local water planning cooperatives; technical assistance and local program delivery systems; and state level planning, coordination, and evaluation of best management practices and the programs used to deliver them. Numerous state, local, and federal agencies are directly responsible for the implementation of this structure.

State programs focusing specifically on forestry and silvicultural activities include: the Minnesota Forestry Incentives Program; the USDA Agricultural Conservation Program; and Department of Natural Resources administered program regulating works in stream beds of public waters (includes forest roads) via a permitting process. The state Division of Forestry of the Department of Natural Resources also administers, monitors, and evaluates voluntary best management practices for forestry.

D. Best Management Practices

The cooperative efforts of a variety of public and private organizations in Minnesota have resulted in the development of a set of best management practices that have been published and made available to owners of forestland and persons involved in the harvest of timber from such land. The manual describing the practices contains a number of definitions, including:

- best management practice -- a practice or combination of practices considered to be the most effective and practical (including technological, economic and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources in such a way as to attain water quality goals.

- filter strip -- area of land adjacent to a water body which acts to trap and filter suspended sediments (and chemicals) before they enter surface water. Harvesting is permitted in filter strips as long as the integrity of the strips is maintained and mineral soil exposure is kept to a minimum.
- wetlands -- geographic areas characteristically supporting hydrophytes, hydric soils, and some saturation or flooding during the growing season.

The specific practices suggested to landowners and operators all have an orientation toward preventing pollution from nonpoint sources of water pollutants. They are grouped into the following major categories with examples of specific practices.

- General practices: Locate fueling areas at locations away from water where a potential spill can be contained and properly treated with minimum opportunity for water contamination. Identify filter strips for purposes of decreasing pollutants from forestry activities. Filter strip specifications vary according to slope of land adjacent to stream or water body, namely, 2 to 10 percent slope -- 30 to 50 foot filter strip ... 21 to 40 percent slope -- 70 to 110 foot filter strip. Forest management activities carried out in filter strips should be accomplished so as to produce minimal exposure of residual soil and maintain an acceptable amount of residual vegetation.
- Forest roads: Minimize total road miles and stream crossings; coordinate road plans with adjacent owners of forestland. Where possible, construct roads with a slight grade (one or two percent); avoid grades of 10 to 12 percent. Place road crossings at a 90 degree angle to streambed. Give preference to crossing at locations where: (a) channel will be minimally distributed; (b) streambanks are composed of rock or firm soils; and (c) approaches to stream banks have a low slope and short length. Do not drain surface water from roads directly into open water; drain into filter strip or vegetative draw. Install culverts or broadbased dips at specified intervals (3 to 4 percent grade -- 300 foot spacing ... 8 to 10 percent grade -- 150 foot spacing). Install siltation barriers (e.g., straw bales or mulch) as necessary to help stabilize exposed soils.
- Timber harvesting: Timber harvest plans should be prepared in full consideration of location of surface waters, location of stream crossings, number and size of landings, and timing of harvest. Locate landings away from poorly drained areas (especially wetlands).

Establish filter strips adjacent to lakes, ponds, perennial streams, and intermittent streams. Avoid felling timber into non-forested wetlands. Vegetation adjacent to designated trout streams should be managed to minimize increases in stream temperature.

- Mechanical site preparation: Use site preparation techniques that will minimize disturbance to site and adjacent water areas. Avoid concentrating residues from shearing and raking operations in wetland areas. Locate windrows outside filter strips. Use patch and row scarification as the preferred mechanical site preparation method for artificial regeneration.
- Pesticide use: Avoid use of broadcast application methods in filter strips. Properly clean and dispose of pesticide equipment. Specifications are given for pesticide application according to conditions, including wind speed, temperature, and humidity. Detailed characteristics given for specific pesticides (e.g., water solubility, half-life, leaching potential).
- Prescribed burning: Locate fire lines on contours. Avoid placement of piles for burning in sensitive areas next to lakes, streams, or drainage channels. Minimize width of fire lines and amount of soil disturbed.

E. Forest Practice Rules

Minnesota does not have comprehensive rules that govern the application of water quality impacting forestry practices that might be applied by private owners of forestland or timber harvesters.

