

Interagency Mitigation Monitoring Program

General Framework Report



May 1, 2006

**California Resources Agency
California Department of Forestry and Fire Protection
California Department of Fish and Game
California Geological Survey
Central Valley Regional Water Quality Control Board
North Coast Regional Water Quality Control Board**

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Executive Summary

Monitoring efforts conducted by the California Department of Forestry and Fire Protection (CDF) and the Board of Forestry and Fire Protection (BOF) over the previous decade have provided detailed information on California Forest Practice Rule implementation and effectiveness on randomly selected Timber Harvesting Plans. The Interagency Mitigation Monitoring Program (IMMP) is now being developed by a diverse group of state agency personnel, landowner representatives, and the public to provide information regarding forestry-related practices at sites where there is a high risk of impacts to water quality. The IMMP will use multi-agency teams composed of representatives from CDF, Department of Fish and Game (DFG), California Geological Survey (CGS), and the Regional Water Quality Control Boards (RWQCBs). It is anticipated that this team approach will provide a balance of interests for all the Review Team agencies and greater public confidence in the monitoring results.

CDF has received commitments from each of the four Review Team agencies, as listed above, to participate in both IMMP field and office work required to plan and conduct monitoring activities. When fully staffed, the IMMP will have three designated teams headquartered in Redding, Santa Rosa and Fresno, with primary goals of evaluating Timber Harvesting Plan (THP) program effectiveness and promoting information sharing and cooperative efforts within and among agencies. Field work will emphasize implementation and effectiveness monitoring of forestry practices applied at sites within a plan that pose a particularly high risk to water quality, including added mitigation measures and special plan requirements. Office work will entail selecting high risk sites, compiling the information collected from the field work, and communicating the results to field personnel. Plans (THPs and Nonindustrial Timber Management Plans [NTMPs]) with high risk sites will be selected for monitoring utilizing criteria agreed to earlier by the Review Team agencies, rather than using a random sample. Monitoring protocols applied in the IMMP will also be accepted by Review Team members, be repeatable so that the results will be verifiable, and will utilize a mixture of qualitative and simple quantitative approaches. To put the results of the IMMP in proper context, the IMMP teams will document the number of high risk sites relative to all of the sites evaluated in the program. In addition, a second phase of the Modified Completion Report (MCR) monitoring program using a random sample of the THPs will be implemented to provide context for the non-random IMMP.

A pilot IMMP project will begin during the summer of 2006 to test the proposed methodology and make needed refinements prior to implementing a full-scale program. The pilot will focus on watercourse crossings and the road segments that drain to crossings, since past monitoring work has shown that these are particularly high risk sites for sediment delivery to stream channels. Due to limits on current funding and staffing, the pilot project work will be conducted by two IMMP teams, with one team in the Coast Forest Practice District headquartered in Santa Rosa and the other in Northern Forest Practice District, working out of Redding. The Review Team agencies are currently assembling lists of potential plans for the pilot and investigating potential monitoring approaches. Following completion of the pilot project in one to two years, a final report will be prepared to document findings and recommend procedures for the long-term IMMP. Training programs will then be used to explain the final protocols, and a QA/QC program will be developed to determine repeatability of data collected in the long-term study.

Introduction and Background Information

The California Department of Forestry and Fire Protection (CDF) and the State Board of Forestry and Fire Protection (BOF) recognize the importance of implementation and effectiveness monitoring in determining whether the rules of the BOF and the Timber Harvesting Plan permit process administered by CDF are adequate to protect, enhance, and restore beneficial uses of the state's waters. Based on a strategy developed through the BOF's Monitoring Study Group (MSG), CDF and the BOF have participated in several hillslope and instream monitoring efforts since 1990 (BOF 2000). These efforts included a Pilot Monitoring Program (PMP) that operated from 1993 through 1995 to test procedures for hillslope, instream, and geologic monitoring (Tuttle 1995, Rae 1995, Spittler 1995, Lee 1997). Following the completion of the PMP, a long-term monitoring program was initiated in 1996. This program has included several cooperative instream monitoring projects and two state-sponsored hillslope monitoring programs that were conducted from 1996 through 2004.

The initial Hillslope Monitoring Program (HMP) ran from 1996 to 2002, with data collection by highly qualified, independent contractors (BOF 1999, Cafferata and Munn 2002). The first phase of the Modified Completion Report (MCR) monitoring program was implemented from 2001 to 2004, utilizing Forest Practice Inspectors to collect onsite data as part of required Work Completion Reports on plans inspected by CDF (Brandow and others 2006). Results from these two studies were similar and have been widely distributed to state and federal agencies, timberland owners, and the public. In general, implementation of California's Forest Practice Rules (FPRs) was found to be high, and erosion features were usually associated with improper application of the rules.

State and federal resource agencies and environmental organizations, however, have remained skeptical about the effectiveness of forest practice rules in adequately protecting beneficial uses of water in California and the other western states (Ice and others 2004). Reasons for such uncertainty in this state are based on the monitoring methods used by past studies (e.g., lack of information about both fine sediment delivery to streams during winter storms and in-unit mass wasting [Stillwater Sciences 2002]) and the lack of multi-agency participation in the monitoring process. Concerns have also been expressed about how monitoring results have been used in the public arena. As a result, there is general agreement that a new, more broadly-based approach is needed for onsite monitoring of water quality impacts from timber operations.

Options for collecting onsite monitoring data on non-federal timberlands in California have been described by Tuttle (1995). These include using: (1) private consultants, (2) CDF Forest Practice Inspectors, (3) a multi-interdisciplinary team of state agency staff, and (4) self-monitoring with or without state agency oversight. The HMP and MCR programs used options (1) and (2), respectively, and the Regional Water Quality Control Boards are currently using option (4) for monitoring requirements associated with Region-specific conditional waivers of Waste Discharge Requirements (WDRs) or general WDRs for silvicultural activities.

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The multi-interdisciplinary team approach has been used effectively in the past in California and other western states. For example, the “208” monitoring project evaluated 100 Timber Harvesting Plans (THPs) in 1986 using representatives from CDF, Department of Fish and Game (DFG), the State Water Resources Control Board (SWRCB), and the timber industry (SWRCB 1987).¹ Results from this monitoring project were used by the BOF to modify the FPRs for water quality protection. Advantages provided by the designated multi-interdisciplinary team approach include a balance of interests for all the Review Team agencies and greater public confidence. Designated staff can provide dependable participation and continuity in applying monitoring protocols. The main disadvantage is the relatively high cost of dedicating agency staff to multi-agency teams (Tuttle 1995).

In response to a recently adopted Memorandum of Understanding (MOU) between CDF, the SWRCB, and the Regional Water Boards, an interagency MOU Monitoring Workgroup was formed in 2003 to find ways of providing greater interagency cooperation and consistency in the application of monitoring requirements to timber operations. While final agreement was not reached on specific monitoring requirements for THPs, consensus was reached on agency monitoring goals, authorities, descriptions of the various types of monitoring, and what constitutes a threat to water quality (MOU Monitoring Workgroup 2005). North Coast Regional Water Quality Control Board (NCRWQCB) staff expressed the desire to have a cooperative monitoring program grow out of the MOU Monitoring Workgroup effort (BOF 2003).

