# Interagency Mitigation Monitoring Program
# Pilot Project Final Report

September 2008

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

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**Governor**
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Representatives from all of the Review Team agencies (CGS, DFG, RWQCBs, and CAL FIRE) contributed to this final report. Primary authors were: Dave Longstreth, Anthony Lukacic, Joe Croteau, Angela Wilson, Dennis Hall, and Pete Cafferata. Shane Cunningham was the lead author on the protocol questions (Appendix A) and the protocol field guide (Appendix B). John Munn was the main document editor.

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[1] The State Board of Forestry and Fire Protection's Monitoring Study Group (MSG) and its subcommittees are composed of members from the public, state and federal resource agencies, and the timber industry. Each agency and organization is responsible for determining the appropriate person(s) to serve as a representative on the MSG and its subcommittees (i.e., the Board does not make formal appointments).

[2] Subcommittee members with asterisks following their names participated as Coast or Inland team members collecting pilot project field data during 2006 and/or 2007. Some of the listed IMMP Subcommittee members did not participate throughout the entire three year pilot project program (March 2005 through June 2008). Several additional people participated to a limited degree.

[3] The Board and Monitoring Study Group recognize the contributions to the pilot project made by Palma Risler of the US EPA. Ms. Risler passed away on June 21, 2008 in San Francisco.

# EXECUTIVE SUMMARY

The California Department of Forestry and Fire Protection (CAL FIRE) and the State Board of Forestry and Fire Protection (Board) have supported several monitoring projects over the past decade to evaluate the implementation and effectiveness of the California Forest Practice Rules. This monitoring work has provided considerable information on the effects of timber harvesting related to water quality. Data have been collected from randomly selected Timber Harvesting Plans (THPs) and locations within plans. Overall, rule implementation rates were reported to be high and erosion features were usually associated with improper application of the rules. Additionally, these monitoring programs found that there was a need for improved implementation of practices on forest roads, particularly at or near watercourse crossings.

The public and other resource agencies have expressed skepticism about these monitoring conclusions in the past, largely due to the monitoring methods used (including random site selection) and lack of direct participation in data collection. To address these concerns and increase cooperation between agencies, in the fall of 2004 CAL FIRE proposed using a multi-agency team approach that included all the Review Team agencies in the collection of monitoring data. Following agreements to participate by the Resources Agency and the California Environmental Protection Agency, the Interagency Mitigation Monitoring Program (IMMP) Subcommittee of the Board's Monitoring Study Group was formed in the spring of 2005 to develop the new program. The IMMP Subcommittee is composed of a diverse group of state agency personnel, landowner representatives, and the public. It includes representatives from the Department of Fish and Game (DFG), California Geological Survey (CGS), the North Coast Regional Water Quality Control Board (NCRWQCB), and the Central Valley Regional Water Quality Control Board (CVRWQCB), as well as CAL FIRE.

The IMMP Subcommittee established the following goals for the program: (1) to develop a forum for cooperation and to promote information sharing among interagency team members; (2) to develop and test repeatable protocols for field data collection to evaluate the effectiveness of practices; and (3) to test the interagency team approach as a mechanism for enabling state agencies to work together productively and for widely distributing monitoring conclusions.

A pilot project was conducted from 2005 to 2008 to develop a methodology and make needed refinements prior to implementing the long-term program. The pilot focused 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 watercourses. The pilot project field work was conducted by two IMMP teams, with one team working in the Coast Range, headquartered in Santa Rosa, and the other working in the interior portion of the state and headquartered in Redding. Each team had one representative from each of the four Review Team agencies.

Field protocols were evaluated on 54 watercourse crossings selected from 22 plans on non-federal timberlands in California in 2006 and 2007. Watercourse crossings for the

pilot project were selected based on screening criteria that included the types of practices used for watercourse crossing construction, identified beneficial uses of water present, slope, soil types, geologic considerations, and/or design and mitigation needed for complex conditions. This was not a random sample. Field work emphasized performance-based effectiveness evaluations after at least one wintering period for practices applied at or near watercourse crossing sites within a plan that were thought to pose a high risk to water quality. The pilot project work focused on the effectiveness of practices currently being utilized on plans, and not on specific regulatory requirements or violations that could result in legal/enforcement actions.

To expedite the pilot program, the IMMP Subcommittee adapted a portion of the Best Management Practices (BMP) Monitoring Protocol developed by the U.S. Forest Service for 12 northeastern states. The IMMP Subcommittee found this approach to be a transparent, repeatable, standardized monitoring method emphasizing performance-based evaluation of practices that could help achieve stated pilot project goals. While the USFS BMP approach proved to be a valuable model for developing pilot program protocols, field testing of the USFS BMP monitoring protocol during 2006 revealed that it does not apply well to California watersheds, included questions related to BMPs not relevant to this state, and does not include questions related to California forest practices.

To address these problems, numerous additional "California-specific" questions were added to the USFS BMP protocol, as well as a set of subjective questions used to promote consensus among all the agency team members. Following the 2006 field season, the two pilot project teams merged the USFS BMP monitoring protocol, California-specific questions, and subjective questions, forming a new "California watercourse crossing protocol." This revised protocol consists of 270 questions, including general questions; questions regarding both road approaches to the crossing, the crossing structure, water drafting areas; and summary questions. In most cases, fewer than half of the questions are answered at a single site, since many do not apply to the crossing being evaluated. Usually three to four crossings can be evaluated per day (45 minutes to two hours per crossing). Detailed field guidelines and a photographic log were developed, as well as a relational database to store watercourse crossing data.

Changes in pilot project protocols during and between the two phases of the pilot project limited data entry, analysis, and conclusions that can be made from the overall data set. Therefore, general findings from the pilot are presented in this report rather than specific data results. These findings include:

(1) A protocol for evaluating practice effectiveness at and near watercourse crossings in California has been successfully developed;
(2) While tedious to use, the protocol forced team members to be objective and reach consensus;

(3) The pilot project was an effective team building exercise—demonstrating that the Review Team agencies can work together cooperatively and achieve consensus;
(4) Virtually all crossings and/or road approaches to crossings deliver some sediment (i.e., “trace” amounts) to watercourses, even when the rules and additional THP measures are properly applied;
(5) Improper installation and/or maintenance of crossings and drainage structures near crossings, and improper crossing removal, are major causes of sediment movement and deposition;
(6) Road approaches near crossings produce a high percentage of sediment transport/deposition problems;
(7) Photographic logs are extremely valuable in documenting effectiveness of practices;
(8) The pilot project was a beneficial training exercise that developed skills necessary for evaluating watercourse crossing and road approach performance;
(9) The IMMP approach for problem solving should be continued, but not be limited to watercourse crossings; and
(10) Better practice implementation can be achieved with improved Licensed Timber Operator (LTO) training, and more active and post-active multi-agency inspections.

The main recommendations from the pilot program focus on using the California watercourse crossing protocol as a **multi-agency training tool** to help field personnel recognize critical situations during field inspections. The IMMP Subcommittee recommends that the protocol be used as a mandatory Review Team training tool, where agency staff are rotated into regional teams on a regular basis to prevent staff “burn-out.” Quality assurance/quality control (QA/QC) oversight team(s) will be needed to verify data accuracy and consistent application of the protocol. Additional recommendations include securing adequate funding to allow the program to continue, obtaining long-term database assistance, using the field teams to refine and test additional monitoring protocols selected by the IMMP Subcommittee, and continuing outreach to landowners, Registered Professional Foresters, and LTOs based on monitoring results.

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| | |
|---|---|
| BMPs | Best Management Practices |
| BOF/Board | California State Board of Forestry and Fire Protection |
| CAL FIRE | California Department of Forestry and Fire Protection |
| CFA | California Forestry Association |
| CGS | California Geological Survey |
| CLFA | California Licensed Foresters Association |
| CRA | California Resources Agency |
| CSES | Critical Sites Erosion Study |
| CVRWQCB | Central Valley Regional Water Quality Control Board |
| DFG | California Department of Fish and Game |
| ECMP | Erosion Control Maintenance Period |
| EHR | Erosion Hazard Rating |
| ELZ | Equipment Limitation Zone |
| FLOC | Forest Landowners of California |
| FORPRIEM | Forest Practice Rule Implementation and Effectiveness Monitoring |
| FPA | Forest Practice Act |
| FPRs | Forest Practice Rules |
| GPS | Global Positioning System |
| HMP | Hillslope Monitoring Program |
| IMMP | Interagency Mitigation Monitoring Program |
| KREW | Kings River Experimental Watershed Study |
| LTO | Licensed Timber Operator |
| MCR | Modified Completion Report Monitoring |
| MOU | Memorandum of Understanding |
| MSG | Monitoring Study Group |
| NTMP | Nonindustrial Timber Management Plan |
| NCRWQCB | North Coast Regional Water Quality Control Board |
| PDA | Personal Digital Assistant (pocket computer) |
| PHI | Pre-Harvest Inspection |
| PMP | Pilot Monitoring Program |
| QA/QC | Quality Assurance/Quality Control |
| RPF | Registered Professional Forester |
| RWQCB | Regional Water Quality Control Board |
| SWRCB | State Water Resources Control Board |
| THP | Timber Harvesting Plan |
| US EPA | U.S. Environmental Protection Agency |
| USFS | U.S. Department of Agriculture, Forest Service |
| WDRs | Waste Discharge Requirements |
| WLPZ | Watercourse and Lake Protection Zone |

# INTRODUCTION

## Background Information

This report summarizes findings of the Interagency Mitigation Monitoring Program (IMMP) pilot project conducted from March 2005 through June 2008. Work on the IMMP has been directed by a subcommittee of the State Board of Forestry and Fire Protection's Monitoring Study Group (MSG), composed of individuals from the resource agencies, the timber industry, and the public. Primary goals of the IMMP have been to reach agreement on monitoring methods and to improve agency communication.

The IMMP pilot project promoted agency consensus on the development and use of monitoring methods to be used in a full scale monitoring program, as recommended by MacDonald (1994). The IMMP Subcommittee determined that the pilot should be focused on watercourse crossings and road segments draining to crossings (Figure 1), since past monitoring and research work has shown that these are particularly high risk sites for sediment delivery to watercourse channels (Pyles and others 1989, Wemple and others 1996, Furniss and others 1998, BOF 1999, Cafferata and Munn 2002, Bundros and others 2003, MacDonald and others 2004, USFS 2004, Coe 2006, Brandow and others 2006).

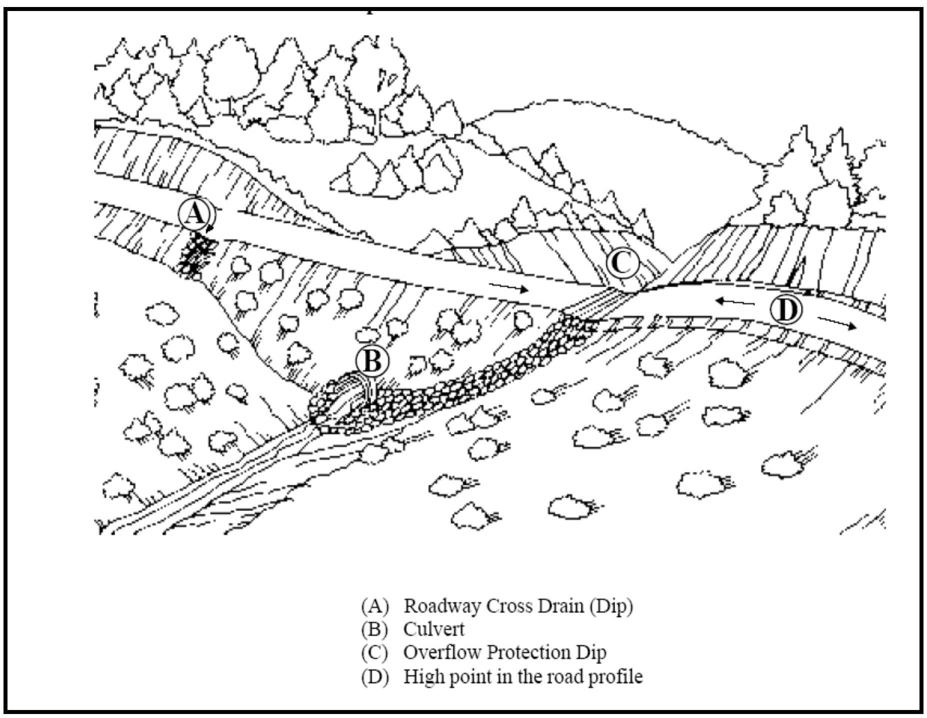


Figure 1. Diagram of a watercourse crossing and road segments draining to the crossing. Figure 7.11 in Keller and Sherar 2003.

The pilot project work was conducted by two IMMP field teams, one working out of Santa Rosa (Coast team) and the other headquartered in Redding (Inland team). The Coast team evaluated crossings in the Coast Range, while the Inland team examined crossings in the interior portion of the state (i.e., Klamath Mountains, Cascade Range, and northern Sierra Nevada). This report includes findings and recommendations for future monitoring protocols, but does not include data or results from field evaluations of individual watercourse crossings. Changes in pilot project protocols during and between the two phases of the pilot project limited data entry, analysis, and conclusions that can be made from the overall data set.

**Past Water Quality Monitoring Projects and Their Relation to the IMMP**

The California Department of Forestry and Fire Protection (CAL FIRE) and the California State Board of Forestry and Fire Protection (Board) have recognized the importance of implementation and effectiveness monitoring to determine whether the Forest Practice Rules (FPRs) and the Timber Harvesting Plan (THP) review process adequately protect the beneficial uses of the state's waters since the mid-1980's. The earliest monitoring project, implemented as a cooperative project by the Board, CAL FIRE, the California Department of Fish and Game, and the State Water Resources Control Board, was a qualitative assessment of 100 non-randomly selected THPs conducted on non-federal timberlands in 1986 by a team of four resource professionals (i.e., the "208 Study"). This effort found that the FPRs were generally effective when properly implemented on terrain that was not overly sensitive (i.e., areas without highly erodible soils or elevated mass wasting potential), and that inadequate rule implementation was the most common cause of water quality impacts. Poor road location, construction, drainage and/or removal were noted as common reasons for significant adverse impacts (CSWRCB 1987). Results from this monitoring project were used by the Board to modify the FPRs for water quality protection (Johnson 1993).

Further monitoring was required, however, as a condition of having the FPRs certified as Best Management Practices (BMPs) by the U.S. EPA (BOF 2007). Based on a strategy developed through the MSG, several hillslope and instream monitoring projects were implemented, beginning in the early 1990's. These efforts included the Pilot Monitoring Program (PMP) that operated from 1993 through 1995 to test procedures for hillslope and instream 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 or onsite monitoring programs that were conducted from 1996 through 2004.

The Hillslope Monitoring Program (HMP) ran from 1996 to 2002, with data collected by independent contractors (BOF 1999, Cafferata and Munn 2002). The first phase of a Modified Completion Report (MCR) monitoring program was implemented by CAL FIRE from 2001 to 2004, using state Forest Practice Inspectors to collect onsite data as part of required Work Completion Report inspections (Brandow and others 2006). Results from these studies were similar and have been widely distributed to state and federal agencies, timberland owners, and the public. In general, implementation rates of California's water quality-related FPRs were found to be high (>90 percent), which is similar to findings of studies in other western states (Ice and others 2004, Ice and Schilling 2007, CWSF 2007). The California studies also reported that erosion features were usually associated with improper application of the rules, and that individual practices required by the Rules were effective in preventing hillslope erosion features when properly implemented.

On randomly selected high risk sites (i.e., roads, landings, skid trails, crossings, and Watercourse and Lake Protection Zones) found within the randomly sampled THPs, most of the water quality problems and sediment delivery sites were associated with roads and associated watercourse crossings. Watercourse crossings had the highest rate of problems, with significant implementation and/or effectiveness issues reported on approximately 20 percent of the randomly sampled crossings in both monitoring programs. These problems were mainly related to diversion potential, plugging, scour at the outlet, road drainage structure function near the crossing, and fillslope erosion.

The other main problem area was erosion from roads caused by improper design, construction, and maintenance of drainage structures. In the HMP, nearly half the randomly selected road transects had one or more rills present and approximately 25 percent had at least one gully. Evidence of sediment transport to a watercourse channel was found on approximately 13 percent and 25 percent of these rill and gully features, respectively, with high percentages of delivery to Class III watercourses (headwater channels). These erosion features were mostly caused by drainage feature deficiencies that were usually not in compliance with the FPRs (Cafferata and Munn 2002).[4] In the MCR study, erosion was found at more than 50 percent of the road-related features that were identified as departing from the FPRs, and evidence of sediment transport to channels was found at 11 percent of these sites. In contrast, erosion was found at five percent of the sites with acceptable FPR implementation, and evidence of sediment transport to a channel was observed only one percent of the time (Brandow and others 2006).

These past monitoring programs have clearly shown the need for improved implementation of practices on forest roads and at watercourse crossings to prevent adverse impacts to water quality. However, considerable skepticism has been expressed about the conclusion that properly implemented FPRs are generally effective in protecting beneficial uses of water in California (as well as in other western states) (Ice and others 2004). Reasons for such lack of confidence include the monitoring methods used by past studies (e.g., lack of information about both fine sediment delivery to watercourses during winter storms and in-unit mass wasting rates [Stillwater

[4] More recent work by Coe (2006) showed that the majority of forest road sediment delivery from surface erosion processes occurs at or near watercourse crossings. Working in the central Sierra Nevada, he found that adequately maintained roads typically have smaller areas between drainage structures, which limits sediment production, and that when the Forest Practice Rules are properly implemented, sediment delivery is usually not an issue (BOF 2006).

Sciences 2002]); lack of multi-agency participation in the monitoring process; and the use of random sampling procedures that limited evaluation of less frequent "high risk" sites that are major sources of erosion and sediment.[5] Concerns have also been expressed about how monitoring results have been used in the public arena, as well as lack of public participation in monitoring programs and data collection. As a result, a new, more broadly-based monitoring approach was needed to address concerns about water quality impacts from timber operations at high risk sites.

Options for collecting onsite monitoring data on non-federal timberlands in California have been described by Tuttle (1995). They include using: (1) private consultants, (2) CAL FIRE Forest Practice Inspectors, (3) one or more multi-interdisciplinary teams of state agency staff, and (4) self-monitoring by landowners with or without state agency oversight. The HMP and MCR programs relied on options (1) and (2), respectively, and the Regional Water Quality Control Boards are currently using option (4) to monitor requirements of Region-specific Waivers of Waste Discharge Requirements (WDRs) or General WDRs for silvicultural activities.

The multi-interdisciplinary team approach has been used effectively in the past in California (e.g., the "208 Study") and in other western states. For example, Montana has used interdisciplinary teams to monitor BMP implementation and effectiveness since 1990 (Ethridge 2004). Advantages provided by the designated multi-interdisciplinary team approach include a balance of interests among involved agencies and greater public confidence in monitoring results. In addition, trained staff can provide continuity in applying monitoring protocols. The main disadvantage is the relatively high cost of dedicating agency staff to multi-agency teams (Tuttle 1995).

