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**Recommendations for Evaluating the  
Effectiveness  
of the California Forest Practice Rules  
as the Best Management Practices (BMPs)  
for the Protection of Water Quality**

Prepared by

**The Best Management Practices Effectiveness  
Assessment Committee**

with assistance from

**William M. Kier Associates**

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## Executive Summary

This report proposes both policy and technical guidance for the State Board of Forestry's consideration in developing a program to assess how well its forest practice regulations work to prevent adverse impacts to water quality in lakes and streams. It was prepared by a volunteer panel, the Best Management Practices Effectiveness Committee or "BEAC", appointed by the State Board of Forestry. The committee was made up of persons knowledgeable about how the public's use and enjoyment of water can be affected by timber harvest activities, and how to measure such effects.

The report explains how compliance with the federal Clean Water Act requires the Board of Forestry to demonstrate to the public and water quality management agencies that its rules for regulating forest practices on private timber lands, together with the Department of Forestry and Fire Protection's program for implementing and enforcing such rules, represent best management practices for the protection of water quality. It identifies which rules and implementation activities should be evaluated to assure a dependable water quality monitoring program.

The BEAC's report draw **significantly** on advice that landowners, watershed associations, local water suppliers, foresters, hydrologists, biologists, environmental groups and other interested persons offered at a series of public meetings held throughout the forested regions of the state during 1991. The recommendations and concerns expressed at those public meetings are summarized, including the BEAC's response to them, in the report's first appendix. The appendices that follow provide additional information contributed by the public, together with further details regarding the forest practice assessment program.

This report was submitted to the Board of Forestry and the state's Interagency Monitoring Task Force in December, 1991. The BEAC trusts that it will prove valuable during 1992 as the Board formally completes and adopts a forest practice rules assessment program to meet both the letter and spirit of the state and federal water quality protection laws.

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# Part 1. The BMPs Effectiveness Assessment Program History and Purpose

## Foreword

This report is one step in a process by which the Board of Forestry (BOF) plans to establish whether or not its regulatory program for timber harvest on California's private forest lands protects water quality. To do so, the Board of Forestry is committed to establishing a monitoring program to demonstrate whether or not the Forest Practice Rules (FPRs) provide effective and adequate water quality protection sufficient to be regarded as "best management practices" (BMPs), as that term is used in the federal Clean Water Act. The report identifies the mix of approaches which can be taken to evaluate the water-protection effectiveness of these rules and the adequacy of the California Department of Forestry and Fire Protection's (CDF) implementation efforts.

## Background

The State of California, acting through its State Water Resources Control Board (SWRCB) and under the authority of the State's *Porter-Cologne Water Quality Act*, has the responsibility for the implementation of the federal *Clean Water Act* (CWA) under a delegation of authority from the U.S. Environmental Protection Agency (EPA). The SWRCB has, in turn, assigned the BOF and CDF first-hand responsibility for the control of nonpoint source water pollution (i.e., from dispersed sources, as contrasted to end-of-a-pipe discharges) which might arise from timber harvesting on private lands. (The U.S. Forest Service, Pacific Southwest Region is directly responsible for water quality management related to timber activities on National Forest lands in California. The Forest Service program for controlling nonpoint source pollution from

timber harvesting activities, which include both water quality monitoring and program implementation monitoring efforts, was certified by the EPA in 1981.)

Timber harvesting operations can adversely effect stream and lake water quality and the beneficial uses of these water resources. Domestic water supplies and cold-water fisheries habitat have been identified as being particularly sensitive to the effects of timber harvesting operations. In the short term, substandard timber harvesting operations involving log skidding, road and landing construction, and road maintenance can accelerate sedimentation, increase water temperatures beyond the tolerance of salmon and trout, and affect aquatic food resources. Studies on the Caspar Creek Experimental Watershed in Mendocino County, have shown little, if any, long term effect, while studies in British Columbia's Carnation Creek watershed have indicated that harvesting activities that occur without regard to the maintenance of channel stability may cause significant change in stream channel structure and degrade streams.

The federal Clean Water Act contemplates the control of nonpoint water pollution sources (NPS) primarily through the use of BMPs. In the case of regulated activities, (the State of California has regulated timber harvesting on private lands since the 1940's) it is necessary that the regulators demonstrate that their rules, together with the program for implementing those rules, are the "best management practices" available for the protection of water quality.

## Beneficial Uses

Protection of water quality includes those actions necessary to support the "beneficial uses" the public makes of streams and other water bodies. Beneficial uses include domestic and municipal water supply, preservation and enhancement of fish and wildlife, recreation, etc. for California's rivers and lakes, and are identified in the SWRCB Basin Plans. The quality of water needed to protect each beneficial use, expressed in physical or chemical parameters, is also delimited in each Basin Plan. Each beneficial use, together with the physical or chemical criteria necessary to protect it, becomes a separate "objective" or standard by which to achieve or maintain water quality.

When different beneficial uses demand differing physical or chemical criteria for their protection, regulators usually gear water quality safeguards to the "most sensitive use". Two of the most sensitive uses are cold-water fisheries and domestic water supplies. Understanding the beneficial uses and their corresponding protective criteria is key in designing any monitoring program - the program must be geared to measure conditions and parameters related to the objectives set for the particular beneficial uses.

Not until the BOF has demonstrated that the Forest Practice Rules and their implementation do, indeed, protect the beneficial uses of water may the EPA certify these rules as Best Management Practices. This is necessary to complete the forestry portion of the delegation of authority to the State for the implementation of the federal CWA.

## The Road to Certification

The journey the BOF embarked on seeking EPA certification of its forest practice rules as BMPs has proved a long one. Discussions among the EPA, State and the interested public concerning ways to assess the FPRs' effectiveness as BMPs began in earnest in 1977. After reviewing its rules and adding several new provisions relating to stream protection in 1983, the

BOF requested the SWRCB certify its rules as BMPs. In June, 1984 the SWRCB certified the FPRs as BMPs on the condition that the BOF would make further, specific improvements to its rules and that it would **develop a monitoring program** by which to assess the rules' effectiveness.

## The "208" Team Report

Resistance to the cost of the proposed monitoring program developed in some State quarters and the BOF decided to pursue a more qualitative approach. Known both as the "Forest Practice Rules Assessment" and "208 Team Report" (after the section of the federal CWA concerning NPS controls), this 12-month effort employed a team of four professionals (one each from the SWRCB, the California Department of Fish and Game, CDF and the forest products industry) to examine a sample of timber harvest sites in the field.

The team study was a snapshot of how the FPRs had been applied and whether, if applied correctly, the rules appeared to have protected water quality. In its 1987 report the team concluded that BOF's program, with certain improvements, could adequately protect water quality from timber harvesting activities. The improvements the team recommended included increased training for both foresters and timber operators, improved enforcement of the rules, specific rule changes and the **development of an ongoing rules-and-water-quality monitoring process.**

It is the continuing development of that rules-and-water-quality monitoring process with which this report is concerned.

## The Interagency Monitoring Task Force

The "208 Team Report" contributed to our understanding of the general effectiveness of FPRs for the protection of water quality, and made several recommendations for rule improvement. In 1988 EPA approved the delegation of the forestry water quality management program to the BOF but withheld

certification of the Rules as BMPs citing the twin need for rule improvement and establishment of a monitoring program. In response to EPA's continuing requests for an ongoing field assessment of Rules' effectiveness, an Interagency Monitoring Task Force was formed, consisting of representatives from BOF, CDF, SWRCB, the North Coast Regional Water Quality Control Board, Department of Fish & Game, and the timber industry.

The Interagency Task Force reviewed its options and concluded that the design of a monitoring program by which the BMPs' water quality protection effectiveness would be assessed was a subject of increasing public interest. The Task Force concluded that the design process should fully involve the public. The Task Force recommended that the BOF appoint a citizen's advisory committee to assist the public involvement process and employ outside help to assist the citizen's committee prepare recommendations to the Task Force and BOF.