Based on these identified monitoring needs and direction from the California Resources Agency for improved interagency cooperation, in the fall of 2004 CDF proposed forming a new Interagency Mitigation Monitoring Program (IMMP) to monitor impacts of timber operations on non-federal forestlands in California. The general framework for this program is outlined in the sections that follow.

Interagency Mitigation Monitoring Program Objectives

The primary goals of the IMMP are to provide a mechanism for interagency monitoring by the Review Team agencies, promoting cooperation between the agencies, and to collect data on the implementation and effectiveness of practices that past monitoring has shown to be the most likely sources of impacts to water quality. This project will build on the earlier HMP and MCR monitoring efforts. The IMMP will emphasize evaluation of high risk plans (i.e., non-random)² and the effectiveness of practices implemented at high risk locations within a plan to protect water quality.³ Some lower risk sites will be included as well, however, to determine if pre-determined high risk sites actually produce a larger water quality impact. Since it will be important to put the

¹ Outside of California, Montana has used an interdisciplinary team approach for monitoring BMP implementation and effectiveness since 1990 (Ethridge 2004).

² MacDonald (2005) has concluded that if the primary objective is to evaluate the effectiveness of BMPs for protecting water quality, then it makes more sense to focus the sampling on sites that are at higher risk, rather using than a random sample. Jim Baldwin, USFS-PSW Statistician, stresses, however, that it is imperative to know the proportion of high risk sites that occur in a population (J. Baldwin, USFS-PSW, Albany, electronic communication). “Plans” in this document refer to Timber Harvesting Plans (THPs), Nonindustrial Timber Management Plans (NTMPs), and Program Timber Harvesting Plans (PTHPs).

³ Higher risk sites are usually in close proximity to watercourses and/or located on steeper slopes.

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results of the IMMP in proper context, the number of high risk sites selected in relation to the total number of sites evaluated in the program will be determined. Designated high risk sites and other selected sites (possibly of lower risk) will be uniquely identified to facilitate data analysis. The IMMP will not be evaluating the implementation and effectiveness of individual FPRs related to water quality, as has occurred in the Hillslope and MCR Monitoring Programs.

The primary objectives of the IMMP are to:

- Provide a forum that allows interagency team members to cooperate and promote information sharing.
- Determine how often practices designed to reduce impacts to water quality at high risk locations within a plan are properly implemented (including but not limited to mitigation measures developed by the RPF and/or an interagency Review Team).
- When these practices are properly implemented, determine how often they are effective in protecting water quality on non-federal timberlands in California, where effectiveness refers to whether prescribed measures applied during the plan operations resulted in the intended conditions (MOU Monitoring Workgroup 2005).
- Provide feedback to the BOF, Registered Professional Foresters (RPFs), Licensed Timber Operators (LTOs), CDF Forest Practice Inspectors, other state and federal agencies, landowners, and the public regarding forestry-related practices at high risk sites that require improvement to protect water quality.

Interagency Mitigation Monitoring Program Fundamental Approach

The basic IMMP concepts that have been developed to date include:

- Using the Regional Interagency Teams to promote information sharing and cooperative efforts within and among agencies;
- Forming three designated monitoring teams in Redding, Fresno, and Santa Rosa composed of specified CDF, DFG, CGS, and Regional Water Board staff members, with commitments from each agency for providing the time required to participate in field and office work (i.e., Regional Interagency Teams);
- Providing compliance information as a feedback mechanism for agency managers, but excluding use of compliance monitoring for law enforcement;
- Focusing on high risk sites within THPs and NTMPs, rather than a randomly selected sample;
- Emphasizing implementation and effectiveness monitoring of practices applied at locations where there is a high risk of impact to water quality (including mitigation measures and special plan requirements);
- Using repeatable protocols;
- When possible, evaluating implementation following the installation of watercourse crossings and road drainage structures, but prior to the start of winter storms; and
- Evaluating effectiveness after at least one winter following installation of watercourse crossings and road drainage structures, but within the Erosion Control Maintenance Period (or acceptance of the stocking report, whichever is longer).

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Further details on the Designated Interagency Team approach include having:

- Three designated teams that include one specified member from each of the Review Team agencies (CDF, DFG, WQ, and CGS) for the IMMP monitoring evaluations; involvement of all the agencies is critical for proper evaluation of practices at high risk sites.
- The interagency teams as a mechanism to allow the state agencies to work together productively and widely distribute monitoring results.
- Management at each agency provide team members with sufficient time for participation in required field and office activities.
- The three CDF Monitoring Coordinators organize monitoring activities for the IMMP Teams in each CDF Forest Practice District (Coast, Northern, and Southern).

Selection of sites with a high risk of water quality impacts will be based on the results of both published research and past monitoring programs in California and the western United States. For example, there has been agreement at IMMP development meetings to date that watercourse crossings and road segments that drain to watercourse crossings are particularly high risk sites for sediment delivery to stream channels (Figure 1). This conclusion is supported by monitoring results reported by Cafferata and Munn (2002), MacDonald and others (2004), and the USFS (2004).

