BOARD OF FORESTRY PILOT MONITORING PROGRAM: HILLSLOPE COMPONENT

FINAL REPORT

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This report summarizes the hillslope component of the Pilot Monitoring Program conducted in 1993-94. It should be read in conjunction with other reports that provide information on the monitoring program as a whole. These include the 1995 Monitoring Study Group (MSG) report to the Board of Forestry (BOF) summarizing the Pilot Monitoring Program (MSG, in preparation), the report on the Instream component of the Pilot Program (California Department of Fish and Game, 1995), the 1993 MSG report recommending the structure for a pilot program (BOF, 1993), the Best Management Practices Effectiveness Assessment Committee ("BEAC") report summarizing the outreach effort to identify public concerns (California Department of Forestry and Fire Protection, 1991), and the "208 report" presenting an earlier phase of field evaluations (State Water Resources Control Board, 1987).

PART I. THE HILLSLOPE MONITORING COMPONENT

BACKGROUND

The California State Board of Forestry is engaged in a program to assess the effectiveness of the Forest Practice Rules ("Rules") in protecting water quality. The effort stems from a 1988 Management Agency Agreement between the State Water Resources Control Board and California Department of Forestry and Fire Protection which, among other things, stipulates that a monitoring program will be implemented.

It has become increasingly clear, however, that larger purposes can be met by a monitoring program beyond the legal and administrative requirements of the involved agencies. The last decade has focussed intense public attention on forest practices in California, manifested through attempts at ballot initiatives, legislative measures, and administrative rule changes. To the exasperation of both the timber industry and the environmental community, the rules governing forestry have grown progressively more complex, yet still don't provide public confidence that the process "works". The timber industry contends that current Rules are overly restrictive, and demands that scientific evidence demonstrate clear necessity before any new Rules are considered. The environmental community points to salmonid

declines and site-specific problems as evidence that stream protection is still inadequate, and advocates tighter Rules based on a conservative approach to risk. No one, particularly the regulatory bodies of the Board of Forestry, State Water Resources Control Board or U.S. Environmental Protection Agency, has an objective basis for evaluating current Rules and judging the need for more -- or less -- protective ones, other than anecdotal reports. The feedback loop between rule-writing and rule-evaluation simply has not been completed.

Designing a program to evaluate the effectiveness of forest practices, however, takes careful thought. It is one thing to agree to assess the linkage between timber operations and the health of streams. It is another to demonstrate cause-and-effect relationships at the level of specificity and confidence now needed. The issue is not whether timber operations can adversely affect streams -- the literature is rich with evidence linking the impact of sediment on salmonids, and more recently the importance of large woody debris in creating aquatic habitat[1]. And indeed, there are over 1300 provisions within the Rules which address water quality protection in some way. Rather, the issue is the specificity of the evidence supporting the efficacy and feasibility of one forest practice over another. Additional restrictions mean substantial economic costs to the timber industry -- for example, the difference between a 50-foot versus 300-foot riparian buffer, or retention of two versus five conifers per acre for woody debris recruitment, means significant foregone revenue. On the other hand, the difference between thousands versus tens of spawning salmonids means material difference to the fundamental survival of the commercial and sport fishing industry. Obtaining better evidence is the only means for transcending an otherwise strictly political basis for decisionmaking.

Design of a monitoring program that would meet the tests of credibility, cost-effectiveness and acceptability to all interested parties was the task assigned to the Monitoring Study Group by the Board of Forestry. Originally formed in 1989 and named the Interagency Monitoring Task Force, the MSG has evolved into a group of approximately 20 members representing various resource agencies (CDF, DFG, SWRCB, North Coast Regional Water Quality Control Board, Division of Mines and Geology, U.S. Forest Service, EPA), the timber industry (California Forestry Association, California Licensed Foresters Association), and the environmental community.

In 1990 the MSG conducted a public outreach effort to determine which forest practices were causing the greatest concern, followed by a Pilot program in 1993-1994 to develop and test monitoring methods in the field before commitments were made to a long-term program. This report presents the results of one portion of the Pilot program: the "hillslope component". This component developed methods for evaluating timber operations at the harvest site and appurtenant areas -- that is, "on the hillslope". The

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[1] See, for example, the extensive citations compiled in Meehan (ed.), 1991, prepared under the auspices of the U.S.Forest Service and American Fisheries Society.

companion program, conducted by the Department of Fish and Game, tested methods for evaluating the condition of sensitive beneficial uses of water within the stream channel, and is reported on in a separate document (DFG, 1995).

THE HILLSLOPE COMPONENT: GOALS AND FOCUS

The hillslope component developed procedures for evaluating both the implementation and effectiveness of the Rules in keeping soil on the hillslope and maintaining shade over watercourses. Implementation monitoring refers to assessing whether activities have been carried out as required ("was the Rule followed?"), while effectiveness monitoring refers to evaluating whether the activities had the desired effect ("did the Rule work?") (MacDonald et al., 1991). The two types of monitoring are necessary for differentiating between water-quality problems caused by non-compliance with a Rule, versus problems with the forest practice itself. It is intended that the data, collected over time, will provide information on: 1) how well the Rules are being implemented in the field; and 2) where, when, to what degree, and in what situations problems occur -- and don't occur -- under proper implementation.

The hillslope component focussed on Rules that address the five aspects of timber operations considered to have the largest potential impact on water quality: roads, landings, skid trails, activities within Watercourse and Lake Protection Zones (WLPZs), and watercourse crossings. The monitoring methods generally require that soil disturbance from timber operations be evaluated through a series of structured sampling procedures. Any evidence of soil movement offsite must be traced downslope to its point of deposition, or to its discharge point at the edge of a watercourse. [2]

A primary goal of the hillslope component was to develop methods that provide as much quantitative information as possible, yet are pragmatic in application. The success of any long-term monitoring program will be largely determined by the degree of commitment by all participants and the cost. The MSG recognized that evaluating the effectiveness of forest practices on all THPs statewide was beyond the fiscal capacity of any party. Similarly, meeting a truly "scientific" level of proof, in the technical sense of the term, would be prohibitive as it would require a controlled experimental approach to test the effectiveness of each rule against a null hypothesis, as in a paired watershed approach. Results from comprehensive watershed studies can, and do, become available over time, such as the 33-year cooperative program testing cumulative effects at Caspar Creek[3], or issue-specific research on federal or

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[2] The Hillslope component focusses on soil movement, but also includes some canopy cover measurements taken within the WLPZ of Class I and II streams. Most other stream zone parameters are included within the Instream Program.

private ownerships. But although the standards of good scientific design were incorporated wherever possible, the MSG recognized that decisionmaking regarding Rule effectiveness would need to accept a more realistic "management" level of rigor. The methods therefore rely on a combination of quantitative and qualitative analyses, which can be applied in a sampling regime that can be adjusted over time as experience is gained.