Based on the need for greater acceptance of monitoring results and direction from the California Resources Agency for improved interagency cooperation, CAL FIRE proposed forming the Interagency Mitigation Monitoring Program (IMMP) in the fall of 2004. Following agreement by Department of Fish and Game (DFG), California Geological Survey (CGS), the North Coast Regional Water Quality Control Board (NCRWQCB), and the Central Valley Regional Water Quality Control Board (CVRWQCB) to participate in this new program, the first MSG IMMP Subcommittee meeting was held in March 2005. Prior to initiating field studies, a "general framework report" was prepared to document agreed-to IMMP concepts (CRA and others 2006). A timeline for the pilot project is presented in Figure 2.

[5] Currently, information on fine sediment delivery during winter storm events related to forestry operations is being evaluated by cooperative instream monitoring projects, such as the Caspar Creek, Little Creek, Judd Creek, South Fork Wages Creek, and Kings River watershed studies. Regarding random sampling, MacDonald (2005) concluded that if the primary objective of a study is to evaluate the effectiveness of BMPs for protecting water quality, then the focus of sampling should be on sites that are at higher risk, rather than using a random sample. It is imperative, however, to know the proportion of high risk sites that occur in a population to extend results to the total population of high risk and other sites.

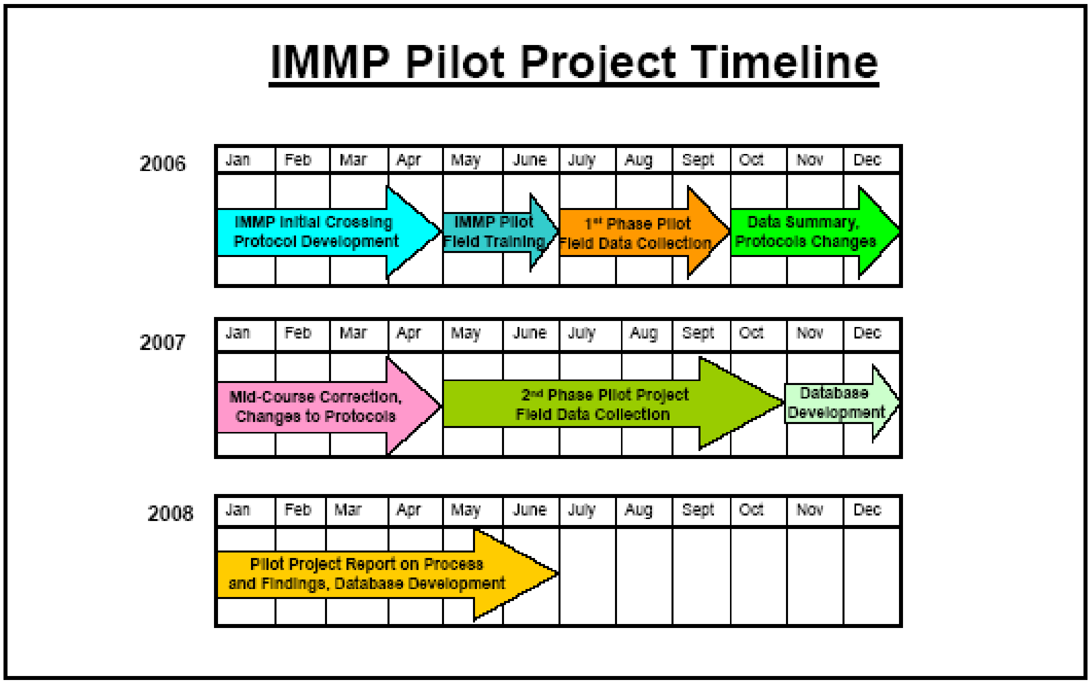


Figure 2. The pilot project timeline from January 2006 through June 2008.

## IMMP Pilot Project Goals and Objectives

The primary goals of the pilot project were to: (1) provide a mechanism for interagency monitoring by the Review Team agencies, promoting increased cooperation between the agencies, and (2) develop a set of protocols for data collection on the effectiveness of practices that past monitoring has shown to be the most likely source of adverse impacts to water quality (i.e., watercourse crossings and road segments that drain to crossings). To implement these objectives, the pilot project focused on developing protocols for evaluating the effectiveness of practices used at higher risk (non-random) watercourse crossing sites.[6] Some lower risk crossings were included to test whether pre-determined high risk sites actually produce larger water quality impacts. The pilot project did not develop protocols to evaluate the implementation and effectiveness of individual FPRs related to forest roads and watercourse crossings, since this had previously been done by the HMP and MCR work (Cafferata and Munn 2002, Brandow and others 2006).

Specific objectives of the pilot project were to:

(1) Develop a forum for cooperation and to promote information sharing among interagency team members.

[6] Higher risk sites in plans related to water quality are usually in close proximity to watercourses and/or located on steeper, more erodible slopes. Specific criteria for higher risk sites are provided in the MOU Monitoring Workgroup (2005) document titled “Joint Report on Monitoring Terms and Authorities.”

(2) Develop and test repeatable protocols for field data collection to evaluate the effectiveness of practices implemented at watercourse crossings and road segments that drain to crossings (locations where there is a high risk of impact to water quality). Practices included FPRs, additional mitigation measures, and special plan requirements. The protocol developed should allow any user (agency representatives, landowners, etc.) to reach similar conclusions.

(3) Test the interagency team approach as a mechanism for enabling state agencies to work together productively and widely distribute monitoring conclusions.

# PILOT PROJECT STUDY AREA

The study area for the pilot phase of the IMMP was located in northern California and was divided into two sub-units defined primarily by the participating agency districts (Figure 3). Site evaluations within each area were conducted by separate teams of agency representatives.

The Inland pilot project team was comprised of CGS's Northern Unit, DFG's Northern Region, the northern part of the RWQCB's Central Valley Region, and the Cascade component of CAL FIRE's Northern Region. These boundaries overlapped in Shasta and Tehama Counties, southeast Siskiyou County, southern through north-central Modoc County, and western through northern Lassen County.

The Coast team was comprised of the same CGS unit, DFG's Bay-Delta Region, the RWQCB's North Coast Region, and the coastal part of CAL FIRE's Northern Region. Overlapping districts included only portions of Sonoma, Napa, and Santa Cruz counties. To obtain a more representative sample of watercourse crossings, the Santa Rosa team extended its sample area within the boundaries of CAL FIRE's Coast Forest Practice District. This allowed Humboldt and Mendocino Counties to be added to the study area.

The field teams included members from each agency that participates in timber harvest review (CAL FIRE, CDFG, RWQCBs, and CGS). To promote interagency interaction, unbiased observations, cooperation, and information sharing, it was determined that no individual agency would assume control of the field work. Inland team members in 2006 were Shane Cunningham, CAL FIRE; Joe Croteau, DFG; Angela Wilson, CVRWQCB; and Dave Longstreth, CGS. In 2007, Stacy Stanish replaced Joe Croteau as the DFG team representative. Coast team members in 2006 were Anthony Lukacic, CAL FIRE; Richard Fitzgerald, DFG; Dave Hope, NCRWQCB; and Dave Longstreth, CGS (Figure 4). In 2007, Suzanne DeLeon replaced Richard Fitzgerald as the DFG team representative.

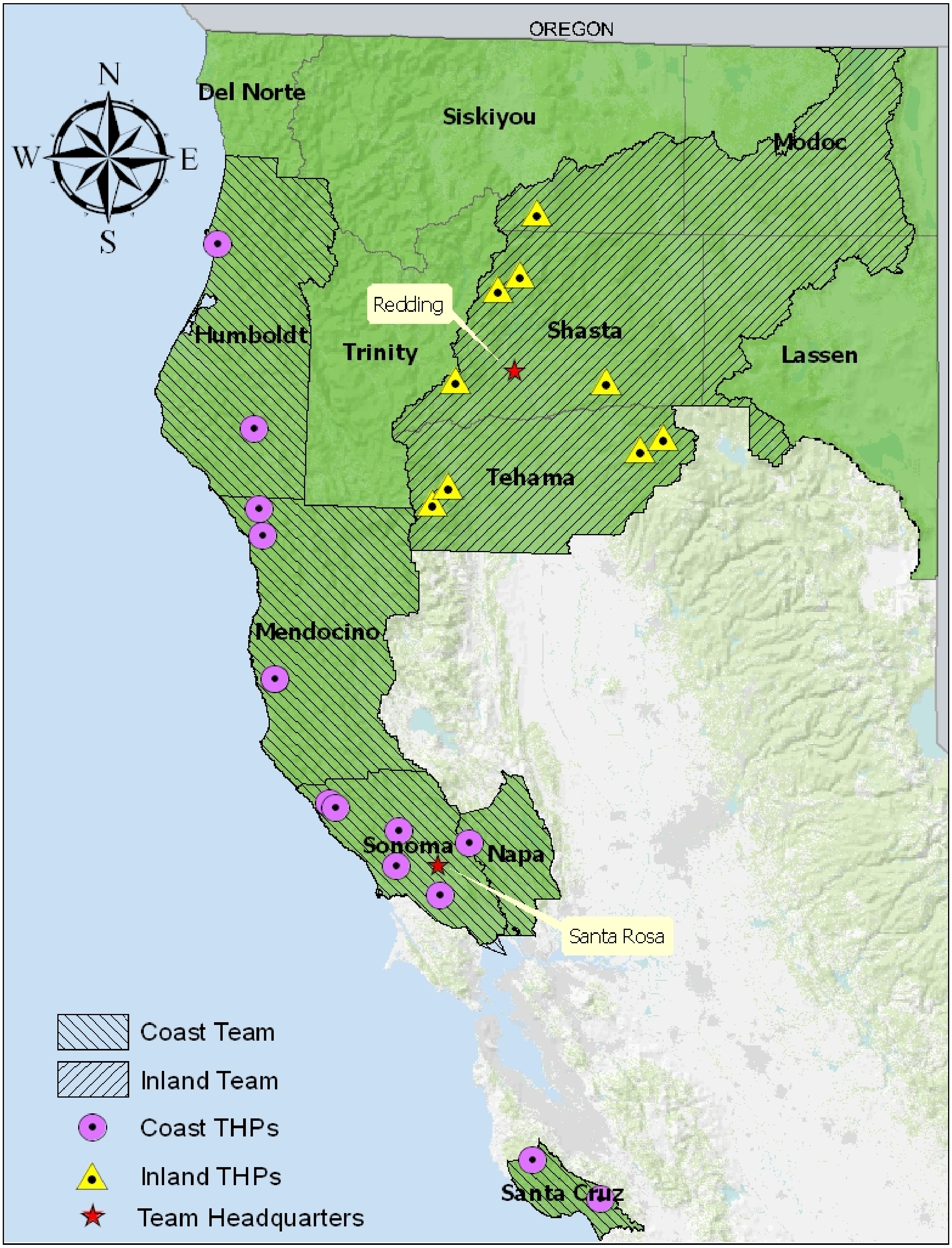


Figure 3. Map displaying locations of 22 plans sampled as part of the pilot project during 2006 and 2007.

Figure 4. Pilot project Coast team during 2006, comprised of Dave Longstreth, CGS, Anthony Lukacic, CAL FIRE, Dave Hope, NCRWQCB, and Richard Fitzgerald, DFG.

# PROTOCOL DEVELOPMENT AND METHODS

The pilot project consisted of the development of procedures that evaluate effectiveness of practices prescribed for perceived "high risk" watercourse crossings. The various approaches tested in the pilot are described in the sections below.

## Crossing Selection Procedure

One of the main complaints about previous monitoring efforts was the infrequent evaluation of higher risk sites that resulted from use of random sampling, which limited sample size of these less frequent, but very important, potential erosion sites. To overcome this limitation, IMMP Subcommittee members have stated that the effectiveness of the FPRs must be evaluated at worst-case scenarios (i.e., "high risk" locations).[7]

Contributing factors that can be used to categorize "risk" at a watercourse crossing are many, and may include the following (and their relationships to one another) (see MOU Monitoring Workgroup 2005 for a more detailed list of factors):

- Underlying geology, unstable soils
- Watercourse classification
- Channel morphology
- Road approach conditions
- Side slope steepness
- Proposed use of the crossing
- Ease of access for maintenance
- Beneficial uses of water in and downstream of adjacent watercourses (aquatic organisms, threatened or impaired species, domestic supply, etc.)
- Past flow events
- Topography
- Elevation (area of rain-on-snow events)
- Precipitation levels
- High and Extreme erosion hazard rating (EHR)

To address these concerns, watercourse crossings in the pilot project were selected using agency knowledge of proposed and/or existing crossings that appeared difficult and/or complex to install, repair, upgrade, or remove because of existing conditions, which were assumed to pose the greatest chance of performance problems and sediment delivery.

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[7] Use of non-randomly selected sites is supported by past studies, which have shown that a small percentage of a road network produces most of the hillslope erosion (McCashion and Rice 1983, Durgin and others 1989) and a small percentage of decommissioned or upgraded watercourse crossings produce most of the sediment input to streams (Klein 2003, PWA 2005, Keppeler and others 2007, Harris and others 2008).

THPs submitted by both large and small timberland owners were included in the pilot program. Selected sites generally had been through at least one winter period following installation, upgrading, or removal of watercourse crossings and the installation of road drainage structures, but were still within the Erosion Control Maintenance Period (ECMP). Crossings on Class I, II, and III watercourses were included in the pilot work, as were all types of watercourse crossings (e.g., culverts, fords, bridges, removed crossings, etc.).

The resulting sample did not provide a basis for reaching conclusions about all crossings. It did, however, provide an objective and repeatable approach for promoting interagency cooperation and interaction, and for addressing each agency's concerns. Because the resulting sample was limited to "high risk" crossings, a non-random method of evaluation was conducted. As such sampling was not conducted as a controlled experiment that would provide a "scientific" level of trial and evidence and does not provide a statistically valid basis for conclusions about all types of watercourse crossings (high risk and non-high risk). The goal of the pilot project was to provide an objective and repeatable approach for promoting interagency cooperation and interaction, and for addressing each agency's concerns regarding forest practices in California and their impacts to water quality.

An unanticipated complication from using a non-random sampling approach arose during the first phase of protocol development. During the THP review process, a "high risk" crossing is identified either by the Registered Professional Forester (RPF) or by the Review Team agencies. Consequently, the RPF/Plan Submitter and/or reviewing agencies often spend considerable effort in mitigating the site to effectively lower the perceived risk. Thus, a previously identified "high risk" crossing should, by the process of applying mitigations <u>in addition to</u> FPR requirements, result in a reduction of potential impacts. Subsequent review might then indicate that the site has not merited the "high risk" categorization. This could lead to a conclusion that resource professionals evaluating these sites are not correctly identifying potentially "high risk" crossings when, in fact, the mitigations applied to the crossing prevented or significantly reduced the threats that led to identification of the crossing in the first place.

## Adaption and Modification of USFS BMP Monitoring Protocol

To expedite the pilot program, the IMMP Subcommittee adapted a portion of the Best Management Practices (BMP) Monitoring Protocol developed by the U.S. Forest Service for 12 northeastern states (Welsch and others 2007).[8] The IMMP Subcommittee found this approach to be a transparent, repeatable, standardized monitoring method emphasizing performance-based evaluation of effectiveness of practices that could help achieve stated pilot project goals. It was thought that use of the USFS protocol in California would produce data comparable with other states using the same protocol. Only those portions of the USFS BMP protocol that evaluated watercourse crossings and road approaches to crossings were used in the pilot project. Other sections of the

[8] Further description of the U.S. Forest Service BMP monitoring protocol are found in the following references: Ryder 2004, Ryder and Edwards 2005, and Ferrare and others 2007.

USFS BMP protocol that evaluated roads and landings in the buffer, riparian buffers, chemical pollution control, and wetlands were not used (136 out of 197 questions were answered).

<u>Overarching Questions</u>

Initial testing of the USFS BMP Monitoring Protocol suggested that it does not specifically address performance of California Forest Practice Rules and other Review Team agency concerns, primarily because it was developed outside of California. In order to address issues that were not covered by the USFS protocol, each agency developed key (overarching) questions that were needed to properly evaluate effectiveness of California Forest Practice Rules and impacts to water quality at or near watercourse crossings (summarized below, complete questions are included in CRA and others 2006).

- IMPLEMENTATION and EFFECTIVNESS of watercourse crossings in relation to requirements of current California Forest Practice Rules (FPRs) and additional Best Management Practices (BMPs).
- AQUATIC HABITAT PROTECTION in relation to watercourse crossing design, installation, and the California Department of Fish and Game 1600 Streambed Alteration Agreement process.
- FISH PASSAGE and DOWNSTREAM RESOURCE PROTECTION in relation to watercourse classification and crossing characteristics.
- PERFORMANCE OF CROSSING TYPES in relation to PHYSICAL SETTING FACTORS.
- GEOLOGY, GEOMORPHOLOGY, and SOIL CHARACTERISTICS in relation to mass wasting, erosion, and sediment delivery at watercourse crossings.