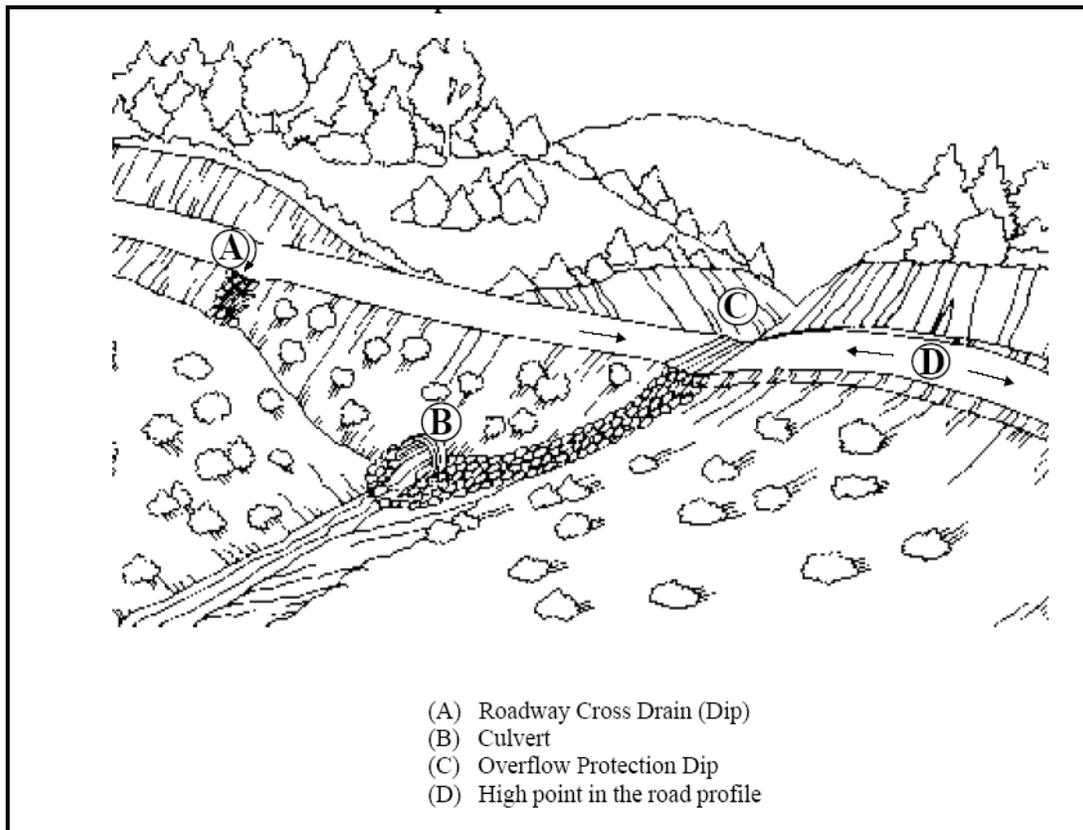


Figure 1. Diagram of a watercourse crossing and road segments draining to the crossing (from points A to D). Figure 7.11 in Keller and Sherar (2003).

Published research has shown that roads are connected to channel networks at stream crossings, as well as by road-induced extensions of the channel network, such as gullies (Montgomery 1994, Wemple and others 1996; Coe and MacDonald 2001, Coe 2004, Coe 2006). Coe and MacDonald (2001) reported that, for their studies in the central Sierra Nevada Mountains, connectivity with sediment sources occurs mostly at stream crossings. Therefore, initial IMMP pilot project work will focus on crossings and associated road segments (**see the detailed IMMP Pilot Project discussion that follows**). Using non-randomly selected crossing sites appears justified, since past studies of abandoned crossings have shown that 20 percent or less of crossings produce 50 percent or more of the delivered sediment (PWA 2005, Klein 2003, W. Baxter, CDF, Willits, per. communication).⁴ Additional high risk areas within plans that may be added in the future include unstable areas, riparian buffer areas, etc.

Monitoring approaches used in the IMMP must be repeatable so that results can be verified and trusted by all team members when any one member is not present for part of the field work. It is anticipated that a mixture of qualitative and simple quantitative approaches will be used. The IMMP development committee has investigated the feasibility of using a subset of 197 field questions that have been developed for the Regional BMP Monitoring Program and extensively field tested in 12 northeastern U.S. states (Ryder 2004, Ryder and Edwards 2005, Ryder and others 2005). These BMP monitoring protocols focus on areas of high risk to water quality—watercourse crossings and riparian areas—and BMP effectiveness is measured quantitatively for a given principle, avoiding the use of subjective ratings such as good, minimal, or inadequate (Ryder and others 2005). Because of the overlapping goals between the Regional BMP Monitoring Program and the IMMP, it is anticipated that a subset of 136 of these questions related to watercourse crossings and road segments that drain to crossings will be used for the IMMP pilot program (Figure 2).

Additional questions specific to California will be developed for testing during the IMMP pilot. A list of over-arching questions was agreed to by the IMMP development subcommittee as a structured method to logically develop the set of additional California questions needed for the pilot project. The new questions developed will be similar in structure and approach to the existing Regional BMP Monitoring Program questions (i.e., concise, performance-based, unambiguous, etc.). The agreed to set of over-arching questions for the pilot program are:

- **Are the current California Forest Practice Rules (FPRs) and additional Best Management Practices (BMPs) being incorporated into the installation, maintenance, and removal of watercourse crossings [implementation]?**
- **Do the current FPRs and additional BMPs prevent significant impacts to beneficial uses of water when applied to new, upgraded, removed, or abandoned watercourse crossings [effectiveness]?**

⁴ Mr. Baxter provided information on sediment yields after one overwintering period following abandonment of 33 crossings in the South Fork Caspar Creek watershed, located in western Mendocino County.

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- Are crossings and adjacent approaches designed and constructed for long-term use and in a manner that provides protection for aquatic habitats and water quality, including downstream and upstream beneficial uses?
- Are the underlying geology, geomorphology, and soils at the location of the crossing and its approaches contributing to mass wasting, soil erosion, or sediment delivery to a watercourse?
- Are watercourse crossings and adjacent road approaches contributing sediment to watercourses in amounts deleterious to aquatic life?
- Which crossing type performs best in different situations?
- Is the DFG 1600 agreement process reducing negative impacts to aquatic habitats?
- Are Class I watercourse crossings installed to allow fish passage?
- Do Class III watercourse crossings have an elevated potential to impact downstream resources?

While the IMMP pilot program will gather information towards answering these overarching questions, it is recognized that the pilot is not designed to develop specific information on the percent of properly functioning watercourse crossings.

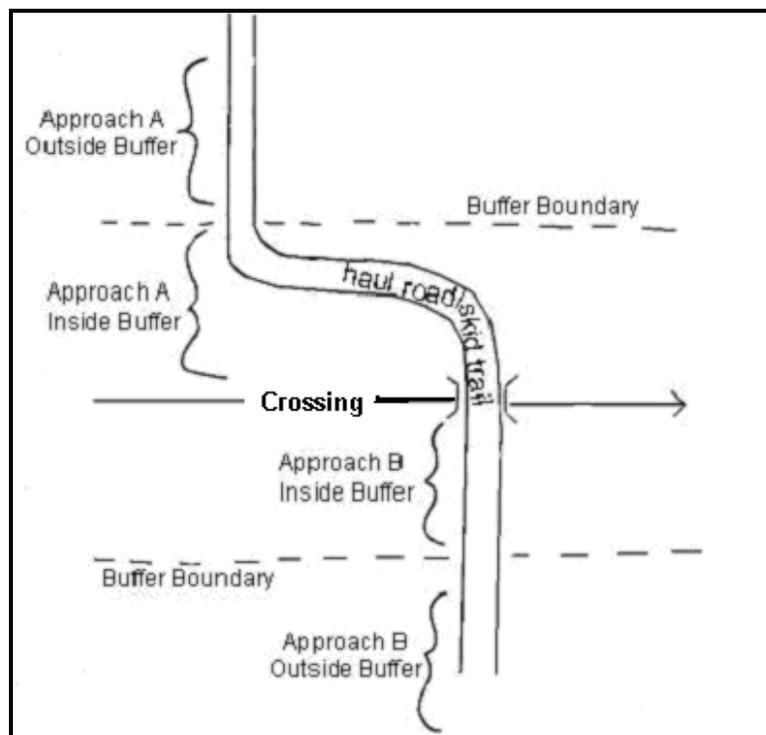


Figure 2. Diagram illustrating areas included for evaluation as part of the Regional BMP Monitoring Program protocol (road approach areas A and B inside and outside the buffer and watercourse crossing; Figure 1 in Ryder and others 2005).

