12 Ensuring the Application of Sound Forest Practices on Private Forests: Challenges Facing the Design and Implementation of State Compliance Monitoring Programmes

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Introduction

States have invested significantly in the development of programmes that encourage more widespread application of preferred forest management practices. Many such practices have as a primary focus the nation's non-industrial private forests, comprising 353 million acres owned by more than 9 million landowners (National Research Council, 1998). These practices are often identified as best management practices (BMPs), acceptable management practices, forest practice guidelines or forest practice rules. Developed primarily since the mid-1970s and designed for voluntary or mandatory use primarily by private landowners and timber harvesters, 47 states in 1996 reported having a programme that advances the application of best management practices (National Association of State Foresters, 1996). These programmes were often a response to federal laws (for example, Clean Water Act of 1987, Coastal Zone Management Act Amendments of 1990) which required the development of state plans to control non-point source water pollution and which encouraged proactive approaches to plan implementation.

As state best management practices programmes (both voluntary and regulatory in nature) were developed, attention focused on designing and implementing programmes to evaluate the use of these preferred practices. Developing such programmes requires attention to several key issues (MFRC, 1997). Examples include determining:

- What goals and objectives should guide the programme (e.g. providing information needed to revise and clarify the recommended forest practices or designing programmes needed to deliver information and education on the practices to landowners and timber harvesters)?
- What types and level of information are expected to be generated from the programme (e.g. compliance rate by ownership, geographical region, site characteristics, type of management activity, source of information about the practices)?
- What forest sites should be examined (e.g. all harvested sites or a sample of sites, sites meeting certain criteria such as greater than a certain size, near water or having erodible soils)?
- How should harvest sites actually be selected (e.g. from notifications of intent to harvest, random selection of sites across a landscape, or voluntary reporting of sites by landowners, timber harvesters or others)?

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- When can private property be accessed (e.g. only after landowner permission, establish incentives for granting access, access without permission)?
- Who should actually visit and record conditions at the site (e.g. single professional resource manager, team of resource professionals from various disciplines, independent contractors, or teams of professionals and lay persons)?
- When should forest sites be examined (e.g. immediately after completion of the forest management activity, at a specified time following completion of the forest management activity)?
- How should the forest site be evaluated (e.g. pass/fail, evaluation of individual practices)?

National Review of State Compliance Monitoring Programmes

In 1997, we initiated a national review of state BMP monitoring programmes. Our interest was in assessing why states initiate these programmes, how they structure and administer them (e.g. who is responsible, what is being monitored, how monitoring is carried out and its cost), what use is made of the gathered information, what issues challenge programme development and implementation, and what experiences might states share with others contemplating the design of new or revision of existing monitoring programmes. All 50 states responded to a written questionnaire which formed the basis for our assessment.

Forest practice monitoring can take many forms and serve many purposes. Our focus was on compliance monitoring, namely the systematic gathering of information to determine whether forest practice guidelines or rules are actually being applied by landowners and timber harvesters. Compliance monitoring addresses questions such as: are reforestation levels being accomplished; is large woody material being placed in streams in amounts and manners specified; are riparian management zone (RMZ) widths being adhered to during harvest operations; and are fuel and lubricants being managed (e.g. spill cleanup, landings used as equipment maintenance areas) in the prescribed manner? Compliance monitoring is also referred to in some states and provinces as implementation monitoring, silviculture audits, monitoring surveys, site-level audits, and forest practice inspections.

Number of states involved with compliance monitoring

The number of states implementing compliance monitoring programmes has risen steadily since the mid-1980s. In both 1983 and 1990, 18 states had compliance monitoring programmes; 22 states indicated so in 1992; and 29 in 1996 (National Association of State Foresters, 1996). Thirty-four states responding to our survey indicated they conducted compliance monitoring in 1997 (Table 12.1). Nearly one-third of the states indicated they have not initiated a formal compliance monitoring programme, though this does not mean forest practices are not monitored in those states. In some states, monitoring activities (inspections) are carried out when landowners benefit from cost-share practices (e.g. federal Forestry Incentives Programme and Stewardship Incentives Programme) or when formally designed Tree Farms are reinspected. In other states, pre- and post-harvest inspections required by forest practice regulatory laws are considered to be compliance monitoring (because a harvest and associated practices are considered incomplete until approved by an inspector). In still other states, compliance inspections occur in response to citizen complaints or other sources alleging inappropriate application of BMPs (e.g. Alabama, Georgia, Maine, Mississippi, North Carolina, West Virginia). The Georgia Forestry Commission, for example, investigated and mediated 575 forest practice complaints from 1981 to 1996; although only one resulted in a penalty (Green, 1996).