<u>California Specific Questions</u>

In order to address the overarching questions, each agency developed specific questions not already included in the USFS BMP monitoring protocol. Collectively, the agencies produced 54 questions in addition to those in the USFS protocol. These questions require observation of potential or actual causes of erosion and sediment delivery associated with watercourse crossings and their approaches. Examples of specific questions that were developed in response to overarching questions are provided below.

| OVERARCHING QUESTION | | SAMPLE OF SPECIFIC QUESTIONS |
|---|---|---|
| IMPLEMENTATION and EFFECTIVENESS of watercourse crossings in relation to requirements of current California Forest Practice Rules (FPRs) and additional BMPs. | → | Enter the code indicating if the size of the crossing structure opening meets state requirements at the time of plan approval.<br>1. Yes<br>2. No<br>3. Unknown<br><br>Were principles / practices applied?<br>1. Yes<br>2. No<br><br>Were measures employed that were over and above the requirements of the plan and/or Rules?<br>1. Yes<br>2. No<br><br>Enter one or more codes that describe the plan requirements for the crossing site being evaluated.<br>1. Standard California Forest Practice Rules including the Threatened or Impaired Watersheds Rule Package (July 1, 2000) where appropriate.<br>2. Additional mitigation measures assigned during plan review were required and/or the RPF proposed additional measures, which were above and beyond the FPRs.<br>3. Exceptions, alternatives or in-lieu practices were proposed, which superseded the standard Forest Practice Rules. |
| AQUATIC HABITAT PROTECTION in relation to watercourse crossing design, installation and the California DFG Streambed Alteration Agreement (1600). | → | Is there a DFG 1600 agreement?<br><br>1. Yes<br>2. No<br>3. Unknown<br><br>Have modifications been made to the crossing, for purposes such as water drafting, which have impacted the functionality of the crossing?<br><br>1. No<br>2. Yes<br>3. Yes (1600 agreement)<br>4. Unknown<br><br>Enter the code indicating if there is evidence of stream downcutting, scouring, or aggradation within 100 feet downstream of the outlet end of the structure.<br><br>1. Evidence of scouring and downcutting.<br>2. Evidence of aggrading or widening.<br>3. Stable.<br><br>Enter the code indicating if there is evidence of stream downcutting, scouring, or aggradation within 100 feet upstream of the inlet end of the structure.<br><br>1. Evidence of scouring and downcutting.<br>2. Evidence of aggrading or widening.<br>3. Stable. |

| OVERARCHING QUESTION | | SAMPLE OF SPECIFIC QUESTIONS |
|---|---|---|
| FISH PASSAGE and DOWNSTREAM RESOURCE PROTECTION in relation to watercourse classification and characteristics. | → | Is the pipe located on a Class I fish bearing watercourse?<br>1. Yes (go to C-125)<br>2. No (go to C-160)<br><br>Enter the code indicating depth of the residual pool at the inlet in inches.<br>1. < 6”<br>2. ≥ 6”<br><br>Enter the code indicating if there is streambed substrate throughout the pipe.<br>1. Yes<br>2. No<br><br>Enter the code indicating if the pipe includes baffles or weirs.<br>1. Yes<br>2. No<br><br>Enter the code indicating if there is a pool at the outlet.<br>1. Yes<br>2. No<br><br>Enter the code indicating pipe outlet drop in inches.<br>1. 0-11”, 2. 12-24”, 3. >24” |
| PERFORMANCE OF CROSSING TYPES in relation to PHYSICAL SETTINGS FACTORS. | → | Is there perched fill material at the inlet or outlet of the crossing within or immediately adjacent to bankfull.<br>1. Yes<br>2. No<br><br>Enter the active channel bed width in feet (measured at a riffle).<br><br>Enter the bankfull channel width in feet (measured at a riffle).<br><br>Enter the bankfull depth in feet (measured at a riffle).<br><br>Enter the code best describing the entrenchment of the natural watercourse channel above the crossing.<br>1. Entrenched (Confined).<br>2. Moderately entrenched (Unconfined).<br>3. Slightly entrenched (Braided).<br><br>Enter the code best describing the average percent grade of the natural watercourse channel above and below the crossing.<br>1. 0-2%<br>2. 2-4%<br>3. 4-10%<br>4. 10-30%<br>5. > 30%<br><br>Enter the code indicating the approximate volume of sediment delivered to the watercourse based on volume of voids and/or measurable sediment deposits observed at the crossing and approaches.<br>1. No observed sediment<br>2. Trace to 1 cubic yard<br>3. 1-10 cubic yards<br>4. 11-50 cubic yards<br>5. 51-100 cubic yards<br>6. 101-500 cubic yards<br>7. 501-1000 cubic yards<br>8. Greater than 1000 cubic yards |

| OVERARCHING QUESTION | | SAMPLE OF SPECIFIC QUESTIONS |
|---|---|---|
| GEOLOGY, GEOMORPHOLOGY, and SOIL CHARACTERISTICS in relation to mass wasting, erosion, and sediment delivery at watercourse crossings. | → | Enter the code for the Erosion Hazard Rating (EHR) listed in the plan for the crossing area.<br><br>1. Low, 2. Moderate, 3. High, 4. Extreme<br><br>Enter the code indicating the specific underlying rock type/formation (the standard geologic formation letter symbology may be initially coded in).<br><br>Enter the code indicating the type of mapped landslides under the site (pick one or more).<br><br>1. Active rockslide<br>2. Dormant rockslide<br>3. Active debris flow or debris slide<br>4. Dormant debris flow or debris slide<br>5. Active earthflow<br>6. Dormant earthflow<br>7. Inner Gorge<br>8. Debris slide slope<br>9. No mapped landslide<br><br>Enter the code indicating if a recent landslide impacts the crossing.<br>1. Yes<br>2. No |

California Subjective Questions

To achieve interagency interaction, cooperation, and normalization of observations, a series of summary questions were designed to query whether the interagency team members reached agreement on the overall performance of the crossing and approaches being studied. The questions ask the IMMP team members to reach a *subjective* conclusion about performance of the crossing and approaches, with the hope of developing a common point of view that can eventually be applied to other forestry topics. An example of one of these subjective questions is provided below in Figure 5.

Additionally, at the end of the questionnaire, the interagency team "graded" each crossing and its approaches (together) using a letter grading system. This was included as an intuitive grading system that the project IMMP participants were familiar with (A = Excellent, B = Good, C = Fair, D = Poor, F = Fail). The assigned letter grade is recorded in the pilot project protocol and on the photographic log discussed below. Grading the crossings and its approaches compelled the team members to discuss their opinions regarding the evaluation before reaching consensus.

Enter the appropriate rating for the crossing, utilizing the matrix provided below.

| | Performing properly, no sign. sediment delivery problems | Performing properly, sediment is still being delivered | Performing properly, no sediment delivery, but there is potential | Not performing properly, sign. sediment delivery problems |
|---|---|---|---|---|
| Properly designed and constructed | 1 | 2 | 3 | 4 |
| Properly designed, not properly constructed | 5 | 6 | 7 | 8 |
| Not properly designed, constructed to design | 9 | 10 | 11 | 12 |

Figure 5. California subjective crossing matrix used for the pilot project.

## Structure of the California Watercourse Crossing Protocol

After field testing in 2006, the California specific and subjective questions (described above) were merged with the crossing portion of the USFS BMP monitoring protocol, forming a new "California watercourse crossing protocol" consisting of 270 questions (described below and provided in Appendix A). This revised protocol was field tested in 2007.

The California watercourse crossing protocol is divided into seven main categories:

- General Questions. Questions gathering information on landowners, THP number, crossing location, bedrock geology, watercourse classification, and other site information.

- Approach Areas A and B. Questions that evaluate design, implementation, and performance of the road approach on the left side of the crossing when looking downstream ("A Side Approach") and on the right side of the crossing when looking downstream ("B Side Approach") (Figure 6). The approaches are further divided into the portions of the approaches that are outside and inside of the Watercourse and Lake Protection Zone (WLPZ)/Equipment Limitation Zone (ELZ) (i.e., areas of increased watercourse protection as defined in the FPRs).

- Water Drafting Areas A and B. Questions that evaluate implementation, design, and performance of water drafting sites on either side of the crossing.

- Crossing Structure. Questions evaluating implementation, design, and performance of the crossing structure itself.

- Summary Questions. Subjective questions requiring field crew members to formulate conclusions based on cumulative knowledge and opinion developed during discussion and response to the numerous objective questions in the monitoring protocol. These questions query overall performance (implementation, design, and observed direct or potential sediment delivery) of the crossing and its approaches. Additionally, a letter grade is assigned to the crossing and its approaches. Responses are based on consensus among field crew participants.

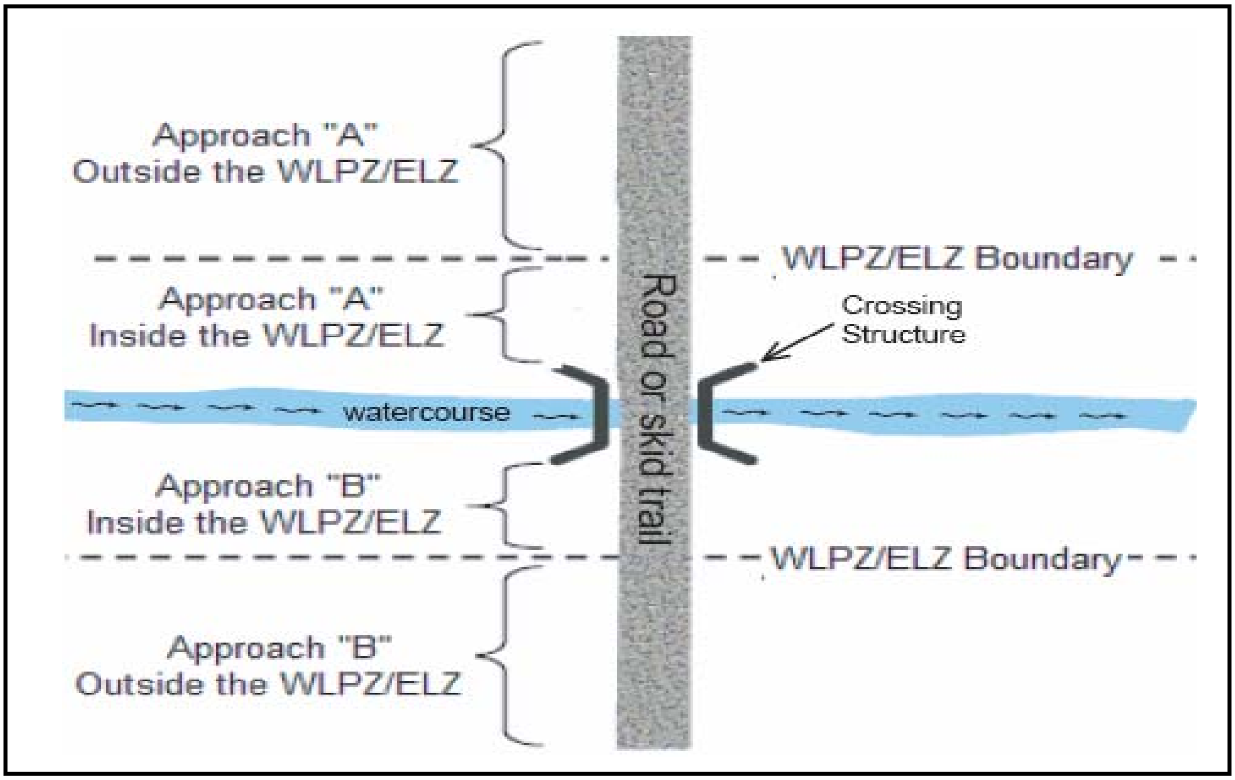


Figure 6. Typical protocol survey area, including approach areas A and B inside and outside the WLPZ/ELZ, and the crossing structure (Figure 2 in the IMMP Protocol Field Guide).

## Field Testing

Field work began in July 2006 and was divided into two data collection phases (one in 2006 and the other in 2007), with each phase followed by revisions to the monitoring protocol (see discussion above, "Adaption and Modification of USFS BMP Monitoring

Protocol”). Landowner cooperation was recognized as a key component to success of the pilot project. As such, a letter that described the pilot project with assurance that the project would not include legal/enforcement actions was widely distributed (e.g., sent to CFA, FLOC, CLFA, the Forest Guild, UC Cooperative Extension, Farm Bureau, Forest Stewardship newsletter).

a) Training

Two training sessions were conducted with the purpose of familiarizing field crews with the USFS BMP monitoring protocol questions, California specific questions, and data collection. Field training sites were located at Jackson Demonstration State Forest and nearby industrial timberlands in the northern part of Coast Range and at LaTour Demonstration State Forest in the Cascade Range during May and June of 2006 (Figures 7 and 8). Data was recorded on hand held computers (PDAs), as specified by the USFS BMP monitoring protocol. Each watercourse crossing and both road approaches to the crossing were photo documented with standardized protocols.

Figure 7. Pilot project training in western Mendocino County in May 2006.

Figure 8. Pilot project training on LaTour Demonstration State Forest, located in Shasta County, in June 2006.

b) Protocol Testing

Following training, the field crews evaluated watercourse crossings in their respective areas. Sites were located on both large and small private timberland ownerships. Of the 22 plans visited, all were THPs except for two Nonindustrial Timber Management Plans (NTMPs). Two THPs were associated with timberland conversions. A total of 54 crossings were evaluated by the two teams during 2006 and 2007. Generally, three to four crossings were evaluated per field day with each evaluation taking between 45 minutes and two hours to complete, depending on field team familiarity with protocol questions and crossing complexity. The Inland team inspected 14 additional crossings without using the protocol. An overall summary of the crossings evaluated during the pilot program is provided in Table 1.

Table 1. Summary of pilot project field testing of monitoring protocols.

| | Coast Team | Inland Team | Totals |
|---|---|---|---|
| Crossings Inspected with Protocols | 29 | 25 | 54 |
| Crossings Inspected without Protocols[9] | 0 | 14 | 14 |
| Crossings Re-Inspected with Protocols | 0 | 3 | 3 |
| Total Crossings Evaluated | 29 | 42 | 71 |
| Total Number of Times Protocols Used | 29 | 28 | 57 |
| Plans | 13 | 9 | 22 |
| Field Days | 9 | 14 | 23 |
| Crossings/Day | 3-4 | 3-4 | 3-4 |

Field sampling typically began by driving and/or walking to a pre-selected high risk watercourse crossing. After answering general questions, the portion of the "A" side road approach that was outside of the WLPZ/ELZ was identified using a cloth or nylon tape (Figure 9). Questions in the protocol about this portion of road approach were then answered. Next, road approach side "A" within the WLPZ/ELZ was observed and questions related to this segment were answered. The crossing structure itself was then evaluated, followed by an evaluation of road approach side "B" (inside and outside the WLPZ/ELZ). Finally, summary questions about total sediment delivery and overall performance of the crossing and approaches were answered. Late in the second field season, additional questions about water drafting sites within approach areas A and B were added to the protocol.

During the course of field work, problems in using the USFS BMP monitoring protocol were identified. In particular, the field teams found that the USFS protocol did not apply well to California forested watersheds, and included BMPs that are not relevant to California timber operations, while not addressing California FPR requirements. For example, the USFS protocol required making evaluations several hundred feet from the watercourse being evaluated, with observed sediment movement often being assessed in a watercourse other than the one being evaluated.

[9] After the Inland team completed protocol evaluations, additional crossings were inspected the same day without using the California watercourse crossing protocol due to the tedious nature of the process (i.e., "protocol fatigue") and because of limited field time.

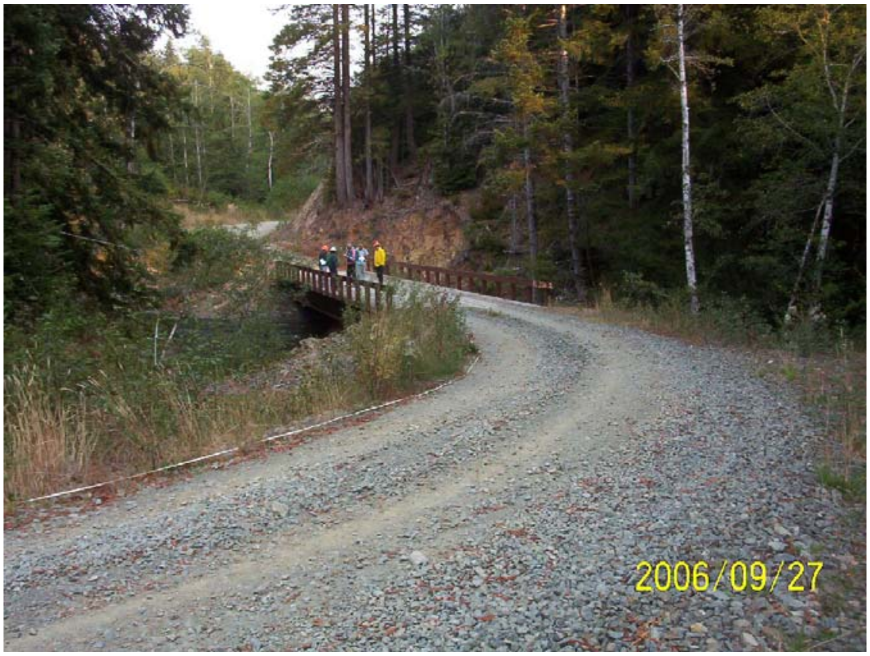


Figure 9.  Bridge evaluated in Humboldt County by the Coast team during the 2006 field season.  Note the tape stretched along the road approach to measure road length in the WLPZ.

c) Photo Documentation

Site conditions were documented with a series of digital photographs that were taken from the “A” side approach towards the crossing, the “B” side approach towards the crossing, upstream towards the crossing, and downstream towards the crossing.  Additional photographs were taken of noteworthy features (e.g., where there was evidence of significant problems related to Forest Practice Rule implementation or effectiveness, such as fill slope failure, sediment deposition related to the crossing, etc.).  A paper field photo log was developed to track photos (see example, Figure 10). While sketches were not regularly made during the pilot project, the photo log form includes space to draw sketches if needed.  A blank photo log is included in the Protocol Field Guide (Appendix B).

## IMMP PHOTOGRAPHIC REPORT

CAL FIRE · California Department of Fish and Game · Regional Water Quality Control Boards · California Geological Survey

| Page | Of | Date | Protocol No. (enter code G1) | Plan No. | Crossing No. | Photographer: |
|---|---|---|---|---|---|---|
| 1 | 1 | 7/18/2006 | CA06N0004 | 2-05-060-SHA | 4 | Longstreth |

| Participants: | GPS Location Latitude N | GPS Location Longitude W | Crossing Type (enter code GC-110) |
|---|---|---|---|
| Cunningham, Wilson, Croteau, Longstreth | 40.93096 | 122.49384 | 1 – Single Pipe Culvert |

| Overall Letter Grade For Crossing (enter code O-269) | Overall Letter Grade For Approaches (enter code O-270) |
|---|---|
| C | C |

NARRATIVE DESCRIPTION OF PHOTOGRAPHS / SKETCHES

VIEW LOOKING UPSTREAM TOWARDS CROSSING OUTLET

Looking north, upstream (outlet), at the crossing. Note the boulders in the foreground. These boulders apparently originated from above the CMP where there is an evident lack of armoring. Also note the gully to the left of the armoring and the CMP. This apparently resulted when the crossing was overtopped this winter.

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):~ 25 feet/ North

PHOTO FILE NO. 3

VIEW LOOKING DOWNSTREAM TOWARDS CROSSING INLET

Looking south, downstream (inlet) of the crossing. Note the skewed installation of the CMP and the fresh excavation in the foreground. Forensic evidence indicated that this CMP overtopped and maintenance was conducted which resulted in the channel excavation pictured.

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):~ 40 feet/South

PHOTO FILE NO. 2

VIEW FROM APPROACH A SIDE

Approach A looking west towards crossing. Crossing is in the middle off the picture.

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):~ 50 feet/ West

PHOTO FILE NO. 1

VIEW FROM APPROACH B SIDE

Approach B looking east towards the crossing in the middle of the picture. Note gray road rocking in front of the pickup. This road material was found down slope in a gully indicating that the culvert likely overtopped.

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET): ~40 feet/East

PHOTO FILE NO. 4

Figure 10. Example of a completed pilot project photo log.