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Figure 3. The IMMP Subcommittee developing a list of over-arching questions during the meeting held on March 21, 2006 at Willows. Photo provided by Mr. Clay Brandow, CDF.

Where possible, crossings will be observed by the interagency teams prior to the first winter period following construction to evaluate implementation.⁵ Then, following one to three over-wintering periods, the IMMP Team will evaluate the effectiveness of the same features that were rated for implementation. The team will also attempt to document the category of stressing storm(s) experienced between the implementation and effectiveness evaluations.⁶ Additionally, they will estimate the degree and duration of potential water quality impacts for sites with poor effectiveness. Both episodic and chronic erosion will be evaluated if a large stressing storm event has occurred during the Erosion Control Maintenance Period, but only chronic erosion will be evaluated if such a storm has not occurred.⁷ It is also anticipated that a subset of the sites previously rated for implementation and effectiveness will be re-evaluated following strong stressing storms (e.g., greater than 10-year return interval streamflows). This is particularly important for watercourse crossings, since they have a designed flow capacity (i.e., 50 or 100-year return interval flow event) that can be exceeded by unusually large storms. Failure also commonly occurs due to blockage by wood or sediment delivered to crossing structures associated with lower recurrence interval

⁵ Implementation inspections by the teams will have a lower priority than effectiveness inspections following the first winter period. Implementation evaluations may also be based on individual Forest Practice Inspections or individual agency inspections, held independently of the team.

⁶ Stressing storms can be rated using the following criteria (Cafferata and others 2005): very frequent (<1-5 yr recurrence interval), frequent (5-20 yr), moderately frequent (20-50 yr), and infrequent (>50 yr).

⁷ Lewis and Baldwin (1997) state in their statistical review of the HMP that implementation must be rated following completion of operations and effectiveness must be rated during a separate site visit following stressing winter storms to reduce observer bias. An attempt should be made to wait until strong stressing storm(s) have occurred before completing the effectiveness portion of the monitoring work.

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storm events (Flanagan 2004, Cafferata and others 2004). Re-evaluation of the subset of crossings following very large stressing storm events is expected to be possible during the Erosion Control Maintenance Period, eliminating the need for requesting access from landowners, as occurred in the HMP with mixed results.

IMMP Plan Selection Criteria

Selection of plans for review by the IMMP will be based on the level of threat to water quality from timber operations, with the likelihood of plan selection going up as the threat to water quality increases. Threat to water quality will be determined using a combination of the following factors (MOU Monitoring Workgroup 2005):

- Distribution and sensitivity of beneficial uses of water present
 - Presence of domestic water supplies
 - Presence of sensitive aquatic species (including listed species)
 - Close proximity of operations to other beneficial uses or sensitive receptors
- Current water quality conditions
 - Existing TMDLs or 303(d) listings
 - Lack of compliance with Basin Plan standards
 - Known or suspected watershed impacts
- Physical setting
 - Unstable geologic setting/steep slopes
 - Erodible soils
 - Existing landslides or active erosion sources
 - Roads or watercourse crossings in poor condition
 - History of intense land-disturbing activities and presence of legacy effects
 - Harsh climates and/or intense precipitation regimes
 - Sensitive stream characteristics and streamflow regimes
- Type and Scope of Proposed Activities
 - Intensive silvicultural and/or yarding methods
 - Site preparation and/or road construction
 - Winter operations and/or “in lieu” practices
 - Operations in or near watercourses and flood prone areas
 - current water quality conditions
 - physical setting (geology, soils, climate, etc.)
 - type and scope of proposed activities

Potential impact to state and federal listed species will also be used as a selection criteria. In addition to these criteria, IMMP plan selections will consider watercourse crossing-related issues documented during the review process.

Interagency Mitigation Monitoring Program Pilot Project

IMMP Pilot Project General Description

A pilot project will be used to test methods and make needed corrections prior to full-scale implementation of the IMMP (MacDonald 1994; MacDonald's 12 steps for a successful monitoring program are displayed in Figure 4). The focus of the IMMP pilot program will be on watercourse crossings and road segments that drain to the crossings, since past studies have identified these areas as high risk sites for water quality problems (includes new crossings, upgrades, removal/abandonment) [see Figures 5 and 6]. Crossings with special mitigations and/or greater risk will have higher priority for monitoring than crossings constructed or abandoned with standard FPRs, but the sample will not be limited to crossings with added mitigation measures.⁸ All types of crossings will be included (culverts, fords, bridges, temporary crossings, etc.).

The IMMP pilot will use a subset of the Regional BMP Monitoring Program questions, which uses performance-based standards to evaluate crossing effectiveness (Ryder and others 2005, Ryder and Edwards 2005). Also, a specific set of questions developed for California will be tested during the pilot. Possible items that may be included in the pilot project, in addition to the Regional BMP Monitoring Program questions and new California questions, may include field diagrams, digital photographs, and others to be determined.

Key steps in the design and execution of a monitoring project can be summarized as follows:

- (1) Propose general objectives;
- (2) Define approximate budget and personnel constraints;
- (3) Review existing data;
- (4) Define specific objectives and hypotheses;
- (5) Determine variables to be monitored, sampling locations, sampling procedures, and analytic techniques;
- (6) Evaluate hypothetical or a comparable set of real data;
- (7) Reassess the specific objectives and compatibility with available resources;
- (8) **Initiate monitoring on a pilot basis;**
- (9) Analyze and evaluate data from the pilot project;
- (10) Reassess monitoring objectives and compatibility with existing resources, and modify the monitoring project as appropriate;
- (11) Continue monitoring; and
- (12) Prepare regular reports and recommendations.

Figure 4. Flowchart for proper design of a monitoring project (MacDonald 1994).

⁸ For example, if crossings selected for IMMP work due to identified higher risk criteria (e.g., Class I watercourses, steep channel gradients, etc.) or special mitigation measures occur on larger THPs with multiple crossings, additional crossings may be monitored within the plan area to maximize the efficiency of the pilot monitoring process.

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To select plans with high risk sites, the IMMP team will take advantage of documentation in agency Pre-Harvest Inspection (PHI) reports and Review Team discussions. Input on potential “high risk sites” will be provided by the PHI team and Review Team to the CDF Monitoring Coordinator, who will then compile the information for the IMMP team. The final selection of pilot program plans will be made by the IMMP team. Factors affecting plan selection will include: number of crossings, practices proposed for those crossings, geology, erosion hazard rating (EHR), precipitation regime, etc. (see previous description of IMMP Plan Selection Criteria).

The pilot project will be used to develop and test monitoring procedures and protocols, as well as the selection process for plans with high risk sites. No set number of plans per Forest Practice District will be established for the pilot project.