Purposes of conducting compliance monitoring

Forest BMP programmes initiated by state governments have generally evolved from an iterative process wherein acceptable forest practices are specified, applied, monitored and subsequently changed to be more effective in future applications. Compliance monitoring plays a very important role in this cycle as is reflected by

Table 12.1. Characteristics of forest practice compliance monitoring programmes of states, by region and number of states, 1997.

Region	Existence of state compliance monitoring programme		Compliance monitoring conducted			Training required to participate in monitoring	Incentive provided private landowner to access property	Individual landowner compliance information made public
	Yes	No	All sites harvested	Sample of harvested sites	Certain sites more intensely			
North	11	9	2	9	4	10	2	5
South	13	0	2	12	2	11	0	7
West	10	7	4	5	7	7	1	9
Total	34	16	8	26	13	28	3	21

Note: Compliance monitoring may be focused on forest practice guideline programmes that are voluntarily complied with, mandatorily required of landowners and harvesters, or both. Nationally, 13 states have compliance monitoring programmes as part of a voluntary practice programme (North – 4; South – 8; West – 1), nine as part of a mandatory programme (North – 3; South – 1; West – 5), and 12 involve both voluntary and mandatory programmes (North – 4; South – 4; West – 4). North Region: CT, DL, IA, IL, IN, MA, MD, ME, MI, MN, MO, NH, NJ, NY, OH, PA, RI, VT, WV, WI; South Region: AL, AR, FL, GA, KY, LA, MS, NC, OK, SC, TN, TX, VA; West Region: AK, AZ, CA, CO, HI, ID, KS, MT, NB, ND, NM, NV, OR, SD, UT, WA, WY.

examples of state-specified reasons for undertaking compliance monitoring.

- Determine statewide compliance with silvicultural BMPs (Florida).
- Target future education efforts and technical assistance (Michigan).
- Provide information on the need to revise, clarify or strengthen BMPs; focus future study on subjects and geographical areas needing further investigation (Montana).
- Determine major factors which affect BMP compliance for timber harvesting (South Carolina).
- Determine landowner and timber harvester awareness of forestry BMP requirements and their attitudes towards them (Maryland).
- Provide baseline information on extent of current BPM implementation; identify BMP specifications requiring technical modification; identify improvements needed in future monitoring efforts (Indiana).
- Educate participating landowners about the importance and use of BMPs when conducting timber harvesting activities (Michigan).

Considering these and other statements provided by programme administrators suggests that compliance monitoring programmes are undertaken primarily for purposes of securing reliable estimates of forest practice application, refining recommended or required forest practices where necessary, and targeting educational and technical assistance programmes to landowners and harvesters whose compliance with specified forest practices is considered unacceptable.

Organizations involved with compliance monitoring

A state's lead public forestry agency may not be the only public entity monitoring forest practice compliance. Of the 54 principal organizations involved in compliance monitoring in the 34 states with compliance monitoring programmes, 43% (23 agencies) were entities other than the state's lead forestry agency. Most commonly, a state's environmental or pollution control agency was involved. In the North and West regions, other entities actually exceeded the number of lead state forestry agencies engaged in compliance monitoring (see Table 12.1 for definition of regions). Specifically in the North region, nine state forestry agencies, eight environmental or pollution control agencies, and two other jurisdictions (e.g. unit of local government) were involved. In the South region, 13 state forestry agencies, one environmental or pollution control agency, and two other agencies (e.g. federal agency) were involved. In the

West region, nine state forestry agencies, five environmental or pollution control agencies, and five other agencies (e.g. fish and game agency) were involved. In only 20 states was the state's lead forestry agency identified as the only agency involved in the monitoring of compliance with recommended forest practices.

The involvement in compliance monitoring of entities in addition to a state's lead forestry agency is often one of providing the forestry agency with specialized knowledge and skills that are available from other sources. To secure these specialized talents and perspectives in 1996, state forestry agencies linked up with nearly 65 different public and private organizations. In order of frequency, these organizations were affiliated with state and local governments, forestry businesses, university extension services, federal agencies, conservation and environmental groups, and landowner organizations (National Association of State Foresters, 1996).