### The BEAC

In early 1991 the BOF named a 18-member "Best Management Practices Effectiveness Assessment Committee", which, for obvious reasons, became known as the "BEAC". The BOF selected William M. Kier Associates, specialists in natural resources planning and management, to assist the BEAC and, following that, to assist the BOF in utilizing the BEAC's guidance. The BEAC met in late April, 1991 and drew up plans to involve the interested public in shaping the BMPs effectiveness assessment program. A brochure, "*Stream Reach*", explaining the purpose of the proposed forestry water quality monitoring program and announcing the dates and places of the BEAC's public meetings, as prepared and distributed widely with the assistance of the SWRCB, Fish and Game and the members of the BEAC.

The BEAC held seven public meetings in June and July, 1991 in communities with nearby timber harvesting: Fort Bragg, Eureka, Redding, Nevada City, Sonora, Santa Rosa and Santa Cruz. The public

provided over 100 oral and written testimonies which the BEAC considered, together with the record of the meeting discussions and their own professional judgments, in arriving at the recommendations presented in this report.

The BOF will consider the BEAC's report, together with the advice of the Interagency Monitoring Task Force, in adopting a monitoring work plan for the BMPs effectiveness assessment program.

### The Dynamic Rule-making Process

California's forest practice rules have been under constant political fire, since the state's present policy, the *Z' Berg-Nejedly Forest Practice Act*, was adopted in 1973. One reason for this increasing environmental concern is that California's population continues to grow steadily, much of it into the state's forested regions, and conflict between timber management and competing social demands for land and water seem to grow proportionally.

From not so much as a word regarding water quality in the forest practice statutes of the 1960's, both the Act and the rules now provide substantial guidance concerning water quality protection. Registered professional foresters (RPFs) who prepare timber harvest plans (THPs) in accordance with the BOF's FPRs, for the review and approval of CDF, must consider:

- ◆ site preparation in a manner which "prevents substantial adverse effects to soil resources and to fish and wildlife habitat, and prevents degradation of the quality and beneficial uses of water" (14 CCR 915); and
- ◆ roads and landings that shall be planned, located, used and maintained in a manner which " ... minimizes damage to soil resources and fish and wildlife habitat; and prevents degradation of the quality and beneficial uses of water" (14 CCR 923); and
- ◆ timber operations that shall be conducted to "prevent damage to residual trees, fish and wildlife habitat as identified in the THP or contained in the rules,

reproduction, and riparian vegetation; to prevent degradation of the quality and beneficial uses of water; and to maintain site productivity by minimizing soil loss" (14 CCR 914); and

◆ **watercourse protection** to "insure the protection of the beneficial uses that are derived from the physical form, water quality, and biological characteristics of watercourses and lakes" (14 CCR 916). RPFs must map all watercourses within the area of the timber operations for THP submittal along with specified watercourse and lake protection zones (WLPZs); and, importantly,

◆ **cumulative impacts** to determine whether the environmental effects of a particular harvesting project, even though minor in themselves, might interact with identifiable past or future projects -- on-site or downstream -- in ways that, taken together, cause "significant environmental impacts", as that term is used in the California Environmental Quality Act of 1970 (CEQA). BOF's explanation of this new FPR package ("Technical Rule Addendum #2") makes clear that the cumulative environmental impacts that THP preparers are to consider are the very watershed resources and biological values that are to be protected under the provisions of the federal CWA and the State's Porter-Cologne Act:

#### Watershed resources, including

- ▲ sediment effects
- ▲ water temperature effects
- ▲ organic debris effects
- ▲ chemical contamination effects and
- ▲ peak flow effects

#### Watercourse conditions, including

- ▲ gravel compaction
- ▲ pool filling
- ▲ streambed aggrading
- ▲ bank cutting and mass wasting
- ▲ stream channel downcutting and scour
- ▲ beneficial organic debris
- ▲ stream-side vegetation, and
- ▲ the recency of flood events

#### Biological resource considerations, including

- ▲ direct impacts on known rare, threatened, or endangered species or species of special concern;
- ▲ significant cumulative effects on the habitat or other life requirements of significant, known wildlife or fisheries resources;
- ▲ stream structural diversity (e.g., pool-to-riffle relationships)

In addition to the duties of THP preparers to recognize and provide for water quality protection needs, and for licensed timber operators to strictly follow THP provisions, CDF also has fairly broad discretion to deny or require modification of THPs that fail to provide adequate safeguards to water quality and the beneficial uses of water.



In developing the following recommendations for the monitoring program, the BEAC members relied heavily upon public comment and written testimony. Using their best professional judgment, the BEAC attempted to address the issues raised at the public meetings (see Appendix A for more detail) while at the same time providing a framework from which the BOF could develop a program which would satisfy Clean Water Act requirements.

The BOF will consider these recommendations, together with the advice of the Interagency Monitoring Task Force, in adopting a monitoring work plan for the BMPs effectiveness assessment program.

### **General Objectives of the Effectiveness Assessment Program**

The overall objectives of the proposed BOF forest practice rules assessment program are:

1. Determine whether those rules to be considered as BMPs are, in fact, being **adequately applied on-the-ground.**
2. Determine, both qualitatively and quantitatively, **whether properly applied forest practices meet applicable water quality standards** for use as 'Best Management Practices', adequately protect the most sensitive beneficial uses of water - domestic and municipal water supplies and coldwater fish spawning and rearing habitats.
3. Provide the results of the above determinations to the Board of Forestry and the public in a timely manner so as to contribute effectively to the Board's program for reviewing and, where necessary, **strengthening the rules' performance as BMPs.**

4. Acknowledge the evolution in the understanding of forestry-related water quality interaction and provide a **mechanism by which monitoring procedures and BMPs may be modified over time.** Periodically evaluate the monitoring program to determine its effectiveness in relation to its objectives.

### **Specific Objectives of the Effectiveness Assessment Program**

The monitoring program should:

1. Employ feasible monitoring methods for data collection and analysis that complement, rather than rely, upon long-term research-oriented methods.
2. Determine the changes, if any, in the quality of anadromous fish habitat in stream areas below timber harvest sites and logging roads where BMPs have been applied.
3. Include an outreach element to gather existing information and place priority on monitoring those sites where such information is available.
4. Place priority on monitoring sites involving domestic water supply watersheds and/or high value fisheries.
5. Target sites that exhibit the highest risk to sensitive beneficial uses.



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## Part 2. Water Quality Monitoring Program Issues and Recommendations

The key components of an effective water quality monitoring program are the WHO-WHAT-WHERE-WHEN-WHY and HOW. The BEAC has identified each of these categories as priorities of equal weight to be addressed in developing the final, detailed program. To see the relationship between the public's suggestions and the BEAC's recommendations, please refer to Appendices A and B.

The WHY of the program is the Objectives, and without these clear statements of attainable ends, the effort will flounder. The General and Specific Objectives of the Program are proposed in Part 1. Part 2 describes the other components and suggests the minimum criteria with which to develop a credible, effective and specific water quality monitoring program.

### Monitoring Implementation of Rules

The first essential step to monitoring the effectiveness of forest practice rules is to be certain that each rule is properly implemented. Initially, the appropriate rule must be included in the Timber Harvest Plan (THP) by the Registered Professional Forester (RPF), which is detected at the pre-harvest phase. Second, the rule must be adequately carried out in the field by the Licensed Timber Operator (LTO), whose performance is reviewed at the post-harvest phase.

To ensure uniform and correct forest practice compliance, a formal internal audit of all employees making forest practice inspections is presently conducted by the

California Department of Forestry and Fire Protection. The intent of the compliance inspections is to: 1) improve uniformity of rule application; 2) identify practices which are or are not providing adequate forest resource protection; 3) identify rules which need modification; 4) identify problems where rules need to be developed; 5) **identify practices which are or are not best management practices** (*emphasis added*); and 6) identify individual inspectors who are: a) performing at or above expected levels, and b) inspectors that are performing below normal performance standards, or c) inspectors that are not consistently applying departmental and Board of Forestry rules, regulations, and policies.

