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Rural Issues: Silvicultural Nonpoint Source Pollution

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U.S. DEPARTMENT OF AGRICULTURE'S PERSPECTIVE ON SILVICULTURAL NONPOINT SOURCE WATER QUALITY

J. LAMAR BEASLEY
WARREN C. HARPER
U.S. Forest Service
Washington, D.C.

U.S. Department of Agriculture interest and responsibility for protecting water resources on forested land dates back to 1897, 88 years ago. The U.S. Forest Service has carried out this responsibility by developing management programs for the National Forest System that include managing the water resource through watershed research and by assisting States with watershed management through State and private forestry programs. The National Forest System was created by Congress in 1897 when it withdrew certain lands from the Federal domain. The Department of the Interior, and subsequently the Forest Service under the Department of Agriculture, was charged with managing the National Forests for continuous production of timber and favorable conditions of waterflow.

In addition to enabling legislation that created the National Forest System in 1897, Congress has continued to provide specific direction for managing public forest lands. Even though the Forest Service traditionally managed all resources, its responsibilities were officially broadened in 1960 beyond water and timber to include recreation, range, and fish and wildlife. Specifically, Congress directed that National Forest System lands were to be managed under the concept of multiple use. Forest Service land management planning incorporates the concept of multiple use and recognizes the importance of managing National Forest lands to protect water quality. As a required part of these plans, the Service developed a strategy for evaluating the impact of other management activities on the water resource. In addition, the development of these plans includes extensive review by public interests and consultation and cooperation with State and local authorities. The Congress has directed that the Department promote efforts to prevent or eliminate damage to the environment while allowing use of the natural resources. To accomplish this task, the Department must evaluate environmental impacts prior to beginning programs and activities that might have negative environmental consequences. Following congressional direction for the management of forest lands, the Forest Service clearly established programs to balance resource uses among often competing demands under the concept of multiple use.

In contrast to multiple-use management responsibilities of the Forest Service, the Environmental Protection Agency is responsible for water under the Clean Water Act. While EPA is the implementing agency, the primary responsibility for program development and implementation is delegated to individual States upon request, with EPA retaining responsibility for program approval and oversight. Programs developed by EPA and State agencies can produce conflicting requirements for land management agencies because they are single resource-driven programs requiring that nonpoint sources be controlled to the extent feasible; whereas the statutes under which USDA programs are developed require consideration of competing resource uses. Because Federal agencies are responsible for complying with State and local water quality program requirements, provisions directed only toward water quality protection can create situations that make it difficult for USDA to meet its statutory requirements as Congress mandated. Rather than requiring a balance among resource uses, recent court decisions have narrowly interpreted compliance with this requirement.

The potential conflict between managing a single resource and managing multiple resources becomes apparent when legislative authorities of the Forest Service are considered: the Organic Act requires the Forest Service to maintain a continuous flow of timber in addition to protecting the water resource; the Multiple-Use Sustained-Yield Act requires a balance among resources; and the National Forest Management Act requires managing National For-

ests to meet multiple-use objectives. In contrast, the Clean Water Act addresses only the water resource, providing authority for State and Federal Governments to develop water quality standards and comprehensive programs for water pollution control. Along with other provisions, the Clean Water Act addresses nonpoint sources by establishing a State planning program that requires States to identify nonpoint sources, and establish management strategies to meet State and Federal water quality goals.

The concept of feasibiity as contained in section 208 of the Clean Water Act is an important link between various "multiple-use" Acts and the Clean Water Act. Because it is to society's benefit that forest resources are available for public use, feasibility must be defined to include use of these resources. To prevent potential conflict, Federal agencies must cooperate closely with individual States to ensure program compatibility to the extent "feasible." The Department remains committed to environmental protection through developing programs that efficiently balance resource use and ensure that all forest resources will be available to future generations.

Responsibilities and obligations to protect the water resource on forest lands are specifically identified in the Forest Service Manual. Objectives related to watershed management identified in the manual include: (1) protecting, maintaining, and utilizing soil and water resources on National Forest System lands to provide goods and services in harmony with environmental protection, (2) making National Forest and rangelands fully productive without destroying or degrading soil and water resources or adversely affecting the environment, and (3) cooperating with appropriate Federal, State, city and county agencies responsible for soil, water, and environmental management, to meet national economic, social, and environmental goals.

It is clear from statements of authority as specified in various legislative actions and in the Forest Service Manual that the Forest Service is responsible for managing water resources on lands under its administrative control to provide for a balanced use of all resources.

The Forest Service believes that certain principles must be incorporated into management strategies designed for addressing nonpoint sources:

1. Point and nonpoint sources require differing management strategies and a clear distinction must be made.
2. Natural background levels must be considered.
3. Best management practices (BMP's) as determined by an approved process to identify such practices must be defined and used as the primary management strategy for nonpoint sources.
4. Water quality standards developed for nonpoint sources must not be used as a direct means of control but may be used for evaluating effectiveness of practices.
5. Antidegradation policy for nonpoint sources must be applied on a watershed basis over time, rather than requiring no change for individual points on stream segments.
6. Cumulative effects evaluations must be based on a number of watershed characteristics rather than only on water quality.

It is unfortunate that the distinction between point and nonpoint sources has recently been blurred through incorporation of sources traditionally treated as nonpoint into point source permit programs. This has confused both regulatory agencies and land managers. Because nonpoint sources are dispersed and difficult to quantify, permit programs for them are difficult to design and to enforce. During early development of water quality control programs, emphasis was placed on easily identified point source discharges associated with manufacturing facilities. In the early to mid-1970's, when point sources had been fairly well identified and control strategies developed, initial efforts for controlling nonpoint sources attempted to use methodology developed for point source control. This proved impossible because of the difficulty of identifying nonpoint sources, the difficulty in specifying effluent limitations, and the difficulty in developing and implementing controls. Point source control strategy was designed to establish an effluent discharge compatible with the needs of the receiving water and to require conformance with specified effluent requirements. When applied to nonpoint sources, the point source strategy was found inappropriate primarily because of the lack of knowledge concerning the amount of material introduced as a result of a land management activity. Further, while it is possible to take corrective action, it is not often possible to alter or stop a nonpoint discharge once a land management activity has taken place.