DEVELOPMENT OF THE HILLSLOPE EVALUATION METHODS

Adaptation of USFS Forms

The 18-month time frame for the Pilot study required a quick response to develop methods that could be field tested during the summer months. The 1993 MSG report recommended that the forms and procedures already developed by the USFS, Region 5 for its Best Management Practice Evaluation Program (USFS, 1992) be adapted for the hillslope component of the state program. The USFS program had been underway for about three years and had been through many revisions based on the results of field testing. Adapting the approach for use in the state program was thought to be a relatively straightforward task.

It soon became evident, however, that substantial changes would be needed because the federal and state approaches to forestry BMPs are structurally different. The USFS approach is based on BMP prescriptions which become attached to a project from many sources (e.g., the project Environmental Assessment ("EA"), sale contract, implementation plan, handbooks, use permits, contract daily diaries), and vary from project to project. Sometimes they are expressed as quantitative measures (such as "Groundcover objective = 90%"), while others are more general in nature. In contrast, the state requires that every Timber Harvest Plan (THP) comply with a set of specific Forest Practice Rules which contain a mix of prescriptive, performance and intent standards. In order to conduct both implementation and effectiveness monitoring, the state approach needed to be able to reference each Rule individually.

Field Testing of Hillslope Forms and Procedures

Many revisions were made to the USFS forms and pre-tested in the field before use in the full Pilot test. Pre-tests were conducted between April and June, 1994 in the Caspar Creek watershed at Jackson

[3] The Caspar Creek Watershed Study is a cooperative venture between the USFS Pacific Southwest Research Station and the California Dept. of Forestry and Fire Protection. The study area is located in western Mendocino County (Rice et al., 1979).

Demonstration State Forest, the Gualala River watershed lands of Gualala Redwoods, Inc., the Mokelumne River watershed lands of Georgia-Pacific Corporation, and the American River watershed and owned by Fruit Growers Supply Company. The pre-tests were variously attended by MSG members, CDF field Inspectors, private industry representatives, staff members from Review Team agencies, and members of the public.

Criteria for THP Selection

By early July the forms had been sufficiently developed to begin testing on a set of THPs made available by the same willing landowners as noted above. The THPs selected for testing had to meet the following criteria:

1) The THP had been filed, approved, and operated under Rules adopted by the BOF after October, 1991 (the most recent Watercourse and Lake Protection Rules);
2) The site had at least one Class I or II watercourse or lake which was located within or immediately adjacent to (a) a harvest area at least 10 acres in size and/or (b) a logging road, of which at least one-half mile was reconstructed or constructed;
3) The site had been through at least one winter; and
4) At least one site was located in the drainage of each stream reach selected for DFG Instream sampling.

To the extent possible, the selected timber operations represented a range of risk, based on terrain (e.g., low to high geologic stability); types of operational activity (e.g., roads or landings within the WLPZ, tractor yarding on high EHR sites); and resources-at-risk (e.g., domestic water supplies, spawning/rearing habitat).

Using these criteria, the THPs selected for testing included ten in the Coast District, ten in the Southern District, and eight in the Northern District. CDF Forest Practice Audit Foresters and Inspectors were assigned to conduct the evaluations during the 1994 field season. Evaluations were completed at 17 sites, including six in the Gualala watershed, four in the Noyo-Ten Mile area, five in the Mokelumne River watershed, one site in the Burney area, and one site in the American River basin. Only two THPs were completed in the Northern District due to the limited number of days left in the field season when the work began.

Commitments were made to the timberland owners that the data gathered during the pilot was to be used for developing methods only, and would not be used to draw conclusions about any Rules. The landowners were also assured that the pilot testing would not result in any evaluation of their compliance with the Rules, the effectiveness of their operations, or enforcement actions.

Classification of Rules for Monitoring

Approximately 1300 provisions within the Rules were originally identified as having some association with water quality. These included provisions on harvest planning, administrative review, special county and district Rules, general intent Rules, and operational Rules -- many of which were difficult or inappropriate to evaluate in a statewide field program. A substantial effort was undertaken by CDF staff and MSG members to classify the Rules according to the type of monitoring approach that would be required.[5]

Due to the limited time of the Pilot, most effort was concentrated on developing methods to monitor field sites following completion of timber operations. The winnowing of the list resulted in a ten-fold reduction to 154 Rules suitable for post-operation field testing. These were divided by subject area (i.e., roads, landings, skid trails, WLPZ operations, and watercourse crossings), and appropriate evaluation procedures and forms were developed for each. A second set of 92 Rule provisions related to the intent and planning of timber operations was used in a separate process for evaluating THPs as a whole. Methods to evaluate other categories of rules will be addressed at a later time.

STRUCTURE OF THE HILLSLOPE EVALUATION PROCESS

Two approaches were developed to evaluate timber operations on the hillslope. The first utilizes a quantitative approach to examine a small portion of a THP, providing a detailed look at Rule compliance and effectiveness at randomly-selected locations within a plan. Hillslope erosion often occurs on a very limited portion of the landscape, however, and it is likely that a fine-grained, randomized approach will miss critical sites or prescriptions. Therefore, a second approach was developed to obtain a qualitative evaluation of forest practices as seen over a THP viewed as a whole. This is coupled with an examination of large erosion events (greater than 100 cubic yards per acre).

The Randomized Quantitative Approach

The first approach developed hillslope evaluation forms and sampling procedures for each of the five timber operational activities that are considered to be the largest potential contributors of sediment

[5] The Rules were divided into categories as follows: 1) *Administrative requirements* for a) THP preparation, content and review, b) RPF and LTO responsibilities, and c) CDF inspections and reports; 2) *General intent statements* and/or performance standards; 3) Prescriptive operational standards which *apply to a timber operation as a whole or are too subjective* (e.g., "minimize", "reduce"); 4) Prescriptive operational standards which can be evaluated *during an operation but not after completion* because no evidence remains (e.g., fill placement and compaction); and 5) Prescriptive operational standards which can be evaluated in the field *after completion of operations*.