The focus of the inspections is on the entire spectrum of Forest Practice Rules (FPRs), not primarily on water quality. Today's competing issues of forest sustainability and wildlife habitat protection will continue to force a broader view than just water quality to this internal audit process. During the BEAC hearings, the public expressed concern that CDF efforts were not focused on rule implementation, and compliance. Commenters felt that compliance inspections were either not occurring at all, or if such inspections were conducted, they were not sufficient to ensure a satisfactory compliance with the rules. While the audit process has been occurring, the BEAC does not have enough information to judge whether the current CDF compliance process is sufficient or not. Since CDF's internal evaluation is also considered a personnel matter (see #6 above), audit report results are available to the public, only where there is no personnel action

involved. However, CDF does produce an annual summary of Enforcement Actions which indicates enforcement and compliance activities conducted against LTOs and RPFs.

Another approach to internal compliance monitoring is the one recently developed by the Pacific Southwest Region (California) of the U.S. Forest Service. Although still in draft form, the intent of this two-part evaluation process is to assess both BMP implementation and BMP effectiveness. First, administrative assessments of multiple BMPs for one timber sale are performed post-project. Secondly, on-site evaluations are performed to gather representative, objective data at the site of BMP implementation, based on 'ocular' estimates and actual measurements. Another key element of the draft program is the development of a database that allows for evaluation of the data collected from these assessments.

The Committee believes that a similar process should be used to supplement the current CDF compliance effort. Coordinating these on-site evaluations by the water quality monitoring teams (see below) set up on a regional basis, at a minimum, with those by the CDF Compliance Officers would help provide more quality assurance of BMP implementation, and would also develop implementation information which can be made publicly available. It is crucial to have an implementation process which can be accountable to the public.

**WHO: Type of people who should perform field monitoring**

To assure an objective and credible BMP effectiveness evaluation process, entities outside of CDF must also be involved in the monitoring effort. Greater integrity in the regulatory process will result from a split in responsibility, or a form of checks and balances, between the two tasks of: (1) developing BMPs and

approving THPs, and (2) monitoring their effectiveness and providing feedback into the regulatory loop. However, CDF staff must still be involved as one of the members of a monitoring team because of their knowledge of Forest Practice Rules as BMPs.

In addition to regional multidisciplinary members from interested agencies, we recommend the involvement of a local, public representative as essential to the composition of an effective monitoring team. Besides their knowledge of and concern for the local area, the public's participation will help improve communication and mutual understanding.

We recommend the following criteria be used to determine who should perform and be involved with field monitoring:

◆ Multi-disciplinary team composed of the same state agencies involved with the 1987 "208 report":

- ▲ California Dept. of Fish and Game (DFG),
- ▲ State Water Resources Control Board (SWRCB),
- ▲ California Dept. of Forestry and Fire Protection (CDF),
- ▲ Regional Water Quality Control Board (RWQCB) should also be added to this monitoring effort.

◆ A member of the public from the local area who has expressed concern and interest in the monitoring program should be allowed to become part of the monitoring team or at least an observer of the team's monitoring efforts;

- ▲ The public member should have resource management knowledge and be selected by the interagency team.

◆ A representative of the local water district and the local Resource Conservation District (RCD) could also be invited to observe the monitoring team in the field.

◆ Several teams will be needed, one in each high activity center or at a minimum each CDF Region.

- ▲ Monitoring methods should be "calibrated" between teams to ensure comparability.

The Registered Professional Forester (RPF) who prepared the THP should also be invited to observe the field monitoring on that site, if possible.

If the agencies' staffs are not able to fully participate in the monitoring team effort, another option is for them to issue a contract to qualified researchers, institutions, or consultants to ensure the program is carried out. The proposed water quality teams would report to the Interagency Monitoring Task Force.

#### **WHERE: Types of sites - location within site**

Not every THP or watershed in California can be monitored due to the numbers and cost. We initially need to decide the best places to sample, and then where to monitor within the THP site. Which BMPs should be monitored is separately discussed. Specific suggestions for watershed locations were offered during the public comment period (Appendix C), some of which could become selected sites if they meet the criteria described below.

The process used for CDF's internal compliance inspections first identifies THP sites having practices of particular concern for potential environmental damage (e.g., alternative or *in lieu* practices for road construction, tractor logging on slopes greater than 65%). These THP sites are then placed into a "pool" from which a certain number are randomly selected for further scrutiny. CDF's selection process should be coordinated, to the extent possible, with the sampling design adopted for the monitoring program.

The BEAC discussed the option of targeting only the "worst", or high risk, sites for monitoring as a way of making the most of limited time and funding. However, after much discussion, we concluded there is also need to know if BMPs function properly on more benign sites.

Recommended criteria for directing monitoring efforts are:

#### **Sampling Design:**

- ◆ Use a stratified random sampling procedure to include a sufficient number of THP sites at different levels of water quality risk for evaluation of forest practice rules across a wide range of conditions.

#### **Selection Considerations for THP Site to be Monitored:**

- ◆ Isolate timber harvest areas from other land uses to the extent possible.
- ◆ Use only THP sites accessible during winter.
- ◆ Include highly erodible soils and steep unstable areas, e.g.
  - ▲ sites with decomposed granitic soils;
  - ▲ coastal sites with high risk of mass wasting.
- ◆ Include off-site monitoring to document effects of other land uses, where needed.
- ◆ Include riparian and fish habitat areas.
- ◆ Incorporate local volunteers for help in off-site monitoring.
- ◆ Seek areas with some existing data, such as from USGS gauge stations, if possible; share databases.
- ◆ Those watersheds proposed by the public (*see Appendix C*) should be considered as candidate sites, if they meet the above criteria.

#### **Priority Areas for Collection of Water Quality Data within Site**

- ◆ Monitor above and below, or upstream and downstream from the THP/BMP area in question (= "baseline").
- ◆ Monitor Class III ephemeral streams as potential conduits of sediment.

- ◆ Important settings to monitor will vary by region, such as effects of elevation (i.e., snow, or rain-on-snow events).
- ◆ Monitor above and below domestic water supply intakes.

#### Landowner

- ◆ It is desirable to have approval and cooperation of landowners rather than make monitoring a condition of THP approval, but it may be necessary to compel participation on long-term monitoring sites.

#### WHEN: Timing, Frequency and Duration

When to monitor depends upon the method being used and the beneficial use being evaluated. For coldwater fisheries such as salmon and trout, the effects on certain critical times of their life cycle would need to be evaluated. Temperature problems from lack of adequate riparian canopy, for example, would be measured during their rearing phase in the summer to late fall. A primary indicator of the health of their habitat, macroinvertebrates, may need to be sampled at their different life stages during the year. However, winter storm runoff periods are the optimum time to measure the sediment load in streams, while the deposition of sediment can be measured during low flow periods.

The following criteria are recommended to evaluate when to sample:

#### Timing

- ◆ Relate sampling time to the evaluation method being used.

For soil erosion and sediment delivery evaluation, sampling should occur:

- ◆ During and after the winter period and before significant grass growth which can hide sediment deposits.

- ◆ During height or inclining peak of storms for observation of sediment movement.
- ◆ When saturated soil conditions have begun.

#### Duration

- ◆ Both short-term and long-term monitoring sites should be set up.
- ◆ Some sites should be monitored for prolonged time frame, at least until after a "significant" storm event to "stress" the BMP.
- ◆ Relate monitoring duration to the water quality impacts possible from the BMP at that site, e.g.
  - ▲ short-term monitoring (1-5 years) for riparian canopy effects from WLPZ practices;
  - ▲ long-term monitoring for slope stability in steep unstable watersheds with new roads, culverts or clearcutting.

#### HOW: Methods used, parameters to be measured

#### Methods

Most water quality parameters are measured quantitatively, such as stream temperature and turbidity. However, qualitative methods are also often used. Examples include periodic photo documentation of selected reference points upslope, instream, or in the riparian zone, and ocular estimates of stream gravel embeddedness. While qualitative data are quicker and easier to collect, their objectivity and reliability can be questioned unless concerned participants are involved and replicability can be demonstrated between different teams.