The IMMP team will record field notes on problem areas (i.e., major sediment source areas) if observed while in the selected portions of the plan area to help develop monitoring procedures for IMMP efforts beyond the pilot project. If focusing on watercourse crossings and road segments that drain to crossings for the IMMP pilot works well, other areas of interest may be added at a later time. A time study will be included in the pilot project to document the length of time required to make field measurements and observations.



Figure 5. Example of a high-risk location for a watercourse crossing installation (7-foot diameter culvert installed as part of a THP in the Indian Creek watershed, Mendocino County). High-risk factors include: (1) the watercourse carried a large quantity of sediment and wood; (2) the stream gradient below the culvert was fairly steep; (3) the road turns at the crossing, requiring significant fill; and (4) the former crossing had failed. This crossing was designed to accommodate flow plus the sediment and debris that was likely to be transported during floods. Photo provided by Mr. Tom Spittler, CGS.

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Figure 6. Example of a higher risk temporary watercourse crossing recently installed as part of a fire salvage operation in the central Sierra Nevada. Photo provided by Mr. Clay Brandow, CDF.

IMMP Pilot Project Teams

Due to limits on current funding and staffing, the pilot project work will be conducted by two IMMP teams, with one team working in the Coast Forest Practice District (FPD) and the other in the Northern Forest Practice District (Figure 7). The Coast FPD team will be headquartered in Santa Rosa and led by **Anthony Lukacic**, CDF Coast Monitoring Coordinator. **Dave Hope**, NCRWQCB, **Dave Longstreth**, CGS, and **Richard Fitzgerald**, DFG, will also serve on the Coast FPD team.

Shane Cunningham, CDF Northern Monitoring Coordinator, will lead the Northern Forest Practice District pilot project team, which will be headquartered in Redding. **Angela Wilson**, CVRWQCB, **Dave Longstreth**, CGS, and **Joe Croteau**, DFG, will serve on the Northern FPD team.

IMMP Pilot Project Detailed Information

The pilot will use two phases: Phase 1 will involve all team participants from both the Coast and Northern FPDs for training and protocol development; Phase 2 will use separate Coast and Northern FPD teams for protocol testing and time study information.

In general, the number of crossings evaluated for a plan will be limited to what can be completed in one day (which will likely be several crossings). On a given plan, some of the crossings will probably be “low” risk, while some will be “high” risk. This information,

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as well as the degree of stressing storm experienced, will be recorded. A pilot project database will be developed and pilot data will be entered to test the database.

It is anticipated that training sessions will be held on state or university forest(s) (e.g., Jackson Demonstration State Forest, LaTour Demonstration State Forest, Blodgett Forest Research Station, etc.), and that landowner and public representatives will be able to participate.

IMMP Pilot Project Timeline

The Review Team agencies will assemble initial lists of potential plans for the pilot during the winter of 2006. During this time, the IMMP development team will also investigate potential monitoring approaches. It is anticipated that the pilot work will start during the first half of July in 2006. The pilot work is envisioned to last one to two years. Following completion of the pilot project, a final report will be prepared to document the findings and recommend procedures to be used for the long-term IMMP. Training programs will then be used to explain the final protocols. A draft timeline flow chart is displayed in Figure 8.

The initial IMMP pilot project training session will be held in mid-May at the Jackson Demonstration State Forest Learning Center, located at Camp 20 between Willits and Fort Bragg. Both IMMP pilot project teams (Coast and Northern FPD) will meet for this session, as well as the IMMP Subcommittee, for office and field training. A second training session for both teams is to be scheduled before July 1st in the Sierra Nevada Mountains.

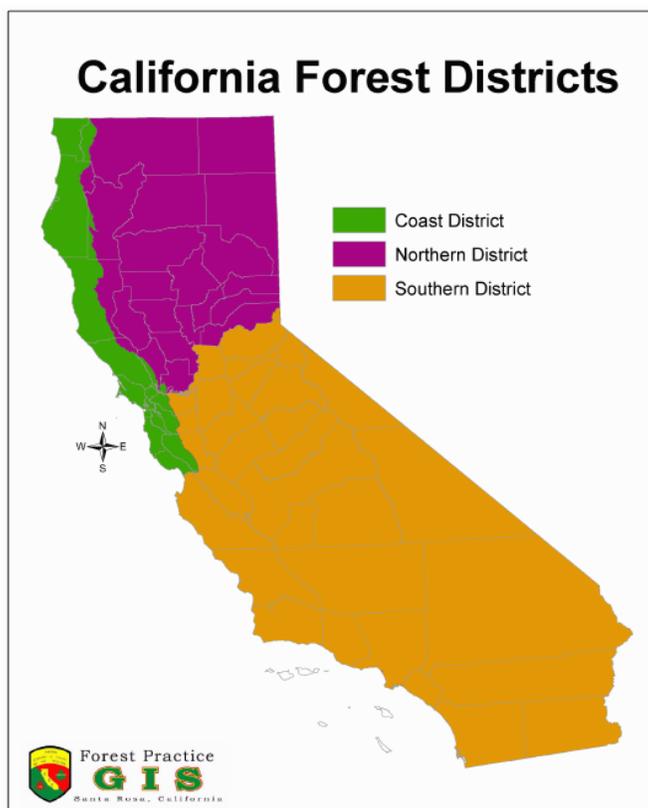


Figure 7. CDF's Forest Practice Districts in California.