Natural background accounts for a portion of water quality levels observed for any water body and is the second principle which must be observed in program development. Because most water quality constituents potentially affected by forest management occur naturally in the environment, it is important to understand and include a consideration of natural background levels when setting water quality goals and standards. While it may be possible to control natural background levels, primary management concern should be directed toward increases above those levels as a result of land management activities.

Most published material addressing nonpoint source impacts ignores the large component of observed water quality changes of natural rather than human-caused origin. These materials, without adequately accounting for natural background levels, cite nonpoint sources as the primary reason for not meeting goals of the Clean Water Act. Information on natural background is lacking primarily because current technology for estimation and measurement is difficult to apply and is of low accuracy except for highly instrumented, site-specific studies. As a result, accuracy of determination or estimation is low for statewide or nationwide evaluations.

With establishment of preventive practices as the central component of nonpoint source programs, the third principle that must be observed is that an approved process for determining best management practices must be provided as opposed to a sample list of practices. In the Clean Water Act, Congress recognized that nonpoint sources are best controlled through prevention rather than through treatment and controlled release. The Department has recognized for many years that the most practical management strategy for protecting the soil and water resource is one based on defining appropriate practices before conducting an activity. As the BMP concept has been developed and applied by EPA and the States over the years, BMP's have been defined as management practices designed for the protection of water quality that are practical, technically feasible, and mindful of institutional, social, and economic factors. The requirement for development of feasible practices is consistent with the concept of multiple-use in that it does recognize resource use.

For purposes of managing forested lands, the Forest Service Watershed Management Program has been developed based on defining and applying watershed management practices designed to protect the soil and water resource. In implementing this program, the Forest Service recognizes that management practices must be tailored to site-specific conditions because it is not possible to develop a set of watershed management prescriptions appropriate to all situations and all places. Forest Service direction at the national and regional level is designed to define the "process" by which a land manager can arrive at the appropriate practice or set of practices, for a given

project and site. This same direction should be developed by the EPA at the national level and by States at the State level to assist private forest land managers in designing appropriate practices.

The fourth principle recognizes that water quality standards must reflect nonpoint source conditions and must only be used for evaluating effectiveness of BMP's, not as a direct means of control. Existing water quality standards for most States were developed for control of point sources of pollution. By understanding the assimilative capacity of a receiving water, an effluent limitation could be set for point sources and the discharge monitored for compliance. Attempts to apply such a strategy to nonpoint sources, however, were not very successful. Effluent limitations for nonpoint sources are more difficult to define and monitor because of natural background levels and variability. Irrespective of human activity, water quality constituents vary with time, space, and antecedent conditions. The amount of runoff produced often depends more upon climatic events than upon human activity. For these and other reasons, it is not now possible to measure water quality to a level of accuracy and precision sufficient for direct regulatory control of nonpoint sources. The "change" resulting from changes in land use is often less than the natural variability. Because of these difficulties, most specialists and managers agree that attempts to use water quality standards as a direct means of regulatory control will not be successful.

The difficulty in applying water quality standards to nonpoint sources has been acknowledged by EPA. Rather than relying on water quality standards as the sole control mechanism, existing EPA policy states that conformance with approved best management practices constitutes compliance with water quality standards. While definition and implementation of management practices is the appropriate management strategy, properly designed water quality standards can, and should, play a role in defining such practices. Once water quality standards have been refined to address natural background levels and variability, standards can be used to measure the effectiveness of management practices. Such information can then form the basis for adjusting practices where necessary.

The fifth principle recognizes that antidegradation policy must incorporate a consideration of "change" over time and area, rather than requiring no change at all points and at all times. Existing EPA direction provides for control based on conformance with BMP's, but an interpretation of antidegradation based on no change can place a land manager in violation of antidegradation while being in compliance with approved BMP's. EPA water quality standards regulations currently require States to include an antidegradation provision in their water quality programs. EPA antidegradation policy direction results from an interpretation of the goals of the Clean Water Act mandating that water quality be maintained or improved. If water quality is to be maintained or improved, it is certainly a reasonable interpretation that water quality cannot be lowered. While the Department agrees with this interpretation, it does not necessarily follow that water quality can always be maintained at every point, on every stream, all the time. Such a requirement is impossible if any level of management activity or resource use is to be allowed on forest lands. It is important to note that changes in water quality as a result of forest management activity are most often of short duration, low level, minimal impact on beneficial use. While water quality cannot be maintained at all points at all times, it is important for water quality to remain constant or improved over both time and space. This concept allows for minor short-term water quality impacts from resource use, while maintaining water quality for an entire watershed over the long-run.

Finally, the sixth principle recognizes that evaluation of cumulative effects must consider characteristics other than water quality constituents. Concern for identifying and managing cumulative impacts has recently been raised by regulatory agencies, Congress and the courts. Cumulative impact is an extremely complex issue and one that the Department recognizes a responsibility for resolving. Unfortunately, while nonpoint strategy needs to address cumulative effects, the current state of technology again makes it difficult.