State approaches to compliance monitoring implementation

States have developed a wide range of approaches to compliance monitoring, each designed to fit the unique bundle of preferred forest practices that they wish to have applied (voluntarily or mandatorily) by landowners and timber harvesters. Which forest practices a state monitors, how it proceeds to monitor them, and the level of investments made in doing so are dependent on the complexity of forest practices to be applied, extent and type of forests occurring within a state, financial and professional resources available for monitoring activities, and the pressure exerted by various interests.

Conditions monitored

Forest practices are most commonly monitored by states for their influence on water quality (33 states), riparian areas (30 states) and forested wetlands (24 states) (Table 12.2). Least mentioned as a focus of monitoring are practices affecting recreational opportunities and cultural-historical resources (four and five states, respectively). Examples of other monitored conditions mentioned include: air quality (Idaho), size and arrangement of clearcuts (Maine), disposal of chemical containers (Arkansas), site preparation (North Carolina), adherence to a timber harvest plan (California), threatened and endangered species (Hawaii), and fish habitat and slope stability (Oregon). Regional differences in monitoring emphasis are also apparent. In the West region, states are more active in monitoring practices involving reforestation, wildlife habitat, and wildfire, insect and disease conditions. The South region leads in the number of states monitoring practices affecting water quality and forested wetlands. These regional differences are explained primarily by differences in the importance of certain forest resources or by regional sensitivity to the application of certain forest practices.

Table 12.2. Forest resource subject area focused on by forest practice compliance monitoring programmes of states, by region and number of states, 1997.

	Region			
Subject area	North	South	West	Total
Water quality	11	13	9	33
Riparian	10	11	9	30
Wetland	9	8	7	24
Soil productivity	1	5	7	13
Wildfire, insects and diseases	3	1	9	13
Aesthetics	4	3	5	12
Wildlife habitat	2	1	8	11
Reforestation	3	1	6	10
Cultural-historic resources	2	0	3	5
Recreation	2	0	2	4
Other	1	3	5	9

Site selection and intensity

States employ a variety of procedures to select sites and carry out monitoring activities. Nationally, 13 states have compliance monitoring programmes as part of a voluntary forest practice programme, nine as part of a forest practice regulatory programme, and 12 focus compliance monitoring on both voluntary and mandatory forest practices programmes. Few states monitor all harvested sites (only eight states do so), while 26 of 34 responding states indicated they monitored a sample of sites. On a regional basis, Southern states are more likely to monitor a sample of harvest sites, with 12 of 13 states doing so (Table 12.1). Sample sites are typically stratified by land ownership (state, industry, non-industrial private and, in some cases, federal) and land characteristic, such as soil type and forest type. They will often focus on monitoring practices occurring near water, on steep slopes, or involving highly erodible soils. Thirteen of 34 responding states, particularly Western states, monitored certain sites more intensely. The more sites were sampled, the more likely it was that different people monitored different sites. The number of sites visited in a state during any one monitoring cycle in the early 1990s ranged from fewer than 40 to several thousand (Brown *et al.*, 1993).

Examples of site selection procedures include Michigan, which requests voluntary submission of potential sites from consultants, county foresters and state private forest management specialists. A random sample of these sites is drawn that is roughly proportional to the average amount of timber removed during a specified period (e.g. an 8–10-year period) in a region of the state. Sites must be 2 ha or more in size, within 1 mile of a road, and a proportion must be within 61 m of a stream or other water body. Florida's sites are selected by Division of Forestry personnel from a fixed-wing aircraft flying randomly selected township or range lines until a statewide goal of approximately 200 sites are selected. Sample sites must have been harvested within the past 2 years and some part of the site must occur within 91 m of a stream, lake or wetland. West Virginia, which has a notification regulatory system, selects every fifth harvest notification, while Idaho, which also has a notification regulatory system, inspects roughly half of all harvested sites. Idaho's 13 forest practice inspectors focus on sites near certain types of streams and on those with steep slopes, erodible soils and high-hazard land types.

Participants in site visits

The credentials of persons conducting compliance monitoring activities in a field setting vary enormously among states. However, in most cases state forestry agency personnel make the required field measurements. Most states recognize the importance of having knowledgeable people performing on-site monitoring activities, and the importance of consistency in making field measurements and discretionary judgements about the appropriateness of certain practices. One means of accomplishing this is via some form of special education or training for those participating in monitoring activities; 28 of 32 responding states indicated they required compliance monitors to take some form of training, often referred to as 'calibration workshops' (Table 12.1).