(roads, landings, skid trails, watercourse crossings and WLPZs), utilizing transects that are randomly located within the THP.

Forms and Procedures

A full set of forms and procedures is provided in Appendices A and B. The forms and procedures are divided into three basic sections:

(1) A **Site Information block** containing information on location of the THP, status of the timber operation (e.g., year of grading, yarding), identification and distance to nearest watercourses, and natural characteristics (e.g., geomorphology, soil, slope). Completion of this information requires review of the THP, the administrative file, reference to maps, and visual observation. Provision is made for identifying locations by GPS coordinates so sites can be relocated for repeat sampling over time if necessary. Much of this section is intended to be completed prior to field inspection.

(2) An **Effectiveness Evaluation block** containing the procedures and data sheets for conducting the effectiveness evaluation in the field. In most cases this involves randomly establishing a transect and sampling specified elements along its length. In some cases non-transect sampling methods are used. The effectiveness evaluation consumes the bulk of the field effort and can be rather complex since many features must be identified. In some cases a rating scale is used in the evaluation, while in others a quantitative distance or code is required.

(3) An **Implementation Evaluation block** containing the list of all the Rules that pertain to the subject area. The list of Rules must be evaluated twice. First, the list is referred to every time a "problem" is encountered along a transect during the effectiveness evaluation. Problems are defined as erosional or sediment deposition features, or failed erosion control features such as waterbars or culverts. Whenever a problem point is encountered, the evaluator is required to identify which Rules are associated, partially or wholly, with the cause of the problem, and rate their implementation according to seven categories[6].

A second evaluation is made at the completion of the transect recording how well each applicable Rule was implemented considering the transect as a whole. This is a more subjective evaluation, based on the professional judgment of the evaluator, but it gives a broad impression of overall performance. Both phases of implementation evaluation are also time-consuming tasks since the "forensic" investigation of the cause of a problem may be complex, the judgments require thought,

[6] The implementation categories are: The conditions at the point, or along the transect : 1=exceed the Forest Practice Rule; 2=Meet the Rule; 3=Minor departure from the Rule; 4=Major departure from the Rule; 5=Rule cannot be evaluated (give reason); 0=Cannot determine; and NA= Criteria not applicable at the site.

and the list of Rules is long. A strong working knowledge of the Forest Practice Rules is required to adequately complete this portion of the hillslope evaluation.

Throughout the forms, various rating scales and codes were developed to standardize the recording of evaluations. However, every appropriate opportunity was also provided to add comments, additional descriptions, and discussions of related factors. This text information will be retained with the data record.

Sample Site Selection and Instructions

The forms are accompanied by a set of instructions explaining the procedures for locating the transect sites within the THP and conducting the evaluation. The procedures for sample site selection were not adhered to during the Pilot because of time constraints for the CDF foresters, who had to fit the evaluations into their normal duties. Strict randomization was also not necessary since the Pilot was only to test methods, not draw conclusions about the Rules.

Randomization methods for selecting specific sampling sites within a THP were developed for later use during the long-term program[7]. These may be modified as the program develops, but a framework is available as a starting point. Methods for sample site selection are patterned after the process used for the Critical Sites Erosion Study (CSES) (Durgin et al, 1989; Lewis and Rice, 1989), in which a mile-point within the road network of the THP is selected from a random number table, and used as the starting point for selecting further features for evaluation.

Once the sample site is located, a separate set of instructions explains how the evaluation is to be conducted. For roads, for example, instructions describe how the endpoints of the transect are to be established and what features are to be recorded. Effectiveness evaluation is conducted first, with implementation evaluation performed each time a "problem" is encountered, and again at the end of the transect judging Rule-compliance along the reach as a whole.

Whole THP evaluation

(1) **Qualitative Evaluation of the Entire THP:** While the transect procedure provides a very detailed look at a small portion of a THP, the Whole THP evaluation process provides a look at the entire plan as a whole. Part I of the approach requires the evaluator to conduct a "windshield survey" from all the roads in the plan, and drive or walk all stream zones to form an overall impression of operations throughout the plan. Implementation and effectiveness are evaluated

[7] Refer to Appendix A: " Procedure for Selecting Sample Sites", and Dissmeyer (1994) for a discussion of statistical considerations in water-quality monitoring.

according to a 1-5 rating scale for three phases of activity: harvest planning, timber operations, and post-harvest treatments.

Part 2 of the approach requires evaluation of the implementation[8] and effectiveness[9] of a set of 92 Rule provisions which address the intent of beneficial use protection.

The evaluation criteria rely on professional impression, and are obviously less quantitative than the transect samples. While subjectivity cannot be eliminated, it can be reduced through a combination of practical experience and training. The data from the whole THP evaluation will be analyzed separately from the transect samples so that the proper caveats can be attached to interpretation of the data.

The sampling regime has not yet been fully developed, but it is intended that Whole THP evaluations will be conducted on a subset of the THPs selected for the quantitative evaluation, say for example, 30% of the plans where transects were conducted. This would permit the results of the fine-grained transect analysis to be compared to those from the broader look.

(2) **Large Erosion Site Evaluation:** An additional process, intended to be conducted in conjunction with the Whole THP evaluation, was developed to evaluate large erosion sites wherever they are found. Large sites are defined as 100 cubic yards per acre or more, which was the criteria used in the Critical Sites Erosion Study (op.cit.). The procedure records information on the size and type of erosional feature, and evaluates the causal connection between the feature and specific timber operations. Where specific Rules can be connected to a feature, they are recorded as well. This requires some subjective judgment since the exact cause of the erosion event may be masked or difficult to separate from natural processes. Nevertheless, it indicates the frequency and type of large events encountered during whole THP evaluation, and makes a reasoned analysis of contributing causes. As above, the data must be accompanied with the appropriate caveats for interpretation.

CHANGES TO THE USFS PROCEDURES

Throughout the development of the forms, the goals were: 1) to remove subjectivity wherever

[8] The Implementation rating scale is the same as in the randomized transect approach.

[9] The Effectiveness rating scale is: 1 = Improved protection of beneficial uses of water over pre-project conditions; 2 = Adequate protection of beneficial uses of water; 3 = Minor effects (short term or low magnitude negative effect) on beneficial uses of water; 4 = Major effects (long term or substantial negative effect) on beneficial uses of water; and NA = Activities not applicable on the THP.

practical; 2) provide repeatable results, assuming that trained evaluators were completing the forms; 3) provide enough information to understand the conditions under which problems do, and do not, occur; and 4) structure the procedures and recording sheets for ease of use by evaluators and data entry operators. As might be expected, however, the sheer complexity of watershed processes, coupled with the large number of Rules to be evaluated made these goals difficult to meet.