DRAFT IMMP TIMELINE

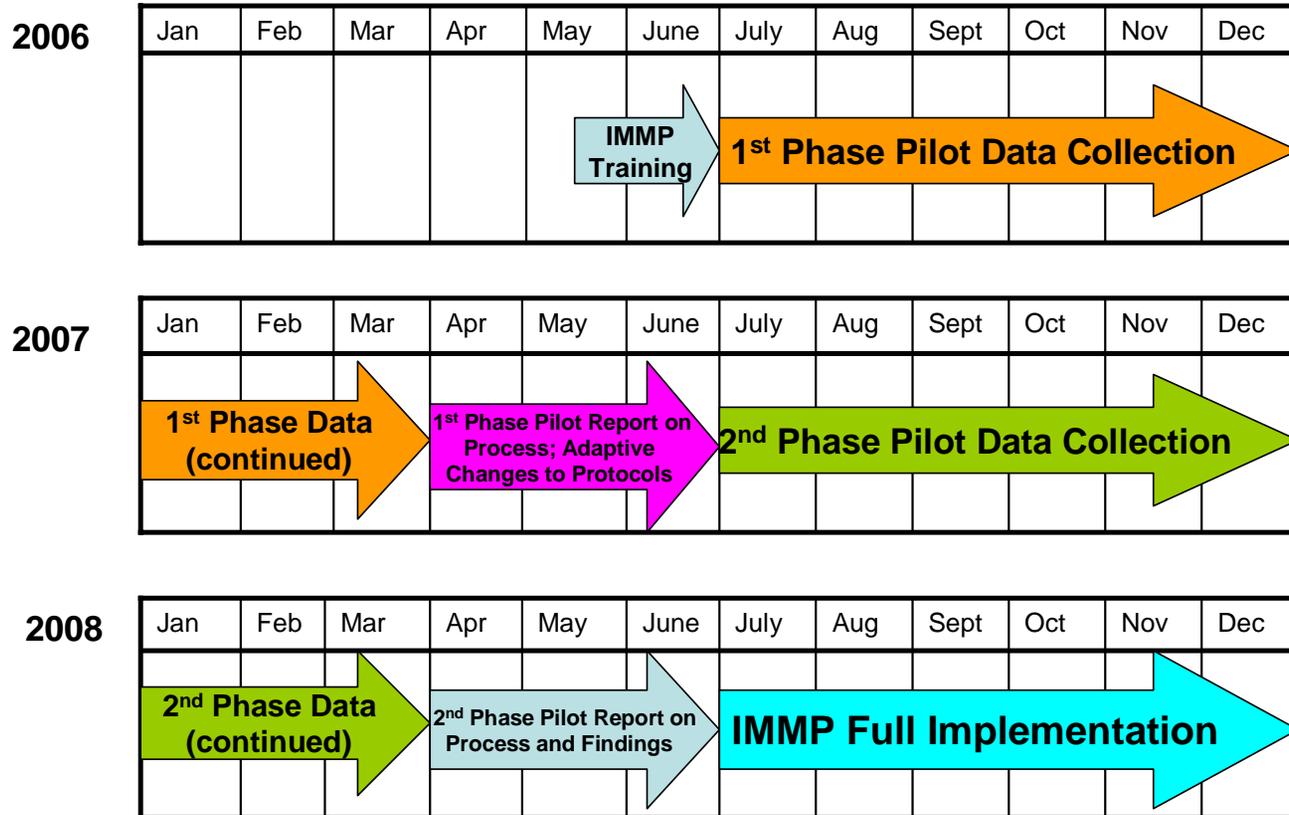


Figure 8. Draft IMMP timeline flowchart.

IMMP QA/QC, Training, Database Development

Development of IMMP quality assurance/quality control (QA/QC) and training programs will follow completion of the pilot project, when field protocols have been completed and thoroughly tested. A primary component of the QA/QC effort will be to test the repeatability of the selected IMMP pilot protocols. The Regional BMP Monitoring Program goal is to have an overall replication rate of 90 percent (Ryder and Edwards 2005). This appears to be a reasonable goal for the IMMP as well. Training will be an important component of the IMMP following the development of the protocols during the pilot project. Work on the IMMP database will commence during the pilot project. The existing database and queries under development for the Regional BMP Monitoring Program (Ryder and others 2005) will be utilized to the extent possible.⁹

Relationship to Other Monitoring Programs

While the IMMP will help determine the implementation and effectiveness of practices at high risk locations for sediment delivery for a non-random selection of plans in California, it cannot answer all relevant monitoring-related questions. Rather, it will fit within a set of monitoring projects (Figure 9). Complementing the IMMP will be a second phase of the Modified Completion Report (MCR) monitoring program that will provide context for the non-random IMMP. This second phase MCR program will begin in 2006 on a random sample of THPs located throughout the state. CDF Monitoring Coordinators in Redding, Santa Rosa, and Fresno will also oversee the second phase of the MCR project. Data will be collected by CDF Forest Practice Inspectors, as in the first phase (Brandow and others 2006); the road sampling procedure will be made more repeatable; and there will be a greater emphasis on participation from the state Review Team agencies.

Also complementing the IMMP are several instream cooperative monitoring projects that are evaluating the overall effectiveness of the FPRs.¹⁰ These projects are occurring at Caspar Creek (Mendocino County), Wages Creek (Mendocino County), Judd Creek (Tehama County), and Little Creek (Santa Cruz County). At the other end of the monitoring spectrum, CDF Forest Practice Inspections provide a large amount of data about implementation of the FPRs, many of which relate to water quality protection. CDF, along with other state agencies (DFG, CGS, and Regional Water Boards), conducts Pre-Harvest Inspections (PHIs) of proposed harvest areas to determine if plans are in compliance with the Forest Practice Act and FPRs. During PHIs, additional mitigation beyond the standard FPRs are often recommended based upon site-specific evaluations. CDF then conducts field inspections during active timber operations and post-harvest inspections when logging is completed to ensure that the plan and FRPs are properly implemented.¹¹ Violations of the plan and FPRs are noted, and appropriate legal actions are taken to correct these deficiencies. This information is entered into the CDF Forest Practice System (FPS) database, which allows queries showing the number of violations associated with different water quality-related rules.

⁹ According to Mr. David Welsch, USFS Northeastern Watershed Area Team Leader, the Regional BMP Monitoring Program queries should be available by July 2006.

¹⁰ This is occurring through long-term trend monitoring or through THP-scale effectiveness monitoring.

¹¹ Additionally, CDF's Audit Program, as detailed within the CDF 5000 Handbook, provides implementation and effectiveness information.

Summary

It has been 20 years since the designated interagency team approach has been used in California to collect forestry-related monitoring data. The IMMP outlined above has a high likelihood of being successful, since California's state Review Team agencies will be cooperating to collect water quality-related monitoring information. The process to be used is still evolving, and will be developed during a one to two year pilot effort that will take place both in the Coast Range and Sierra Nevada Mountains. Performance-based standards to determine practice effectiveness will be emphasized during the pilot project. A report will be prepared to document the findings of the pilot project and to recommend procedures to be used in the long-term program. Training programs will then be developed to explain the final protocols and a QA/QC program will be used to determine repeatability of data collected in the long-term study.