Access to private property

Measurement of forest practice applications on harvested sites often requires access to private property. Most states with voluntary forest practice guideline programmes implement a policy of accessing private property only with the permission of the landowner (e.g. Arkansas, Georgia, Indiana, Louisiana, Michigan, Minnesota, Oklahoma, Texas and Wisconsin). A few among the responding states (three out of 34) provide private landowners with incentives to allow access to their land. Such incentives can take the form of free forestry advice and educational materials (Indiana) or material rewards such as free pictures of forest scenes and free baseball caps personalized with forestry logos (Michigan). Landowners freely grant access to private property in some states, such as South Carolina, where individual site information is kept anonymous, while in other states good agency relations with landowners limit refusals for access (Florida). Landowner participation in compliance monitoring evaluations (Indiana), and open and honest communication and including landowners in the review process (Oregon) facilitates private land access. Entry to private property was reported by some states simply not to be an issue (Idaho, Washington).

Access to private property for compliance survey purposes is authorized by state law in some states, but this is mostly under the rubric of a regulatory programme (Ellefson *et al.*, 1995). Respondents to this survey indicated the following perspectives on legal authority to access to private property.

- 'Entry authorized if conducting official duties' (Delaware).
- 'Right of entry is specified in statutes' (Maine).
- 'Entry as a condition of Sediment Control Plan approval' (Maryland).
- 'Entry when in performance of official duties' (New Hampshire).
- 'Entry when looking for water pollution problems' (Kentucky).
- 'Agency trespass immunity when dealing with noncompliance' (North Carolina).
- 'Entry to private property authorized' (Virginia).
- 'Inspectors have full peace officer status to enter property' (California).
- 'Authorized access to administer state code' (Idaho).

Other states with legal authority to enter private property for monitoring purposes are Alaska, Washington and West Virginia.

On-site monitoring can lead to discovery of resource or environmental activities that are in direct violation of safety, public health or pollution control laws beyond laws involving forests or closely related natural resources. Of the 28 states responding to this specific part of our survey, the person(s) responsible for on-site monitoring in 17 states refers the violation to the state or federal agency having jurisdiction over the matter. In seven states a responsible authority is not notified, and in four states the response takes various forms, including recommending corrective action to a landowner.

Survey intervals and reports

The time interval between compliance monitoring surveys is highly variable, often driven by the availability of financial and professional resources or by a regulatory programme requirement for inspection after each or most operations. In some cases, the interval is shortened by pressure from interest groups, suggesting that best management practices are not being applied at acceptable rates. States that have conducted compliance surveys on a frequent and regular interval include Florida (eight surveys since 1981), Georgia (two surveys since 1991), Minnesota (five surveys since 1991), Montana (five surveys since 1990), North Carolina (three surveys since 1992) and Texas (two surveys since 1992). The other 28 responding states with a compliance monitoring programme have conducted at least one survey.

States typically publish reports presenting aggregate information describing the results of their compliance monitoring. We found that 20 of 29 states engaged in compliance monitoring in 1996 did so, although the detail presented in the reports differed markedly from state to state (from very detailed to very cursory) (National Association of State Foresters, 1996). In some states, compliance information for individual sites and landowners is made public. In 21 of the 34 states responding to our survey, individual landowner's results were made available to the public. States in the North and South regions (12 of 12 responding) were more inclined not to report individual results, while only one of ten responding Western states withheld individual survey results from the public.

Uses of compliance monitoring data collected

Information gained from compliance monitoring activities is used in a variety of ways. However, obtaining reliable information on whether forest practices are being used is of paramount importance to nearly all states responding to our survey. When asked to specifically identify the use(s) of information obtained from compliance monitoring activities, the response among states was far-ranging. Within these extremes, however, some distinct patterns emerge. Twenty-three states indicated that they use compliance information to refocus, and in many cases intensify, educational programmes (usually in workshops or seminars). Specific activities include tailoring workshops about the appropriateness of a specific forest practice and application of that practice to the field. Audiences targeted most frequently for educational programmes were loggers, landowners, consultants and environmental organizations. Modifying forest practice rules or guidelines was

the second most common use of compliance information (reported by 14 states). This occurred when practices were found to be technically inappropriate, impractical to apply or confusing in their presentation.