During the pre-testing period and course of the pilot, several major changes were made to the original USFS forms. These include:

1) More detailed site information: Descriptive information on the geomorphology, soils, and type of timber operations was added to the site information block to allow better correlations to be made between site condition, harvest techniques and Rule effectiveness. Sufficient site information is especially important for evaluating whether critical problem areas are being recognized during harvest planning and the review process. Inadequate identification of potential problem areas by both RPFs and Review Team members was one of the chief weaknesses found during the "208" evaluation (SWRCB, 1987).

2) More intensive transect procedures : The effort to reduce subjectivity led to the development of quantitative transect sampling procedures for the five activity types. The transects generally consist of randomly-selected 1000-foot stretches over which specific features are measured, either as linear features with beginning and end points (e.g., inside ditches and cut banks), or as point features (e.g., culverts). The recording of all features along the transect -- whether erosion problems or not -- is more intensive than the USFS, and does not focus solely on problem sites. By recording the occurrence of all features, the proportion of problem to non-problem areas can be calculated, thus giving a better picture of the relative occurrence of actual problems to the universe of opportunities where problems could occur.

3) Evaluation of individual Forest Practice Rules: As previously described, the implementation rating process provides for evaluation of specific lists of Rules, a procedure not present in the USFS program.

DATABASE DEVELOPMENT

Preliminary development of a database management system began in March, 1994. Early meetings between a subgroup of the MSG, the Department of Fish and Game, and CDF's Strategic Planning Program (SPP) were held to identify database needs and assure linkage between the CDF/SPP and the

DFG database systems. Geographic referencing of THP number, sampling site, planning watershed, and DFG stream reach will be provided through a common latitude-longitude referencing system. By October, SPP staff had started design of the database system using Microsoft Access for Windows. Work will continue into mid-1995 developing queries and reporting formats using the data obtained in the 1994 field testing.

The database design will permit updating as the Rules change over time, and will also allow identification of the Rules in effect at different dates in the past (since 1991). Similarly, the database will permit modification to the format and contents of the forms.

RESULTS

As noted, the purpose of the Pilot Monitoring Program was to develop and test methods. Forms and procedures have been developed for 1) quantitatively evaluating the implementation and effectiveness of the five most significant aspects of timber operations (roads, landings, skid trails, watercourse crossings and WLPZs), and 2) whole THP evaluation.

Following pre-testing and modification, forms for the randomized quantitative approach were completed by CDF Forest Practice Inspectors for seventeen THPs in the coast, Sierra and Cascade regions. Two samples of each activity type (i.e. 2 roads, 2 skid trails etc.) were evaluated on each THP. Both the forms and procedures were substantially modified from the original USFS versions, and additional minor modifications were made after the Pilot fieldwork to clarify data entry for the database management system.

The forms and procedures were field tested for each of the five activity types. However, there was not sufficient time to test the Whole THP evaluation process, including the Large Erosion Site form. These should be field tested before use in a long-term program.

As previously noted, it is inappropriate to draw any conclusions from the data collected. Agreements were made with the timberland owners that data collected would not be used to draw conclusions about the Rules, and on that basis the requirements for randomization of field sites were disregarded to save time. The data for the 17 sites will be used to test the database management system. Development of input screens, data entry, structure of queries, and reporting formats is still underway.

DISCUSSION

Evaluating Implementation and Effectiveness

The purpose in assessing both implementation and effectiveness is to differentiate between problems caused by inadequacies in a Rule versus problems in the way it is carried out. The logic of the possible interpretations is illustrated in Figure 1.

Figure 1: Interpretation of Implementation and Effectiveness

	No Problem*	Problem
Rule Properly Implemented	Case 1	Case 2
Rule Not Properly Implemented	Case 3	Case 4

Possible Interpretations:

Case 1: The Rule prevented a problem : the Rule "works"
-- true only if stressing events have occurred to test effectiveness
-- but cannot tell if the Rule was needed in the first place

Case 2: The Rule "doesn't work" : even though properly implemented there is still some deficiency

Case 3: The Rule is not needed
-- true only if stressing events have occurred to test effectiveness

Case 4: The problem resulted from non-compliance
-- but cannot tell if the Rule would have been sufficient to prevent the problem

* "Problem" is defined as an observable erosion or sedimentation feature, or failed erosion control structure which is not due to some unrelated cause.

Pragmatic considerations, however, make it difficult to design sampling methods that clearly distinguish between all four cases, particularly for Case 1 and Case 3.

Ideally, to determine if a Rule "works", implementation must be evaluated concurrently with effectiveness. This means that every time any feature is encountered along the transect -- whether a problem or not -- it would be necessary to go through the list of Rules, identify all those that are applicable, and rate each on the 1-to-5 scale of implementation. For example, for roads, the 59 Rules would have to be rated every time a cut or fill feature (8 types), road surface feature (9 types) , drainage feature (7 types) or crossing feature (4 types) was encountered. whether a problem or not.

Because this is so time-consuming, the decision was made that implementation would be rated only when problem sites were encountered. That is, if there is no problem, there is no implementation rating at the point within the transect -- thus missing the chance to identify Case 3. To partially address this gap, a second evaluation was included at the end of the transect, in which implementation is evaluated for the transect considered as a whole. This gives a reasonable approximation of a feature-by-feature evaluation, but in a more efficient way.

ISSUES FOR FURTHER CONSIDERATION

Evaluation of Class III streamcourses

Class III watercourses are ephemeral watercourses that flow in response to rainfall and have the potential to store and transport sediment. They are one of the primary physical links between disturbed soil on the hillslope and Class I or II streams downslope. During the 1991 public workshop sessions of the BEAC, the treatment of Class III streams was cited as a primary concern, particularly with respect to streamside buffers, equipment exclusion, disposal of soil and debris, road and skid-trail crossings, and post-operation restoration (CDF, 1991). Similar concerns were expressed by CDF Forest Practice Inspectors polled in a 1994 survey concerning the WLPZ Rules (CDF, 1995).