F. Special Rules

Minnesota has a number of statutes, rules and polices that limit the manner in which forestry practices are applied to private forestland. For example, statewide rules establish standards for forest management in shoreland areas (Shoreland Management Act), namely:

- timber harvesting and associated reforestation must be conducted consistent with provisions of Minnesota Nonpoint Source Pollution Assessment (Forestry) and with provisions for water quality specified in best management practices in Minnesota.
- forestland conversion to another use (if permitted by local governments) must adhere to the following:
 - (a) shore and bluff impact zones must not be intensively cleared of vegetation; and
 - (b) an erosion and sediment control plan must be developed and

approved by the local soil and water conservation district prior to issuance of a conditional use permit.

- use of fertilizers or pesticides must be done in such a way as to minimize impact on shore impact zones and public waters.

Alterations of shoreland vegetation are generally limited in manners such as: intense vegetation clearing on shore impact zones and on steep slopes is not allowed; limited clearing of trees in shoreland areas is allowed under special circumstances; and use of fertilizers and pesticides is to be accomplished with minimal impacts on public waters.

Cutting vegetation within areas designated as state wild, scenic, and recreational rivers is also restricted by state law. For example, within specified distances of the high water mark of a particular type of designated river (100 to 200 feet, depending on designation category), clearcutting is prohibited, and selective cutting of trees over four inches in diameter is permitted only under certain conditions. Clearcutting anywhere in watersheds within a designated wild, scenic, or recreational river is subject to legal standards, including:

- clearcutting is prohibited where soil, slope or watershed conditions are fragile;
- clearcuts must be shaped and blended with natural landscapes;
- clearcuts must be kept minimal in size;
- where feasible, clearcuts must be conducted between September 15 and May 15.

The Department of Natural Resources also has established policy statements which prohibit or severely limit timber harvesting activities in scientific and natural areas and in wildlife management areas.

A county government in Minnesota (Winona) has established a timber harvesting ordinance that requires licensing and bonding of persons intent on harvesting timber. When evaluating a person's application to harvest timber, the county administrators require: (a) restoration of all cuts, access roads, and stripped slopes to a useable condition; (b) proper disposal of all slash and logging debris; (c) taking actions to prevent and suppress wildfires; (d) application of timber stand improvement practices to the harvested area; and (e) cutting operations to be carried out consistent with standards established by the state Department of Natural Resources.

G. Program or Rule Changes (Since 1980)

Forestry best management practices to protect water quality were expanded in 1991 pursuant to the federal Clean Water Act of 1987.

H. Compliance and Effectiveness

In 1991, 1992, and 1993, the Division of Forestry conducted statewide audits of the application of best management practices. The audits assessed the rates of adoption of best management practices and the factors influencing the adoption of such practices. Results from the 1992 audit are presented in Table 9.

TABLE 9 ADOPTION (PERCENT) OF BEST MANAGEMENT PRACTICES IN MINNESOTA, BY LANDOWNER CATEGORY - 1992

Best Management Practice	All Categories	Non-Industrial Private Forests	Industrial Forests	Federal Forests	State Forests	County Forests
Filter Strip Use	78	70	81	100	98	96
Filter Strip Width	85	63	92	94	93	91
Filter Strip Activities	46	70	35	35	33	48
Ford Construction	83	79	87	83	88	73
Road Maintenance	80	67	91	100	94	100
Road Drainage	68	46	91	92	89	96
Slash Disposal	92	93	89	82	84	92
Site Preparation Methods	50	23	78	76	62	36
Skid Trail Drainage	35	18	44	71	36	36
Landing Drainage	23	11	41	41	100	100
Pest Control	95	63	100	100	79	90
Prescribed Burn Methods	81	73	89	86		

Source: A Survey to Assess Adoption of Best Management Practices in Minnesota Forestry by J. N. Gathman, N. Troelstrup, M. Phillips, and J. Perry. 1992. Department of Forest Resources. University of Minnesota. St. Paul, MN.

I. Special Issues

Minnesota has several major issues confronting forestry in the state. Among the most compelling are proposals for establishing a state forest practices law. A bill proposing adoption of such a law was introduced in the 1991-1992 session of the state legislature. Similar bills were introduced in the 1992-1993 session for purposes of registering and certifying timber harvesters.