Addressing nonpoint sources on a watershed basis, in fact, necessitates a consideration of cumulative effects. Most watersheds involve a large land base, many landowners, and many types of land management activities. As a result an assessment of cumulative effect must address both method of operation and scheduling of where and when a given operation occurs. Unfortunately, scheduling involves specifying how landowners can use their lands. Both Congress and individual States have been reluctant to issue land control legislation, particularly in rural environments. To determine scheduling for various land uses, or for individual activities, regulatory agencies have attempted to estimate pollution loads for each activity or group of activities. Unfortunately, the concept of loading is difficult to apply because technology does not exist that will provide sufficiently accurate and precise estimates to establish defensible restrictions.

The Department has been working toward resolving the difficulties of addressing cumulative impacts as related to forested lands, and believes the technology currently under development by the Forest Service holds some promise. The concept being explored is management strategy based upon evaluation of watershed condition. Having been talked about for many years, the concept is not necessarily new, although it is believed that the current interpretation is somewhat new and offers a solution for addressing degradation and cumulative impacts. The concept as now envisioned by the Forest Service provides for an evaluation of watersheds based on soil and hydrologic conditions. The principal idea is that watershed "health" must remain constant through time, and appropriate adjustments made periodically when this is not the case. Properly developed, watershed condition can provide information on actual water quality impact and related beneficial uses, and may reduce the extremely costly requirement of water quality monitoring. While water quality monitoring will be an important part of watershed condition evaluation, the complex task of water quality sampling can be reduced through evaluation of other factors such as erosion, channel stability, and channel condition. The end result will be directed toward environmental protection that allows resource use while protecting water quality and related beneficial uses.

The Department of Agriculture believes that control of nonpoint sources of pollution is important to the Nation. Further, the Department believes that it is possible to reach the goals of the Clean Water Act while providing for conservation and use of the renewable resources available from forested lands. In reaching these objectives, it will be necessary to consider the following 10 points in developing a rational approach to nonpoint source pollution control:

1. Changes in water quality result from *both* natural events and land management activities; these sources must be separated so that efforts can be concentrated on situations created by human activity.

2. Sources from human activity can be effectively controlled, while controlling natural sources may not be economically feasible nor even desirable.

3. Nonpoint sources must be appropriately addressed through prevention rather than through treatment of water

and controlled release; compliance with approved BMP's satisfies compliance with water quality standards.

4. Best management practices must be based on the concept of prevention, site-specific conditions, and feasibility, and on a "process" for determining practices rather than requiring selection from a "list."

5. Nonpoint water quality standards must include a consideration of natural background and natural variability over space and time.

6. Standards should not be used as a direct means of regulatory control but should be used for evaluation of the effectiveness of recommended or required practices.

7. Antidegradation policy should include a time and area component, recognizing some change in the short-term, no change in the long-term, and a "watershed" basis.

8. Water quality programs and management strategies must consider beneficial uses when defining water quality standards and antidegradation policy.

9. Evaluation of cumulative effect should be based on watershed condition rather than only on water quality constituents.

10. To provide for use and conservation of all forest resources, water quality must include "feasibility."

While managing nonpoint sources is an extremely complex challenge, we believe that issues can be effectively and efficiently resolved, provided the concerns outlined are considered, and that management strategies are developed that effectively incorporate these concerns.

IMPLEMENTING THE PUBLIC/PRIVATE NONPOINT SOURCE MANAGEMENT PARTNERSHIP: A STATE FORESTRY PERSPECTIVE

ROGER L. DAVIS
ROBERT L. MILLER
Forestry Division
Oklahoma State Department of Agriculture
Oklahoma City, Oklahoma

ABSTRACT

State forestry agencies currently recognize two principal areas of concern in nonpoint source water quality management: to work with the private sector to get the management job done in the face of poor economic conditions, and to establish a more effective framework in law and policy for doing so. The new national nonpoint source policy promises to be an important advancement toward these ends, particularly because of its support for a cooperative public/private partnership approach. Opportunities exist for improvements where economic factors are not primarily limiting, particularly in public sector actions. As first priority, the public sector should put its house in order by applying the public/private partnership provisions of the new national nonpoint source policy. Action needs include clear signals, recognition of pertinent technical and social considerations in assessments and performance evaluations, insuring local private sector participation in program development, and recognition of the necessity for developing local management program infrastructure and managerial resources.

INTRODUCTION

The new national nonpoint source policy (U.S. Environ. Prot. Agency, 1984) offers important opportunities for advancement in nonpoint source management. From the forestry viewpoint, particularly good features of the new policy are its commitment to a public/private partnership approach, and its provisions for recognizing relevant social and technical considerations and suiting programs to local situations.

This development, along with general management capabilities and experience gained through the 208 Program, and improvements in forestry nonpoint source management (as noted elsewhere in this proceedings by Ice and by Bethea) provides a solid foundation. Forestry in general has implementation tasks yet to do. However, in the face of a problematic economic outlook, critical economic limitations make it imperative to maximize the effectiveness of nonpoint source management programs.

Serious shortcomings in current assessment and implementation approaches limit program effectiveness. These limitations stem in substantial degree from a combination of persistent, simplistic concepts and analyses and the current dominance of judicial and other rulemaking processes that operate on management issues from the top (Miller, 1985). Public program shortcomings and complex and locally variable technical and social factors are often ignored. As a consequence, there are tendencies to underestimate progress, to superficially analyze reasons for limited performance by parts of the private sector, to be pessimistic about achieving satisfactory nonpoint source management, and to overemphasize regulatory approaches.

Given these considerations, we suggest the need for a timely introspection by those of us who are involved in the public sector. An attempt at such introspection on specific limitations in assessments and other evaluations of implementation program alternatives follows.

IS THE PUBLIC-SECTOR HOUSE IN ORDER?