States also use compliance information to modify technical assistance programmes, which usually involve one-on-one consultations with landowners and timber harvesters (reported by seven states). On-site monitoring results can be used to focus technical assistance toward individuals who do not understand how to correctly apply a forest practice. States also reported using compliance information to evaluate and plan programmes (reported by six states), including the preparation of budget requests and the design of new programmes such as cost share programmes. Five states reported that compliance information was useful for informing broader communities about forest practices via distribution of reports to community organizations and briefing the public and media at various forums. Four states reported using compliance information to intensify enforcement activities where compliance levels were found to be unacceptable, while three states reported it was used to better understanding of the effectiveness of specific guidelines or rules. Other reported uses of compliance information included to meet legal requirements (two states) and to provide evidence needed to avoid regulatory programmes (two states). One state respondent reported quite simply and straightforwardly '. . . little is done with compliance information'.

Cost of monitoring

Monitoring compliance with BMPs and forest practice guidelines by the 34 states studied required an estimated nationwide total investment of nearly $940,000 in 1997 (note that this excludes states with compliance checks required by regulatory initiatives). This cost is an increase of more than 2.5 times the $365,000 expended for 1996 compliance monitoring when 29 states checked more than 11,500 harvest sites for voluntary application of forest practice guidelines (National Association of State Foresters, 1996). Compliance monitoring costs (direct and indirect, in the form of services) for voluntary forest practice guideline programmes ranged from $20,000 to $150,000 per state, averaging $60,000 per programme. States with regulatory programmes invested $500,000–750,000 per state in compliance checks. Staffing allocated for monitoring compliance with voluntary programmes was typically two tothree full-time equivalent (FTE) employees per state. This figure expanded to 40–50 FTEs where teams were used, and as high as 135 FTEs in California, where regulatory inspectors were used for compliance checks.

Compliance monitoring programme strengths and weaknesses

We asked managers of compliance monitoring programmes to specify the strengths and weaknesses of their programmes. Strengths include process, focus and consistency of their monitoring efforts, cost effectiveness, integration with other programmes, and a positive working relationship between agencies and landowners and harvesters. Conversely, site selection and location, access to private property, and consistency among individuals performing site reviews were cited as weaknesses. Frustration at monitoring responsibility being assigned to many agencies, ambiguous forest practice rules and guidelines, and limited funding and staffing were also mentioned. Monitoring programmes are viewed as a divisive rather than a cooperative exercise in some states.

Minnesota's Guideline Implementation Monitoring Programme: a Case Study

With the national review as a backdrop, focus on one state's compliance monitoring programme can provide significant insight into specific programme design and implementation issues. What follows is a discussion of Minnesota's recently developed guideline compliance (implementation) monitoring programme.

Background

The Minnesota Forest Resources Council (MFRC) recently developed voluntary timber harvesting and forest management guidelines. Initiated in

1996, representatives from a broad range of forestry interests from within the state were engaged in a process to develop guidelines in four topical areas: riparian zone management, site-level wildlife habitat, forest soil productivity and historical/cultural resources. Once developed, these new suites of guidelines were integrated with existing water quality, wetland and visual quality BMPs to produce a single, comprehensive guidebook (MFRC, 1998). The MFRC published its new comprehensive guidelines, *Sustaining Minnesota Forest Resources: Voluntary Site-Level Forest Management Guidelines*, in early 1999.

Implementation monitoring programme design

Shortly after the guidelines became available, the MFRC initiated development of a guideline implementation monitoring programme. Designing the implementation monitoring programme was divided into five components: (i) developing field monitoring protocols; (ii) designing a site selection process; (iii) gathering information on the sites to be monitored; (iv) conducting on-site reviews; and (v) analysing field monitoring data.

Developing field monitoring protocols

Considerable effort was placed on identifying field monitoring protocol issues. These included determining: (i) which guidelines can and should be monitored; (ii) when monitoring should take place; (iii) how monitoring should be carried out; and (iv) who should conduct the monitoring. For purposes of monitoring, a site was defined as the area where harvesting activities were conducted (harvest area) and adjacent areas that were taken into consideration when determining the actual harvest unit. Collection of field monitoring data on guideline application was restricted to those guidelines that were measurable and quantifiable. This was done to minimize subjective judgements made during implementation monitoring. Once measurable guidelines were identified, the appropriate measures were developed to quantify their application in the field. The guideline implementation data collected also included background information obtained from the landowner/resource manager and during the on-site field evaluations.