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XII MISSOURI

A. Statutes, Regulations, and Programs

The Division of Forestry of the Department of Conservation plays a prominent role in addressing nonpoint forestry sources of water pollution. The Division administers programs of the following nature: education and training, technical assistance, financial assistance, and voluntary best management practices.

The state's Department of Natural Resources also has statutory authority to implement programs that address nonpoint sources of pollutants. Most such programs are not forestry specific. For example, the state's Soil and Water Conservation Program provides low interest loans to landowners for purposes of reducing or preventing soil erosion; cost share to landowners for purposes of soil conservation practices; and grants to Soil and Water Conservation Districts for technical assistance and demonstration projects. The Department's Water Pollution Control Program funds surface and groundwater quality monitoring projects.

B. Nonpoint Assessment Report

The Division of Water Quality, Department of Natural Resources, assessment of nonpoint forest sources of water pollutants concluded that pollution from silvicultural sources is not a major concern within the state. Timber harvests, the most common silvicultural activity, occur infrequently on a specific tract and annually amount to about only two percent of Missouri's commercial forestland area. In relation to agricultural practices, the Division concluded that silvicultural practices are small scale in terms of the amount of soil lost, frequency of soil disturbance, amount of chemicals used, and acreage treated.

C. Nonpoint Management Plan

Because pollution from forest management activities is not significant, no regulatory compliance program is considered necessary. Land management agencies and the logging companies are judged to have already voluntarily initiated watershed protection practices to maintain high water quality from forests. Technical and general assistance will be provided landowners and operators by state agencies as necessary.

D. Best Management Practices

The Division of Forestry, Department of Conservation, has prepared guidelines for managing nonpoint sources of pollutants in forested areas. Some examples of the subjects addressed by the guidelines and specific practices suggested therein follow.

Streamside zones: Streamside zones should be established adjacent to perennial and intermittent streams, springs and lakes. Such zones are of two parts: a primary filter strip 25 feet wide from a stream; a secondary filter strip, beyond the primary strip, that varies in width according to slope (twice the slope percentage of surrounding land). For fish and wildlife habitat purposes, a streamside zone of 100 feet is recommended. Within the primary zone, harvesting should be limited to approximately one-quarter of the forest (basal area of 20 to 30

square feet). Wheeled or tracked tractors should not be used within 25 feet of a stream bank.

Streamside crossings: Roads should be planned so as to minimize the need for stream crossings. Fords should be located at right angles to stream channels and, where permanent, should be protected with coarse rock or large stones.

Road construction and maintenance: Roads should be planned, located, and constructed so as to provide for adequate drainage. They should generally be constructed at grades of less than eight percent, and when heavy equipment is to be used, surfaced with gravel for adequate support. Broadbased dips should be used at proper intervals (specified for every 500 feet where road grade is one percent, to every 180 feet where grade is five percent). Likewise, water bars should be installed when retiring temporary roads and main skid roads (intervals specified). Temporary roads should be reshaped, seeded and mulched as appropriate (grass species, seed application, rates and dates for application are specified).

Timber harvesting: Locate log landings on stable well drained soils. Equipment should not be serviced in close proximity to streams; petroleum products should be properly disposed of; logging debris should be removed from streams.

Site preparation and reforestation: Avoid mechanical site preparation which bares soil on steep slopes. Install filter strips to prevent erosion.

Chemical treatments: Avoid use of chemicals in streamside zones.

E. Forest Practice and Special Rules

Missouri does not have rules specifically focused on water quality impacting forestry practices that might be applied by private landowners or timber operators.

F. Program or Rule Changes (Since 1980)

Informal cooperative agreements between land management agencies and logging industry have resulted in the development and implementation of voluntary forest practice guidelines aimed at watershed protection.

G. Compliance and Effectiveness

Compliance with voluntary best management practices has not been monitored in Missouri.

H. Information Sources

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XIII NEBRASKA

A. Statutes, Regulations, and Programs

The Nebraska Forest Service, affiliated with the University of Nebraska (Lincoln), is responsible for programs focused on nonpoint forestry sources of water pollutants. The agency does not administer regulatory programs focused directly on forestry activities. The state does, however, have laws which prohibit depositing of certain material (e.g., logging debris) into streams. The Forest Service administers a variety of non-regulatory programs directed at protecting water quality on private forestlands. Specifically, the Service administers education and training, technical assistance, tax incentives, and financial cost share programs. Such programs are consistent with the modest amount of forestland that exists in Nebraska.