The U.S. Forest Service (California) has developed and field tested a draft evaluation process which includes on-site evaluations to gather representative, objective data at the site of BMP implementation, which are based on ocular

estimates and actual measurements. After review of the draft USFS standardized BMP evaluation forms and procedures, the BEAC recommends that they also be adapted and applied to the proposed monitoring effort on private timber lands. The BEAC also found that natural baseline studies would not be feasible, since these are too time-consuming and it would be difficult to find undisturbed areas.

Methods to use should include:

- ◆ Intensive on-site inspections of THP area, using a format similar to the draft USFS BMP Evaluation Program, at the minimum; coordinate timing with CDF's internal compliance inspections, where possible.
- ◆ Objective qualitative and quantitative measures, depending upon the BMP being evaluated.
- ◆ Simple and direct methods which are repeatable by a completely different team are best.
- ◆ Ocular estimates and general consensus alone are not sufficient; numbers are needed that any reasonably intelligent person could reproduce the results using the same devices.
- ◆ Low level aerial evaluation could be used for upslope movement.
- ◆ Photo sets to illustrate the types and rates of soil erosion for guiding uniform evaluation by monitoring teams.
- ◆ Photo points to record site condition over time.
- ◆ Analysis of trends and perturbations from data.
- ◆ Incorporation of results of research study areas into future adjustment of BMPs, where extrapolations are reasonable.

## Parameters to be Measured

Selecting which parameters to monitor depends on several factors: the beneficial use of concern, sensitivity to management activities, cost of data collection, and overall usefulness in analyzing water quality impacts. A newly-released EPA monitoring handbook offers practical guidelines for selecting the best methods to evaluate the effects of forestry on western streams (MacDonald et al, 1991). A set of tables from this handbook can be found in Appendix E. The public's suggestions covered most of the parameter options identified in this handbook.

Major categories to describe the water quality parameters used in monitoring are: Physical and Chemical, Sediment, Channel Characteristics, Aquatic Organisms, and Riparian Conditions.

We recommend the following criteria for parameter selection:

- ◆ Use the EPA MacDonald report tables to guide sampling for types of parameters to be measured, based on domestic water supply and cold water fisheries as the most sensitive beneficial uses. Priority parameters appear to be:
  - ▲ temperature (for fisheries habitat)
  - ▲ turbidity (for water supply)
  - ▲ aquatic invertebrates (for fisheries)
  - ▲ certain channel characteristics (for fisheries)
- ◆ Relate parameter and method to the water quality impacts possible from the BMP at that site. For instance, WLPZ-related BMPs should be evaluated for effect on temperature and cold water fisheries habitat;
- ◆ Evaluate fish rearing (i.e., pools) as well as spawning areas;
- ◆ Use data for some of the drinking water parameters previously submitted by water districts to the State Department of Health Services (DOHS); turbidity monitoring of

surface water drinking sources is now required of some water purveyors;

- ◆ Rainfall intensity is important to measure locally for interpretation of data (i.e., tipping bucket with data recorder); use local volunteer to check on equipment during winter;
- ◆ Include description of pertinent factors: stream flow, geology, unusual climatic effects, and natural erosion;
- ◆ Final choice of measures should use practicality and budgetary feasibility as additional criteria.

#### **WHAT: Specific Rules/BMPs to be monitored**

Many specific measures within the Forest Practice Rules have been proposed as Best Management Practices to protect water quality. While the list of all of these Rules is too long to include in this report, neither are they intended to be uniform throughout CDF's jurisdiction. Rules can vary according to Forest District (Coast, Northern, and Southern) as well as within a District where special rules or measures apply (e.g., Coastal Commission Special Treatment Areas; County Rules; "Grass Valley Creek Mitigation Measures" for decomposed granite soils). In addition, alternative and 'in lieu' practices were not uncommon in the past, as the 1987 "208 Report" noted. While non-standard practices are still allowed, they are unlikely to be used as frequently since each proposed change now has to be thoroughly "explained and justified" before it can be allowed.

The Forest Practice Rules are also currently in a state of flux. What is a Rule in 1991 may be substantially different in 1992. Recognizing the dynamic nature of these practices, the BEAC does not find such change to be a reason for postponing or avoiding monitoring. Instead, the more we can learn about the effectiveness of each erosion and stream protection measure, old or new, will be beneficial to our

understanding of how to protect water quality from the effects of forest practice activities.

The BEAC recommendations for priority rules to be monitored appears different than that of the public's (See Appendix B: Public Views Regarding Specific Forest Practice Rules) perception of problematic rules. The BEAC conclusion that roads and landings should be the first priority was based on their understanding of the scientific literature and professional judgment.

The BEAC recommends that the monitoring program:

- ◆ Evaluate all of the forest practice erosion and stream protection measures represented as BMPs. In order of priority, BMPs to be monitored are those which pertain to:

- ▲ Logging Roads and Landings
- ▲ Watercourse and Lake Protection
- ▲ Harvesting Practices and Erosion Controls
- ▲ Cumulative Impacts Assessment

#### **Program Implementation**

The BEAC's recommendations will be used as a foundation for the Interagency Task Force and the Board of Forestry to develop a fully implementable monitoring program. More technical detail will be added, and they will further define agency resources, funding and time constraints necessary to realize the program. Funding sources outside of CDF will also be explored.

#### **Trial Monitoring Effort**

A work plan for a one-year pilot monitoring study will be the product of the next level of involvement: the Interagency Monitoring Task Force and the Board of Forestry's Forest Practice Committee. Following public hearings and approval of

a final work plan by the Board, the pilot study could be implemented in 1992-1993 (See Appendix F: Chronology of Monitoring Program Planning). Based on the results of this one-year effort, the proposed BMP Effectiveness Assessment Program will be refined as needed, including the objectives. Within a few years, the program should become established as a routine effort.

### Data Management

How best to manage all of the water quality-related data which will be generated out of this monitoring program is an important concern. If not sorted coherently, analysis will be very difficult. The U.S. Forest Service's BMP Evaluation Process uses a standardized data storage and retrieval system. Electronic data entry forms are the same as the paper forms used in the field. A User's Guide is also available to help ensure consistency in data management. Standard summary forms can be generated, with yearly transmittal of summarized data provided to headquarters. Similar procedures should be developed for CDF's monitoring program.

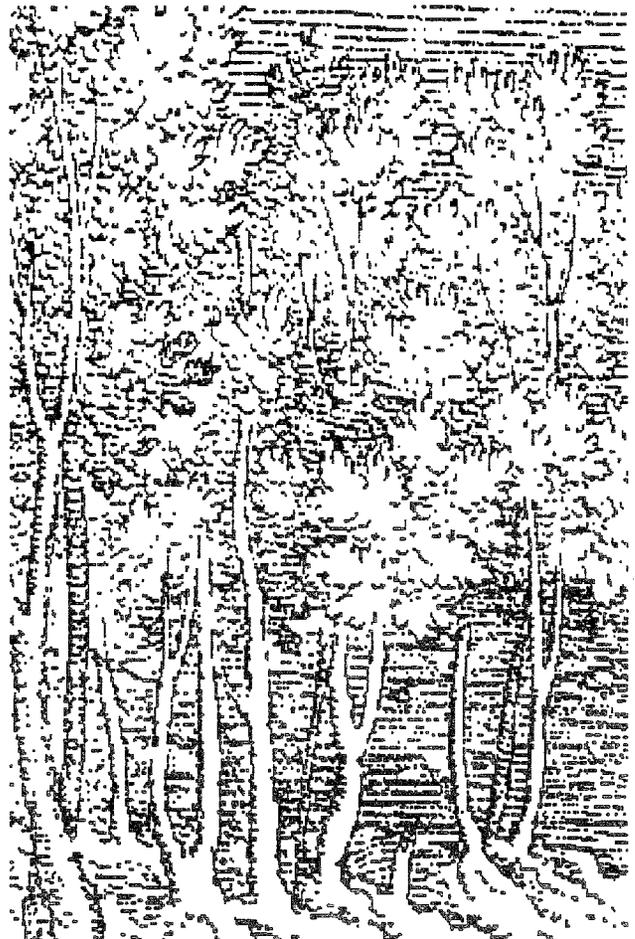
### Feedback Loop

Ensuring that everyone learns from the results of the monitoring effort is the function of effective "feedback loops". The results should be used to:

1. Help correct the problem in the field (BMP Implementation Phase);
2. Identify those BMPs which are not adequately protecting water quality;
3. Find ways to improve those BMPs deemed inadequate;
4. Inform the RPFs and the Board of Forestry about their effectiveness and the need for any improvements.