## Development of Protocol Field Guide

A field guide describing use of the protocol was developed at the beginning of the pilot project and substantially modified in 2007 (see Appendix B). The field guide includes a list of equipment needed to complete watercourse crossing evaluations, explanation of how to conduct field procedures, photo log and sketch procedures, monitoring tips, and definitions of terms used in the protocol. Also included are numerous illustrations and photographs to aid in the understanding of the protocol questions.

## Data Recording

Fifty-four watercourse crossings were evaluated using protocols that varied from between 194 to 270 questions (depending on which revision of the protocol was being used). While not every question was answered during each evaluation, a substantial amount of data has been accumulated.[10] At the start of the 2006 field season, the field teams entered data directly into hand held PDAs (Figure 11), but it was determined that keeping track of the evaluation questions in the field was easier if paper forms were used. Some questions were inadvertently skipped when using the PDA because not all of the protocol questions are shown on the PDA screen at one time. Additionally, the PDAs were difficult to use in bright sunlight, and, in some instances, battery power was depleted before the end of the field session. As a result, much of the pilot program data was recorded on paper log sheets.

Figure 11. Anthony Lukacic, CAL FIRE, using a PDA for data entry during the LaTour Demonstration State Forest field training session in June 2006.

[10] For the seven watercourse crossing evaluations entered in the IMMP pilot project database, an average of approximately 120 questions per watercourse crossing were answered.

## Database Development

A Microsoft Access database has been developed for entering and analyzing the pilot project data. Beta version 0.9 of this database has incorporated all the California watercourse crossing protocol questions and answers developed during the two-year pilot phase, and an intersect table has been developed to facilitate question branching and identifying unique answer codes. A responses table is provided to store the answers for each crossing. The database form includes several input masks, edit and new crossing prompts, sample queries, and at least one sample report. Examples of possible database queries, loosely tied to IMMP overarching questions, include the following:

- How many crossings (defined as the road area within bankfull channel width), where the provisions of both the FPRs and the plan were properly implemented, contributed measurable amounts of sediment to the watercourse?

- By what mechanism was the measurable amount of sediment delivered to the watercourse from the crossing (defined as the road area within bankfull channel width), where the FPRs and the plan were properly implemented?

- What was the one, primary cause or contributing factor of soil movement from the crossing (defined as the road area within bankfull), where the FPRs and the plan were implemented?

- What percentage of culvert crossings had diversion potential?

- What percentage of culvert crossings had a diameter equal to or larger than the active channel width?

- Number/percentage of crossings or approaches receiving various letter grades (i.e., A, B, C, D, and F).

- Percentages of crossings, by crossing type (e.g., culvert, ford, bridge, etc.) with different sediment delivery categories (e.g, trace (<1 cubic yard), 1-10 cubic yards, 11-50 cubic yards, etc.).

# IMMP PILOT PROJECT FINDINGS

Field work completed in 2006 and 2007 by the two pilot project field teams provide the following products and conclusions. Because the pilot project protocols were revised several times during collection of field data, not all data is comparable, which limits formal analysis of the overall data set.

- **Development of a watercourse crossing evaluation protocol.**

  As described above, a portion of the existing USFS BMP monitoring protocol was used as the starting point for IMMP watercourse crossing evaluations. During the course of the pilot project, the field teams determined that the USFS protocol, while detailed, did not adequately account for situations routinely found on state and private land timber harvesting projects in California. The IMMP teams, with support from the IMMP Subcommittee, made and tested several protocol revisions to more accurately reflect conditions as found in California THPs. The resulting IMMP protocol can be used by Review Team agencies and the regulated public to evaluate how well practices associated with perceived “high risk” watercourse crossings are performing.

- **Demonstration that the Review Team agencies can work together cooperatively and achieve consensus, with a greater appreciation for each agency’s concerns and objectives related to the impacts from timber harvesting (Figures 12 and 13).**

  All the Review Team agencies agree protection of resources at risk (e.g., soil, water quality, biological) are of primary importance. However, during the review process, agency representatives may disagree as to the best way to specify crossing mitigation within a plan, or even if a given mitigation is necessary. These differing opinions can affect the overall review process, both by creating tension among the Review Team members and occasionally by affecting individual landowners. Such inability to reach consensus can lead to longer plan review periods.

  The IMMP process allowed Review Team agency representatives to work together in a non-regulatory environment without review process concerns, regulatory timelines, and competing and sometimes conflicting regulations. This more “relaxed” situation allowed the members of the IMMP field teams to focus on evaluating the selected watercourse crossings, often prompted spirited discussion, and ultimately led to consensus on all watercourse crossings evaluated. This environment and discussion also led to a greater appreciation among the Review Team agencies for each agency’s expertise and concerns that are not always obvious during the narrowly focused review process.

Figure 12. Pilot project Inland team members Dave Longstreth, CGS, and Joe Croteau, DFG, at a culvert installed on a THP in Shasta County in August 2006.

Figure 13. Pilot project Coast team members Dave Longstreth, CGS, and Richard Fitzgerald, DFG, evaluating a removed watercourse crossing in Mendocino County in August 2006.

- **Agreement that the IMMP approach to interagency problem solving should be fostered and continued, but not limited to watercourse crossings.**

  A goal of the IMMP was to encourage Review Team agencies to work cooperatively and reach consensus on issues related to timber harvesting. As noted previously, high risk watercourse crossings were selected as the subject of the pilot project to test this approach. However, it was not the intent of the IMMP Subcommittee to focus exclusively on watercourse crossings for the long-term program. Rather, it was agreed that the IMMP process should be used to look at multiple issues related to the impacts of timber harvesting on resources at risk.

- **For the IMMP team members, the pilot project was a beneficial training exercise for evaluating watercourse crossings and an effective team building exercise.**

  The detailed evaluation of watercourse crossings required by the protocol developed a heightened appreciation in IMMP Team members for what is required to properly install or remove a watercourse crossing. This awareness has carried over to team members' duties on Pre-Harvest Inspections (PHIs), routine plan inspections, etc.

  The detailed evaluation of watercourse crossings required by the protocol increased the awareness of the IMMP teams to the issues surrounding watercourse installation (including upgrading) and removal. It also pointed to the need for follow-up inspections by trained staff to insure proper implementation of required practices. Finally, the protocol helped the team members recognize the need to evaluate the entire crossing area, including road approaches and the watercourse upstream and downstream of the crossing.

- **Virtually all watercourse crossings or approaches to crossings deliver some sediment, even when the Forest Practice Rules or any additional THP specific mitigation measures are followed appropriately.**

  The detailed evaluation of watercourse crossings required by the protocol revealed that virtually all crossings and/or the associated approaches delivered some sediment to a watercourse. This sediment delivery consisted of "trace" (defined as less than one cubic yard) amounts for the majority of evaluated crossings. But some sediment was delivered. The IMMP teams concluded that, while it appears some sediment delivery is unavoidable, assiduously following the Forest Practice Rules and THP requirements generally limited delivery to trace amounts. There was general agreement that: (1) it is nearly impossible to stop trace amounts of fine sediment from entering watercourses at crossings, (2) better location and installation of road drainage facilities/structures is required near crossings to prevent larger amounts of sediment from being delivered, (3) rock, mulch, or additional sediment control measures are often needed on road approaches near crossings to limit sediment entry, and (4) training and oversight of crossing installation is necessary.

- **Improper installation of crossings and drainage structures near crossings, and improper crossing removal, are major causes of sediment movement and deposition, which is consistent with findings of both the earlier HMP and MCR studies.**

  Installation problems included misapplication of the requirements of the Forest Practice Rules/BMPs or THP-specific engineering requirements, or simply poor workmanship.

- **The high value of photo logs to document practices.**

  The final IMMP protocol specifies that at least four photos be taken of every crossing (upstream and downstream of each crossing and from both approaches). The resulting photo logs provide a means of comparison for crossings that are re-inspected, allowing the Review Team agencies and the regulated public to evaluate how well crossings have held up over multiple winters. The photo log catalogs well installed and poorly installed crossings that can be used for training purposes.

- **Although the protocol was comprehensive, repetitious, and tedious to use, it forced team members to be objective and was instrumental in allowing the team members to reach consensus.**

  The pilot project protocol is tedious to carry out. As a result, the IMMP teams often reached the point of “protocol fatigue” by the end of the day. This condition increased as the field portion of the pilot protocol progressed. However, the required attention to detail forced the team members to work in a more cooperative manner than is generally experienced during PHIs and Review Team meetings, which often require agency representatives to focus on individual resources. This positive atmosphere led to greater appreciation for each agency’s expertise and concerns, provided an effective team building exercise, and was also instrumental in reaching team consensus.

- **Although more time was often spent on road approaches than on the crossing itself, this effort revealed that a high percentage of problems (i.e., sediment transport and deposition into a watercourse) originate on the approaches.**

  The Forest Practice Rules and THP specific mitigations, as well as evaluations during PHIs, generally focus on the relatively small area taken up by the crossing because the relatively large amount of earth movement during installation is considered to be the major potential source of sediment to the watercourse.

  However, when tracking potential sediment sources from origin to the final deposition point, as required by the protocol, the field teams discovered that sediment deposited in the WLPZ or within bankfull stage often originated from the approaches, or was in addition to sediment being input from crossing installation or removal.

- **In areas not dominated by mass wasting processes, the majority of management-related sediment input into watercourses is often a result of poor installation or maintenance of crossings and associated road approaches. This includes installation and maintenance of road drainage structures and appropriate road surfacing near crossings.**

  Reducing sediment deposition into a watercourse can be accomplished with improved installation, maintenance, and removal practices at and near crossings. IMMP field team members have concluded that this requires:

  1. Improved Licensed Timber Operator (LTO) training. LTO recognition of the importance and need for quality installations is a key factor in reducing sediment input. This training should include why sediment input into a watercourse can result in an adverse impact to the beneficial uses of water.

  2. Greater emphasis placed on active and post-active multi-agency inspections. Inspections by trained staff from all Review Team agencies will allow potential problems to be noted and addressed. This could also reduce adverse effects from poor implementation or maintenance-related issues.

# IMMP PILOT PROJECT DISCUSSION AND LIMITATIONS

The pilot project has accomplished a majority of its goals. A monitoring protocol that promotes interagency interaction and cooperation and that addresses overarching agency questions about watercourse crossing design and installation has been developed, tested, and is ready for routine use. In addition, a database application has been developed to automate data entry and analysis.

## Interagency Interaction and Cooperation

The California watercourse crossing protocol is a labor intensive process, where the same or very similar questions are asked several times during an evaluation. This repetition may appear to be a limitation, but field testing found the process to focus attention on details that may be overlooked under other circumstances. The protocol also promoted field discussions at crossing evaluation sites and required development of answers to subjective summary questions. This led to consensus among different agency representatives about the extent and cause of observed problems and how crossing installation or design might be improved.

Field team interactions improved the quality of observations and analysis skills of individual team members for evaluating watercourse crossing performance and potential for sediment delivery. Both field teams found that the pilot project promoted interagency cooperation, consensus building, and development of interpersonal communication skills. The teams also determined that use of the California watercourse crossing protocol could provide useful training for both the government and private sectors.

## Development of Database, Analysis, and Overarching Questions

A Microsoft Access database was developed for data entry and to analyze pilot project data. Field data from seven watercourse crossing evaluations that utilized the most recent version of the protocol have been entered into the database. From this limited sample, it appears that queries can be developed to answer agency overarching questions. However, because the monitoring protocol includes dependent layers, these queries may capture only a portion of the monitoring protocol data related to an overarching question. Moreover, because overarching questions encompass numerous generalized issues while the monitoring protocol asks very specific questions, it may take several queries to address one overarching question.

Because sampling was limited to “high risk” crossings, a non-random method of site selection was used. As a result, the pilot project was not a “scientific” or “statistically valid” study. Results from this approach may be useful in understanding impacts from high risk watercourse crossings in California, but does not provide a basis for developing generalized principles or conclusions.

**Field Monitoring, Corrective Actions, and Water Quality Protection**

The pilot project focused on the effectiveness of current practices, and not on legal/enforcement actions. Field observations did, however, lead to implementation of some corrective work to reduce the potential for sediment delivery before stressing winter storms. Such corrective work required communication with the RPF and LTO responsible for the THPs. Additionally, it became clear to the field teams that forest practices could be corrected and improved upon utilizing increased multi-agency inspection that results in LTO and RPF education.

**Timber Harvest Review Efficiency**

The California watercourse crossing protocol produced by the IMMP pilot program encourages interagency cooperation, normalization of observation skills, and development of multi-agency post PHI (active and post active) inspections to minimize the potential for sediment delivery. This is consistent with the recommendations of larger statewide plans that call for improvements in timber harvesting review efficiency that conserve available financial, governmental, physical, and social resources, while providing more expeditious review timelines.

**Comparability to Other Monitoring Programs**

Because the California watercourse crossing protocol was adapted from the USFS BMP monitoring protocol (Welsch and others 2007), many of the questions remain the same or are very similar. As such, comparison of IMMP protocol findings with results from states using the USFS BMP monitoring protocol may be possible. Such analyses, however, have not been completed to date.

While the pilot project may be used to evaluate the implementation and effectiveness of practices at high risk, non-random watercourse crossings in California, it cannot answer all relevant water quality-related monitoring questions. To put the results of the IMMP work into proper context, it must be viewed as only one part of several additional monitoring projects already being undertaken in California (Figure 14). These efforts include monitoring work that occurs on all or a large percentage of plans (e.g., Forest Practice inspections conducted by CAL FIRE, DFG 1600 permit inspections), a random 10 percent selection of plans for crossing, road, and WLPZ monitoring known as FORPRIEM (Forest Practice Rule Implementation and Effectiveness Monitoring) conducted by CAL FIRE, and a limited number of instream watershed-scale research projects/instream channel monitoring studies (e.g., Caspar Creek, Kings River Experimental Watershed [KREW] study, South Fork Wages Creek, Judd Creek, etc.).

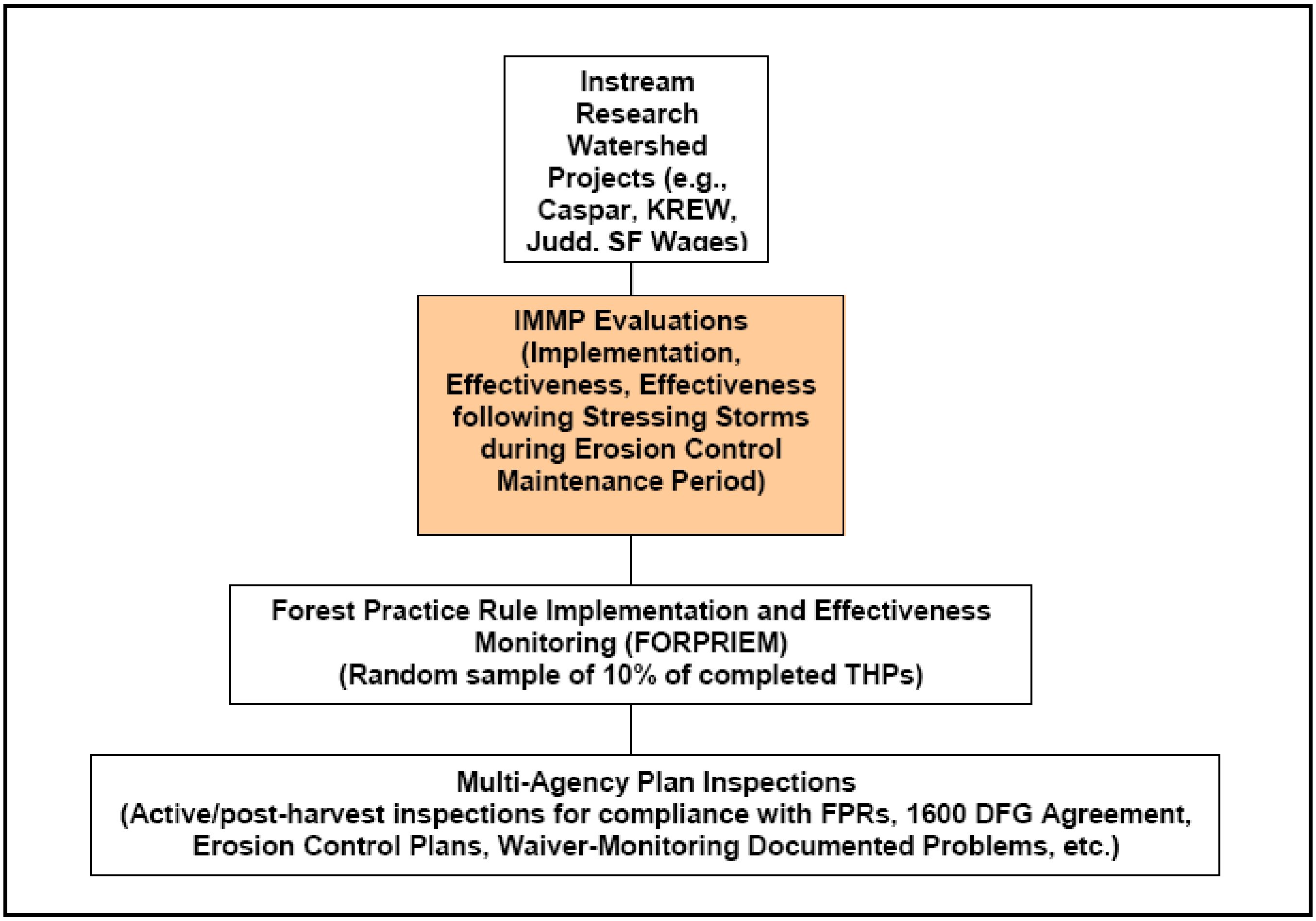


Figure 14. Diagram illustrating the relationship of IMMP work to other water quality-related monitoring approaches currently underway in California.

## Wider Concerns Regarding Timber Harvest Practices in California

The IMMP pilot project is focused on evaluation of high risk watercourse crossings and the road approaches to the crossings. It does not address a variety of other topics and issues regarding review of timber harvesting in California (e.g., tree removal (harvesting, wildfire) versus impacts to habitat, slope stability, water quality and public safety). While the IMMP pilot project has been successful in meeting its initial goals regarding interagency study of high risk watercourse crossings, future work by the IMMP Subcommittee will need to be implemented to address these other issues.

# IMMP PILOT PROJECT RECOMMENDATIONS

The recommendations developed from the pilot project are as follows:

1. Use the current version of the protocol as a multi-agency **training tool** to help field personnel recognize critical situations on post-harvest Erosion Control Maintenance Program (ECMP) inspections. There is consensus that the IMMP watercourse crossing protocol should be used as a **mandatory** Review Team training tool, allowing agency staff to benefit and learn from the IMMP "process."

2. Form interagency teams of professionals and/or technicians from the Review Team agencies to fully implement the IMMP watercourse crossing protocol. Agency personnel from all the Review Team agencies should be trained on erosional processes at and near crossings, rotating agency staff into multiple regional teams on a regular basis to prevent staff "burn-out." Resource professionals and/or technicians can do this work if: (1) they are adequately trained, (2) they carefully read and consider the questions, (3) they have observational skills, (4) they have a basic understanding of erosion processes and BMPs, and (5) the IMMP Subcommittee has an adequate quality assurance/quality control (QA/QC) program in place to check their work.