B. Nonpoint Assessment Report

The Division of Water Quality of the Department of Environmental Control assessed 1,361 watersheds within the State of Nebraska. Seven percent of the watersheds had no adverse water quality impacts or beneficial use impairments; 36.4 percent had adverse water quality impacts as well as suspected beneficial use impairments. The remaining watersheds had unknown impacts or no known impacts. Since the state's land base is less than four percent forested, silvicultural and forestry related activities were found to have minimal impacts on the quality of the state's waters. The majority of the state's water quality problems originated from agricultural practices. Thirty-eight percent of the "high concern" nonpoint pollutant sources were agricultural; 33.3 percent were hydromodification activities; and 16.7 percent of high concern nonpoint sources were from land disposal activities. Silvicultural activities were rated as "low" concern or "not an existing concern."

C. Nonpoint Management Plan

Among the areas for focus of the state's nonpoint source (NPS) program implementation activities, the Division of Water identified the following:

- NPS Surface Water Quality Monitoring System: objectives are to: identify watersheds where water quality or beneficial uses are imminently impaired; identify contributing pollutants in impaired watersheds; determine quantitative level of water quality and beneficial use impairment; and identify critical areas within target watersheds for application of best management practices (BMPs).
- Information and Education: publishing articles and manuals regarding control of nonpoint source pollution from various land disturbing activities; and display appropriate water quality exhibits at regional agricultural and environmental conferences.

The plan does not identify programs targeted specifically at forestry practices.

D. Best Management Practices

Nebraska does not have formally developed documents that describe best management practices for forestry. However, property-specific best management practices are recommended in forest management plans developed for private landowners by the state Forest Service.

E. Forest Practice or Special Rules

Nebraska does not have rules pertaining specifically to water quality impacting forestry practices that might be applied by private landowners or timber operators.

F. Compliance and Effectiveness

Compliance with best management practices suggested by the Forest Service has not be formally assessed.

G. Information Sources

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XIV NORTH DAKOTA

A. Statutes, Regulations, and Programs

Programs directed at nonpoint forestry sources of water pollution are administered by the North Dakota Forest Service. The latter administers programs of the following nature as they relate to forestry activities: education and training, technical assistance, tax incentives, and financial cost share incentives. Such programs are consistent with the modest amount of forest that exists in North Dakota.

B. Nonpoint Assessment Report

The Division of Water Supply and Pollution Control of the State Department of Health and Consolidated Laboratories assessed the state's waters in 1988. Approximately 30 percent of the 9,851 stream miles and most of the lakes assessed were classified as impaired due to nonpoint source pollution. For purposes of the assessment, the state was divided into four major river basins: Red River, Souris River, James River, and Missouri River. In turn, the basins were further subdivided into sub-basins. Of all the sub-basin assessments, agriculture and hydromodification accounted for an average of 90 percent of the nonpoint sources identified. Silviculture was not identified as a source of water pollutants.

C. Nonpoint Management Plan

The state-wide strategy for addressing nonpoint source water pollution in general is through the administration of best management practices. Statutes and regulations exist for construction, land disposal, and resource extraction. There is particular emphasis on coordinating technical assistance and cost sharing mechanisms between local, state and federal programs. None are specifically directed at forestry. Among such programs are the Resource Conservation and Development Fund, Watershed Protection Project, Rural Clean Water Program, Water Bank Program, and No Net Loss Wetlands Program.

D. Best Management Practices

North Dakota does not have voluntary guidelines for forestry.

E. Forest Practice Rules

North Dakota does not have rules pertaining to water quality impacting forestry practices that might be applied by private landowners or timber harvesters.

F. Compliance and Effectiveness

Compliance with best management practices is not monitored in North Dakota.