A subgroup of the MSG met to consider possible methods for evaluating Class IIIs in the Hillslope component. Unfortunately, methods to evaluate sediment movement through small ephemeral channels are still poorly refined and the hydrologic processes affecting Class IIIs vary greatly across the state. Current research techniques of the USFS and a recent report based on Ph.D. research (O'Conner and Harr, 1994) were examined. It was determined that a comprehensive analysis of Class III channels would require a drainage-wide perspective in order to assess the impacts of roads, skid trails and yarding upon drainage, channel capture and gullying, woody debris recruitment etc. This level of analysis would require a research effort that was beyond the capability of the Pilot program, and perhaps beyond the long-term program.

Some important aspects of Class IIIs are evaluated, however, within the current hillslope procedures. Each time a Class III is crossed by a Road or Skid Trail transect, the effects above and below the crossing are evaluated as a feature, and gullying and channel capture would be noted. In addition, the Watercourse Crossing protocol requires that crossings at Class IIIs be evaluated for removal of debris and restoration of grade and orientation. As the monitoring program progresses, additional procedures such as a stream-walk inventory or basin-wide analysis could be developed.

Cable Yarding

Consideration was given to developing evaluation procedures for Rules pertaining to cable yarding. Preliminary efforts indicated that development of transect techniques for cable yarded areas would be straightforward since they could be patterned after the USFS methods. The need to conduct the sampling, however, was brought into question. Ground disturbance and hillslope erosion associated with cable yarding is considerably lower than that associated with ground skidding operations. In addition, hillslope sediment that is transported downslope on cable units will be documented during the procedures for Watercourse and Lake Protection Zones as material that has moved into the buffer zone . In light of the time required to evaluate more disturbing activities, it was decided that cable yarding evaluations would not be included in the Pilot.

Evaluation of Non-Standard Practices

Most of the forest practices prescribed by the Rules can be substituted by non-standard practices through waivers, exemptions, exceptions, in-lieu practices, and alternative practices as specified in the Rules. The opportunity to apply non-standard practices provides flexibility to adjust specific requirements to the wide variation in the State's timberlands. Questions have been raised, however, whether approved non-standard practices provide the same level of protection as the standards set forth in the Rules.

A form was developed to document the occurrence of non-standard practices and comment on their implementation and effectiveness. However, the format is an open-text comment block, which provides no criteria for evaluation nor standardization in the way responses are recorded. This means that data will be difficult to compile and analyze. It is difficult to design evaluation protocols ahead of time for every kind of non-standard practice that may be proposed. However, it may be possible to design methods incrementally each time a non-standard practice is approved, using existing techniques as models. Over time, enough data from similar non-standard practices may be collected to permit comparisons between standard and non-standard practices. Further attention should be given to this issue by the MSG.

Integrating Geologic Considerations in Site Selection and Data Analysis

In conjunction with the Pilot program, the California Division of Mines and Geology (DMG) participated in developing procedures for incorporating geologic and geomorphic information into the monitoring process. One component of the work involved defining the physical characteristics of three watersheds[10] in which methods were tested during the Pilot, in order to demonstrate the analysis techniques and types of relevant information that can be provided (Spittler, in preparation). A second component involved the preparation of Erosion Potential maps for the private forested watersheds of northern California (McKittrick, 1994). These maps indicate, for groups of Planning Watersheds[11], the intrinsic risk of surface erosion, shallow mass wasting, and deep landsliding. A composite map aggregates the three factors into a single set of low, medium, and high erosion hazard rating classes.

Both scales of maps, regional and watershed-specific, are critical to a long-term monitoring program. The regional Erosion Potential maps should be incorporated in the site selection process in order to ensure that sites representing a range of geologic risk are being evaluated. These can either be used ahead of time to identify general regions where monitoring should be conducted, or after voluntary monitoring has been conducted, to keep track of how many samples are being submitted from each risk class. Because these maps aggregate thousands of acres into general risk classes however, a finer stratification on a site-specific basis will also be needed to identify high-risk locations within otherwise low risk areas, and vice versa.

The watershed-specific maps provide the geologic and geomorphic backdrop for assessing the effectiveness of specific THP-related impacts on slope processes. Over the short term, correlations between transect evaluations and geologic risk are not expected to be high because geologic processes are controlled by abnormal, episodic events. But over the long term, statistical relationships should become evident over a regional scale. More directly, the watershed-specific maps identify high-risk land forms, and can be used to guide design of necessary mitigations during THP review. Similarly, over time, it may be possible to identify certain Rules that do not need to be applied in low-risk situations. Utilization and upgrading of geologic and geomorphic information should be a continuing aspect of the long-term monitoring program.

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[10] Portions of the Gualala River in Mendocino County, North Fork of the Mokelumne River in Amador County, and the North and South Forks of Caspar Creek in Mendocino County were evaluated.

[11] Planning watersheds are land-analysis units established by Rule which comprise approximately 10,000 acres each.

CONCLUSIONS AND CAUTIONS

The primary purpose of the Hillslope component was to develop field methods and obtain practical experience before commitments were made to a long-term program. This goal has been met.

The hillslope component has produced a set of evaluation procedures and data forms which can be used to evaluate timber operations in the field. Although changes will be made as experience is gained, a basic structure and rationale has been established. With certain cautions, the techniques present a structured and logical approach for evaluating individual Forest Practice Rules. The several pieces that have been developed can be applied individually or together in a variety of sampling approaches.

The cautions in using the hillslope forms include the following:

(1) **Training**: The procedures for completing the forms are not difficult, but do require explanation and field experience. Any person conducting the hillslope evaluations will need training and practice, and a strong commitment to follow procedures exactly as given if the data is to be included in the State's monitoring data base.

(2) **Experience with the Forest Practice Rules**: A working knowledge of the Rules is indispensable, especially for completing the implementation evaluation.

(3) **Interpreting qualitative information**: Although quantitative measures were developed wherever possible, portions of the evaluation techniques call for subjective ratings. Training and experience will help reduce variability between individuals, but will not remove it. Conclusions drawn about the effectiveness of a Rule must clearly state the variability expected from qualitative measures, and the basis on which the conclusion was drawn.

(4) **Time for evaluations**: By necessity, the forms call for a large amount of information. The time required to select the sample sites, conduct the office review of the file, reach the site, locate transects, conduct the effectiveness sampling, and complete the implementation evaluation can take several days per THP. At present, the information required on the forms appears to be necessary to draw satisfactory conclusions. Already compromises have been made to reduce field time, such as the Case 3 situation. With experience, however, it may be possible to further reduce the data required without a significant loss of analytical capability.