National Assessments

The 1984 report to Congress by EPA on nonpoint source pollution describes nonpoint source pollution as a major national problem (U.S. Environ. Prot. Agency, 1984). It concludes that forestry generates major localized problems, and causes some problems in most States. As noted in the panel discussion on status of nonpoint runoff programs in this conference, a national nonpoint source update is presently being conducted by the Association of State and Interstate Water Pollution Control Administrators, under contract from EPA.

From the forestry standpoint, the current assessment update procedure contains a serious shortcoming in that no appropriate classification exists for many situations where new access road construction temporarily increases sediment movement. This problem exists because the criteria for the protection of water quality and designated beneficial uses fail to recognize particular production characteristics, including the necessity for forest road development and the associated unavoidable sedimentation, the periodicity and related aspects of other forestry operations, and forestry–streamflow interactions. Because of these considerations, water quality standards, antidegradation policy, and assessments should be applied in an appropriate management unit, production cycle framework, that is, in terms of the time and space considerations as provided in the new national policy. The initial evaluation report on our program in Oklahoma discussed these considerations (Miller et al. 1980), as did Harper (1985) and Beasley (this volume).

The current assessment necessarily depends heavily on judgments because we lack data on water quality and effects of pollutants on designated beneficial uses for many waterbodies. In the case of sediment-related pollution, nonpoint source assessments are particularly limited because of the universal inability to separate the three sources of sediment, that is, natural background, lag deposits in channels that have resulted from past practices, and contributions from current land management practices.

Because of these limitations, judgments can err substantially. To the degree that identified problems result from lag deposits from past practices, the current assessments will overestimate problems caused by current management practices. Bias may also enter because of a perception that the assessment results may be used to allocate public funds.

The following actions would improve objectivity and accuracy in future assessments: (1) direct participation of

State forestry and other land management agencies in State assessments; (2) additional guidelines for the exercise of judgment on waterbodies where there are no data (for example, specifying the conditions for acceptable extrapolation); (3) separate classification of waterbodies on which the assessment is based entirely on judgment, or extrapolation of data from elsewhere; (4) identification of waterbodies that are affected by sediment lag deposits from past practices; (5) required appraisals of accuracy and descriptions of the degree to which the assessments in each classification are based on actual data; and (6) recognition of the time and space aspects noted previously.

Other Evaluations

Recent broad evaluations have tended to overgeneralize from the basis of quite limited research and past conservation programs. Such analyses (for example, Braden and Uchtmann, 1985; Harrington et al. 1985) fail to adequately consider the effects of uncertain signals and, in some instances, plain bad examples in government programs, as well as the necessity to develop local water quality management infrastructure and suit programs to local conditions. As a consequence, perceptions and conclusions about historical private sector conservation practice performance may be in error.

Readily evident examples of lack of performance by government are: (1) projected goals and time frames that are divorced from reality, (2) the politicizing of subsidy programs and consequent general failure to require cross-compliance with conservation practices, and (3) the inconsistencies of programs through time. A specific management example, frequent and obvious in many States, is an apparent lack of concern by government units about controlling erosion on public roads (the authors specifically exclude National Forest roads from this criticism). Such failures send a confused signal to producers about the seriousness of soil erosion and water pollution, and the depth of government commitments.

In generalized examinations of economic and other social considerations, analysts tend to accept the assumptions that most nonpoint source management practices are uneconomic for landowners, that factors other than the purely economic are not significant to landowner decisions, and that regulatory measures are therefore necessary. Four examples are articles by economists in the January, 1985, issue of the Journal of Soil and Water Conservation (Braden and Uchtmann; Harrington et al.; Libby; Epp and Shortie). Yet, the same issue of the Journal reported on a survey in 17 States in which the majority of the farmers contacted in each State favored mandatory cross-compliance between conservation practices and price supports (Soil Conserv. Soc. Am., 1985). Other examples of extra-economic interest of landowners and willingness to cooperate in nonpoint source programs are the Ontario program as reported by Puddister (1985), the willingness of landowners to accept package (cross-compliance) programs in Wisconsin (Konrad et al. 1985), and landowner participation in Maryland, reported by Magette et al. (1985). Another example is the recent policy statement by the Farm Bureau in favor of prohibiting price supports for production on highly erodible soils (Farm Bureau, 1985).

In our experience in Oklahoma with a wide range of ownership conditions, we have found the most critical problems in water quality management implementation lie in awareness, understanding of good practices, and control of properties and operations, rather than in rejection on economic grounds. Other examples of private concern in forestry are the environmental achievement award programs of the American Paper Institute and National Forest Products Association (1985), and as reported in this volume by Dr. George Ice.

Another common assumption is that, simply because practices can be enforced, a regulatory approach will necessarily be more successful. However, to succeed in terms of maximizing net social benefits in the long term, which should be the basic goal of any resource management program (and which is implied in the new national nonpoint source policy), one finds that such an assumption is not always valid when relevant considerations are carefully examined. For example, as previously noted (Okla. State Dep. Agric. 1984):

> A regulatory approach, *if it is adequately funded,* would have the advantages of an acceleration of some practice implementations. It would have relative simplicity and ease, from the enforcement agency standpoint, of enforcing a set of highly standardized practices, and evaluation of progress in terms of numbers of inspections, permits issued, etc. However, as examined in considerable detail by Miller et al. (1980), a regulatory program has inherent shortcomings. . . . Among these limitations are the large investments in enforcement which could otherwise be made available for use against management obstacles, and inherent tendencies to overlook important system interactions and trade-off relationships and to standardize excessively.

Evaluations of programs and progress also often fail to recognize the necessity for establishing effective local leadership, organization, management support, and other infrastructure. While the initial 208 program had some serious faults, when viewed in the long term it resulted in a fundamentally important advancement in across-the-board nonpoint source management capability. Rittal pointed this out in a Journal of Soil and Water Conservation panel discussion (Soil Conserv. Soc. Am. 1985a). The Congressional staff member on the panel said that Congress does not and will not recognize such developments as relevant to evaluating progress. Nevertheless, it is our view that developing local management infrastructure is a fundamental part of nonpoint source management that must be recognized in *any* evaluation.