Designing a site selection process

The MFRC's interest was to design a site selection process that would be cost and time effective and provide for:

- Statistically credible estimates of implementation rates statewide.
- Statistically useful comparisons among land owner categories.
- Trends in implementation over time by major ecoregion, watershed or landscape.
- Trends in implementation over time by landowner categories.
- Flexibility with respect to available data, current and future technologies for data capture including remote sensing, and to facilitate modelling.

A multi-stage sampling method was adopted. This method used primary sampling units (PSUs) (i.e. half-townships) and then sampled harvesting sites within those PSUs. The advantages of this approach are feasibility in creating a list of harvesting sites within PSUs, and savings in travel time since a number of sites were visited in each selected half-township rather than travelling to individual harvesting sites located at random around the state. The approach also provides for essentially unbiased estimates of guideline implementation rates. Forty-one townships were selected statewide for the PSUs for the 2000 field reviews.

Once sample half-townships had been selected, colour or colour-infrared aerial photographs were taken of the PSU. The timing of the flights occurred when most deciduous leaves were off but before snow cover (i.e. late autumn) to maximize the ability to see harvesting site detail. An aerial photograph interpreter subsequently identified (December 1997–October 1999) harvested sites and categorized them by size and other characteristics. The process was designed to identify approximately 0–15 harvesting sites per township for any one year.

To facilitate the identification of potential sampling sites within the half-townships, public agency and industrial forest landowners were asked to identify all harvests on their land within the half-township that met the specifications for monitoring. These landowners were also asked to

identify any harvest activity on non-industrial private forest land they were aware of. This request was to assist in the identification of potential harvest sites that were either too small in size or selectively harvested – a common feature of many non-industrial private harvests. Timber harvests with such features were found to be difficult to identify using aerial photographs.

Gathering site profile information

Sites selected for monitoring had been harvested within 2 years of when the aerial photography was done. Potential harvesting sites were identified, and the boundaries of the harvest area were delineated. Once ownership information was collected, landowners were contacted to confirm when harvesting for the specific site was completed, and request permission to monitor the harvesting site. If the landowner agreed, the site was added to the statewide pool of potential harvesting sites.

Information on the harvest sites collected through remote sensing or querying databases included:

- Harvest site boundaries.
- The occurrence and location of any open water wetlands, lakes or streams.
- Actual riparian management zones (RMZs) (what exists on-site) and theoretical RMZs (as recommended in the guidebook) for each open water body.
- The presence of trout lakes or streams.
- All roads and landings within the harvest unit.
- The apparent method(s) of 'leave tree' management used (e.g. scattered individual trees versus clumps, strips and islands).
- The presence of known natural heritage features and/or endangered, threatened or special concern species.
- The visual sensitivity of the site based on county visual sensitivity maps.

Conducting on-site reviews

Field monitoring of timber harvesting sites was conducted between April and August 2000 by an independent contractor hired by the MFRC. A guideline monitoring instruction manual was developed to facilitate the contractor's proper and consistent application of the guideline monitoring measures identified in the on-site worksheet. The contractor was required to attend a 3-day calibration workshop to discuss and review the guidelines and implementation monitoring protocols. Workshop instruction employed both classroom discussions and field exercises designed to provide an understanding of the guidelines and their measures, and to demonstrate the proper collection of field data and use of the field monitoring forms. Upon completion of the calibration workshop, the guideline monitoring instruction manual was refined to reflect the discussions and changes agreed to during the workshop. Quality control reviews were employed through random comparisons of contractor monitoring results with those derived from project staff for 5–10% of completed sites.

First year monitoring findings

A total of 108 harvest sites were monitored in 2000. Initial site-level implementation monitoring represents a baseline evaluation of the application of timber harvesting and forest management practices (i.e. a description of various timber harvest practices being applied in Minnesota immediately prior to availability of the guidelines, and how those practices compare to recommendations contained in the guidebook). Specific conditions and practices assessed include riparian management, water and wetland approaches and crossings, preharvest planning, compliance with visual quality recommendations, slash disposal and distribution, extent of rutting, 'leave tree' distribution, preharvest review for cultural resources, and endangered, threatened and special concern (ETS) species, site infrastructure percentage, skid trail distribution, and water diversion device use for roads and skid trails. Some of the important findings collected from the first year of implementation monitoring were (Phillips, 2001):