3. Create QA/QC field team(s) from experienced personnel to provide oversight of the rotating IMMP field teams. The IMMP Subcommittee should develop QA/QC procedures that will utilize CAL FIRE Monitoring Foresters and other agency representatives as available, to verify data accuracy and consistent application of the IMMP protocols.

4. Create a dedicated database site where interagency teams may deposit data and photographic logs. The database site will require dedicated personnel capable of managing and processing data, conducting data analysis, and reporting results on a regular basis to the regulated public, agency managers, and appropriate boards.

5. Continue interagency outreach to landowners, RPFs, LTOs, and agency representatives based on the results of monitoring work. Training should also be provided to RPFs and landowners on use of the IMMP watercourse crossing protocol on their lands, with the goal of improving crossing practice implementation and ensuring effective crossing design in THP development.

6. The State Board of Forestry and Fire Protection's newly forming Research and Science Committee should investigate the use of the IMMP watercourse crossing protocol to meet various agency monitoring requirements, including monitoring requirements in watersheds with state and federally listed coho salmon.

7. Provide adequate funding and agency personnel years for full implementation of the IMMP watercourse crossing protocol, to support training programs, and to develop and test monitoring protocols developed by the IMMP Subcommittee for timber

operations. Funding should be sought through a joint agency Budget Change Proposal. The Board and the IMMP Subcommittee members should also investigate the possibility of acquiring funding from other sources, including state, federal and/or private grants to support this work.

8. Evaluate the remainder of the U.S. Forest Service's "Repeatable Regional Protocol for Performance-Based Monitoring of Forestry Best Management Practices" (Welsch and others 2007) utilizing the IMMP Subcommittee, to determine if more comprehensive and efficient protocols could be developed for additional practices used to protect water quality in California.

9. Use the IMMP field teams to refine and test new monitoring protocols determined to be appropriate by the IMMP Subcommittee.

10. Utilize the IMMP Subcommittee and IMMP field teams to: (1) examine other issues of concern related to timber harvesting operations; (2) facilitate the resolution of issues in a mutually agreeable manner; (3) develop recommendations for each team member's respective agency's management, and (4) develop curriculum for interagency training. This will continue improvements in agency response to timber harvesting issues to protect water quality and increase efficient THP review.

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# APPENDICES

# APPENDIX A—CALIFORNIA WATERCOURSE CROSSING PROTOCOL

G-1 Enter the code for the state, year, sample type, iteration, and sample crossing number.

> Examples: California, 2006, new sample, initial measurement, crossing number 24 would be coded CA 06 N 0 024.
>
> If this same crossing was re-sampled for quality control purposes it would code CA 06 Q 0 024
>
> If this same crossing was re-sampled the first time, the following year, it would code CA 07 R 1 024

G-2 Enter the code for the plan number (x-yy-zzz AAA), where x = Forest Practice District number, yy = year plan was filed, zzz = plan number, and AAA = county abbreviation.

G-3 Enter the number of whole acres in the harvest area as stated in the plan.

G-4 Enter the crossing identification number provided in the plan.

G-5 Enter the code indicating if the crossing was a pre-identified high risk crossing.

1. Yes
2. No

G-6 Enter the code indicating landowner category

1. Non-industrial private forest landowner
2. Industrial forest landowner
3. Public forest landowner
4. Other – Land trust etc
5. Unknown
6. Harvest area is being / has been developed for non forest use.

G-7 Enter the code that best describes the primary adjacent land use for the crossing.

1. Forest
2. Agriculture
3. Residential/Commercial
4. Other

G-8 Is there a DFG 1600 agreement.

1. Yes
2. No
3. Unknown

G-9 Enter one or more codes that describe the plan requirements for the crossing site being evaluated.

1. Standard California Forest Practice Rules including the Threatened and Impaired Watersheds Rule Package (July 1, 2000) where appropriate.
2. Additional mitigation measures assigned during plan review were required and/or the RPF proposed additional measures, which were above and beyond the FPRs.
3. Exceptions, alternatives or in-lieu practices were proposed, which superseded the standard Forest Practice Rules.

Note: The response to this question modifies and pertains directly to the questions regarding Principles and Practices.

G-10 Is there evidence that the crossing site is actively being used?

1. Yes. (Go to G11)
2. No. (Go to G12)

G-11 Is the use identified in G-10 associated with active timber operations?

1. Yes.
2. No.

G-12 Enter the code for the Erosion Hazard Rating (EHR) listed in the plan for the crossing area.

1. Low
2. Moderate
3. High
4. Extreme

G-13 Enter the code indicating the specific underlying rock type/formation. The standard geologic formation letter symbology is recorded (e.g., Mesozoic granitic rocks = g r).

G-14 Enter the code indicating the predominant type of landslide under the crossing or approaches. See Appendix B and C for diagrams and descriptions of each geologic feature.

1. No observed landslide
2. Active rockslide
3. Dormant rockslide (translational/rotational)
4. Active debris flow or debris slide
5. Dormant debris flow or debris slide
6. Active earthflow
7. Dormant earthflow
8. Inner gorge
9. Debris slide slope

G-15 Enter the code for the watercourse class of the channel being evaluated at the crossing site.

1. Class I
2. Class II
3. Class III
4. Class IV

G-16 Enter the code indicating the water body type being crossed.

1. Perennial.
2. Intermittent.
3. Ephemeral.

G-17 Enter the GPS latitude of the water crossing being evaluated based on NAD 83. Enter as decimal degrees latitude including the decimal point and six decimal places.

G-18 Enter the GPS longitude of the water crossing being evaluated based on NAD 83. Enter as decimal degrees longitude including the decimal point and six decimal places.

G-19 Enter the code indicating whether you are evaluating a haul road or skid .

1. Haul road
2. Skid trail

G-20 Has the crossing “over wintered” at least one winter period?

1. Yes, go to G-21.
2. No, go to O-265

G-21 Did the crossing experience a rare or extreme weather event likely to have influenced the crossing during the last winter period?

1. Yes.
2. No.
3. Unknown

Examples may include rain on snow events, severe rainstorms, severe drought, etc,

## WATER BODY CROSSING APPROACH AREA A

AG-22 Enter the WLPZ/ELZ width in whole feet based on the plan or Forest Practice Rules for approach A of the water body being crossed.

AG-23 Enter the code that describes the current road/skid trail status.

1. New
2. Existing
3. Reconstructed
4. Abandoned

AG-24 Enter the code indicating the road type.

1. Permanent road
2. Seasonal road
3. Temporary road
4. Skid Trail

### Approach Area A-Outside the WLPZ/ELZ

Establish the protocol survey area on Approach Area A by measuring the distance on the road surface equivalent to 3X the WLPZ/ELZ width or 300 feet, whichever is less. Distances are measured from bank full.

If within this distance, there are topographic features or a change in grade that prohibits road drainage from draining to the subject watercourse, the upland boundary of the protocol survey area is established at that point. This change is not applicable for drainage facilities including waterbreaks or rolling dips and the change must be continuous throughout the remainder of the measured distance.

AO-25 Does Approach Area A exit the WLPZ/ELZ within this distance?

1. If yes, go to AO26.
2. If no, go to AI53

## Approach Area A-Outside the WLPZ/ELZ DEFINED

Approach Area A-Outside the WLPZ/ELZ originates at the upland edge of the WLPZ/ELZ and extends inland perpendicular to the bank to the edge of the protocol survey area. When road runoff drains away from the watercourse crossing, the protocol survey area is truncated at that point and further survey beyond that point is not necessary. For this purpose, ignore road drainage facilities such as waterbreaks or rolling dips.

If there is no WLPZ/ELZ, limit the approach area outside the WLPZ/ELZ to 25 feet.

Observe the conditions on the ground within Approach Area A - Outside the WLPZ/ELZ and answer the questions. You may have to follow some indicators such as rills, ruts or gullies into the approach area inside the buffer or into the water body itself to answer the questions.

AO-26 Enter the code that best describes the road prism inApproach Area A – Outside the WLPZ/ELZ

1. Landing adjoining maintained road.
2. Road/trail insloped with no inside ditch.
3. Road/trail insloped with an inside ditch.
4. Road/trail outsloped with no inside ditch.
5. Road/trail outsloped with an inside ditch
6. Road/trail crowned with an inside ditch.
7. Road/trail crowned with no inside ditch
8. Road/trail inverted below general grade of adjoining land (includes through cuts and roads on flat ground).
9. Road/trail bermed with no inside ditch.
10. Road/trail bermed with an inside ditch.

AO-27 Enter the code that best describes the road construction at Approach Area A – Outside the WLPZ/ELZ.

1. Road/trail profile created by cut and fill construction.
2. Road/trail profile created by full bench construction.
3. Road/trail profile created by through fill.
4. Road/trail created by through cut.
5. Road/trail created with no cut or fills (i.e. road on flat ground)

AO-28 Is the drainage from the road surface of Approach Area A – Outside the WLPZ/ELZ diverted off the road prism by a drainage facility before it reaches the crossing?

1. Yes
2. No
3. Not applicable, crossing is higher in elevation than Approach Area A.

AO-29 Enter the code that best describes predominant improvements used on any portion of the road / trail in Approach Area A-Outside the WLPZ/ELZ

1. Native material construction, no improvement evident.
2. Erosion control methods/improvements added such as Geo-textile, pallets, mats, slash, corduroy etc.
3. Permeable surfacing material such as gravel added
4. Non-permeable paving such as asphalt or concrete
5. Other

AO-30 Enter the percent grade of the road / trail in Approach Area A- WLPZ/ELZ measuring from the upland edge of the WLPZ/ELZ at the crossing.

Enter + for a positive or upgradient and - for a negative or downgradient followed by the percent grade in whole numbers.

Example: a 15% uphill grade as seen from the crossing would code +15. A 17% downhill grade would code -17

AO-31 Enter the code that best describes any soil movement on Approach Area A-Outside the WLPZ/ELZ

1. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel. (go to question AO-32 )
2. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel. (go to question AO-32 )
3. Soil was deposited inside the WLPZ/ELZ, but did not reach the water body or within the bankfull width of the channel. (go to question AO-41)
4. Soil moved in Approach Area A-Outside the WLPZ/ELZ, but did not reach the WLPZ/ELZ. (go to question AI-49)
5. Soil is stabilized for Approach Area A-Outside the WLPZ/ELZ (go to question AO-48)

In cases where the sediment delivery system (AO-32) indicates strongly that measurable volumes of sediment have been deposited in the water body, but have since been washed away, enter “1” for question AO-31 and enter “0” for question AO-35.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as any ditches and adjoining cut or fill slopes. Look for evidence of soil movement such as rills, gullies or other sediment trails. Consider also material moved by machines during construction as well as material pushed by wheels or dragged by logs.

Depending on the time of year it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion occurred during a prior harvest or is ongoing.

Only one code can be entered. Consider the various problems evident and report on the worst case scenario choosing the answer codes that best describe the situation.

Sediment deposited in the water body from Approach Area-A, Outside the WLPZ/ELZ

AO-32 Enter the code that best describes the evidence that sediment reached the water body or to within the bankfull width of the channel from Approach Area A-Outside the WLPZ/ELZ.

1. Ditch or rut (wheel, track, log drag, etc ). (go to question AO-33 )
2. Gully. (go to question AO-33 )
3. Rill (go to question AO-35)
4. Sheet flow, sediment deposition trail or alluvial fan. (go to question AO-35)
5. Soil slumping or dropping. (go to question AO-35)
6. Mechanical deposition. Examples include soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs. (go to question AO-35)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form continuously evolves into another (such as when a rill becomes a gully) record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut etc.

AO-33 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question AO-32.

Where one erosion form continuously evolves into another (such as when a rill becomes a gully) measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. For an inside ditch, measure the entire length of the ditch, even if it extends outside of the protocol survey area. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

AO-34 Enter the mid point cross sectional area in whole square inches of the rill, gully, ditch or rut identified in question AO-32.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

AO-35 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic yards by the delivery system identified in question AO-32.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole yards.

Enter "0" if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

AO-36 Enter the code that best describes the predominant type of sediment delivered to the water body or to within the bankfull width of the channel by the delivery system identified in question AO-32.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

AO-37 Can sedimentation be expected to occur during the next storm event based on your answers to questions AO-32 through AO-36.

1. Yes.
2. No.
3. Unknown.

AO-38 Were principles / practices applied?

1. Yes.
2. No.

AO-39 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

AO-40 Enter the code that best describes the specific cause of sediment delivery to the water body or to within the bankfull width of the channel from Approach Area A-Outside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.3. Incorrect maintenance
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering proceed directly to question AI-49**

<u>Sediment deposited inside the WLPZ/ELZ, but not the water body from Approach Area A-Outside the WLPZ/ELZ</u>

AO-41 Enter the distance from the watercourse that the sediment terminated.

Measure horizontal distance in whole feet perpendicular to the bank.

AO-42 Enter the code that best describes the evidence that sediment reached the WLPZ/ELZ but not the water body nor to within the bankfull width of the channel from Approach Area A-Outside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc )
2. Gully
3. Rill
4. Sediment deposition trail, sheet flow, or alluvial fan
5. Soil slumping or dropping
6. Mechanical deposition of soil

Where one erosion feature continuously evolves into another (such as when a rill becomes a gully) record the dominant form.

AO-43 Enter the code that best describes the predominant type of sediment delivered to the WLPZ/ELZ, but not the water body nor to within the bankfull width of the channel, by the delivery system identified in question AO-42.

1 Organic material
2 Clay (forms ribbon 1 inch or longer)
3 Silt / loam (feels smooth but will not form ribbon)
4 Sandy (feels gritty)
5 Gravel (0.8 – 2.5 inches)
6 Cobble & larger (> 2.5 inches)

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

AO-44 Can sedimentation be expected to occur during the next storm event based on your answers to questions AO-42 and AO-43.

1. Yes.
2. No.
3. Unknown.

AO-45 Were principles / practices applied?

1. Yes.
2. No.

AO-46 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

AO-47 Enter the code that best describes the specific cause of sediment delivery to the WLPZ/ELZ (but not the water body nor to within the bankfull width of the channel) from Approach Area A-Outside the WLPZ/ELZ.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering proceed directly to question AI-49**

Soil stabilized in Approach Area-A, Outside the WLPZ/ELZ

AO-48 Were principles / practices applied?

1. Yes.
2. No.

**After answering question AO-48 and reading the following explanation proceed directly to question AI-49.**

## Approach Area-A, Inside the WLPZ/ELZ

Approach Area A-Inside the WLPZ/ELZ originates at the outer edge of the stream's bankfull width and extends to the outer edge of the WLPZ/ELZ.

Observe the conditions on the ground within Approach Area A-Inside the WLPZ/ELZ and answer the questions.

Report only those conditions that originate from the approach area inside the buffer. Conditions originating beyond the approach area inside the buffer were reported in the previous section.

AI-49 Is there a WLPZ/ELZ?

1. Yes, go to AI-50
2. No, go to GC-101

AI-50 Enter the percent grade of the road / trail in Approach Area A Inside WLPZ/ELZ measuring from the bankful width of the water body at the crossing.

Enter + for a positive or uphill gradient and - for a negative or down hill gradient followed by the percent grade in whole numbers.

Example: a 15% uphill grade as seen from the crossing would code +15. A 17% downhill grade would code -17

AI-51 Enter the code that best describes improvements used on any portion of the road / trail in Approach Area A-Inside the WLPZ/ELZ

1. Native material construction, no improvement evident.
2. Erosion control methods/improvements added such as geo-textile, pallets, mats, slash, corduroy etc.
3. Permeable surfacing material such as gravel added
4. Non-permeable paving such as asphalt or concrete
5. Other

AI-52 Enter the code that best describes the road prism Approach Area A – Inside the WLPZ/ELZ

1. Landing adjoining maintained road.
2. Road insloped with no inside ditch.
3. Road insloped with an inside ditch.
4. Road outsloped with no inside ditch.
5. Road outsloped with an inside ditch
6. Road crowned with an inside ditch.
7. Road crowned with no inside ditch
8. Road inverted below general grade of adjoining land (includes through cuts and roads on flat ground).
9. Road bermed with no inside ditch
10. Road bermed with inside ditch.

AI-53 Enter the code that best describes the road construction Approach Area A – Inside the WLPZ/ELZ

1. Road/trail profile created by cut and fill construction.
2. Road/trail profile created by full bench construction.
3. Road/trail profile created by through fill.
4. Road/trail created by through cut.
5. Road/trail created with no cut or fills (i.e. flat ground)

AI-54 Is the drainage from the road surface Approach Area A – Inside the WLPZ/ELZ diverted off the road prism by a drainage facility before it reaches the crossing?

1. Yes
2. No
3. Not applicable, crossing is higher in elevation than Approach Area A.

AI-55 Enter the code that best describes any soil movement on Approach Area A-Inside the WLPZ/ELZ

1. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel. (go to question AI-56)
2. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel. (go to question AI-56)
3. Soil moved in Approach Area-A, Inside the WLPZ/ELZ, but did not reach the water body nor to within the bankfull width of the channel. (go to question AI-65)
4. Soil is stabilized for Approach Area-A, Inside the WLPZ/ELZ ( go to question AI-72)
5. Soil movement occurs in Approach Area-A, Inside the WLPZ/ELZ, but has been recorded elsewhere in the protocol. (go to question AI-74)

In cases where the sediment delivery system (AI-56) indicates strongly that measurable volumes of sediment have been deposited in the water body, but have since been washed away, enter "1" for question AI-55 and enter "0" for question AI-59.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes. Look for evidence of soil movement such as rills, gullies or other sediment trails. Consider also material moved by machines during construction as well as material pushed by wheels or dragged by logs.

Depending on the time of year it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion occurred during a prior harvest or is ongoing.

Only one code can be entered. Consider the various problems evident and report on the worst case scenario choosing the answer codes that best describe the situation.

Sediment deposited in the water body from Approach Area A Inside the WLPZ/ELZ

AI-56 Enter the code that best describes the evidence that sediment reached the water body or to within the bankfull width of the channel from Approach Area A-Inside the WLPZ/ELZ.

1. Ditch or rut (wheel, track, log drag, etc ). (go to question AI-57)
2. Gully (go to question AI-57)
3. Rill (go to question AI-57)
4. Sheet flow, sediment deposition trail or alluvial fan (go to question AI-59)
5. Soil slumping or dropping (go to question AI-59)
6. Mechanical deposition of soil. Examples include soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs. (go to question AI-59)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut, etc.