In summary, evaluations of nonpoint source management program alternatives and performance have often failed to adequately consider public sector shortcomings and local development actions that are essential to effective implementation. These essentials are outlined in the following section.

ESSENTIALS FOR EFFECTIVE IMPLEMENTATION

Program needs and approaches should be established first at local levels, because technical and social factors that affect management vary locally, the necessary infrastructure must be designed for local conditions, and producer participation and capabilities must be developed on a local basis.

Identification and Analysis of Local Influences on Management

Implementation program development should begin with recognition and analysis of technical and social factors and interactions that affect management, such as in our initial program analysis (Miller et al. 1980), in our forestry nonpoint source management strategy (Okla. State Dep. Agric. 1984) and in the final report on a pilot 208 program task in implementation and evaluations (Okla. State Dep. Agric. 1983). This will form the basis for designing appropriate management support and other infrastructure for developing managerial potentials, for prescribing sound

ownership-specific management practices, and for evaluating program effectiveness and regulatory vs. nonregulatory choices.

Influences and interactions vary locally, according to economic, institutional and other social conditions, as well as technical aspects. Examples include the differences between industrial and small, private, nonindustrial forest ownerships in management objectives, production characteristics, and economic and other limitations. If management obstacles related to such conditions are disregarded in a regulatory approach, socially undesirable side effects may occur, as Libby (1985) pointed out: "Across-the-board regulations inevitably hurt some people more than others. It could be that the human impacts and cost of any program to ease the social burden could be greater than the cost of soil erosion on those farms."

Also, as noted in our forestry nonpoint source strategy (Okla. State Dep. Agric. 1984), with respect to regulatory programs:

> Trade-off relationships with other social benefits and system interactions that affect net benefits tend to be ignored, or viewed as somehow not relevant to water quality management decisions. As a consequence, practice prescriptions tend to be standardized and applied without regard to . . . the need to design alternatives to suit differences in social factors at the local site. . . . Resulting inequities are likely to be frequent. Furthermore, because of the dependence on enforcement, there is less incentive for addressing ownership-specific conditions of an institutional, managerial, financial or other social nature that limit practice acceptability and may cause adverse side-effects on other social benefits. Specific and important instances of such conditions in Oklahoma are the widespread free public use of nonindustrial private forest tracts, and limited control, higher costs and relatively high risk for absentee landowners in this situation.

The new national nonpoint source policy recognizes the need to evaluate program outcomes in terms of net social benefits. Any adverse social effects of a program alternative are relevant to the net benefits equation.

Broad surveys can provide data on practice needs. However, additional information on technical and social factors and interactions that affect management performance should be developed on a pilot watershed basis. Efforts concentrated on selected high priority watersheds will serve as pilot programs to identify management problems and to design and test management approaches and infrastructure, as well as to accelerate accomplishments in specific waterbodies.

Development of Management Program Infrastructure and Managerial Resources

In this paper the term *infrastructure* as applied to local management implementation refers to these necessary supports: (1) technical expertise; (2) public agency and private leadership; (3) educational resources (personnel, materials, sites); (4) management support (technical assistance; protection from fire, theft, and other loss; private management services); and (5) cooperative organization.

Where it is lacking, the development of State agency technical expertise must have priority. It is prerequisite to satisfactory progress in other infrastructure development. This requires substantial elements of time in training and experience development. Making equitable and effective ownership-specific management practice prescriptions, through consideration of social as well as technical aspects, demands experienced, professional judgment.

Lack of expertise can result in regulatory actions of an undesirable nature. For example, Popovich et al. (1984) described cases where problems are created by differences between counties in required practices, prohibition of sound forestry practices, and adverse tax base reclassifications. In studying one of these instances, Goodfellow and Lea (1985) concluded that foresters must become better informed to fill a vacuum in expertise that exists in many local situations.

Youell (1984) pointed out unsatisfactory implementation conditions that occur in the absence of adequate professional input:

> Why is there so much controversy in forestry circles about the proliferation of regulations? Basically because the regulations vary from town to town in their provisions, soundness, administration, and degree of enforcement. Many are conflicting. Some are written without professional forestry input, and as a result contain restrictions which are often impractical and difficult for foresters and loggers to follow. Some may be illegal, and all are costly in terms of time and money. As one logger put it, "You have to have a lawyer in your back pocket" to keep track of them all.

The infrastructure supports outlined are necessary for developing the potentials in managerial resources as advocated by the new national nonpoint source policy. Particular needs lie in developing the managerial potentials associated with the large number of small, nonindustrial forest ownerships. These include loggers, timber buyers, consultants, and other managers, as well as landowners. In the advocated partnership approach, producers must participate in local program development. This participation along with positive approaches in cooperative extension should help develop local leadership, favorable agency–producer relationships, and high *maturity levels* (in situation leadership terms, the latter condition cannot exist with coercion (Hersey et al. 1979)).

Good examples of these implementation essentials are programs in Wisconsin (Sorenson, 1985), Maryland (Magette et al. 1985), and Ontario (Puddister, 1985). Our experience in Oklahoma also serves as an example.

The Oklahoma Experience

In Oklahoma, industry, State government, and interest groups became intensively involved early in controversy about regeneration clearcutting and regulatory proposals. That involvement, along with foresight by our Department, led to a State forestry code assignment of primary responsibility on forest environmental concerns to our Division. This mandate was basic to developing our full participation in the State's water quality management program, including 208 program funding and planning, assessments, and inputs into water quality standards revisions, and to integrating water quality management into the State's forestry program.