- Around 26% of the monitored sites were visually sensitive. Landowners and loggers were aware of the visual sensitivity classification on 36% and 29% of these sites, respectively.
- Landowners and/or resource managers checked cultural/historic resource inventories on 50% of the sites monitored prior to timber harvesting. Inventories for ETS

species were checked on 69% of the sites monitored prior to timber harvesting.
- Filter strip compliance with the guideline recommendation (< 5% mineral soil exposure, dispersed over the filter strip) was 70%.
- For lakes, perennial streams and open water wetlands, one-half of the observed RMZs met the guideline recommendations for width and residual basal area. A higher proportion of RMZs that met the guideline recommendations were adjacent to the harvest area compared to those for water bodies that were within (i.e. open water wetlands, lakes) or traversed (i.e. streams) the harvest area.
- A high percentage of skid trail and road approaches to wetlands and streams did not have the appropriate devices installed to divert surface water runoff from directly entering these water bodies.
- Infrastructure (i.e. roads, landings) was found to occur at the guideline-recommended level of 3% of total harvest area.
- Landings were located outside of filter strips and RMZs 95% and 99% of the time, respectively.
- Slash was retained at the stump or redistributed back on the site for 73% of the sites monitored.
- Rutting was found on one-third of the sites monitored and was most prominent on skid trails, wetland inclusions and roads.
- Harvesting with reserve trees met the guideline recommendations approximately 60% of the time.
- As an ownership class, non-industrial forests were found to be applying the practices recommended in the guidelines at a level generally consistent with other forest ownerships (i.e. county, state, federal, industry), although this varied extensively according to the type of practice monitored.

Using the monitoring results

The inaugural guideline implementation monitoring programme identified a number of changes that need to be employed in future guideline implementation monitoring efforts. Examples include modifications to criteria for identifying primary sampling units used in identifying harvest sites for review, pre-site visit landowner/resource manager/logger interview questions, and parameters evaluated during the site visit. The MFRC and Minnesota Department of Natural Resources plan to monitor guideline implementation on an annual basis.

The initial results point to areas where continuing education and training efforts for loggers, resource managers and landowners need to be emphasized. Examples include installing appropriate protection measures for water and wetland approaches and crossings and the use of temporary structures. The MFRC will be working with organizations responsible for delivering logger and resource professional education to develop education and training programmes that address the areas identified through monitoring as being in need of greater emphasis.

The monitoring results will be informative to the MFRC in evaluating the extent to which its guideline implementation goals are being met. These include assessing awareness and understanding of the guidelines (as measured through logger/resource manager attendance in introductory guideline training and field demonstrations), demonstrated commitment to using the guidelines, and rates of guideline application. By law, the MFRC is to recommend to the Governor and Minnesota Legislature additional ways of seeking greater guideline use when information generated through implementation monitoring suggests the goals are not being achieved.

Conclusions

Looking forward, public support for timber harvesting and forest management will depend, in part, on whether the practices applied are consistent with broadly accepted guidelines and standards that promote sustainable forestry. State compliance monitoring programmes can play a critically-important role in this regard. As a systematic way of gathering information, these programmes can accurately and credibly describe the extent to which preferred harvesting and management practices are being used. This information will be especially helpful in shaping public sentiment and policy about the management and

use of these forests. Among the attributes that can make for a successful state guideline compliance monitoring programme are:

- Providing sufficient resources needed to fully implement the monitoring programme on a regular basis.
- Engaging knowledgeable people who understand the practices being monitored.
- Establishing credible processes for selecting the sites and conducting the monitoring.
- Providing accurate analysis and timely reporting of monitoring results.
- Creating a favourable climate towards monitoring.
- Fostering good relationships with private forest landowners.

The latter two attributes are particularly noteworthy. With the nation's non-industrial private forests increasingly looked to for the production of economic and amenity goods and services, information on the management and use of these lands needs to be an important part of any state compliance monitoring programme. Consequently, states need to build understanding of and support for the use of guidelines and monitoring programmes among their private landowners. Doing so requires careful attention to their needs and concerns in such areas as: increasing landowner awareness of state forest management guidelines and compliance monitoring programmes; providing sufficient technical resources to assist them in conducting forest management activities that are consistent with forest management guidelines; and providing incentives to encourage their participation in compliance monitoring programmes.

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