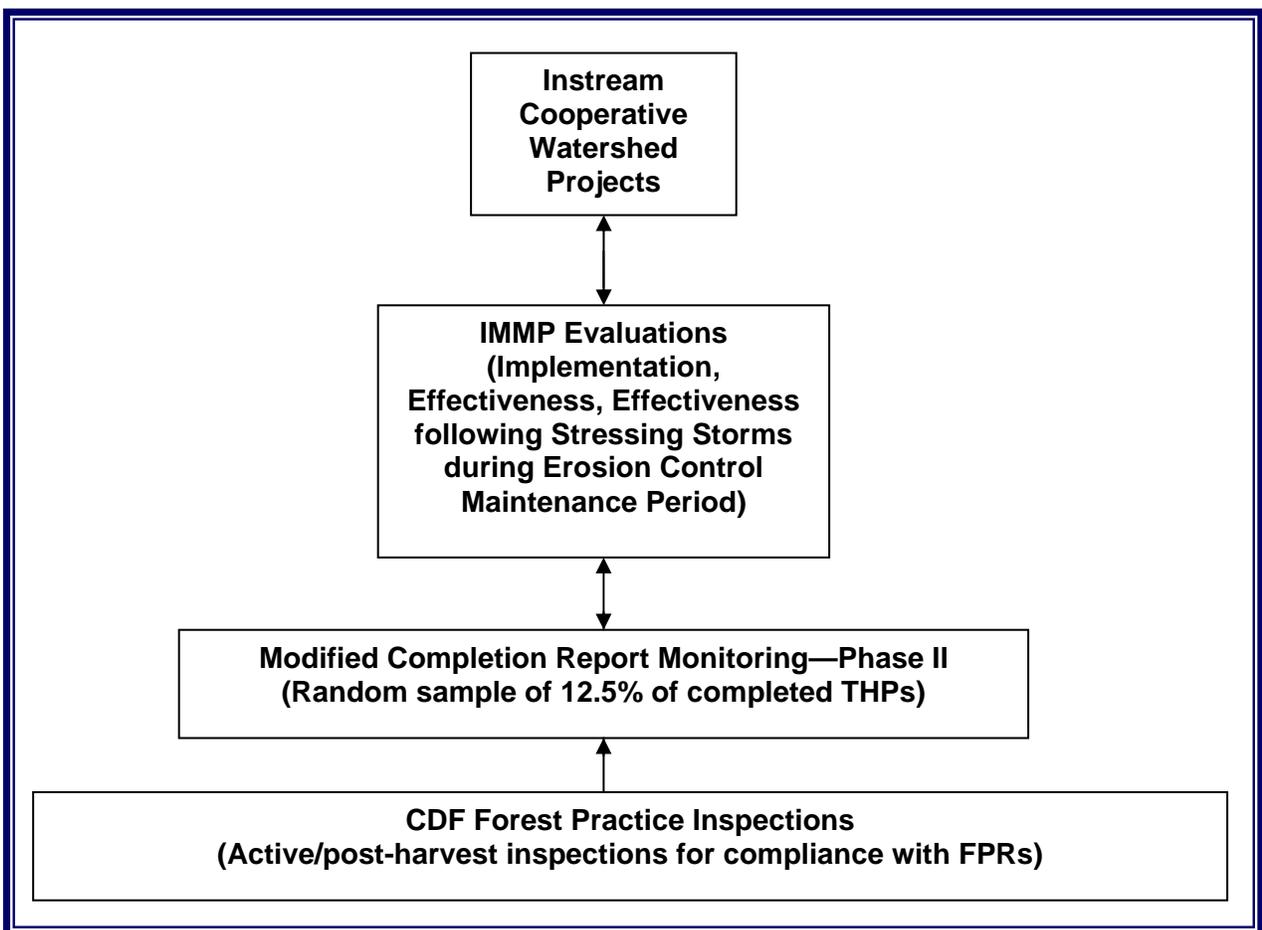


Figure 9. Diagram showing the relationships between various CDF/BOF/MSG monitoring-related programs (modified from a diagram developed during USFS BMP Evaluation Program discussions held in Corvallis, OR, 17-19 August 2005, led by Dr. Lee MacDonald, Colorado State University).

References

- Brandow, C.A., P.H. Cafferata, and J.R. Munn. 2006. Modified completion report monitoring program: monitoring results from 2001 through 2004. Monitoring Study Group Draft Final Report prepared for the California State Board of Forestry and Fire Protection. Sacramento, CA. 85 p.
- Board of Forestry and Fire Protection (BOF). 1999. Hillslope monitoring program: Monitoring results from 1996 through 1998. Interim report prepared by the Monitoring Study Group (MSG). Sacramento, CA. 70 p. Found at: <http://www.bof.fire.ca.gov/pdfs/rept9.PDF>
- Board of Forestry and Fire Protection (BOF). 2000. Monitoring Study Group Strategic Plan. California State Board of Forestry and Fire Protection, Sacramento, CA. 24 p. Found at: http://www.bof.fire.ca.gov/pdfs/MSG_Strategic_Plan_draft5.pdf
- Board of Forestry and Fire Protection (BOF). 2003. Monitoring Study Group meeting minutes, August 14, 2003, Arcata, California. Found at: <http://www.bof.fire.ca.gov/pdfs/MSG%20August%202003.pdf>
- Cafferata, P., M. Berbach, J. Burke, J. Hendrix, R. Klamt, R. Macedo, T. Spittler, K. Vyverberg, and C. Wright-Shacklett. 2005. Flood prone area considerations in the coast redwood zone. Final Report of the Riparian Protection Committee. California Department of Forestry and Fire Protection. Sacramento, CA. 67 p. Found at: http://www.fire.ca.gov/php/rsrc-mgt_content/downloads/RiparianProtComWhitePaperfinal.pdf
- Cafferata, P.H. and J.R. Munn. 2002. Hillslope monitoring program: monitoring results from 1996 through 2001. Final Report submitted to the California State Board of Forestry and Fire Protection. Sacramento, CA. 114 p. Found at: http://www.bof.fire.ca.gov/pdfs/ComboDocument_8_.pdf
- Cafferata, P.H., T.E. Spittler, M. Wopat, G. Bundros, and S. Flanagan. 2004. Designing watercourse crossings for passage of 100-year flood flows, sediment, and wood. California Forestry Report No. 1. California Department of Forestry and Fire Protection. Sacramento, CA. 34 p. Found at: <http://www.fire.ca.gov/ResourceManagement/PDF/100yr32links.pdf>
- Coe, D. 2004. The hydrologic impacts of roads at varying spatial and temporal scales: a review of the published literature as of April 2004. Final Report prepared for the Upland Processes Science Advisory Group of the Committee for Cooperative Monitoring Evaluation, and Research (CMER). Nooksack Indian Tribe, Bellingham, Washington. 30 p. Found at: <http://www.dnr.wa.gov/forestpractices/adaptivemanagement/cmer/finalreport1-4-05.pdf>
- Coe, D.B.R. 2006. Sediment production and delivery from forest roads in the Sierra Nevada, California. Master of Science Thesis. Colorado State University, Fort Collins, Colorado. 110 p. Found at: http://www.bof.fire.ca.gov/pdfs/DrewCoe_FinalThesis.pdf
- Coe, D., and L.H. MacDonald, 2001. Sediment production and delivery from forest roads in the Central Sierra Nevada, California. Eos Trans., AGU, 82(47), Fall Meet. Suppl., Abstract H51F-03. Found at: <http://www.agu.org/cgi-bin/sessionsfm01?meeting=fm01&part=H51F>
- Ethridge, R. 2004. Montana Forestry Best Management Practices Monitoring – 2004 Forestry BMP Audit Report. Montana Department of Natural Resources and Conservation. Missoula, MT. 64 p. Found at: <http://www.dnrc.state.mt.us/bmp.pdf>
- Flanagan, S.A. 2004. Woody debris transport through low-order stream channels of northwest California -- implications for road-stream crossing failure. Master of Science Thesis, Humboldt State University, Arcata, CA. 114 p. Found at: <http://www.bof.fire.ca.gov/pdfs/FlanaganThesisFinal.pdf>
- Ice, G., L. Dent, J. Robben, P. Cafferata, J. Light, B. Sugden, and T. Cundy. 2004. Programs assessing implementation and effectiveness of state forest practice rules and BMPs in the west. Paper prepared for the Forestry Best Management Practice Research Symposium, April 15-17, 2002, Atlanta, GA. Water, Air, and Soil Pollution: Focus 4(1): 143-169. Found at: http://www.bof.fire.ca.gov/pdfs/IceEtAlBMPPaper_pub.pdf