AI-57 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question AI60.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. For an inside ditch, measure the entire length of the ditch, even if it extends outside of the protocol survey area. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

AI-58 Enter the mid point cross sectional area in whole square inches of the rill, gully, ditch or rut identified in question AI-56.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

AI-59 Enter the currently evident volume of sediment deposited in the water body or to within the bankfull width of the channel in whole cubic yards by the delivery system identified in question AI-56.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole cubic yards.

Enter “0” if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

AI-60 Enter the code that best describes the predominant type of sediment delivered to the water body or to within the bankfull width of the channel by the delivery system identified in question AI-56.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 inches)
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

AI-61 Can sedimentation be expected to occur during the next storm event based on your answers to questions AI-56 through AI-60.

1. Yes.
2. No.
3. Unknown.

AI-62 Were principles / practices applied?

1. Yes.
2. No.

AI-63 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

AI-64 Enter the code that best describes the specific cause of sediment delivery to the water body or to within the bankfull width of the channel from <u>Approach Area A-Inside the WLPZ/ELZ</u>

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question AI-73**

<u>Soil moved in Approach Area A-WLPZ/ELZ, but did not reach the water body</u>

AI-65 Enter the distance from the watercourse that the sediment terminated.

Measure horizontal distance in whole feet perpendicular to the bank.

AI-66 Enter the code that best describes the evidence that soil moved, but did not reach the water body nor to within the bankfull width of the channel from within Approach Area A-Inside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc )
2. Gully
3. Rill
4. Sediment deposition trail, sheet flow, or alluvial fan
5. Soil slumping or dropping
6. Mechanical deposition of soil

Where one erosion form continuously evolves into another(such as when a rill becomes a gully) record the predominant form.

AI-67 Enter the code that best describes the predominant type of soil that was moved, but did not reach the water body nor to within the bankfull width of the channel by the delivery system identified in question AI-66.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

AI-68 Can sedimentation be expected to occur during the next storm event based on your answers to questions AI-66 and AI-67.

1. Yes.
2. No.
3. Unknown.

AI-69 Were principles / practices applied?

1. Yes.
2. No.

AI-70 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

AI-71 Enter the code that best describes the specific cause of soil movement in Approach Area A-Inside the WLPZ/ELZ.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question AI-73**

Soil stabilized In Approach Area A-Inside the WLPZ/ELZ

AI-72 Were principles / practices applied?

1. Yes.
2. No.

**After answering question AI-72 proceed directly to question AI-73**

AI-73 Enter the code that best describes the preponderant hydrologic soil type in Approach Area A- Inside the WLPZ/ELZ.

1. Type A (sand/gravel - feels gritty)
2. Type B/C (loams – feels crumbly)
3. Type D (silt, clay, muck – smooth, plastic to gelatinous)

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

## **Water Drafting - Approach Area-A, Inside the WLPZ/ELZ**

AID-74 Is there a water drafting approach constructed in Approach Area A – Inside the WLPZ/ELZ

1. Yes. (If yes, go to AID-75)
2. No. (If no, go to CG76)

AID-75 Enter the length, in feet, of the water drafting approach constructed in Approach Area A – Inside the WLPZ/ELZ

AID-76 Enter the percent grade of the water drafting approach in Approach Area A Inside the WLPZ/ELZ measuring from the termination point of the approach to the junction at the road.

Enter + for a positive or uphill gradient and - for a negative or down hill gradient followed by the percent grade in whole numbers.

Example: a 15% uphill grade as seen from the crossing would code +15. A 17% downhill grade would code -17

AID-77 Enter the code that best describes improvements used on any portion of the water drafting approach in Approach Area A-Inside the WLPZ/ELZ

1. Native material construction, no improvement evident.
2. Erosion control methods/improvements added such as geo-textile, pallets, mats, slash, corduroy etc.
3. Permeable surfacing material such as gravel added
4. Non-permeable paving such as asphalt or concrete
5. Other

AID-78 Enter the code that best describes the water drafting approach's construction adjacnt to Approach Area A – Inside the WLPZ/ELZ

1. Created by cut and fill construction.
2. Created by full bench construction.
3. Created by through fill.
4. Created by through cut.
5. Created with no cut or fills (i.e. flat ground)

AID-79 Is there evidence of petroleum or petroleum residue on the water drafting approach adjacent to Approach Area A – Inside the WLPZ/ELZ?

1. Yes. (go to AID-80)
2. No. (go to AID-81)

AID-80 Enter the diameter in feet or decimal fractions of a foot of the area occupied by the petroleum or petroleum residue.

AID-81 Does runoff from Approach Area A – Inside the WLPZ/ELZ flow to or across the water drafting approach.

1. Yes. (go to AID-82)
2. No. (go to AID-83)

AID-82 Are there sediment deposits on the water drafting approach adjacent to Approach A – Inside the WLPZ/ELZ?

1. Yes.
2. No.

AID-83 Enter the code that best describes any soil movement on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ

1. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel. (go to question AID-84)
2. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel. (go to question AID-84)
3. Soil moved on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ, but did not reach the water body nor to within the bankfull width of the channel. (go to question AID-93)
4. Soil is stabilized on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ ( go to question AID-100)
5. Soil movement occurs on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ, but has been recorded elsewhere in the protocol. ( go to question GC-101)

Sediment deposited in the water body from the water drafting approach in Approach Area A-Inside the WLPZ/ELZ

AID-84 Enter the code that best describes the evidence that sediment reached the water body or to within the bankfull width of the channel from the water drafting approach in Approach Area A-Inside the WLPZ/ELZ.

1. Ditch or rut (wheel, track, log drag, etc ). (go to question AID-85)
2. Gully (go to question AID-85)
3. Rill (go to question AID-85)
4. Sheet flow, sediment deposition trail or alluvial fan (go to question AID-87)
5. Soil slumping or dropping (go to question AID-87)
6. Mechanical deposition of soil. Examples include soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs. (go to question AID-87)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut, etc.

AID-85 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question AID-84.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. For an inside ditch, measure the entire length of the ditch, even if it extends outside of the protocol survey area. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

AID-86 Enter the mid point cross sectional area in whole square inches of the rill, gully, ditch or rut identified in question AID-84.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

AID-87 Enter the currently evident volume of sediment deposited in the water body or to within the bankfull width of the channel in whole cubic yards by the delivery system identified in question AID-84.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole cubic yards.

Enter “0” if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

AID-88 Enter the code that best describes the predominant type of sediment delivered to the water body or to within the bankfull width of the channel by the delivery system identified in question AID-84.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 inches)
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

AID-89 Can sedimentation be expected to occur during the next storm event based on your answers above?

1. Yes.
2. No.
3. Unknown.

AID-90 Were principles / practices applied?

1. Yes.
2. No.

AID-91 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

AID-92 Enter the code that best describes the specific cause of sediment delivery to the water body or to within the bankfull width of the channel from the water drafting approach in Approach Area A-Inside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question GC-101**

<u>Soil moved on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ, but did not reach the water body</u>

AID-93 Enter the distance from the watercourse that the sediment terminated.

Measure horizontal distance in whole feet perpendicular to the bank.

AID-94 Enter the code that best describes the evidence that soil moved, but did not reach the water body nor to within the bankfull width of the channel from the water drafting approach in Approach Area A-Inside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc )
2. Gully
3. Rill
4. Sediment deposition trail, sheet flow, or alluvial fan
5. Soil slumping or dropping
6. Mechanical deposition of soil

Where one erosion form continuously evolves into another(such as when a rill becomes a gully) record the predominant form.

AID-95 Enter the code that best describes the predominant type of soil that was moved, but did not reach the water body nor to within the bankfull width of the channel by the delivery system identified in question AI75.21.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

AID-96 Can sedimentation be expected to occur during the next storm event based on your answers to questions?

1. Yes.
2. No.
3. Unknown.

AID-97 Were principles / practices applied?

1. Yes.
2. No.

AID-98 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

AID-99 Enter the code that best describes the specific cause of soil movement on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question GC-101**

<u>Soil stabilized on the water drafting approach in Approach Area A-Inside the WLPZ/ELZ</u>

AID-100 Were principles / practices applied?

1. Yes.
2. No.

**After answering question AID-100 proceed directly to question GC-101**

## CROSSING STRUCTURE

GC-101 Enter the code that describes the current crossing status.

1. New—permanent
2. Pre-existing—permanent
3. New—temporary
4. Pre-existing—temporary
5. Abandoned/removed

GC-102 Is there evidence that the crossing has been maintained since the last winter period?

1. Yes.
2. No.

GC-103 Is there perched fill material at the inlet or outlet of the crossing within or immediately adjacent to bankfull.

1. Yes.
2. No.

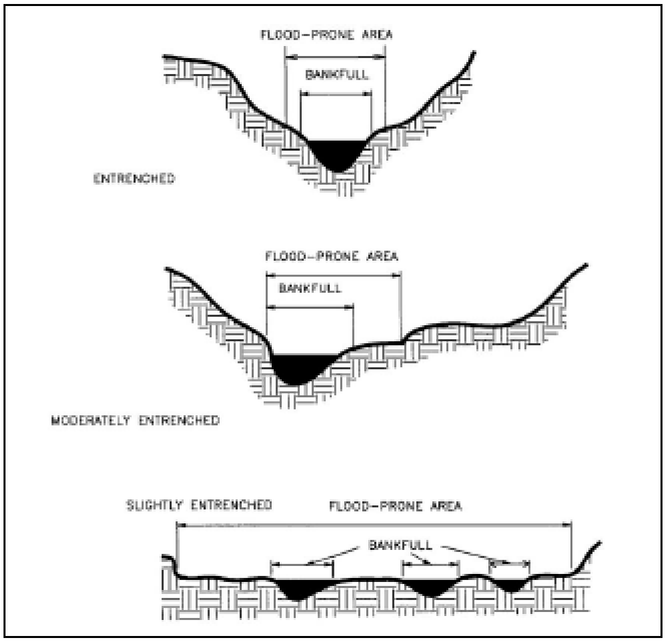
GC-104 Enter the active channel bed width in feet (measured at a riffle).

GC-105 Enter the bankfull channel width in feet (measured at a riffle).

GC-106 Enter the bankfull depth in feet (measured at a riffle).

GC-107 Enter the code best describing the entrenchment of the natural watercourse channel above the crossing.

1. Entrenched (Confined)
2. Moderately entrenched (Unconfined)
3. Slightly entrenched (Braided)




GC-108 Enter the code best describing the average percent grade of the natural watercourse channel above and below the crossing.

1. 0-2%
2. 2-4%
3. 4-10%
4. 10-30%
5. > 30%

GC-109 Enter the code indicating if a crossing was impacted by a landslide after its construction.

1. Yes.
2. No.

GC-110 Enter the code that best describes the crossing structure.

1. Single-pipe culvert (Go to C-111)
   This type of culvert may have an overflow pipe and would not qualify as a multiple pipe crossing. The crossing shall be treated as a single pipe crossing.
2. Multiple culverts (Go to C-130)
3. Pipe arch (Go to C-111)
4. Arch bottomless (Go to C-138)
5. Native Surfaced Ford (Go to C-142)
6. Dry Ford – rocked outfall (Go to C-144)
7. Wet Ford – rocked outfall and surface (Go to C-144)
8. Arizona crossing/vented ford (Go to C-111)
9. Ford with concrete apron (Go to C-144)
10. Temporary crossing (Go to C-151)
11. French drains/burrito crossing (Go to C-160)
12. Bridge – closed top (Go to C-147)
13. Bridge – open planked top (Go to C-147)
14. Other (Go to C-160)

Culverted Crossing

C-111 Enter the code that describes the culvert/pipe arch/arch entrance type.

1. Projecting pipe
2. Pipe end mitered
3. Headwall
4. Headwall and wingwalls (concrete and/or rock)
5. Flared metal inlet
6. Not applicable

C-112 Enter the code describing whether a critical dip was installed at the crossing.

1. A critical dip is installed, and has experienced flow from the crossing, and did erode or down cut
2. A critical dip is installed, has experienced flow from the crossing, and did not erode or down cut
3. A critical dip is installed at the crossing and there is no indication of flow
4. No critical dip was installed (go to C-113)

C-113 Is there diversion potential at the crossing? Diversion is defined as the ability for the watercourse to be channeled down the road for a distance greater than the WLPZ/ELZ width.

1. There is potential, but no physical evidence for watercourse diversion down the road.
2. There is potential and physical evidence of flow down the road.
3. There is no potential for watercourse diversion due to crossing design or topographical features.
4. Design accommodates for potential of overflow (i.e. significantly oversized culvert installed).

C-114 Enter the number of pipes present at the crossing site.

C-115 Enter the diameter, in inches, of the channel pipe present at the crossing site.

C-116 Enter the code that describes the pipe gradient.

1. Similar to natural channel slope
2. Significantly lower gradient, compared to natural channel slope
3. Significantly higher gradient

C-117 Enter code indicating the percentage of the pipe inlet area that is currently blocked by wood and/or sediment.

1. 0-10%
2. 11-25%
3. 26-50%
4. >50%

C-118 Enter the code indicating if there is a trash rack installed.

1. Yes
2. No

C-119 Enter the code that describes the horizontal alignment of the pipe present.

1. In line with channel
2. Offset from channel
3. Skewed

C-120 Enter the code that describes the degree of deformation of the pipe.

1. No significant deformation
2. Pipe deformed <10%.
3. Pipe deformed >10%.

C-121 Is the pipe length adequate?

1. Yes.
2. No.

C-122 Is the fill over the pipe centered on the pipes length?

1. Yes.
2. No.

C-123 Is the fill face over steepened on either side of the pipe?

1. Yes.
2. No.

C-124 Is the pipe located on a Class I fish bearing watercourse?

1. Yes (go to C-125)
2. No (go to C-160)

C-125 Enter the code indicating depth of the residual pool at the inlet in inches.

1. < 6”
2. ≥ 6”

C-126 Enter the code indicating if there is streambed substrate throughout the pipe.

1. Yes
2. No

C-127 Enter the code indicating if the pipe includes baffles or weirs.

1. Yes
2. No

C-128 Enter the code indicating if there is a pool at the outlet.

1. Yes
2. No

C-129 Enter the code indicating pipe outlet drop in inches.

1. 0-11”
2. 12-24”
3. >24”

**After answering C-129, go to C-160**

Multiple Pipes

C-130 Enter the code that describes the culverts entrance types.

1. Projecting pipe
2. Pipe end mitered
3. Headwall
4. Headwall and wingwalls (concrete and/or rock)
5. Flared metal inlet
6. Not applicable

C-131 Enter the code describing whether a critical dip was installed at the crossing.

1. A critical dip is installed, and has experienced flow from the crossing, and did erode or down cut
2. A critical dip is installed, has experienced flow from the crossing, and did not erode or down cut
3. A critical dip is installed at the crossing and there is no indication of flow
4. No critical dip was installed (go to C-132)

C-132 Is there diversion potential at the crossing? Diversion is defined as the ability for the watercourse to be channeled down the road for a distance greater than the WLPZ/ELZ width.

1. There is potential, but no physical evidence for watercourse diversion down the road.
2. There is potential and physical evidence of flow down the road.
3. There is no potential for watercourse diversion due to crossing design or topographical features.
4. Design accommodates for potential of overflow (i.e. significantly oversized culvert installed).

C-133 Enter the number of pipes present at the crossing site.

C-134 Enter the percentage of the pipe inlet area that is currently blocked by wood and/or sediment (0 to 100%).

C-135 Enter the code that describes the horizontal alignment of the pipe present.

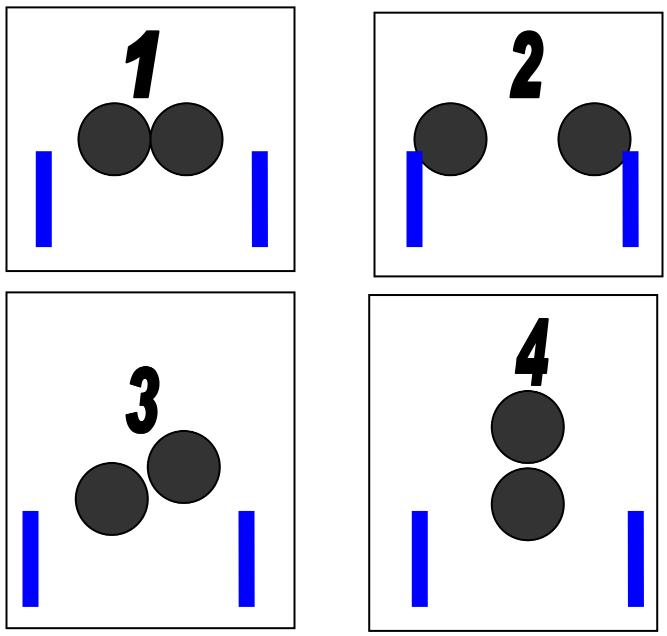
1. In line with channel
2. Offset from channel
3. Skewed

C-136 Is there a trash rack associated with the crossing?

1. Yes
2. No.

C-137 Which diagram below most closely resembles the arrangement of the multiple pipes at the crossing location relative to bankfull (vertical, parallel lines)?

1. 1
2. 2
3. 3
4. 4




**After answering C-137, go to C-160**

Bottomless Arch Crossing

C-138 Enter the code that describes the arch entrance type.

1. Projecting pipe
2. Pipe end mitered
3. Headwall
4. Headwall and wingwalls (concrete and/or rock)
5. Flared metal inlet
6. Not applicable

C-139 Enter the span, in feet, of the arch.

C-140 Enter the height, in feet, of the arch.

C-141 Enter the code that describes stream channel stability within the crossing structure.

1. Stable
2. Scouring laterally
3. Down-cutting
4. Aggrading
5. Other

**After answering C-141 go to C-160**

<u>Native Surfaced Ford Crossing</u>

C-142 Is the ford constructed to handle the flows experienced at the crossing as evidenced by containment of flow within the constructed width?

1. Yes.
2. No.

C-143 Enter the code(s) for observed erosion at fords.

1. Road surface channelization >2”
2. Gullied outfall
3. Gullied outfall at edge of armor
4. Gully/surface channelization out of ford (diversion)
5. None or minimal erosion
6. Other

**After answering C-143, go to C-160**

<u>Wet/Dry Ford Crossings</u>

C-144 Is the ford constructed to handle the flows experienced at the crossing as evidenced by containment of flow within the constructed width?

1. Yes.
2. No.

C-145 Enter the code(s) for observed erosion at fords.

1. Road surface channelization >2”
2. Gullied outfall
3. Gullied outfall at edge of armor
4. Gully/surface channelization out of ford (diversion)
5. None or minimal erosion
6. Other

C-146 Does at least 50% (by volume) of the rock used for the constructed outfall equal or exceed the stable rock sizes observed in the watercourse channel upstream/ downstream of the ford?

1. Yes
2. No
3. Indeterminate

**After answering C-146, go to C-160**

<u>Bridge Crossings</u>

C-147 Enter code that describes the predominant bank protection under the bridge.