(5) **Limits of the data**: Taken alone, the hillslope component evaluates how well the Rules keep soil on the slope, and tracks the movement of sediment from a disturbed site to the margin of a

watercourse. This provides a proximate evaluation of the relation between forest practices and stream health, but does not answer the ultimate question of how well the Rules protect beneficial uses. That can only be determined by coupling the hillslope evaluation with a corresponding instream evaluation.

(6) **Quality Assurance/ Quality Control:** To ensure the integrity of the State monitoring database, standards must be established for all data that is to be included. Quality assurance and control (QA/QC) procedures should be developed for the various phases of data collection, entry and verification.

(7) **Testing Variability across Evaluators**: The forms and procedures developed in the Pilot were field tested by CDF foresters solely for the purpose of evaluating clarity, content and workability. No evaluation has yet been made of the variability in responses within and between different types of evaluators (e.g., industry RPFs, independent RPFs, Review Team agency representatives, members of the public). Such information is important for establishing the range of expected variability, so that the significance of differences can be determined. The MSG is currently considering a first step in this evaluation by contracting with Resource Conservation Districts to hire RPFs to conduct monitoring during the first phase of the long-term program. Responses from this group can be used to compare with the responses of others.

PART II. OPTIONS FOR A LONG-TERM MONITORING PROGRAM

Without a well-constructed plan it makes no sense to institute a monitoring program. Piecemeal, ad hoc programs that are built without clear objectives and logical rationale will not lead to usable conclusions and will only erode public confidence.

This does not mean that monitoring must wait until massive funding and staff commitments appear. Indeed, given California's fiscal picture, funding for resource issues will continue to be limited. The challenge is to construct a monitoring program for a forested area as large as California's, with its diverse landscapes, climate, and land-use history, that can provide reasonable results over a reasonable period of time, with the limited resources available.

The questions addressed in the 1993 MSG report regarding the structure of a long-term monitoring program are still relevant. These relate to ***What*** should be monitored, ***Where*** monitoring should be conducted, ***Who*** should do it, and ***When*** should it be done.

☐ **What should be monitored?**

- ***What:***

As developed in the Pilot program, the structural "pieces" that can be put together to form a long-term monitoring program include:

Hillslope Monitoring:

- Randomized, quantitative evaluations of Roads, Landings, Skid Trails, WLPZs and Watercourse Crossings
- Whole THP evaluation, including Large Erosion Site evaluation

Instream Monitoring:

- Various instream techniques for assessing the conditions and trends of the sensitive beneficial uses of water

The question is which components should be applied in what circumstances, and for what results.

The Linkage question: Hillslope and Instream monitoring

For those Rules related to water quality, the *proximate* goal is to keep soil on the hillslope, shade the water, and protect near-stream conditions. The Rules therefore address soil disturbance, erosion prevention, canopy retention etc. The *ultimate* goal of the Rules is to protect the beneficial uses of water, e.g., water supply and aquatic species, and not prevent the recovery of impaired uses. Depending on whether the proximate or ultimate question is being asked, hillslope monitoring can be conducted as a stand-alone program or coupled with instream analysis. A Hillslope-alone program addresses the proximate question of how well the Rules keep soil from reaching stream channels and protect near-stream conditions. The USFS began its monitoring program with most emphasis on hillslope monitoring, and is now beginning to report conclusions.

But taken alone, the hillslope component does not answer the ultimate question of "so what?" -- i.e., what is the impact of material that is discharged? Best Management Practices do not require zero discharge, and in fact require that costs and feasibility be considered. To the timber industry, the issue is whether current or proposed Rules incur costs greater than their benefit. To the public and regulatory agencies, the issue is whether the soil that is incidentally discharged occurs in large enough quantities to degrade beneficial uses.

Answering the "so what" question requires several orders of magnitude more information than that obtained through hillslope monitoring. To investigate impacts on beneficial uses, causal linkages must be demonstrated between specific Rules and resulting instream impacts. At a minimum, this means that: 1) impacts to aquatic populations, bed and channel conditions, and water quality must be identified and separated from the noise of natural variation; 2) the effects of current Rules must be separated from the legacy of impacts from historic practices; 3) the effects of timber operations must be separated from the effects of other land uses in the basin, climate, and offshore influences; and 4) the instream parameters and monitoring protocols must be carefully selected, since they are not standardized within the professional community, and it is difficult to compare results from different studies.

The point is that although everyone is interested in linking the condition of a stream to current practices, the answer requires a robust research design and commitment to carry it out. It is not something that can be casually attempted. For this reason, the concept of the "Demonstration Monitoring Watershed" has been put forward as one way to focus on the linkage question. In such a program, a limited number of watersheds would be identified in different regions of the state, and hillslope monitoring would be coupled with long-term instream assessment. This concept is described more fully in the full MSG report to the BOF (MSG, in progress). Perhaps one useful place to start would be to add a hillslope monitoring component to the watersheds already selected by some timber landowners for their own instream analysis.

In the meantime, however, it is reasonable to consider a stand-alone Hillslope Program as an initial phase of the long term program. This will provide at least an initial set of data and help in making decisions about a larger demonstration program.

☐ **Where should monitoring be conducted?**

How should sites be selected for hillslope monitoring?

- ***Where:***

  Options for conducting Hillslope monitoring include the following types of THPs (these are not mutually exclusive):

  - All THPs as they are submitted
  - All THPs within pre-designated Geographic Areas, e.g.:
    - -Within Demonstration Watersheds
    - -Within Sensitive Watersheds
    - -Within individual or groups of Planning Watersheds designated on the basis of geomorphic risk, intensity of past or future harvest, domestic water supplies, geographic distribution , etc.
    - -Within high-risk watersheds identified through other BOF rulemaking, e.g. Coho streams.
  - A Statewide or Regional Random Sample:
    - -Randomly selected THPs as they occur statewide or within a region
  - A Stratified Random Sample:
    - -Randomly selected THPs stratified by any characteristic: e.g., region, type of activity, level of risk

Issues and Considerations:

A recurring discussion throughout the MSG meetings concerned the question of where sampling efforts should be directed in a long-term program. One viewpoint stresses the need to evaluate practices across the state as a whole so a broad picture can be obtained with no disproportionate focus on any type of activity, region, or site. Operationally, a set of random numbers could be drawn at the beginning of each year and plans matching those numbers would be designated for monitoring activities.