May 1, 2006

Keller, G. and J. Sherar. 2003. Low-volume road engineering Best Management Practices Field Guide. Final Report prepared for the U.S. Agency for International Development (USAID), in cooperation with the USDA Forest Service and Virginia Polytechnic Institute and State University. Found at: http://ntl.bts.gov/lib/24000/24600/24650/Index_BMP_Field_Guide.htm

Klein, R. 2003. Erosion and turbidity monitoring report, Sanctuary Forest stream crossing excavations in the upper Mattole River basin, 2002-2003. Final Report prepared for the Sanctuary Forest, Inc., Whitethorn, CA. 33 p. Found at: <http://www.bof.fire.ca.gov/pdfs/RKleinSanctSept2003.pdf>

Lee, G. 1997. Pilot monitoring program summary and recommendations for the long-term monitoring program. Final Report prepared by the State Water Resources Control Board. Submitted to the California Department of Forestry under CDF Interagency Agreement No. 8CA27982. Sacramento, CA. 69 p. Found at: <http://www.bof.fire.ca.gov/pdfs/PMPSARFTLTMP.pdf>

Lewis, J. and J. Baldwin. 1997. Statistical package for improved analysis of hillslope monitoring data collected as part of the Board of Forestry's long-term monitoring program. Final report submitted to the Calif. Dept. of Forestry and Fire Protection. Sacramento, CA. 50 p. Found at: <http://www.bof.fire.ca.gov/pdfs/LewisHMP.pdf>

MacDonald, L.H., 1994 . Developing a monitoring project. Journal of Soil and Water Conservation 49(3):221-227. Found at: <http://www.cnr.colostate.edu/frws/people/faculty/macdonald/publications/Developing%20a%20Monitoring%20Project.pdf>

MacDonald, L.H. 2005. Draft document written titled "Discussion Issues: USFS Best Management Practices Evaluation Program (May 2005 Draft)," prepared for the USFS BMPEP peer review group meeting, USFS-PNW, Corvallis, OR, 17-19 August, 2005. 10 p.

MacDonald, L.H., D. Coe and S. Litshert. 2004. Assessing cumulative watershed effects in the central Sierra Nevada: hillslope measurements and catchment-scale modeling. P. 149-158 in Murphy, D.D. and P.A. Stine (eds.). 2004. Proceedings of the Sierra Science Symposium, 2002, October 7-10, Kings Beach, CA, General Technical Report PSW GTR-193, Albany, CA, Pacific Southwest Experiment Station, Forest Service, US Department of Agriculture. 287 p. Found at: http://www.fs.fed.us/psw/publications/documents/psw_gtr193/psw_gtr193_4_05_MacDonald_Coe_Lit.pdf

Montgomery, D.R. 1994. Road surface drainage, channel initiation, and slope instability. Water Resources Research. 30(6): 1925-1932.

MOU Monitoring Workgroup. 2005. Joint report on monitoring terms and authorities. Final Report dated February 9, 2005. Report available from the California Department of Forestry and Fire Protection, Sacramento, California. 9 p.

Pacific Watershed Associates (PWA). 2005. Evaluation of road decommissioning in the Elk River watershed, Humboldt County, California. Final Report prepared for the Pacific Lumber Company, Scotia, California. Pacific Watershed Associates, Arcata, California. 29 p.

Rae, S.P. 1995. Board of Forestry pilot monitoring program: instream component. Unpublished Final Report prepared by the California Department of Fish and Game. Submitted to the California Department of Forestry under Interagency Agreement No. 8CA28103. Sacramento, CA. 49. p.

Ryder, R. 2004. A repeatable BMP protocol for outcome based monitoring for timber harvest operations. PowerPoint presentation for the California Licensed Foresters Association (CLFA). Found at: <http://clfa.org/pdf/files/MonitoringBMPs.pdf>

Ryder, R. and P.J. Edwards. 2005. Development of a repeatable regional protocol for performance-based monitoring of forestry Best Management Practices. Gen. Tech. Rep. NE-335. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 15 p. Found at: http://www.fs.fed.us/ne/newtown_square/publications/technical_reports/pdfs/2005/ne_gtr335.pdf

May 1, 2006

Ryder, R., T. Post, and D. Welsch. 2005. Best management practices implementation monitoring protocol (*Beta Test Manual*). Product of the Northeastern Area Association of State Foresters—Water Resources Committee. Funded by the USFS and the US EPA. Version dated September 30, 2005.

Spittler, T.E. 1995. Geologic input for the hillslope component for the pilot monitoring program. Unpublished Final Report prepared by the Department of Conservation, Division of Mines and Geology. Submitted to the California Department of Forestry under Interagency Agreement No. 8CA38400. Sacramento, CA. 18 p. Found at: <http://www.bof.fire.ca.gov/pdfs/PMP-geology.pdf>

State Water Resources Control Board (SWRCB). 1987. Final report of the Forest Practice Rules assessment team to the State Water Resources Control Board (the "208 Report"). Sacramento, CA. 200 p.

Stillwater Sciences. 2002. Review of the Hillslope Monitoring Program report addressing the effectiveness of Forest Practice Rules in preventing sediment input to streams. Unpublished report presented to the State Water Resources Control Board hearing on SB 390, waivers for waste discharge requirements, July 17, 2002, Sacramento, CA. 5 p.

Tuttle, A.E. 1995. Board of Forestry pilot monitoring program: hillslope component. Unpublished Final Report prepared by Andrea Tuttle and Associates, Arcata, California. Submitted to the California State Board of Forestry under Contract No. 9CA38120. 29 p. plus Appendix A and B: Hillslope Monitoring Instructions and Forms. Found at: <http://www.bof.fire.ca.gov/pdfs/tuttle.pdf>

United States Forest Service (USFS). 2004. Best Management Practices evaluation program: 1992-2002 monitoring results. USDA Forest Service Pacific Southwest Region. November 2004. Vallejo, CA. 76 p. plus Appendices.

Wemple, B.C., J.A. Jones, and G.E. Grant. 1996. Channel network extension by logging roads in two basins, Western Cascades, Oregon. *Water Resources Bulletin*. 32(6): 1195-1207. Found at: <http://www.humboldt.edu/~storage/pdfmill/Batch%203/channel.pdf>