1. Concrete
2. Rip-rap
3. Steel sheeting
4. Wood/timber
5. Log
6. Concrete filled CMPs
7. None
8. Other

C-148 Enter the code that describes bridge alignment.

1. Perpendicular to the waterbody.
2. Skewed to the waterbody.

C-149 Enter the code that describes bridge length.

1. The bridge is long with adequate turning radius.
2. The bridge is short with adequate turning radius.

C-150 Enter code that describes stream channel stability at the crossing.

1. Stable
2. Scouring laterally
3. Down-cutting
4. Aggrading
5. Other

**After answering C-150, go to C-160**

Removed or Abandoned Crossings

C-151 Enter the code that indicates if the crossing has been excavated to form a channel that is similar to the natural watercourse grade and orientation and is wider than the natural channel.

1. Yes.
2. No.

C-152 Are there erosional processes occurring at the removed or abandoned crossing site?

1. Yes (Go to C120)
2. No (Go to C-160)

C-153 Are slumps/debris slides present?

1. Yes.
2. No.

C-154 Is there evidence of channel incision?

1. Yes.
2. No.

C-155 Is the watercourse headcuting through the crossing location?

1. Yes.
2. No.

C-156 Was a grade control structure installed?

1. Yes.
2. No.

C-157 Are there gullies present at the crossing location?

1. Yes.
2. No.

C-158 Is there surface erosion and rilling at the crossing location?

1. Yes.
2. No.

C-159 Is there bank erosion at the crossing location?

1. Yes.
2. No.

**After answering C-159, go to C-160**

C-160 Enter the code that best describes the structure bottom and stream substrate used

1. Open bottom structure or structure removed
2. Closed bottom structure, natural streambed substrate material is present and continuous on the inside bottom of the structure
3. Closed bottom structure, natural streambed substrate material is not present or not continuous on the inside bottom of the structure

C-161 Enter the code that best describes the most significant type of bank protection both upstream and downstream.

1. Rip-rap
2. Gabions
3. Wing-walls
4. Vegetation
5. Seeded/Mulched
6. Slash/wood
7. Naturally stable due to substrate
8. None
9. Other

C-162 Enter the code that best describes the fill face armoring present on the inlet side.

1. Rock armored
2. Partially rock armored around the pipe only
3. Slash armored
4. Not armored but mulched and/or seeded
5. Not armored but supports brush and/or trees
6. Not armored but supports grass and/or forbs
7. Not armored and exposed bare soil
8. Not applicable

C-163 Enter the code that best describes the fill face armoring present on the outlet side.

1. Rock armored
2. Partially rock armored around the pipe only
3. Slash armored
4. Not armored but mulched and/or seeded
5. Not armored but supports brush and/or trees
6. Not armored but supports grass and/or forbs
7. Not armored and exposed bare soil
8. Not applicable

C-164 Is the crossing structure opening, or stream channel in the event the structure has been removed, equal to or greater than the pre-structure bankfull channel width?

1. Yes.
2. No.

C-165 Enter the code indicating if the size of the crossing structure opening meets state requirements at the time of plan approval.

1. Yes.
2. No.
3. Unknown.

C-166 Enter the code indicating if there is evidence of stream down cutting, scouring, or aggradation within 100 feet downstream of the outlet end of the structure

1. Evidence of scouringand downcutting.
2. Evidence of aggrading or widening.
3. Stable.

C-167 Enter the code indicating if there is evidence of stream down cutting, scouring, or aggradation within 100 feet upstream of the inlet end of the structure

1. Evidence of scouringand downcutting.
2. Evidence of aggrading or widening.
3. Stable.

C-168 Enter the code indicating whether the following conditions exist near the crossing (the most prevalent).

1. No significant hazards observed
2. Significant wood accumulations near crossing
3. Significant bedload accumulations threatening crossing
4. Significant wood and sediment accumulations threatening crossing
5. Sizing inadequate (main hazard present)
6. Other (describe)

C-169 Have modifications been made to the crossing, for purposes such as water drafting, which have impacted the functionality of the crossing?

1. No
2. Yes
3. Yes (1600 agreement)
4. Unknown

C-170 Enter the code that best describes soil or fill material movement or mechanical deposition of fill material associated with the crossing structure

1. Measurable amounts of sediment deposited in the water body (go to question C-171).
2. Trace amounts such as films or suspended sediments visible in the water body. (go to question C-171)
3. Soil moves, but does not reach the water body. (go to question C-182)
4. Soil stabilized at crossing. (go to question C-185)
5. Soil movement occurs, but has been recorded elsewhere in the protocol. (go to question BG-186)

In cases where the sediment delivery system (C-171) indicates strongly that measurable volumes of sediment have been deposited in the water body, but have since been washed away, enter "1" for question C-171 and enter "0" for question C-176.

Note that the crossing structure includes only that area within the bankfull width of the channel.

Inspect the structure and any associated fill or abutments that are within the bankfull width of the channel.

Look for evidence of soil movement such as rills, gullies or other sediment trails. Consider also material moved by machines during construction as well as material pushed by wheels or dragged by logs. Material on the deck of bridges within the bankfull width of the channel is considered to be deliverable in the water body.

Depending on the time of year it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion occurred during a prior harvest or is ongoing.

Only one code can be entered. Consider the various problems evident and report on the worst case scenario choosing the answer codes that best describe the situation.

Soil Delivered to the Water Body from the Crossing Structure.

C-171 Enter the code that best describes the evidence that sediment was delivered to the water body.

1. Ditch or rut (wheel, track, log drag, etc.) (Go to question C-172)
2. Gully. (Go to question C-172)
3. Rill. (Go to question C-172)
4. Sheet flows, soil puddling or deposition trail. (Go to question C-174)
5. Soil slumping, piping, leaching, weeping, falling. (Go to question C-174)
6. Mechanical deposition of soil. Example: Soil pushed into the waterbody or onto temporary crossing structures by machinery or dragged logs. (Go to question C-174)
7. Undercutting of crossing structure (Go to question C-174)
8. Overflow or total washout of the crossing structure (Go to question C-174)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form continuously evolves into another in a continuous manner (such as when a rill becomes a gully) record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut etc.

C-172 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question C-171.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

C-173 Enter the mid point cross sectional area in whole square inches of the rill, gully, ditch or rut identified in question C-171.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

C-174 Is the erosion occurring on a fill face?

1. Yes (go to C-175)
2. No (go to C-176)
3. Not applicable (go to C-176)

C-175 Enter the code describing the source of flow causing fill face erosion.

1. The fill face is eroded by overtopping of the crossing by streamflow.
2. The fill face is eroded by accumulated flow from road surfaces.
3. The fill face is eroded by both overtopping and accumulated flow from road surfaces.
4. Over steepened fill faces.
5. Perched fills.

C-176 Enter the currently evident volume of sediment deposited in the water body width of the channel in whole cubic decimal yards by the delivery system identified in question C-171.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole cubic feet.

Enter “0” if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

.

C-177 Enter the code that best describes the predominant type of material delivered to the water body by the delivery system identified in question C136.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

C-178 Is sedimentation expected to continue to occur during the next storm event based on your answers to questions C-171 through C-177?

1. Yes.
2. No.
3. Unknown.

C-179 Were principles / practices applied?

1. Yes.
2. No.

C-180 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

C-181 Enter the code that best describes the specific cause of soil movement in Approach Area A-Inside the WLPZ/ELZ.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

**After answering question C-181 proceed directly to question BG-186**

Soil Moves but does not reach the Water Body

C-182 Were principles / practices applied?

1. Yes.
2. No.

C-183 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

C-184 Enter the code that best describes the specific cause of soil movement in Approach Area A-Inside the WLPZ/ELZ.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

**After answering question C-184 proceed directly to question BG-186**

Quality Practices and Principles Applied for Crossing Structure

C-185 Were principles / practices applied?

1. Yes.
2. No.

**After answering question C-185 proceed directly to question BG-186**

## WATER BODY CROSSING APPROACH AREA B

BG-186 Enter the WLPZ/ELZ width in whole feet based on plan or Forest Practice Rules for approach B of the water body being crossed.

BG-187 Enter the code that describes the current road/skid trail status.

1. New
2. Existing
3. Reconstructed
4. Abandoned

BG-188 Enter the code indicating the road type.

1. Permanent road
2. Seasonal road
3. Temporary road
4. Skid Trail

**Approach Area B-Outside the WLPZ/ELZ**

Establish the protocol survey area on Approach Area A by measuring the distance on the road surface equivalent to 3X the WLPZ/ELZ width or 300 feet, whichever is less. Distances are measured from bank full.

If within this distance, there are topographic features or a change in grade that prohibits road drainage from draining to the subject watercourse, the upland boundary of the protocol survey area is established at that point. This change is not applicable for drainage facilities including waterbreaks or rolling dips and the change must be continuous throughout the remainder of the measured distance.

BO-189 Does Approach Area A exit the WLPZ/ELZ within this distance?

1. If yes, go to BO-190.
2. If no, go to BI-213

## Approach Area B-Outside the WLPZ/ELZ DEFINED

Approach Area B-Outside the WLPZ/ELZ originates at the upland edge of the WLPZ/ELZ and extends inland perpendicular to the bank to the edge of the protocol survey area. When road runoff drains away from the watercourse crossing, the protocol survey area is truncated at that point and further survey beyond that point is not necessary. For this purpose, ignore road drainage facilities such as waterbreaks or rolling dips.

If there is no WLPZ/ELZ, limit the approach area outside the WLPZ/ELZ to 25 feet.

Observe the conditions on the ground within Approach Area B-Outside the WLPZ/ELZ and answer the questions. You may have to follow some indicators such as rills, ruts or gullies into the approach area inside the buffer or into the water body itself to answer the questions.

BO-190 Enter the code that best describes the road prism Approach Area B – Outside the WLPZ/ELZ

1. Landing adjoining maintained road.
2. Road/trail insloped with no inside ditch.
3. Road/trail insloped with an inside ditch.
4. Road/trail outsloped with no inside ditch.
5. Road/trail outsloped with an inside ditch
6. Road/trail crowned with an inside ditch.
7. Road/trail crowned with no inside ditch
8. Road/trail inverted below general grade of adjoining land (includes through cuts and roads on flat ground).
9. Road/trail bermed with no inside ditch.
10. Road/trail bermed with an inside ditch.

BO-191 Enter the code that best describes the road construction at Approach Area B – Outside the WLPZ/ELZ

1. Road/trail profile created by cut and fill construction.
2. Road/trail profile created by full bench construction.
3. Road/trail profile created by through fill.
4. Road/trail created by through cut.
5. Road/trail created with no cut or fills (i.e. road on flat ground)

BO-192 Is the drainage from the road surface of Approach Area A – Outside the WLPZ/ELZ diverted off the road prism by a drainage facility before it reaches the crossing?

1. Yes
2. No
3. Not applicable, crossing is higher in elevation than Approach Area B.

BO-193 Enter the code that best describes predominant improvements used on any portion of the road / trail in Approach Area B-Outside the WLPZ/ELZ

1. Native material construction, no improvement evident.
2. Erosion control methods/improvements added such as geo-textile, pallets, mats, slash, corduroy etc.
3. Permeable surfacing material such as gravel added
4. Non-permeable paving such as asphalt or concrete
5. Other

BO-194 Enter the percent grade of the road / trail in Approach Area B- WLPZ/ELZ measuring from the upland edge of the WLPZ/ELZ at the crossing

Enter + for a positive or upgradient and - for a negative or downgradient followed by the percent grade in whole numbers.

Example: a 15% uphill grade as seen from the crossing would code +15. A 17% downhill grade would code -17

BO-195 Enter the code that best describes any soil movement on Approach Area B-Outside the WLPZ/ELZ

1. Measurable amounts of sediment deposited in the water body or within the bank full width of the channel. (go to question BO-196)
2. Trace amounts such as films or suspended sediments deposited in the water body or within the bank full width of the channel. (go to question BO-196)
3. Sediment was deposited inside the WLPZ/ELZ, but did not reach the water body or within the bank full width of the channel. (go to question BO-205)
4. Soil moved in Approach Area B-Outside the WLPZ/ELZ, but did not reach the WLPZ/ELZ. (go to question BI-213)
5. Soil is stabilized for Approach Area B-Outside the WLPZ/ELZ (go to question BO-212)

In cases where the sediment delivery system (BO-196) indicates strongly that measurable volumes of sediment have been deposited in the water body, but have since been washed away, enter “1” for question BO-195 and enter “0” for question BO-199.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.Look for evidence of soil movement such as rills, gullies or other sediment trails. Consider also material moved by machines during construction as well as material pushed by wheels or dragged by logs.

Depending on the time of year it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion occurred during a prior harvest or is ongoing.

Only one code can be entered. Consider the various problems evident and report on the worst case scenario choosing the answer codes that best describe the situation.

Sediment deposited in the water body from Approach Area-B, Outside the WLPZ/ELZ

BO-196 Enter the code that best describes the evidence that sediment reached the water body or to within the bankfull width of the channel from Approach Area B-Outside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc. (go to question BO-197)
2. Gully (go to question BO-197)
3. Rill (go to question BO-197)
4. Sheet flow, sediment deposition trail or alluvial fan (go to question BO-199)
5. Soil slumping or dropping (go to question BO-199)
6. Mechanical deposition. Examples include soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs. (go to question BO-199)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form continuously evolves into another (such as when a rill becomes a gully), record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut etc.

BO-197 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question BO-196.

Where one erosion form continuously evolves into another (such as when a rill becomes a gully), measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. For an inside ditch, measure the entire length of the ditch, even if it extends outside of the protocol survey area. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

BO-198 Enter the mid point cross sectional area, in whole square inches of the rill, gully, ditch or rut identified in question BO-196.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

BO-199 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width in whole cubic yards by the delivery system identified in question BO-196.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole yards.

Leave zero if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

BO-200 Enter the code that best describes the preponderant type of sediment delivered to the water body or within the bankfull width of the channel by the delivery system identified in question BO-196.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

BO-201 Can sedimentation be expected to occur during the next storm event based on your answers to questions BO-196 through BO-200?

1. Yes.
2. No.
3. Unknown.

BO-202 Were principles / practices applied?

1. Yes.
2. No.

BO-203 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

BO-204 Enter the code that best describes the specific cause of sediment delivery to the water body or to within the bankfull width of the channel from Approach Area B-Outside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering proceed directly to question BI-213.**

Sediment deposited inside the WLPZ/ELZ, but not the water body from Approach Area B-Outside the WLPZ/ELZ

BO-205 Enter the distance from the watercourse that the sediment terminated.

Measure horizontal distance in whole feet perpendicular to the bank.

BO-206 Enter the code that best describes the evidence that sediment reached the WLPZ/ELZ but not the water body nor to within the bankfull width of the channel from Approach Area B-Outside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc )
2. Gully
3. Rill
4. Sediment deposition trail, sheet flow, or alluvial fan
5. Soil slumping or dropping
6. Mechanical deposition of soil

Where one erosion feature continuously evolves into another (such as when a rill becomes a gully) record the dominant form.

BO-207 Enter the code that best describes the preponderant type of sediment delivered to the WLPZ/ELZ but not the water body nor to within the bankfull width of the channel by the delivery system identified in question BO-206.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

BO-208 Can sedimentation be expected to occur during the next storm event based on your answers to questions BO-205 and BO-207.

1. Yes.
2. No.
3. Unknown.

BO-209 Were principles / practices applied?

1. Yes.
2. No.

BO-210 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

BO-211 Enter the code that best describes the specific cause of sediment delivery to the WLPZ/ELZ, but not the water body nor to within the bankfull width of the channel from Approach Area B-Outside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation

**After answering proceed directly to question BI-213**

<u>Soil stabilized in Approach Area-B, Outside the WLPZ/ELZ</u>

BO-212 Were principles / practices applied?

1. Yes.
2. No.

**After answering question BO-212 and reading the following explanation proceed directly to question BI-213**

## <u>Approach Area B-Inside the WLPZ/ELZ</u>

Approach Area B-Inside the WLPZ/ELZ originates at the outer edge of the stream's bankfull and extends to the outer edge of the WLPZ/ELZ.

Observe the conditions on the ground within <u>Approach Area B-Inside the WLPZ/ELZ</u> and answer the questions.

Report only those conditions that originate from the approach area inside the buffer. Conditions originating beyond the approach area inside the buffer were reported in the previous section.

BI-213 Is there a WLPZ/ELZ?

1. Yes, go to BI-214.
2. No, go to O-265

BI-214 Enter the percent grade of the road / trail in Approach Area B Inside WLPZ/ELZ measuring from the bankful width of the water body at the crossing.

Enter + for a positive or uphill gradient and - for a negative or down hill
gradient followed by the percent grade in whole numbers.

Example: a 15% uphill grade as seen from the crossing would code +15. A 17% downhill grade would code -17

BI-215 Enter the code that best describes improvements used on any portion of the road / trail in Approach Area B-Inside the WLPZ/ELZ

1. Native material construction, no improvement evident.
2. Erosion control methods/improvements added such as Geo-textile, pallets, mats, slash, corduroy, etc.
3. Permeable surfacing material such as gravel added
4. Non-permeable paving such as asphalt or concrete
5. Other

BI-216 Enter the code that best describes the road prism Approach Area B – Inside the WLPZ/ELZ

1. Landing adjoining maintained road.
2. Road insloped with no inside ditch.
3. Road insloped with an inside ditch.
4. Road outsloped with no inside ditch.
5. Road outsloped with an inside ditch
6. Road crowned with an inside ditch.
7. Road crowned with no inside ditch
8. Road inverted below general grade of adjoining land (includes through cuts and roads on flat ground).
9. Road bermed with no inside ditch
10. Road bermed with inside ditch.

BI-217 Enter the code that best describes the road construction Approach Area B – Inside the WLPZ/ELZ

1. Road/trail profile created by cut and fill construction.
2. Road/trail profile created by full bench construction.
3. Road/trail profile created by through fill.
4. Road/trail created by through cut.
5. Road/trail created with no cut or fills (i.e. flat ground)

BI-218 Is the drainage from the road surface Approach Area B – Inside the WLPZ/ELZ diverted off the road prism by a drainage facility before it reaches the crossing by a drainage structure or facility.

1. Yes
2. No
3. Not applicable, crossing is higher in elevation than Approach Area B.

BI-219 Enter the code that best describes any soil movement on Approach Area B-Inside the WLPZ/ELZ

1. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel. (go to question BI-220)
2. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel. (go to question BI-220)
3. Soil moved in Approach Area-B, Inside the WLPZ/ELZ, but did not reach the water body or within the bankfull width of the channel. (go to question BI-229)
4. Soil is stabilized for Approach Area-B, Inside the WLPZ/ELZ ( go to question BI-236)
5. Soil movement occurs in Approach Area-B, Inside the WLPZ/ELZ, but has been recorded elsewhere in the protocol. ( go to question BI-237)

In cases where the sediment delivery system (BI-220) indicates strongly that measurable volumes of sediment have been deposited in the water body, but have since been washed away, enter “1” for question BI-219 and enter “0” for question BI186.