Our program began with monitoring of water quality and practices in late 1976. We prepared an initial program analysis and have continued with water quality monitoring and hydrological studies, development of educational and technical assistance programs, and a pilot implementation project (Okla. State Dep. Agric. 1984; Miller, 1984). Cooperative activities with Oklahoma State University, Oklahoma Conservation Commission and other State agencies, USDA Forest Service and Agricultural Research Service, and the forest industry have advanced the program. Present efforts concentrate on evaluating road practices and trends in sedimentation resulting from roads, and on further developments in technical assistance and education. Important elements include use of data on ownership identity recently developed by the Oklahoma State University Extension Service, development of demonstration sites, a followup phase of our initial pilot implementation project, and the additional development of low-cost but effective road practices.

Our experience indicates that the forestry agency must be authorized to act as the primary forestry nonpoint source management agency if water quality management is to be integrated into forestry. It is prerequisite to forestry's appropriate participation in State program planning and development, development of needed cooperative activities, and development of technical capabilities and other infrastructure necessary for the analytical and managerial development tasks as outlined. This experience also points to a systematic agency assessment and program analysis as a key initial element, that is, an *agency strategy*, as recommended by the new national policy.

Finally, our experience supports the need for an analytical approach to questions of enforcement. Through our initial program analysis and subsequent experience we have found important needs and ample opportunities for further development of infrastructure, local leadership and management capabilities, and basic awareness and know-how about protecting water quality and beneficial uses. Development of these opportunities is in any case essential to long-term implementation success. Such development is surely prerequisite to establishing any need for coercive action.

SUMMARY

State forestry agencies currently recognize two principal areas of concern in nonpoint source water quality management: to work with the private sector to get the management job done in the face of poor economic conditions, and to establish a more effective framework in law and policy for doing so. The new national nonpoint source policy promises to be an important advancement toward these ends, particularly because of its support for a cooperative public/private partnership approach. In view of the problematic economic outlook, it is critical that public programs become more effective.

Water quality assessments, implementation programs and program evaluations can be improved by more careful recognition and analysis of important technical and social considerations. Shortcomings in this regard in assessments and evaluations have resulted in problem overestimates and in unwarranted pessimism about program success. In implementation program development, such recognition and analysis of local factors and interactions will lead to the appropriate design of management support and other infrastructure that are necessary for successful implementation and for the development of managerial potentials as advocated by the new national nonpoint source policy.

Other essentials for program success are participation by producers in local program development, and adequate authority for the state forestry agency to act as the primary nonpoint source management agency. The latter is necessary for integrating water quality objectives into state forestry programs and for developing infrastructure and managerial potentials. The Oklahoma experience demonstrates ample opportunity for such development. It is surely prerequisite to establishing any need for coercive action.

The public/private partnership provision of the new national policy should be incorporated into Federal and State programs by two general actions: (1) putting the public sector house in order, and (2) full commitment to essential management development actions. The first is surely top priority. It calls for clear and consistent signals, more objective and accurate assessments that recognize pertinent technical and social considerations, better performance in public programs and practices, and less reliance on threats and bad-mouthing. Regarding the latter—given the facts of past programs and the current economic hardship for which no relief appears in sight—to shake the stick at the small private producer (e.g., Cook (1985), and Tripp (this vol.)) is tantamount to cracking the whip at a hobbled and one-eyed horse, already suspicious and balky from past blind-sidings.

In summary, to implement a true partnership means to replace poor signals, shifting support, bad examples, and threats by cooperative extension, with well-designed management support and other infrastructure, and direct private producer participation in program planning and development.

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THE FOREST INDUSTRY'S PERSPECTIVE OF 208

DALE J. McGREER
Potlatch Corporation
Lewiston, Idaho

FOREST INDUSTRY INVOLVEMENT WITH 208 PROGRAMS

The forest industry was involved with shaping State silvicultural nonpoint source control programs even prior to passage of section 208. Early State agency silvicultural controls helped shape the central concept of 208 policy: prevention of unacceptable impacts to water and beneficial uses by controlling problems at their source. These management practices evolved into the best management practice (BMP) concept. The U.S. Environmental Protection Agency defines BMP's as ". . practices . . . that [are] determined to be . . . the most effective, practicable (including technological, economic, and institutional considerations) means of preventing or reducing the amount of pollution generated by nonpoint sources to a level compatible with water quality goals" (40 CFR S131.2(g) 1976).

Nationally, the American Paper Institute and National Forest Products Association have maintained an active 208 committee since 1975. I have chaired the committee this year. We have worked closely with EPA and other Federal agencies as they have developed 208 policy. Similar efforts of the forest industry continue locally with the States.

The 208 program has matured, and we support it here today, just as we have before Congress through the years. 208 supports our goal of keeping forested watersheds productive for both timber and water. We are committed to the concept that management of both resources is fully compatible.

THE ESSENTIAL ELEMENTS OF SECTION 208 PROGRAMS

Section 208 of the Act, subsequent EPA rules, policies and guidelines, interactions with other sections of the Act, and State actions have resulted in well-crafted, practical programs for controlling silvicultural nonpoint sources. Experience now demonstrates the essential elements of 208 that have allowed it to work so well.

First, with EPA oversight, program development and implementation is the States' responsibility. State control is essential because of the tremendous variability of our lands, waters, and their uses. This in turn determines the types of potential silvicultural nonpoint source problems and control strategies. EPA provides the States with the necessary flexibility to design and implement programs and control strategies. In addition to variability of forest ecosystems, this policy recognizes social factors such as State institutional capabilities and forest ownership patterns.