G. Information Sources

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XV OHIO

A. Statutes, Regulations, and Programs

State forestry programs to control nonpoint silvicultural sources of pollution in Ohio are administered by the Division of Forestry, Department of Natural Resources. The programs involve education and training, technical assistance, voluntary guidelines, and tax incentives -- none are designed exclusively for protection of water quality. There are, however, agricultural sediment pollution abatement rules (Administrative Code Rules 1501:15-3-01 to 1501:15-3-09) that establish state standards for management practices involving farming and silvicultural activities that can accelerate erosion or degrade water quality. The rules are promulgated and implemented by the Division of Soil and Water Conservation, Department of Natural Resources.

B. Nonpoint Assessment Report

The Division of Water Quality Planning and Assessment of the State Environmental Protection Agency carried out an assessment of Ohio's water quality in 1990. For purposes of the assessment, the state was divided into five major drainage basins -- Lake Erie East, Lake Erie West, Ohio River Central, Ohio River East, and Ohio River West. In turn, these drainages were subdivided into 93 hydrologic groups. Of the 43,917 miles of streams surveyed in the assessment, 32 percent (12,463 miles) were found to be impaired by nonpoint sources of pollutants. An additional 53 percent were found to be impacted and 15 percent were judged as threatened.

Agricultural activities were found to be the most prevalent category of nonpoint source pollution, affecting over 70 percent of the impaired stream miles. Other major categories of pollutants identified were land disposal (affecting 25.5 percent of the stream miles), resource extraction and surface mining (25 percent), hydromodification (25 percent), urban sources (17 percent), and natural processes (6.5 percent). Silviculture was cited as impacting only five percent of the state's total stream miles. Of the 12,463 miles of stream identified as impaired by nonpoint sources, approximately 350 miles (2.9 percent) were judged to be impaired by silvicultural activities. Forty-six percent of the state's publicly owned lakes that were surveyed in the assessment were associated with nonpoint source affected streams.

C. Nonpoint Management Plan

Responsibility for Ohio's nonpoint source management program is shared by the State's Department of Natural Resources and the Ohio Environmental Protection Agency. The updated management program (October 1992) outlines six programmatic objectives:

- Develop a nonpoint source education program for agency staff, affected organizations, landowners, and the general public.
- Encourage management agencies and research institutions to provide technical assistance for planning and implementing remedial and preventive nonpoint source projects.
- Establish a state wide monitoring program to track effects of nonpoint source pollution and determine effectiveness of implemented projects.
- Obtain state funding for nonpoint source research, education, planning, technical assistance, monitoring, and enforcement in targeted priority areas.

- Coordinate administrative efforts to insure efficient management of nonpoint source issues.
- Set a legislative agenda for nonpoint source pollution to provide additional funding and for the development of new regulations considered necessary.

The Division of Forestry plays a major role in the plan's implementation. In part, this involves the implementation of a number of existing programs that facilitate management of nonpoint forest sources of water pollutants, including rural forestry assistance and service forestry programs, forest products utilization programs, Stewardship Incentives Program (federal), the Agricultural Conservation Program (federal), and the Forestry Incentives Program (federal). The Division also fostered the development of forestry best management practices via participation in the state's Silvicultural Nonpoint Source Pollution Technical Advisory Committee (composed of, among others, the Division and the Ohio Forestry Association). The Committee has published best management practice (BMP) manuals and has assisted in training programs (e.g., timber operators) regarding their appropriate application.

D. Best Management Practices

The Division of Forestry, Department of Natural Resources, has (with the assistance of the Silvicultural Nonpoint Source Pollution Control Technical Advisory Committee) established best management practices that are suggested to landowners and operators for voluntary consideration and compliance. Among the definitions contained in the suggested best management practices are:

- Filter strip -- protective strip of undisturbed forest soil between areas of mineral soil and a water course.
- Shade strip -- a no cut or light cut 25 foot strip on each side of a stream bank that preserves adequate shading of permanently flowing streams and maintains satisfactory stream water temperatures.
- Buffer zone -- undisturbed area of vegetation used for screening roads or other sensitive areas.
- Critical areas -- areas subject to erosion due to soil type or slope.
- Water bars -- water diversion structures.

Examples of suggested best management practices and the categories within which they are placed are as follows.