The counter-view cites the extensive work that has already been conducted on erosion and harvest practices (see, for example, Rice, 1992). The conclusions of these studies consistently find that the largest proportion of problems stem from a small proportion of the landscape. The Critical Sites Erosion study, for example, found that "(c)ritical plots contained 65.4% of the erosion but occupied only about 2% of the road length and 0.5% of the harvested area"[12] (Lewis and Rice, 1989). The argument contends we should focus sampling on the areas already known to present problems, so that Rules can be improved and refined where most needed.

[12] This is particularly true for northwestern California where mass wasting processes are the dominant form of hillslope erosion. The CSES study was weighted towards this part of the state.

Both viewpoints have validity, and given enough time, would eventually come to the same conclusions. A statewide, unstratified random sample would eventually sample enough of the high-risk sites to demonstrate the types of problems found there -- but it may take a very long time for enough sites to be selected to form a minimum population for analysis. A more efficient approach would be a stratified random sample in which THPs would be randomly selected from defined categories of sites which have been ranked into low, medium and high risk classes. The stratification could be defined along a number of possible dimensions, such as erosion susceptibility, geologic type, intensity of past or planned harvesting within the watershed, the beneficial uses in the stream system, the ecoregion, or other criteria. The proportion of samples in each class could be distributed in some defined way, certainly with low risk sites included, and the data reported accordingly.

☐ **When should monitoring be conducted?**

- ***When:***
  Options include:
  - Within the life of the Timber Harvest Plan
  - Following at least one over-wintering period after the Completion Report
  - Following stressing events, whenever they occur (e.g., 5, 10, 25 yr. storms)
  - After the Completion Report, and for some subset, again after large stressing storms
  - Where shallow-seated landsliding is the dominant factor, 6-10 years after harvest
  - In conjunction with the long-term trend- or project monitoring in an Instream program

Issues and Considerations

In spite of good BMP compliance at the time of operations, the true effectiveness of a management practice may not become evident until time has elapsed and/or a stressing event occurs to test it. Without stress testing, there is no way to differentiate between the Case 1,2 and 3 situations.

Whatever long-term program is adopted, some provision should be made for visiting THPs after Completion Reports have been filed, and again after the first large storm of a specified magnitude to observe effectiveness. Even under a voluntary self-monitoring approach,

some form of agency "spot checking" will be needed to strengthen credibility. This means that permission for access will be needed, preferably through voluntary landowner agreements. Alternatively, statutory authority would have to be sought to obtain agency access beyond the current three-to-five year life of a plan.

In addition, funds and staffing would need to be built into agency budgets to enable response to episodic events whenever the need arises.

☐ **Who should conduct monitoring?**

- ***Who:***
  Options for hillslope and/or instream monitoring tasks include (these are not exclusive):
  - CDF Inspectors
  - A multidisciplinary team of state agency staff and industry
  - Self-Monitoring without state agency oversight
  - Self-Monitoring with state agency oversight
  - Private consultants or local public agencies
  - Members of the public, representing public interest groups

Issues and Considerations

- *CDF Inspectors*

Under this option, Forest Practice Inspectors would conduct the hillslope monitoring activities during inspections and over some post-completion period.

PRO: Inspectors have expertise in the Forest Practice Rules. This would be a logical extension of CDF enforcement responsibility, utilizing Inspector knowledge of the plan and geographic area.

CON: The public has stronger confidence in an interdisciplinary approach rather than CDF working alone. The current workload of Inspectors is already taxed, and new tasks would require additional staff and funding.

- *A multidisciplinary team of state agency staff with timber industry representation*

Under this option a team composed of CDF, RWQCB, DFG, and DMG specialists would be assigned to conduct both hillslope and instream elements. Adding a timber industry representative would provide an industry perspective, similar to the 1986 "208" team effort.

PRO: The team would represent a balance of interests and strengthen public confidence. Designated staff would provide dependable participation, continuity and expertise if built into a permanently budgeted program.

CON: Probably the most expensive option. Staff would need to be assigned from each agency to conduct statewide sampling on a routine basis and for quick-response following large storm events. Landowner cooperation and access would need to be resolved.

- *Self-Monitoring without state agency oversight*

This option has already been adopted by some timberland owners in response to internal management decisions, particularly for instream monitoring[13]. Private consultants or specialist staff have been hired to assess stream conditions either in a one-time, or trend monitoring program.

PRO: Well-structured industry studies will provide useful information to the extent they are made publicly available. The feedback loop created by self-monitoring assists industry foresters in improving future practices.

CON: Public confidence in self-produced data is low, unless Review Team agencies have been included during all phases of the study: planning, method selection, and review of results. Issues of quality control in data collection and perception of bias suggest that data collected without state agency review or oversight should not be included in the State monitoring database.

- *Self-Monitoring with state agency oversight*

Under this option the timber industry would conduct hillslope and/or instream monitoring with state agency oversight, and submit monitoring reports to CDF, similar to the self-monitoring programs that have been conducted by Regional Water Quality Control Boards for many years. Demonstration of Quality Assurance and Quality Control would be necessary before data were included in the state monitoring database. Spot checks would need to be conducted by agency staff to oversee industry monitoring practices.

PRO: Industry RPFs are most familiar with their own lands and can follow sites over the long term. Industry would bear a fair-share of monitoring costs. A feedback loop assists industry foresters in improving future practices based on self-monitoring results.

CON: Lack of public confidence in industry self-policing. Agency oversight and QA/QC for data collection and entry would help reduce public distrust of the program and its results. Training sessions for industry, perhaps via a "certification" program would be necessary. Penalties for data falsification and non-compliance could be considered. A dependable funding source would be required for resource agencies to provide spot checks.

- *Private consultants or local public agencies*

PRO: Private consulting firms with RPFs on staff could provide non-biased information on a long-term basis, for both hillslope and watershed components. Firms could be contracted with expertise in each geographic region. This may potentially have lower costs than hiring new state personnel. Non-industrial private timberlands could be monitored with this option.

Alternatively, local public agencies such as Resource Conservation Districts could be contracted to hire independent RPFs to conduct monitoring tasks.

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[13] Informal hillslope monitoring is also done following large stressing storms to determine where large-scale road repair work is required.

CON: Private consultants are less familiar with field application of the Rules. CDF has less control over consultants than employees, and it is difficult to write explicit contracts when tasks are uncertain and subject to change during program development.

For both private consultants and local agencies, funding sources must be identified. CDF must still provide liaison role with industry landowners for cooperation and access. RPFs and review team members lose the opportunity to benefit from the feedback loop in evaluating practices they have participated in developing. CDF participation would be needed for training and providing QA/QC.