As an example of regional variation, over 70 percent of all forest lands are held by small woodlot owners in some southern States. Topography and stream gradients tend to be gentle, yet erosion can be significant in some circumstances. In these States, nonregulatory programs focusing on education and cooperation have proven most successful. In contrast, the far-western States have many major private landowners, steep slopes, and streams highly valuable and sensitive for coldwater fisheries. These States have opted for forest practices acts with mandatory rules and regulations, in addition to educational and cooperative programs. Both approaches meet regional needs and have worked well.

A third essential element of 208 is development and implementation of the programs by local personnel experienced with silviculture, soils, and water.

THE EXTENT AND NATURE OF SILVICULTURAL NONPOINT SOURCES: THE REAL PROBLEMS

Five years ago at a similar conference panel discussion, our panel moderator, Fred Haeussler, said, "The 208 program's approach to silviculture has been hampered by a lack of high quality cause–effect data to quantify the water quality related impacts of silvicultural activities." The statement remains true today, yet we certainly have compiled some solid knowledge in these last 5 years, and we have applied it.

The 208 process itself has contributed to our knowledge. State evaluations of road construction and logging reveal that concerns such as streamside management, stream debris, shade and water temperature, chemical applications, and other potential problems are well controlled through application of BMP's. These surveys have also found that our primary problem—sediment—is sometimes difficult to manage. Here the carefully conceived and worded concept of BMP's becomes crucial. Again EPA's definition includes such language as "economically practicable," and "amount of pollution compatible with water quality goals." It is not always possible to prevent some sediment from reaching streams. The BMP concept allows this necessary balancing of resource uses and values to society.

Just how serious is silvicultural sediment? EPA estimates that less than 4 percent of the total man-caused sediment reaching the Nation's waters is caused by silviculture—silviculture practiced in forests covering roughly one-third of this Nation. The problem is that silvicultural sediment can be concentrated in space and time.

The Salmon River in Idaho provides an interesting example of abusive practices resulting in damage to water and fish, followed by control and responsible management. Incredibly, roads occupied 25 percent of the total ground area of highly erodible land in areas of the Middle Fork of the Salmon River watershed. Landslides streaked the mountainsides. People still use the Salmon as an example of how terrible silviculture is, but those activities in the Salmon ended over 25 years ago. This sad experience alerted the public, and may have contributed to developing 208 and Idaho's Forest Practices Act. Today it is inconceivable that similar practices could be applied. Tremendous progress has been made in responsibly managing similar lands.

It is interesting to examine rates of erosion from silviculture. National forests in Idaho commonly limit total increase in erosion during the first few years following road construction and logging to 200 percent of natural: about 50 tons/mile^2 compared to 25 tons/mile^2 natural rate on highly erodible granitics. In comparison, annual erosion averages about 16,000 tons/mile^2 from wheatlands located with 100 miles of these same forests. Over a period

of 50 years, it is reasonable to estimate that about 500 times as much erosion will occur from an acre of wheatland as from managed forest land, including its roads.

So why is silviculture a concern? It is because of the high quality water, fisheries, and recreational value of our mountain streams. Riparian habitat must be managed carefully, and sedimentation of valuable fisheries' rearing and spawning areas must be controlled.

MAKING 208 WORK BETTER

Foresters generally know what the potential silvicultural nonpoint sources are, and where and how to control them. However, we do need better data on the cause–effect relationship of sediment to fisheries. (Here I would caution that while sediment indisputably affects fish, current relationships purporting cause and effect between erosion and decline in fisheries' productivity are based on a near absence of in-stream data and verification.) While we need better data, even this may be fine tuning.

As an example, Idaho just completed a study of whether its 208 BMP's for silviculture adequately protect water quality and its beneficial uses. A team of eight, made up of State agency and conservation group representatives and myself as a representative of private landowners, inspected 25 logging jobs. We concluded that with currently proposed changes to a few rules Idaho's Forest Practices rules constitute BMP's as defined in the Clean Water Act and that if enforced would protect beneficial uses in most circumstances. The task force did find administration of the rules to be inadequate. This points out the greatest need we have within silvicultural nonpoint source programs—we need to apply our existing knowledge. The small landowner needs the most assistance. For the entire State of Idaho, we have had no more than five and as few as one man available for assistance with and enforcement of the Forest Practices rules. Funds are very limited. The point is, the technology is known, but the States and landowners need some assistance implementing it.

One other element germane to 208 needs to be discussed and better understood. If we are to maintain good water quality, we must understand the relationship between its beneficial uses; the ways to prevent its degradation, and the BMP's—all within the context of the Clean Water Act.

CONTROLLING NONPOINT SOURCE POLLUTION FROM SILVICULTURAL OPERATIONS: WHAT WE KNOW AND DON'T KNOW

GEORGE W. BROWN
Forest Engineering Department
Oregon State University
Portland, Oregon

For the past 50 years, researchers have attempted to define the impact of silvicultural operations on nonpoint source pollution in streams that drain forested catchments. Much information and practical experience exist that will help managers of forest land minimize nonpoint source pollution. In 1972, Oregon implemented the Nation's first forest practices act to provide a legal basis for nonpoint source pollution control. Other States quickly followed suit. Research, practical field experience, and legal precedent provide a strong base from which nonpoint source pollution can be controlled. As with most problems as complex as nonpoint source pollution on forest lands, a great deal remains to be learned.

NPS POLLUTION ISSUES ON FOREST LANDS

Today's nonpoint source pollution issues on forest lands are both scientific and legalistic. The scientific issues focus on describing and understanding changes in water quality caused by silvicultural operations such as harvesting timber, constructing forest roads, and using silvicultural chemicals such as pesticides or fertilizer. The nonscientific issues focus on using information about changes in water quality to predict impacts on aquatic resources or human health.