Planning harvesting operations: Pre-harvest planning should involve preparation of a detailed plan identifying streams and drainage, critical areas, road and trail locations, buffer zones, and log landing sites. Special consideration should be given to wet areas, to timing of harvest, and to equipment to be used.

Haul roads: Haul roads should be designed for efficient transportation while effectively protecting forest productivity and water quality. Before permanent erosion control practices can be installed (bridges, culverts), temporary erosion control measures may be necessary (hay or straw bales, silt fences). Haul road entrances should be graveled up to 200 feet from public highways to keep mud off highways. In wet areas, wooden mats, planking or other appropriate material should be used to prevent rutting. If possible, trees should be removed along roadsides to allow sunlight to enter and dry road surfaces.

Skid roads: Skid roads should be kept on grades less than 20 percent. Avoid stream channels, rocky places, and adverse grades. Cross as near to right angles to streams as possible. Keep skid trails out of filter strips and shade strips.

Maintenance: Periodically check for obstructions (correct problems) in all ditches, culverts, energy dissipators, rolling and broad-based dips, water turnouts, and silt fences.

Stream crossings: Ford streams at right angles and where stream bottoms and banks are rock. Apply gravel to skid road approaches to streams.

Filter and shade strips: Filter strips along permanently flowing streams should only be selectively harvested. All trees casting shade on a stream should be left uncut. Width of filter strip is to be determined by slope of land adjacent to stream. For common logging areas, 10 percent slope requires a 45 foot filter strip ... 50 percent slope requires 125 foot strip. For logging in critical or municipal areas, 10 percent slope requires a 90 foot strip ... 50 percent slope requires a 250 foot strip.

Landings: Landings should be located on dry sites and have a slight slope for proper drainage. Landings should be revegetated as soon as possible after harvesting.

Sale closings: Sale closure should occur as soon as possible after a timber harvest area is complete. Closure should include installation of water bars and revegetation of landings and roads. Water bars should be spaced according to slope. For example, two percent slope -- every 250 feet; 20 percent slope, every 45 feet. Specifications given for type of seeding and application rate for seed, fertilizers, and lime.

E. Forest Practice Rules

The Division of Forestry, Department of Natural Resources, does not administer rules that directly limit the manner in which water quality impacting forestry practices are applied on privately owned forestland. The Division's efforts to do so are initiated through a voluntary program.

F. Special Rules

The Division of Soil and Water Conservation, Department of Agriculture, is responsible for general implementation of agricultural sediment pollution abatement rules (Administrative Code Rules 1501:15-3-01 to 1501:15-3-09) which address forestry practices that may accelerate erosion or degrade water quality, and is authorized by the state's Agricultural Pollution Abatement Act (Ohio Revised Code chapter 1511). Local Soil and Water Conservation Districts are responsible for monitoring and enforcing standards. Specific rules include:

- Landowners or operators must conduct silvicultural operations such that the soil loss from water and wind erosion does not exceed certain maximums specified by the universal soil loss equation and standards established in technical manuals.
- Landowners or operators carrying out silvicultural operations must properly design and construct water flow channels and must use appropriate practices that will prevent pollution by sediment in gullies, drainage ways, grassed waterways, ditches and streams.
- Landowners or operators responsible for silvicultural operations must not use earth distributing practices adjacent to a ditch, stream or lake such that distributed soil is placed in a ditch, stream, or lake.

G. Program or Rule Changes (Since 1980)

Proposals to amend the Agricultural Pollution Abatement law were introduced during the 1991-1992 session of the Ohio Legislature. Rules adopted pursuant to the proposed amendments were established in 1989.

H. Compliance and Effectiveness

Landowner and operator compliance with best management practices has not been systematically and formally measured in Ohio.

I. Information Sources

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XVI SOUTH DAKOTA

A. Statutes, Regulations, and Programs

The Division of Forestry, Department of Agriculture is responsible for state programs in South Dakota that address nonpoint forestry sources of water pollutants. Although the State Department of Environment and Natural Resources is responsible for implementing projects and plans related to nonpoint source control plans generally, the Division of Forestry is given administrative authority to develop and administer voluntary forestry best management practices.