### The BEAC strongly recommends that BOF/CDF:

- ◆ Publish and distribute a public report of monitoring program findings, including those of the audit program, on an annual basis.
- ◆ Communicate the findings to user groups such as water districts and watershed associations, and the public through U.C. Cooperative Extension, professional societies, agency training programs, and public-oriented publications.
- ◆ Update and maintain a mailing list of public interest groups, watershed associations, water districts and other non-professional groups interested in forestry-related issues.



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## Part 3. Institutional Concerns

### Comment

As we noted earlier, BOF's road to certification of its rules and regulatory program as BMPs has been long and tortuous, the result of a steady increase in the California public's concern over the environmental effects of timber harvesting. It is with this in mind that we note here some central issues the BOF would do well to keep in mind as it develops the BMPs effectiveness assessment program further. These concerns were expressed by a number of public meeting participants, in one variation or another, at virtually every one of BEAC's public meetings.

### Control of the Assessment

*"... forestry is caught in the politics of symbolism and we are at a distinct disadvantage in this game because we have lost the public's trust."*

*- former CDF Director Harold Walt, 1990*

The testimony at BEAC's public meetings made clear that the products of a BMPs effectiveness assessment program which is controlled -- or even perceived as controlled -- by CDF would be suspect in the public's eyes. Therefore, while the burden of mobilizing the assessment program will fall on BOF and CDF, they will have to be extraordinarily sensitive to the need to involve others fully in the work -- not only the other responsible agencies, like Fish and Game and the regional water quality control boards, but members of the forestry-active communities, as well.

This concern goes not only to the water quality monitoring program, but to the monitoring of the rules' implementation, as well. Witness after witness at the BEAC hearings expressed doubt that the FPRs are being adequately applied and enforced in the field. The details of CDF's current implementation audit program are not fully available to the public because the agency regards them as personnel performance reviews first, and program reviews second. CDF will have to figure out how to separate the products of its forest practice rules audits in order to address the public's suspicion that the rules are not being followed in the field.

The options for involving the larger community-of-interest in the monitoring program have been identified in part 2 of this report.

### The Mixed-Use/Closed Watershed Issue

An oft-expressed concern of BEAC's public meeting participants was how timber harvesting effects on water quality could be separated from the water quality effects of other human, or even natural, events in a watershed. A corollary concern would be how will a broad-based monitoring team be able to gain access to lands wholly committed to timber production (i.e., without significant unrelated human activities) since special landowner permission and cooperation would be required. And if such landowner cooperation were available, how would it affect the monitoring results?

The first is clearly a legitimate issue, but it obviously should not deter a good-faith effort by the State to monitor timber harvesting and water quality in mixed-use watersheds. The second, the private watershed issue, deserves further serious consideration by both BOF and forest landowners. How, for example, will access to the monitoring site be assured over time without unduly burdening landowner rights? What is the likelihood of a forest landowner, having allowed access to monitor a timber harvest site, proceeding with that harvest in an "unaffected" way?

### The "Watershed Communities" Concept

One signal that came through loud-and-clear at BEAC's public meetings is that the residents of the forestry-active regions of the state are organizing increasingly around their shared interests in watersheds. Many of the meeting participants identified themselves as members of watershed associations, councils or coalitions. Some, but not all of these, were primarily concerned with protecting their community drinking water supplies from the effects of timber harvesting. Others expressed a wider view of their watershed interests, including the protection and restoration of native fish, protection against floods, and the maintenance of biodiversity.

These watershed-based interest groups will clearly be attentive players as the BOF proceeds to shape the BMPs effectiveness assessment program. Developing approaches for keeping these groups informed about the development of the program is strongly recommended.



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## **Part 4. Appendices**

- A. Summary of Public Concerns and BEAC Responses
- B. Public Views Regarding Specific Forest Practice Rules
- C. Watersheds Recommended for Monitoring
- D. Participants at BEAC's Public Meetings
- E. Tables from McDonald (EPA) Monitoring Guidance
- F. Chronology of Assessment Program Development

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## APPENDIX A

### Brief Summary of Public Comments Followed by the BEAC'S Response

#### General Program Design

For the general program design, public suggestions included:

- An objective and scientific approach which requires consistent sampling and analysis;
- A feedback loop to ensure inadequate BMPs are improved;
- The need to address unique watershed conditions and extrapolate results cautiously;
- Incorporation of a baseline monitoring program;
- Testing the program approach with trial monitoring run before approving;
- The need to establish threshold levels for degree of disturbance that will prevent water quality impairment.

**BEAC RESPONSE:** These ideas are largely incorporated into the Objectives in Part 1 and in relevant sections of Part 2. Most of these suggestions compare favorably with those presented in EPA's Water Quality Monitoring Guidelines (MacDonald et. al, 1991). Identifying "threshold levels" of disturbance, however, is more of a research task than a monitoring task and beyond the scope of this effort.

#### Monitoring Implementation of BMPs

The Committee was repeatedly told in the meetings that BMPs need to be properly implemented before water quality monitoring should begin. Some respondents believed that CDF or another entity should:

- Evaluate degree to which BMPs are accurately being implemented on the ground;
- Use ocular estimates;
- Compare CDF inspections with interagency BMP inspections;
- Review THP files, evaluate review team meetings, visit completed THP sites to see if BMP implementation is occurring; and
- Incorporate post-operation inspections into monitoring program.

**BEAC RESPONSE:** The Committee also agrees strongly that adequate implementation of BMPs is essential prior to monitoring. See Part 2 for a description of the internal BMP audit procedure which CDF currently uses. In addition, the BEAC is recommending the adoption of a process similar to the one the U.S. Forest Service (California Region) has developed. It is a two-part evaluation process to ensure BMP implementation: 1) administrative assessments of multiple BMPs for a timber sale which are performed post-project; and (2) on-site evaluations to gather representative, objective data at the site of BMP implementation, which are based on ocular estimates and actual measurements; these assess both BMP implementation and BMP effectiveness.

#### WHO Should Perform the Monitoring

A wide array of recommendations were made:

- Multi-disciplinary group
- A "208 type" review team:
  - DFG, CDF, SWRCB, industry
- Regional Water Quality Control Board (RWQCB)
- CDF/BOF
- University of California
- U.S. Geological Survey
- County
- Resource Conservation Districts
- Local community
- Local volunteers
- Private landowners/timber companies
- Loggers
- Consultants

Skepticism was expressed by many groups and individuals over CDF/BOF carrying out the actual monitoring in the field. Environmental and community groups, water districts, and individuals desired an entity which would have credibility and independence. Others felt that successful examples of self-monitoring already exist, such as by sewage treatment facilities.

**BEAC RESPONSE:** We believe that CDF/BOF should not be the only one monitoring potential water quality effects of timber harvesting. The "208-type" multi-disciplinary team was successful in developing a qualitative evaluation of BMP effectiveness in 1987 and teams of similar composition are recommended for the proposed monitoring program. In addition, a local public member should be allowed to participate on each of the teams, at least as an observer and also as a collector of data if proper training is available. See additional recommendations in Part 2.

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## WHERE Should Monitoring Occur

This section of concerns describes general areas or environmental settings which could or should be monitored. In addition, specific geographic areas, or site-specific streams, where water quality problems have reportedly occurred due to timber harvesting activities were identified by some speakers (see attached list).