- *Members of the public, representing public interest groups*

PRO: Incorporating members of public interest groups in either industry or agency monitoring programs would increase public confidence in the process and help develop a constituency for the conclusions. Public participation would educate the public in forest practices, and increase industry awareness of public concerns.

CON: Timberland owners have concerns over access and liability, and would want to retain control over participants. There is uncertainty over the commitment and reliability of low-paid or volunteer participants. Most volunteer participants lack experience in field application of the Rules, but could learn or not participate in Implementation evaluations. Training and corresponding funding would need to be developed.

PART III. PRELIMINARY RECOMMENDATIONS

The mutual benefits to the timber industry, the public and the state should be taken advantage of in designing the long-term monitoring program. Preliminary recommendations include:

1. **Consider a multi-faceted rather than a monolithic approach to a long-term program.**
   Recognize that :

   - the several Hillslope and Instream techniques can be combined in different ways to provide good information, within the recognized limits of each type of data.

   - Different parties can be used to collect data, as long as consistent standards are maintained.

   - Voluntary, cooperative, and regulatory approaches should all be encouraged in appropriate ways to contribute to the overall monitoring effort.

2. **Fiscal constraints limit the ability of any single party to be responsible for a long-term monitoring program, whether private, public or governmental.**

- The majority of data collection will need to rest on self-monitoring efforts conducted by timberland owners. Both individuals and industry associations should be encouraged to participate in voluntary monitoring efforts which will contribute to the State's monitoring database.

- To increase public acceptance of self-monitoring data, state agency participation will be needed to guide the location and timing of data collection, conduct training programs, conduct compliance checking, develop Quality Assurance/Quality Control methods, maintain the statewide database, and conduct data analysis.

- Self-monitoring efforts should be supplemented by other state-supported programs as staff and funding become available . These could include a multidisciplinary team program conducted by representatives from Review Team agencies, the timber and fishing industries, and other members as appropriate, assigned to specific geographic areas for specific purposes. This could also include monitoring programs conducted by CDF Forest Practice Inspectors for specific regions or purposes.

- As an additional means of increasing public education and acceptance of monitoring data, the timber industry should consider making outreach efforts to incorporate local community members and public interest groups in monitoring efforts. The BOF and CDF should provide assistance, especially in training programs.

- Private consultants are the least preferred option for data collection because it defeats the educational benefits and feedback loop to RPFs and agency staff gained from evaluating practices they themselves have participated in.

3. **Utilize a portion of remaining CDF Monitoring Funds to generate the first Hillslope data set.**

Voluntary self-monitoring by the timber industry rests on the willing participation of individual landowners, and data may be slow in coming. CDF should consider producing at least a limited set of monitoring results as a product of the current five-year program, utilizing existing funding.

- As a one-time, initial phase of the long-term program ("Phase I"), consider developing a contracting mechanism to pay private RPFs to conduct hillslope evaluations, up to a maximum

of three days per THP. The evaluation process should include: 1) the randomized quantitative evaluation, including a) selection of random sampling sites within each THP according to the required protocols, and b) completion of the Effectiveness and Implementation evaluations for at least two Road, Landing, Skid Trail, Watercourse Crossing , and Watercourse and Lake Protection Zone samples per plan; and 2) completion of Parts 1 and 2 of the qualitative Whole THP survey including the Large Erosion Site evaluation.

- THPs selected for Phase I should meet a similar set of criteria as the Pilot program, specifically:
  1) The THP has been filed, approved, and operated under Rules adopted by the BOF after October, 1991 (the most recent Watercourse and Lake Protection Rules);
  2) The plan has been through at least one winter and the stressing storms of January-March, 1995;
  3) The THP has been selected randomly, and preferably stratified by geographic region and level of risk, with each level of risk represented. Risk should be defined in terms of: i) the type of timber operation being conducted (e.g., tractor operations on flat vs. steep sites; operations within WLPZs vs. high on slope); ii) the inherent stability of the site (e.g., low vs. high erosion hazard rating; low vs. high geomorphic stability); and iii) the beneficial use at risk (e.g., presence and absence of domestic water supply, threatened or endangered species, proximity to salmonid habitat etc.).

- The offer of funding for RPFs should be considered as a one-time-only incentive for participating in the monitoring program, for purposes of producing the first data set. If access to randomly selected THPs for monitoring purposes is denied by the timberland owner, even with the incentive offer, then other mechanisms should be considered for generating the first set of monitoring information.

- As a test of the repeatability of the forms, for a few selected THPs, different RPFs should fill out the forms on identical sites using both the quantitative and qualitative approaches.

4. Training should be provided for persons involved in monitoring activities

This can be provided through the Interagency Watershed Academy or other BOF-approved program. A Hillslope Monitoring module should be developed and required for all persons conducting hillslope evaluations.

5. **Data included in the State monitoring data base should meet defined standards.**

Data should be subjected to QA/QC procedures, compliance checking, and be collected by trained individuals. Any data submitted for inclusion in the data base should be screened according to method of data collection, timing of samples, training of data collector, and opportunity for data validation by outside parties. Individual monitoring efforts submitted to the Board outside the data standards should be considered as part of the public record, but not included in the statewide monitoring data base.

6. **Increase the use of monitoring as a tool in THP review.**

Monitoring can already be required as a condition of THP approval under existing CDF authority. The techniques developed in the Pilot program now provide specific guidance for a consistent monitoring approach, and should be considered especially for certain types of circumstances: e.g., 1) to evaluate specific practices where there is disagreement between RPF and Review Team members concerning the risk of the practice; 2) to evaluate practices where the stream resources have already been degraded by historic activities and there is uncertainty over the effect of additional timber operations; 3) to evaluate alternative and in-lieu practices approved during THP review, etc.

7. **Emphasize the use of monitoring in watersheds designated as "sensitive" under the Sensitive Watershed Rule, or as "impaired" under Section 303(d) of the federal Clean Water Act.**

Where appropriate, consider using monitoring as one of the conditions applied to THPs within sensitive watersheds or within "impaired" water bodies, in order to test the special conditions and mitigations stipulated in the designation.

8. **Consider developing a "Demonstration Monitoring Watershed" program**

The criteria and methods for designating "demonstration" watersheds are still to be fully developed, but in general, a set of geographically-distributed watersheds would be selected for long-term evaluation of the linkages between forest practices and instream uses. The methods developed for Hillslope evaluations would be coupled with Instream techniques to monitor long-term processes, and conduct project -specific monitoring.

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