The programs administered by the Division of Forestry focus on education and training, technical assistance, and fiscal cost share incentives. In the opinion of Division administrators, water quality problems resulting from forestry activities are minimal within the state. Hence, state programs directed at protection of water quality flowing from forestlands are non-regulatory in nature. The Division does, however, implement regulations concerning the disposal of slash from timber harvesting operations.

B. Nonpoint Assessment Report

The Office of Water Resources, Department of Water and Natural Resources, assessed nonpoint sources of water pollutants in 1988. Of the 3,751 miles of river assessed (out of a state total of 9,937 miles), silvicultural activities were found to have no impact on any portions of the assessed rivers. Similarly, of the nearly 1.6 million acres of lake within the state, silvicultural practices were found to have a major impact on 162 lake acres and a moderate or minor impact on 463 acres. Major causes of nonpoint water pollutants were agricultural practices and land disposal.

C. Nonpoint Management Plan

Significant water quality impacts from forestry related activities result from forest wildfires in South Dakota. Between the USDA Forest Service, the USDI National Park Service, the U.S. Geological Survey, and state land management agencies, research has been conducted to determine effects of burns on water yields and water quality. Specific projects directed at studying silvicultural impacts on water yield and water quality have been organized by state and federal land management agencies.

D. Best Management Practices

Best management practices for forestry operations in South Dakota are based in part on standards set forth in the USDA Forest Service Regional Handbook (FSH 2509.22) concerning Soil and Water Conservation Practices. The standards are very lengthy; example categories of standards are as follows:

Vegetative manipulation

- operating seeding and land preparation equipment
- slope limitations for tractor operation
- tractor operation excluded from wetlands and bogs
- revegetation of disturbed areas
- pesticide application and monitoring
- soil protection during and after slash windrowing

Timber

- timber sale planning
- operational period for harvesting
- protection of unstable areas
- riparian area designation
- log landing location and design
- erosion prevention and control measures
- revegetation of disturbed areas
- stream course protection
- reforestation requirements

Roads and trails

- transportation planning
- erosion control plan
- servicing and refueling of equipment
- stream crossing on temporary roads
- bridge and culvert installation
- stream bank protection
- maintenance of roads

E. Forest Practice and Special Rules

The state government of South Dakota does not administer comprehensive rules pertaining specifically to water quality impacting forestry practices that might be applied on private forestland. The state does, however, administer a slash disposal and burning permit law which requires proper treatment and disposal of logging slash and debris. Violations are misdemeanors subject to fines.

F. Compliance and Effectiveness

State administered efforts to determine compliance with best management practices focused on nonpoint forestry sources of water pollutants have not been carried out.

G. Special Issues

Forest wildfires have apparently had detrimental effects on several streams in the Black Hills area of South Dakota. State and federal cooperative efforts at studying effects and reducing impacts of burns on water quality are being given significant attention.

H. Information Sources

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XVII WISCONSIN

A. Statutes, Regulations, and Programs

The Bureau of Forestry, Department of Natural Resources, has major responsibility for a variety of state programs focused on the forestry activities of private landowners and operators in Wisconsin. Among Bureau administered programs are those involving education, technical assistance, tax incentives, financial incentives, and voluntary guidelines. The only regulatory program administered by the agency involved fire prevention and suppression activities.

The Department of Natural Resources and local zoning authorities (counties) may require permits for constructing, crossing over or through, certain designated streams or waterways.

B. Nonpoint Assessment Report

The State Department of Natural Resources assessed (in 1992) the quality of water occurring in approximately 11,336 of the state's 30,539 river and stream miles. Of the assessed miles, 5.1 percent were found as not supporting designated uses (e.g., domestic water supply, recreation, aquatic life), 11.7 percent were partially supporting designated uses, and 0.9 percent of the rivers and streams were threatened by nonpoint sources of pollutants. Agricultural activities were determined to be impacting 6,088 of the stream and river miles assessed (53.7 percent of total stream and river miles assessed); hydromodification was adversely impacting a significant proportion of the remainder. Road construction and maintenance associated with forestry activities were considered as causing moderate impairment of 19.8 miles of streams and rivers in the state.