The public listed these types of areas for potential monitoring:

Target more than problem areas; include a broad spectrum of sites;

Target suspect geologic provinces, soils, and slopes, i.e., highly erodible soils and steep, unstable slopes:

- Inner gorge / steep canyon,
- Headwater swale areas/zero order drainages,
- Small drainage rivulets,
- Stream buffer zones /filter strip /WLPZ,
- Intermittent and perennial streams,
- Fish habitat streams,
- At domestic water supply intakes,
- On borderline of landowner's property,
- Site-specific and watershed-wide points
- Where reliable data for 20 years or more exists (i.e., streamflow, water quality, fish population),
- Similar sites that use different harvesting methods,
- Separate out non-timber harvesting sources of problems,
- Site-specific only in research areas, i.e. Caspar Creek,
- Undisturbed forest ecosystems for baseline,
- Undisturbed riparian zone for baseline,
- Accessible sites.

**BEAC RESPONSE:** Most of these suggestions are incorporated into our recommendations. A broad range of sites with different water quality risks will be evaluated rather than just the "hot spots". Since undisturbed sites are rare, the "baseline" of current conditions is proposed to be used, which is above or upstream of the THP site and the BMP to be evaluated.

## WHEN: Timing, Frequency and Duration of Monitoring

Suggestions offered by the public for timing and duration of monitoring were:

- At Pre-harvest inspection
- During harvest
- At Post-harvest inspection
- Storm and major runoff events
- 5 years duration minimum

**BEAC RESPONSE:** We also recommend that monitoring for sediment movement is most critical during peak runoff periods. The timing of monitoring will also likely relate to the timing of the THP. In some cases, the roads are built in the first year and the harvesting may follow for one or two years after. Measurement of the impacts on beneficial uses requires the "before" condition to be evaluated, which may include the pre-harvest status. If the harvest is completed during the summer season, there may not be a test of the BMPs for the "during harvest" period (unless intense summer thunderstorms occur). Post-harvest inspection assumes that the BMPs have been successfully implemented before the beginning of the winter season, and represents the initial "after" condition. Duration of monitoring varies according to the type of BMP and the type of effect being monitored. In addition to 3-5 year short-term monitoring, some BMPs and sites will need long-term (5-10 year) evaluations.

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## HOW: Methods, Parameters to be Measured

### Methods

For consistency, it was suggested that the Monitoring Program: 1) train people to use the same monitoring techniques; and (2) use a uniform data format to aid comparisons. Some advocated that the Program should rely on the methods previously identified by SWRCB and DFG. The recommended water quality parameters by the public were:

### Instream

- Physical and Chemical
  - Stream temperature
- Sediment
  - Turbidity
  - Bedload
  - Suspended sediment
- Channel Characteristics
  - Channel cross-sections
  - Longitudinal/thalweg profile
  - Pool to riffle ratio
  - Bank stability
  - Bed material/gravel quality
  - Habitat typing
- Aquatic Organisms
  - Macroinvertebrates
  - Fish
- Riparian Conditions
  - Canopy opening (e.g., "RAPID" method)
  - Vegetation

### Upslope

- Soil Erosion
- Soil Quality
  - Microorganisms
  - Compaction
  - Organic matter

**BEAC RESPONSE:** The parameters to be selected should be based on their usefulness in monitoring the effects of forest management practices and in evaluating impacts to the beneficial uses of coldwater fisheries and domestic water supplies. We are recommending the use of an EPA water quality monitoring guideline handbook (MacDonald, 1991) for the selection of appropriate parameters, along with other criteria. Soil quality parameters, while very critical to forest site productivity, are not directly related to water quality monitoring so are not being recommended for evaluation through this program.

## WHAT BMPs Should be Monitored

Some specific existing practices were noted for priority attention:

- Roads and Landings
  - Water bars draining into fill soil
  - Road fill and side cast failures
  - Landings on steep slopes
  - Effects in slide-prone areas
  - Effect of re-use of old roads built before current Rules on sediment production
  - Long-term maintenance practices
- Water and Lake Protection Zones (WLPZs) stream buffer strips: is riparian zone adequately protected?
  - Amount and type of activity in a WLPZ
  - Effect of stream crossings
  - WLPZ width, depending on stream and site conditions:
    - ▲ Class III stream contributions
    - ▲ Fill material setback effectiveness
    - ▲ WLPZ erosion and sediment delivery; effectiveness as a filter strip
    - ▲ Stream crossings on Class III streams
    - ▲ Treatment of bare soil in WLPZs and adequacy of revegetation of cutover sites
    - ▲ Streambank and channel disturbance
  - Effects on stream temperature and bank stability
  - Domestic water supply protection BMPs
- Harvesting Operations and Erosion Control
  - Skid trails
  - Winter operations
- Cumulative Effects
  - Integration of erosion and water quality sections
  - Stream crossing placement and quantity
  - Identification of potential areas of concern

**BEAC RESPONSE:** All BMPs that potentially affect water quality will be monitored. The above listing, while not exhaustive, highlights some of the priority practices. Adequate implementation of the Rules must first be assured, which we also address in our recommendations.

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## APPENDIX B

### Public Views Regarding Specific Forest Practice Rules (FPR) and Technical Guidelines Which Affect Water Quality

#### Public Concerns

General issues regarding the Rules identified by the general public include:

- whether the FPRs are adequately implemented;
- whether current rules concerning WLPZs, domestic water supplies, roads and landings, and cumulative impact assessment sufficiently protect the beneficial uses of water quality;
- whether BOF policy regarding inspection and enforcement supports the water quality goals mandated by the CWA.

#### Specific Rules Which Affect Water Quality

##### A) WLPZs Rules

The Watercourse and Lake Protection Zone rules (WLPZs) were the highest priority amongst public concerns. The public comment expressed a clear understanding that riparian zones were critical to the health of both terrestrial and aquatic ecosystems. Commenters pointed out that well managed riparian areas prevent water quality impacts by maintaining stream temperature and bank stability, providing fish and wildlife habitat, and reducing sediment delivery to the watercourse.

The public is well-aware and agrees that riparian habitat maintenance helps to reduce the impact of timber harvest operations on water quality. According to public comment, however, the current WLPZ rules do not sufficiently protect riparian zones and otherwise reduce rule effectiveness for water quality protection. Specific WLPZ rules provisions identified as practices to monitor include:

- the extent and type of activity allowed in a WLPZ,
- WLPZ width according to slope class,
- WLPZ erosion and sediment delivery, and
- the adequacy of WLPZ rule implementation.

##### 1) Monitor the type and extent of activity in WLPZs

There is a great deal of concern over the extent of heavy equipment, skid trails, road and landings allowed in WLPZs. The monitoring program should respond to this concern by ensuring that WLPZ protections are a priority for THP approval, and will be enforced with post-harvest inspections.

##### 2) WLPZ Width

Amendments to the FPRs concerning WLPZs width and protective measures were adopted with an effective date of October 1991. Although rule changes strengthened WLPZs protection somewhat, slope classes were simplified. The public has expressed concern over the equivalent protection capabilities of the new widths, because slopes of 70% are no longer identified as a separate class with a larger WLPZ width. **There is a need to monitor such steep slope sites in order to identify whether slope class simplification influences buffer zone protection.**

Another area to monitor is the size of the WLPZs. The public feels there is a need to widen WLPZs in order to prevent soil movement into streams. There is no consensus on how wide such zones should be, or if these should vary according to stream classification or site-specific characteristics. **The monitoring program should determine how WLPZ width effectiveness varies under different stream classification and site-specific characteristics.**

The level of protection afforded Class III streams is another area the public considers a priority issue. Many commenters felt Class III streams need wider zones and year-round protection to reduce impacts to Class I and II streams. **The monitoring program should determine whether current measures are adequate to protect Class III areas and prevent downstream impacts to Class I and II streams.**

##### 3) WLPZ erosion and sediment delivery

FPRs that regulate activities which lead to WLPZ erosion and stream sediment delivery are considered extremely important by the public. Specific concerns to monitor include:

- how the number of stream crossings in Class III areas in a watershed affects WLPZ erosion rates;
- the treatment of bare soil in WLPZs;
- the residual vegetation in cutover sites; and
- disturbance at stream crossings during and after timber harvest operations.