Research has demonstrated that silvicultural operations can temporarily change several water quality characteristics in streams draining forest land. Sediment concentrations can increase if erosion accelerates. Temperature of streams can increase if overstory riparian shade is removed. Accumulations of slash in a stream can deplete its dissolved oxygen. Organic and inorganic chemical concentrations can increase because of harvesting or application of pesticides and fertilizers. Today's most pressing scientific issue is how to predict these changes and their duration in water quality and how to affect the outcome by altering management practices.

Today's most important legal issues are imbedded in the prediction problem. Courts have required managers to predict the impact of their silvicultural operations in space and time. It is no longer sufficient to predict the impact of an operation where it occurs. Managers must also predict how a change produced by their operation will interact with changes produced by other activities within a basin (cumulative effects) and the impact of extreme events (worst case analyses).

Given these demands to predict and control nonpoint source pollution from silviculture, what do we know and what do we need to know before we can adequately respond?

RELATIVE MAGNITUDE OF NONPOINT SOURCE POLLUTION FROM SILVICULTURE

An important starting point is to recognize the nature and magnitude of the nonpoint source pollution problem in forest streams. The hydrologic nature of these streams adds an extra dimension of complexity to the nonpoint source pollution problems in silviculture. Except for pesticides, all of the water quality changes mentioned are changes in natural or background values in small streams, such as sediment concentration or temperature. This means that separating natural from man-caused levels can be difficult. The changes produced are usually short lived. Sediment concentrations, for example, usually increase during storms but quickly return to very low levels even on watersheds that are clearcut and burned. Further, the background values may be highly variable. Even on undisturbed watersheds, sediment values may vary 100-fold at any given discharge level. This means that changes are often compressed in time and difficult to detect unless greatly different from background values.

On a national level, the magnitude of erosion from silviculture is far less than from agricultural sources. Estimates vary, but erosion rates from silviculture are usually believed to be 10 to 100 times less than from cropland.

Likewise, the application of chemicals on forest land has been much less than on agricultural land, even before herbicides were banned on Federal forests. In 1977, American farmers applied 180,000 tonnes (400 million pounds) of herbicides and 76,500 tonnes (170 million pounds) of insecticides to crops. Nationally, less than 810,000 ha (2 million acres) of forest land received chemical treatment that year. The Forest Service, our Nation's largest forest owner, applied only 180 tonnes (0.4 million pounds) of herbicide and 68 tonnes (0.15 million pounds) of insecticide in 1976.

Locally, impacts of harvesting or road construction on water quality can be quite high if proper practices are not used. A landslide in a small headwaters stream, for example, can scour a channel or damage property a short distance downstream even though water quality several miles downstream may not be adversely affected.

Regardless of the local nature of most silvicultural impacts on nonpoint source pollution, public perceptions of such changes far outweigh their local impact. Recent court challenges to applications of herbicides and harvest of timber in landslide-prone terrain have had national repercussions for management of forest land.

WHAT DO WE KNOW?

With this general background about the nature of nonpoint source pollution in forest streams and some understanding about the relative magnitude of these problems, what do we know about controlling these problems? In general, we have a good understanding of the factors that cause changes in the temperature, dissolved oxygen, and chemical composition of forest streams. We also understand how to control these changes.

Several States have implemented forest practice regulations to require the use of best management practices. In general, these regulations have markedly improved water quality and management of streamside zones. Localized problems have and will continue to occur, but such regulations and their enforcement by State inspectors have forced operators to focus on ways to minimize impacts on soil and water resources.

This leads us directly to another fundamental principle that we know. Regardless of the rules and the quality of inspection, much of the success or failure of a program to control nonpoint source pollution from silviculture rests with the operator and the care with which he performs the job. Clear specification of objectives, woodsworker training, and close supervision are essential components of any nonpoint source pollution control program. Long before Oregon's Forest Practices Act became law, loggers were harvesting timber from several municipal watersheds around the State without degrading domestic water quality. Here, water quality was clearly a primary objective, and close cooperation between loggers and city water departments provided good examples of what could be done.

WHAT DO WE NEED TO KNOW?

Erosion and the sedimentation it produces are still the most important sources of pollution in forest streams. We still lack the knowledge to adequately predict erosion in steep terrain, especially from landslides, and how harvesting and road construction practices influence erosion rates. Several predictive models have been developed, but most are based on limited data and have not been adequately verified. Further, once eroded soil reaches a stream, we are unable to accurately route it downstream. Mandates from courts to predict cumulative effects are doomed to fail unless sediment transport is better understood.

We also lack a clear understanding of how sublethal changes in water quality affect fish and their habitat. Often lethal and optimal levels can be identified, but not the relationship at points between. Further, the short duration of most water quality changes in forest streams and the high natural variability described earlier, coupled with the natural resilience of aquatic organisms, add to the complexity of assessing impact or attributing it to silvicultural operations at all but the highest levels of nonpoint source pollution. The long-term impacts from most silvicultural activities are not well documented. Nearly all research has concentrated on immediate or short-term impacts. We need more knowledge on the resilience of aquatic ecosystems and the rates of recovery following silvicultural treatments.

The solution to our nonpoint source pollution problems from silviculture lies in good, objective research designed to clearly identify both the relationship between silviculture and water quality changes and between water quality changes and the benefits derived from our water resources. This means honest assessment of the resilience of our aquatic ecosystems to withstand change at less than lethal levels. Ultimately, we need to know how to place changes in water quality and their impact on use of water into a managerial framework. We need to know how to balance alternative uses and impacts so that decisionmakers can optimize the use of all resources in our forested catchments and not just a few.

Once this is accomplished, we need better systems for transferring this technology from researchers and planners to those charged with carrying out silvicultural operations on the ground, including the woodsworkers. If we can accomplish these tasks, there is no reason why silvicultural operations and acceptable water quality cannot be compatible.