C. Nonpoint Management Plan

The Wisconsin nonpoint source pollution abatement program is promulgated in Chapter NR 120 of Wisconsin Statutes (revised 1989). The statute provides for the necessary administrative and financial framework to fully implement the objectives of the program. Emphasis is placed on education and technical assistance administered jointly by the Wisconsin Department of Natural Resources, Department of Agriculture, Trade and Consumer Protection, the University of Wisconsin Extension, the USDA Soil Conservation Service, the USDA Agricultural Stabilization and

Conservation Service, and the USDA Farmers Home Association. In addition to implementing the program via technical assistance, the statute mandates that the Department of Natural Resources develop and administer voluntary best management practices (BMPs) for all major categories of nonpoint source pollutants. In addition to encouraging the application of BMPs statewide, the state's management program also addresses priority nonpoint source problems at the project level. Forestry and silvicultural activities are not explicitly addressed by the state management program.

D. Best Management Practices

Best management practices guiding forestry activities have been developed for use by forest landowners and operators in Wisconsin. The practices are presented as voluntary guidelines to be used on privately owned forestland. The state is in the process of revising the best management practices (available December 1993). Responsibility for doing so rests with four committees (composed of persons representing forest industry, nonindustrial private landowners, state forestry agencies, environmental groups, general public) that are focusing on BMP definition, incentives and financing, education and training, and monitoring and evaluation.

Current best management practice guidelines contain many definitions, among which are the following:

- forest practice -- an activity relating to the growing, harvesting, or processing of forest tree species on forestland, including related management activities conducted for purposes of wildlife, recreation and aesthetics;
- nonpoint sources -- land management activity which contributes to runoff, seepage or percolation which adversely effects or threatens water quality;
- streamside management zone -- an uncut, or partially cut, strip of timber along waterways retained to prevent erosion.

The best management practices are organized around the development of a forest management plan and its subsequent implementation. Examples of practices suggested to be part of a plan's implementation are:

Silvicultural systems: Two basic silvicultural systems, namely even and uneven-aged approaches, are described. Even-aged regeneration methods include: clearcutting, seed-tree, and shelterwood. Uneven-aged systems imply the selection method of harvesting as the appropriate regeneration method. There is a

presentation of circumstances warranting the use of a specific system.

Forest accessways: Road construction should be planned in advance and designed to have a minimal impact on water resources. Stream crossings should be kept to a minimum. Surface disturbance should be kept to a minimum when constructing roads, skid trails, and landings. Roads should be no greater than eight percent in most soil conditions; five percent in erodible soil conditions. Fording of streams should be avoided unless stream beds and banks are sufficiently stable. Revegetation of skid trails, landings, and unused roads is encouraged.

Timber harvesting: Landings should be located so as to minimize impact on natural drainage patterns. After yarding is completed, landing should be seeded where erosion of landing surface may occur. Felling of trees into streams or lakes should be avoided. An uncut, or partially cut, strip of timber should be left along major waterways to prevent erosion and for aesthetic purposes. When skidding, temporary stream crossings (e.g., culverts, logs or portable bridges) should be used and, when operation is complete, promptly removed. Skidding through streamside management zones should be minimized.

Reforestation: There is a general description of major site preparation techniques, including mechanical methods, prescribed burning, and chemical application. The use of such methods should be undertaken with due regard for water quality.

Pest management: A variety of forest management techniques should be undertaken to minimize the effects of insects, diseases, and unwanted vegetation.

Other values: For wildlife purposes, snag and den trees should be retained; depending on the wildlife species, edges should be created (some wildlife species do best in larger stands of the same type); openings in forest should be encouraged (plant to grass and legumes); pile logging slash for use by small mammals; and consider closing logging roads to public in areas with timber wolves and black bear. For recreation and visual purposes, clearcuts should be harmonized with the general forest landscape; buffer strips along roads should be considered as means of reducing the visual impact of harvesting; opportunities to create scenic vistas should be capitalized on; and forest cover in unique areas (rocky bluffs, unusual land forms, water falls) should be retained.

E. Forest Practice or Special Rules

Except for permits required for constructing crossings over certain streams and waterways, Wisconsin does not have comprehensive rules and regulations focused specifically on water

quality impacting forestry practices that might be applied by private landowners or timber harvesters.

F. Compliance and Effectiveness

The Bureau of Forestry has not monitored compliance with forestry best management practices.

G. Information Sources

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