#### 4) WLPZ rule implementation

Public comment identified a communication gap between the registered professional foresters (RPFs) who develop the THPs and licensed timber operators (LTOs) who carry out the plan. In addition, some commenters felt that watercourse classification by RPFs in THPs was inconsistent, and LTO knowledge of operations in watercourse protection zones was inadequate. **To remedy this, the monitoring program should determine whether WLPZs zones are appropriately classified and that LTOs understand the limitations imposed by such classifications.**

#### 5) Protection of Domestic Water Supplies

The monitoring program should evaluate the impact of timber harvest practices, under the current rules, on domestic water supplies, particularly in small water districts. Monitoring of such sites will help to resolve specific issues raised by the public concerning possible adverse effects of timber harvest on drinking water supplies, including whether:

- the THP process should identify water supplies beyond 100 feet of a THP site;
- wider watercourse protection zones in water supply are needed to protect water quality;
- more stringent mitigation measures are needed in these areas;
- more site inspections are needed in areas that are within municipal supply watersheds.

#### B) Roads and Landings

Properly designed and maintained roads and landings are critical to minimizing the impacts of timber harvest on water quality. According to public comment, the monitoring program should address:

- the identification and assessment of road fill and side cast failures, oversized landings on steep slopes, slide-prone areas, water bars draining into fill soil, and areas of off-road vehicle (ORV) use; and
- the amount of sediment that pre-existing roads (those built prior to the current rules) contribute when re-used.

#### C) Cumulative Impacts Assessment

Many commenters indicated that the cumulative impacts assessment process is not adequate or is inadequately implemented. Issues of concern included:

- where the erosion and water quality elements of a THP are not well integrated then cumulative impacts analysis will receive inadequate consideration;
- lack of critical information such as stream crossing placement and numbers; and
- whether THPs identify potential areas of concern, or if there is a need for a broader independent state assessment.

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## APPENDIX C

### Watersheds Which the Public Identified as Potential Monitoring Sites

#### Butte County

Paradise Lake  
Magalia Reservoir

#### Calaveras County

Mokelumne River

#### Humboldt County

Blue Creek  
Klamath River  
Mad River  
Mattole River  
Redwood Creek  
Sproul Creek

#### Mendocino County

Albion River  
Allen Creek  
Cook Creek  
Garcia River,  
Greenwood Creek  
Inman Creek  
Navarro River, North Fork  
Noyo River, Olds Creek  
Rancheria Creek  
Redrock Creek  
Rockpile Creek  
Salmon Creek  
Wages Creek

#### Nevada & Sierra Counties

Yuba River, South and Middle Fork

#### Santa Cruz County

Bracken Brae Creek  
China Grade Creek  
Laguna Creek  
Lompico Creek  
Porter Gulch Soquel Creek

#### Shasta County

Hatchet Creek

#### Siskiyou County

Beaver Creek  
Cottonwood Creek  
French Creek  
Klamath River  
Salmon River  
Scott River

#### Sonoma County

Coleman Creek  
Coop Creek  
Gualala River, Wheatfield Fk.  
Russian River, Duckbill Creek  
Hoboat Creek

#### Trinity County

Grass Valley Creek  
Trinity River, South Fork

**BEAC Response:** We recommend the use of stratified random sampling procedure that will include a sufficient number of THP sites at different levels of water quality risks and with some samples weighted to include such factors as existing information (see discussion, page 2-3). It is highly likely that several of the above areas may be selected as monitoring sites, where they meet the criteria.

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## APPENDIX D

### BEAC Public Involvement Meetings June and July, 1991

Participants by Category	Water Districts
<b>Environmental Groups</b>	Elk County Water District Jacoby Creek County Water District Mendocino County Water Agency
California Native Plant Society Citizens for Watershed Protection Earth First Forests Forever Mattole Restoration Council Mendocino Environmental Center Northcoast Environmental Center Rainforest Futures Seeds of Peace Sierra Club, Humboldt Chapter Sierra Club, Redwood Chapter Sierra Club, Santa Cruz Group, Ventana Chapter Sierra Club, Timber Task Force	<b>Local Agencies</b>  Monterey County Planning and Building Sonoma County Planning Dept. Trinity County Resource Conservation District
<b>Watershed Associations</b>	<b>State Agencies</b>  Calif. Div. of Mines and Geology North Coast Regional Water Quality Control Board
Albion River Watershed Protection Association Anderson Valley Watershed Association Greenwood Watershed Association Jacoby Creek Watershed Protection Association Protect Our Watershed (POW) Ramona Woods Watershed Association Redwood Coast Watershed Alliance	<b>Federal Agencies</b>  Klamath River Basin Fisheries Task Force National Park Service, Redwood National Park USFS, Stanislaus National Forest
<b>Community Groups</b>	<b>RPFs (see also Timber Companies below)</b> Michael Albrecht Harold Appleton Herb Baldwin Keith Chambers Will Dorrell Tim Feller Dan Fisher Donald Gordon George Hollister Dr. Douglas Jager Ron Monk Edward Murphy Joe O'Geen Pete Ribar Louis Sciocchetti Charles Sikora Bill Snyder Jack Sweeley Tom Thompson Michael Vogel Fay Yee
<b>Professional Groups</b>	
American Fisheries Society, Humboldt Chapter California Salmon and Steelhead Restoration Federation	

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## Timber and Logging Companies

Barnum Timber Co.  
Champion International Corp.  
Fiberboard  
Georgia-Pacific Corp.  
Joe Martin Logging and Trucking Inc.  
Louisiana-Pacific Co.  
Roseburg Resources Co.  
Sierra Pacific Industries  
Snider Lumber Products  
Tailshold Company  
The Chy Company

## Loggers

Craig Labby  
Eric Moore

## Consultants

Danny Hagans, Pacific Watershed Associates  
Susan O'Leary, HDR Engineering

## Individuals

Kathy Bailey, Philo (Mendocino Co.)  
Mitch Clogg, Mendocino (Mendocino Co.)  
Gerald and Earlyne Colter, Soquel (Santa Cruz Co.)  
Michele D'Amico, Soquel (Santa Cruz Co.)  
Steven Day, Leggett (Mendocino Co.)  
Eugene Drake, Aptos (Santa Cruz Co.)  
Frank Felch, Redding (Shasta Co.)  
Donald Gordon, Redding (Shasta Co.)  
MaryLee Grieg, Sonoma County  
Richard Harrington, Lompico (Santa Cruz Co.)  
Jim Holmes, Korbelt (Humboldt Co.)  
John Hooper, San Francisco (San Francisco Co.)  
William Houston, Korbelt (Humboldt Co.)  
Arthur and Dorothy Huntley, Manchester (Mendocino Co.)  
Josh Kaufman, Kneeland (Humboldt Co.)  
Clay Knopf, Sonora (Tuolumne Co.)  
Eric Kruger, Arcata (Humboldt Co.)  
Sharon Levy, Fort Bragg (Mendocino Co.)  
Margaret MacDonald, Little River (Mendocino Co.)  
Patricia Madigan, Mendocino (Mendocino Co.)  
Sara Moore, Boulder Creek (Santa Cruz Co.)  
Earl and Dorothy Myers, Soquel (Santa Cruz Co.)  
Peter Myers, Occidental (Sonoma Co.)  
Michael Riordan, Soquel (Santa Cruz Co.)  
Carl Schwarzenberg, Etna (Siskiyou Co.)  
Neil Sinclair, Santa Rosa (Sonoma Co.)  
Greg and Karen Templeton, Fieldbrook (Humboldt Co.)  
Susan Terrance, Forks of Salmon (Siskiyou Co.)  
Alan Wilson, Palo Cedro (Shasta Co.)  
Neil Youngblood, Arcata (Humboldt Co.)

## **APPENDIX E**

**Tables from "Monitoring Guidelines to Evaluate Effects of Forestry Activities on Streams  
in the Pacific Northwest and Alaska" (MacDonald, *et al.* 1991).  
by U.S. EPA, Region X - Seattle**

**Effects of Water Quality Parameters on  
Major Designated Beneficial Uses.**

Table 2. Qualitative assessment of the effects of water quality parameters on the major designated uses of water from forested watersheds in the Pacific Northwest and Alaska. 1 = designated use is directly related and highly sensitive to the parameter in almost all cases; 2 = designated use is closely related and somewhat sensitive to the parameter in most cases; 3 = designated use is indirectly related and not very sensitive to the parameter in most cases; 4 = designated use is largely unrelated to the parameter; V = relationship between the parameter and the designated use is highly variable.

Water quality parameters	Designated uses affected by water quality parameters						
	Domestic water supply	Agricultural water supply	Hydroelectric generation	Recreation	Warm-water fishes	Cold-water fishes	Biological integrity
<u>Water column</u>							
Temperature	3	4	4	2	3	1	1
pH	1	1	4	3	3	3	3
Conductivity	1	1	4	4	4	4	4
Dissolved oxygen	2	3	4	2	1	1	1
Intergavel DO	4	4	4	3	2	1	1
Nitrogen	2	2	4	2	3	3	2
Phosphorus	2	2	4	2	3	3	2
Herbicides and pesticides	1	1	4	2	3	3	1
<u>Flow</u>							
Peak flows	4	4	1	3	3	2	2
Low flows	2	1	1	2	2	2	3
Water yield	2	1	1	3	4	4	4
<u>Sediment</u>							
Suspended	1	1	1	2	2	2	1
Turbidity	1	2	1	1	1	1	1
Bedload	3	3	2	3	2	2	2
<u>Channel characteristics</u>							
Channel cross-sections	4	4	4	3	3	3	3
Channel width/width-depth ratio	4	4	4	2	2	2	2
Pool parameters	4	4	4	2	1	1	2
Thalweg profile	4	4	4	3	2	2	3
Habitat units	4	4	4	3	1	1	2
Bed material							
Size	3	4	4	3	1	1	1
Embeddedness	4	4	4	3	2	1	1
Surface vs. subsurface	4	4	4	4	2	2	2
Large woody debris	4	4	4	2	1	1	2
Bank stability	3	3	3	2	2	2	2
<u>Riparian</u>							
Riparian canopy opening	4	4	4	2	2	2	1
Riparian vegetation	4	4	4	2	2	2	1
<u>Aquatic organisms</u>							
Bacteria	1	3	4	1	4	4	3
Algae	2	3	4	1	2	2	1
Invertebrates	4	4	4	3	1	1	1
Fish	4	4	V	1	-	-	1

## Sensitivity of Water Quality Monitoring Parameters to Management Activities

Table 3. Sensitivity of the water quality monitoring parameters to management activities, assuming average management practices: 1 = directly affected and highly sensitive; 2 = moderately affected and somewhat sensitive; 3 = indirectly affected and not very sensitive; 4 = largely unaffected.

Parameters	Sensitivity of monitoring parameters to management activity								
	Forest management activities						Other management activities		
	Harvest	Road building and maintenance	Applications			Placer mining <sup>a</sup>	Hardrock mining	Grazing	Recreation
		Fertilizers	Herbicides	Pesticides					
<u>Water column</u>									
Temperature	1-2	3	4	3	4	2	3	2	4
pH	3	3	3	3	4	3	1	3	4
Conductivity	3	3	3	3	4	3	1	3	4
Dissolved oxygen	3	3	2	3	4	3	3	1	4
Intergravel DO	2	2	3	3	4	2	2-3	2	3
Nitrogen	2	3	1	3	4	3	3	1	3
Phosphorus	2	3	1	3	4	3	3	1	3
Herbicides and pesticides	4	3-4	4	1	1	4	4	4	3
<u>Flow</u>									
Peak flows	1-2	1	4	3	4	4	3	3	3
Low flows	1	3	3	3	4	4	3	2	4
Water yield	1	3	3	3	4	4	3	3	4
<u>Sediment</u>									
Suspended	1-3	1	3	3	4	1-2	1-3	2	3
Turbidity	1-3	1	3	3	4	1-2	1-3	2	3
Bedload	1-3	1	3	3	4	1	3	2	4
<u>Channel characteristics</u>									
Channel cross-sections	2	1	4	3	4	1	3	1	4
Channel width/width-depth ratio	2	1	4	3	4	1	3	1	4
Pool parameters	2	1	4	3	4	1	3	2	4
Longitudinal or thalweg profile	2	1	4	3	4	1	3	2	4
Habitat units	2	1	4	4	4	1	3	2	4
Bed material									
Size	2	1	4	3	4	1	3	2	4
Embeddedness	2	1	4	3	4	1	3	2	4
Surface vs. subsurface	2	1	4	3	4	1	3	2	4
Large woody debris	1	4	4	3	3	3	4	4	4
Bank stability	2	1	3	2	4	2	3	1	3
<u>Riparian</u>									
Canopy opening	1-3	2	3	1	4	2	4	2	3
Vegetation	1-3	3	3	1	4	3	4	1	3
<u>Aquatic organisms</u>									
Bacteria	4	4	4	4	4	4	3	1	1
Algae	1	3	2	2	4	1	3	1	3
Invertebrates	1	1	3	3	2	1	2	1	3
Fish	2	1	3	3	3	2	3	2	1

<sup>a</sup>Placer mining also includes sand and gravel extraction.

**Frequency and Cost of Data Collection  
by  
Monitoring Parameters**

Table 4. Frequency and cost of data or sample collection by monitoring parameters. L = low; M = medium; H = high; V = variable; NA = not applicable.

Parameter	Typical frequency	Flow conditions for sampling	Collection time	Equipment costs	Analysis costs
<u>Water column</u>					
Temperature	L-M	L	L	L	L
pH	L-M	L	L	L	L
Conductivity	M	All	L	L	L
Dissolved oxygen	L-M	L	L	L-M	L
Intergavel DO	M	V	L	M-H	L
Nitrogen	L-H	V	L	L	M
Phosphorus	L-H	V	L	L	M
Herbicides and pesticides	L	L-M	L	L	H
<u>Flow</u>					
Peak flows	H	H	M-H	M-H	H
Low flows	M	L	M-H	M-H	L-H
Water yield	H	All	M-H	H	H
<u>Sediment</u>					
Suspended	H	H	L-M	L	M
Turbidity	H	H	L	M	L
Bedload	H	H	M	M	M
<u>Channel characteristics</u>					
Channel cross-sections	L	L	M	M	M
Channel width/width-depth ratio	L	L	M	L	L
Pool parameters	L	L	M	L-M	L-M
Thalweg profile	L	L	M	M	M
Habitat units	L	L	M	L	M
Bed material					
Size	L	L	M	L	M
Embeddedness	L	L	H	L	L
Surface vs. subsurface	L	L	H	M	M-H
Large woody debris	L	L	M	L	L
Bank stability	L	L	L-M	L	L
<u>Riparian</u>					
Riparian canopy opening	L	NA	L-M	L-M	L-M
Riparian vegetation	L	NA	L-M	L	L
<u>Aquatic organisms</u>					
Bacteria	M-H	All	L	L	M
Algae	L-M	L	M	L-M	H
Invertebrates	L-M	L-M	L-M	L-M	M-H
Fish	L-H	L	H	M-H	M

APPENDIX F

Chronology of the Monitoring Program Development

<b>Date</b>	<b>Product</b>
April 1991	BEAC meeting #1
June-July 1991	Public Meetings in 7 areas
August 1991	Minutes and summary report of public meetings
September 1991	BEAC meeting #2
October 1991	Final Draft BEAC report
November 1991	BEAC meeting #3 Final BEAC report completed
December 1991	Submit Final BEAC report to Interagency Monitoring Task Force, and BOF's Forest Practice Committee (FPC)
January 1992	Interagency Monitoring Task Force and FPC review BEAC report
March 1992	Draft FPC/Monitoring Task Force Issue Paper
April 1992	Draft preliminary BEAP Monitoring work plan
May 1992	Finalize draft BEAP work plan
June 1992	Final Draft BEAP Plan to the BOF and Public
July 1992	BOF Hearing on Adoption of the work plan
Spring 1993	Pilot Monitoring Program begins