Locate the boundaries of the area in question and carefully inspect the road or trail as well as the ditches and adjoining cut or fill slopes.
Look for evidence of soil movement such as rills, gullies or other sediment trails. Consider also material moved by machines during construction as well as material pushed by wheels or dragged by logs.

Depending on the time of year it may be necessary to brush away newly fallen leaves to follow the sediment trail. Sediment occurring above or below the various leaf layers will provide clues as to whether the erosion occurred during a prior harvest or is ongoing.

Only one code can be entered. Consider the various problems evident and report on the worst case scenario choosing the answer codes that best describe the situation.

Sediment deposited in the water body from Approach Area B Inside the WLPZ/ELZ

BI-220 Enter the code that best describes the evidence that sediment reached the water body or to within the bankfull width of the channel from Approach Area B-Inside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc ). (go to question BI-221)
2. Gully. (go to question BI-221)
3. Rill. (go to question BI-221)
4. Sheet flow, sediment deposition trail or alluvial fan. (go to question BI-223)
5. Soil slumping or dropping. (go to question BI-223)
6. Mechanical deposition of soil. Examples include soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs. (go to question BI-223)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut etc.

BI-221 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question BI-220.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. For an inside ditch, measure the entire length of the ditch, even if it extends outside of the protocol survey area. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

BI-222 Enter the mid point cross sectional area in whole square inches of the rill, gully, ditch or rut identified in question BI-220.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

BI-223 Enter the currently evident volume of sediment deposited in the water body or within the bankfull width of the channel in whole cubic yards by the delivery system identified in question BI-220.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole cubic yards.

Enter "0" if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

.

BI-224 Enter the code that best describes the predominant type of sediment delivered to the water body or to within the bankfull width of the channel by the delivery system identified in question BI-220.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 inches)
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

BI-225 Can sedimentation be expected to occur during the next storm event based on your answers to questions BI-220 through BI-224.

1. Yes.
2. No.
3. Unknown.

BI-226 Were principles / practices applied?

1. Yes.
2. No.

BI-227 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

BI-228 Enter the code that best describes the specific cause of sediment delivery to the water body or to within the bankfull width of the channel from Approach Area B-Inside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question BI-237**

<u>Soil Moved In Approach Area B-WLPZ/ELZ, but did not reach the water body</u>

BI-229 Enter the distance from the watercourse that the sediment terminated.

Measure horizontal distance in whole feet perpendicular to the bank.

BI-230 Enter the code that best describes the evidence that soil moved, but did not reach the water body nor to within the bankfull width of the channel from within Approach Area B-Inside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc )
2. Gully
3. Rill
4. Sediment deposition trail, sheet flow, or alluvial fan
5. Soil slumping or dropping
6. Mechanical deposition of soil

Where one erosion form continuously evolves into another (such as when a rill becomes a gully) record the predominant form.

BI-231 Enter the code that best describes the preponderant type of soil that was moved but did not reach the water body nor to within the bankfull width of the channel by the delivery system identified in question BI-230.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

BI-232 Can sedimentation be expected to occur during the next storm event based on your answers to questions BI-230 and BI-231.

1. Yes.
2. No.
3. Unknown.

BI-233 Were principles / practices applied?

1. Yes.
2. No.

BI-234 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

BI-235 Enter the code that best describes the specific cause of soil movement that did not reach the water body nor to within the bankfull width of the channel in Approach Area B-Inside the WLPZ/ELZ.

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question BI-237**

Soil stabilized In Approach Area B-Inside the WLPZ/ELZ

BI-236 Were principles / practices applied?

1. Yes.
2. No.

**After answering question BI-236 proceed directly to question BI-237**

BI-237 Enter the code that best describes the preponderant hydrologic soil type in Approach Area B-WLPZ/ELZ

1. Type A (sand/gravel - feels gritty)

2. Type B/C (loams – feels crumbly)
3. Type D (silt, clay, muck – smooth, plastic to gelatinous)

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

**<u>Water Drafting - Approach Area-A, Inside the WLPZ/ELZ</u>**

BID-238 Is there a water drafting approach constructed in Approach Area B – Inside the WLPZ/ELZ

1. Yes. (If yes, go to BID-239)
2. No. (If no, go to O-265)

BID-239 Enter the length, in feet, of the water drafting approach constructed in Approach Area B – Inside the WLPZ/ELZ

BID-240 Enter the percent grade of the water drafting approach in Approach Area B Inside the WLPZ/ELZ measuring from the termination point of the approach to the junction at the road.

Enter + for a positive or uphill gradient and - for a negative or down hill gradient followed by the percent grade in whole numbers.

Example: a 15% uphill grade as seen from the crossing would code +15. A 17% downhill grade would code -17

BID-241 Enter the code that best describes improvements used on any portion of the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

1. Native material construction, no improvement evident.
2. Erosion control methods/improvements added such as geo-textile, pallets, mats, slash, corduroy etc.
3. Permeable surfacing material such as gravel added
4. Non-permeable paving such as asphalt or concrete
5. Other

BID-242 Enter the code that best describes the water drafting approach's construction adjacnt to Approach Area B – Inside the WLPZ/ELZ

1. Created by cut and fill construction.
2. Created by full bench construction.
3. Created by through fill.
4. Created by through cut.
5. Created with no cut or fills (i.e. flat ground)

BID-243 Is there evidence of petroleum or petroleum residue on the water drafting approach adjacent to Approach Area B – Inside the WLPZ/ELZ?

1. Yes. (go to BID-244)
2. No. (go to BID-245)

BID-244 Enter the diameter in feet or decimal fractions of a foot of the area occupied by the petroleum or petroleum residue.

BID-245 Does runoff from Approach Area B – Inside the WLPZ/ELZ flow to or across the water drafting approach.

1. Yes. (go to BID-246)
2. No. (go to BID-247)

BID-246 Are there sediment deposits on the water drafting approach adjacent to Approach A – Inside the WLPZ/ELZ?

1. Yes.
2. No.

BID-247 Enter the code that best describes any soil movement on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

1. Measurable amounts of sediment deposited in the water body or within the bankfull width of the channel. (go to question BID-248)
2. Trace amounts such as films or suspended sediments deposited in the water body or within the bankfull width of the channel. (go to question BID-248)
3. Soil moved on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ, but did not reach the water body nor to within the bankfull width of the channel. (go to question BID-257)
4. Soil is stabilized on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ ( go to question BID-264)
5. Soil movement occurs on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ, but has been recorded elsewhere in the protocol. ( go to question O-265)

Sediment deposited in the water body from the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

BID-248 Enter the code that best describes the evidence that sediment reached the water body or to within the bankfull width of the channel from the water drafting approach in Approach Area B-Inside the WLPZ/ELZ.

1. Ditch or rut (wheel, track, log drag, etc ). (go to question BID-249)
2. Gully (go to question BID-249)
3. Rill (go to question BID-249)
4. Sheet flow, sediment deposition trail or alluvial fan (go to question BID-251)
5. Soil slumping or dropping (go to question BID-251)
6. Mechanical deposition of soil. Examples include soil pushed into the bankfull channel or onto a bridge by machinery or dragged logs. (go to question BID-251)

Only one code can be entered. Record the worst case scenario.

Read all of the answers and eliminate the ones that do not apply to arrive at the answer that best describes the situation.

Where one erosion form evolves into another in a continuous manner such as when a rill becomes a gully, record the predominant form. Report the evidence consistent with the definitions in Appendix A for terms such as rill, gully, wheel rut, etc.

BID-249 Enter the total length in whole feet of the rill, gully, ditch or rut identified in question BID-248.

Where one erosion form evolves into another in a continuous manner, such as when a rill becomes a gully, measure and record the total length of the combined forms of erosion. If the rill or gully is branched measure only the length of the main section. For an inside ditch, measure the entire length of the ditch, even if it extends outside of the protocol survey area. Do not add the lengths of the branches. Accurate pacing is acceptable for measurement.

BID-250 Enter the mid point cross sectional area in whole square inches of the rill, gully, ditch or rut identified in question BID-248.

Locate a typical cross section at approximately the halfway point in the combined length of the rill, gully or other formation being reported. Place a straightedge across the top of the eroded zone and measure the width and depth in inches.

BID-251 Enter the currently evident volume of sediment deposited in the water body or to within the bankfull width of the channel in whole cubic yards by the delivery system identified in question BID-248.

Look upstream and down and determine by color, texture and location that the sediment deposit originates from the delivery system described in the three previous questions. Probe the deposit in several places to determine the average depth and measure the length and width to determine the volume.

Record the volume in whole cubic yards.

Enter “0” if sediment has been completely flushed away or if reasonably accurate measurement of existing deposit is not possible.

BID-252 Enter the code that best describes the predominant type of sediment delivered to the water body or to within the bankfull width of the channel by the delivery system identified in question BID-248.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 inches)
7. Sediment deposited in the water body has washed away; therefore, the type is unknown.

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

BID-253 Can sedimentation be expected to occur during the next storm event based on your answers above?

1. Yes.
2. No.
3. Unknown.

BID-254 Were principles / practices applied?

1. Yes.
2. No.

BID-255 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

BID-256 Enter the code that best describes the specific cause of sediment delivery to the water body or to within the bankfull width of the channel from the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question O-265**

Soil moved on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ, but did not reach the water body

BID-257 Enter the distance from the watercourse that the sediment terminated.

Measure horizontal distance in whole feet perpendicular to the bank.

BID-258 Enter the code that best describes the evidence that soil moved, but did not reach the water body nor to within the bankfull width of the channel from the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

1. Ditch or rut (wheel, track, log drag, etc )
2. Gully
3. Rill
4. Sediment deposition trail, sheet flow, or alluvial fan
5. Soil slumping or dropping
6. Mechanical deposition of soil

Where one erosion form continuously evolves into another(such as when a rill becomes a gully) record the predominant form.

BID-259 Enter the code that best describes the predominant type of soil that was moved, but did not reach the water body nor to within the bankfull width of the channel by the delivery system identified in question BI199.21.

1. Organic material
2. Clay (forms ribbon 1 inch or longer)
3. Silt / loam (feels smooth but will not form ribbon)
4. Sandy (feels gritty)
5. Gravel (0.8 – 2.5 inches)
6. Cobble & larger (> 2.5 in )

When in doubt, sandy loams or clay loams should be recorded as sand or clay as these components are more critical than loam in determining erosion or percolation rates.

BID-260 Can sedimentation be expected to occur during the next storm event based on your answers to questions.

1. Yes.
2. No.
3. Unknown.

BID-261 Were principles / practices applied?

1. Yes.
2. No.

BID-262 Were measures employed that were over and above the requirements of the plan and/or Rules?

1. Yes.
2. No.

BID-263 Enter the code that best describes the specific cause of soil movement on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

1. Inappropriate timing of the operation with respect to soil and weather conditions
2. Inappropriate location or design.
3. Incorrect maintenance.
4. No or inadequate maintenance.
5. Failure to add reinforcements.
6. Inappropriate log landing location or harvesting activities.
7. Human activities or natural events unrelated to timber harvesting.
8. Erosion from public roads.
9. Activities related to timber operations, unrelated to crossing installation or maintenance.
10. Principles and practices inadequately or incompletely applied.
11. All feasible and reasonable measures were employed, but soil still moved.

Read all of the answers and eliminate the answers that do not apply to arrive at the answer that best describes the situation.

**After answering question proceed directly to question O-265**

<u>Soil stabilized</u> on the water drafting approach in Approach Area B-Inside the WLPZ/ELZ

BID-264 Were principles / practices applied?

1. Yes.
2. No.

**After answering, go to O-265**

Overall Crossing and Approaches Evaluation

O-265 Enter the code indicating the approximate volume of sediment delivered to the watercourse based on volume of voids and/or measurable sediment deposits observed at the crossing and approaches.

1. No observed sediment.
2. Trace to 1 cubic yard
3. 1-10 cubic yards
4. 11-50 cubic yards
5. 51-100 cubic yards
6. 101-500 cubic yards
7. 501-1000 cubic yards
8. Greater than 1000 cubic yards

**After answering, go to O-266**

Overall Subjective Crossing and Approaches Evaluations

O-266 Enter the appropriate rating for the crossing, utilizing the matrix provided below.

| | Performing properly, no sign. sediment delivery problems | Performing properly, sediment is still being delivered | Performing properly, no sediment delivery, but there is potential | Not performing properly, sign. sediment delivery problems |
|---|---|---|---|---|
| Properly designed and constructed | 1 | 2 | 3 | 4 |
| Properly designed, not properly constructed | 5 | 6 | 7 | 8 |
| Not properly designed, constructed to design | 9 | 10 | 11 | 12 |

O-267 Enter the appropriate rating for Approach A, utilizing the matrix provided below.

| | Performing properly, no sign. sediment delivery problems | Performing properly, sediment is still being delivered | Performing properly, no sediment delivery, but there is potential | Not performing properly, sign. sediment delivery problems |
|---|---|---|---|---|
| Properly designed and constructed | 1 | 2 | 3 | 4 |
| Properly designed, not properly constructed | 5 | 6 | 7 | 8 |
| Not properly designed, constructed to design | 9 | 10 | 11 | 12 |

O-268 Enter the appropriate rating for Approach B, utilizing the matrix provided below.

| | Performing properly, no sign. sediment delivery problems | Performing properly, sediment is still being delivered | Performing properly, no sediment delivery, but there is potential | Not performing properly, sign. sediment delivery problems |
|---|---|---|---|---|
| Properly designed and constructed | 1 | 2 | 3 | 4 |
| Properly designed, not properly constructed | 5 | 6 | 7 | 8 |
| Not properly designed, constructed to design | 9 | 10 | 11 | 12 |

O-269 Based on team consensus, what is the overall letter grade (i.e. A, B, C, D, and F) assigned for the approaches.

O-270 Based on team consensus, what is the overall letter grade (i.e. A, B, C, D, and F) assigned for the crossing?

**END**

# APPENDIX B

## Interagency Mitigation Monitoring Program

# Protocol Field Guide

## September 2007

# Table of Contents

# Field Equipment

The Protocol is based on measurable evidence. The following equipment or equivalent is often necessary to answering the questions and making the measurements:

Required:

Data Sheets
Writing utensil
GPS unit set to read latitude and longitude in decimal degrees based on NAD 84
Clinometer with % scale
Measuring tape (100’ or longer )
Measuring tape (15’ to 30’)
Digital camera
Harvest plan
Latest copy of the FPRs
Spare tire

Optional:

Pocket PC or similar device with minimum 256 Mb memory chip
Protocol database software
Laser Range Finder
Second vehicle

# Field Procedures

The purpose of the Field Procedures segment of this publication is to clearly define the sampling area and the variables that are to be collected from within it. All questions within the protocol, unless otherwise noted, are designed to be objective and repeatable. This portion of the field guide should be taken to the field for reference if questions arise regarding the designation of the sample area or how a specific question is to be researched and answered.

**Crossing Sample Number**

A unique sampling number shall be assigned to each crossing and each subsequent re-measurement of a crossing, if applicable. The crossing number is composed of the following information:

State - Select the two letter state code from the drop down menuCA

Year - Enter the last two digits of the sample year. (2003 = 03).

Type - Select the type code from the drop down menu
N = new sample
R = remeasure of a previous sample
Q = quality control sample

Iration - Enter the iteration of the resample where:

0 = intial measurement

1 = first remeasurement
2 = second remeasurement etc.

Number - Enter the sample crossing number. This number should not change for a given crossing location.

For example, a California crossing, evaluated in 2006, that is a new sample crossing, and is the 24th crossing evaluated in 2006 would be coded CA06N0024.

If this same sample crossing were re-sampled for quality control purposes it would code CA06Q0024.

If this same sample crossing were being re-sampled the first time for long term impact or other purposes the following year it would code CA07R1024.

**Protocol Survey Area**

Stream crossings will be evaluated by examining the crossing itself as well as the approaches to the crossing on both sides of the stream and both inside and outside of the WLPZ/ELZ.

The protocol survey area is the outer boundary of the approaches that will be considered for evaluation in this protocol. Establish the protocol survey on both sides of the watercourse by measuring the distance on the road surface equivalent to three (3) times the WLPZ/ELZ width or 300 feet, whichever is less. This distance is measured from bank full.

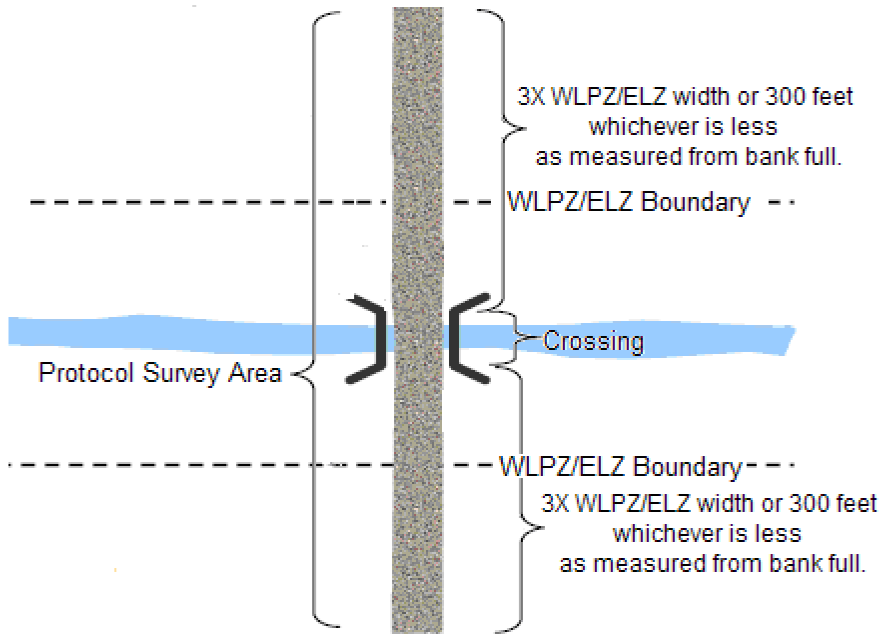



Figure 1. Typical Protocol Survey Area, see discussion under the **Approaches to stream crossings** heading for a-typical approach discussions.

The protocol survey area is then divided into five (5) parts for purposes of describing features and their locations relative to the watercourse. These descriptive areas are as follows:

- Approach Area A -Outside the WLPZ/ELZ
- Approach Area A-Inside the WLPZ/ELZ
- Crossing Structure
- Approach Area B-Outside the WLPZ/ELZ
- Approach Area B-Inside the WLPZ/ELZ

The approaches, designated A and B, need to be identified in a consistent manner to facilitate re-sampling for quality control. Therefore, approach Area A will be the approach on the left bank as the investigator faces downstream.

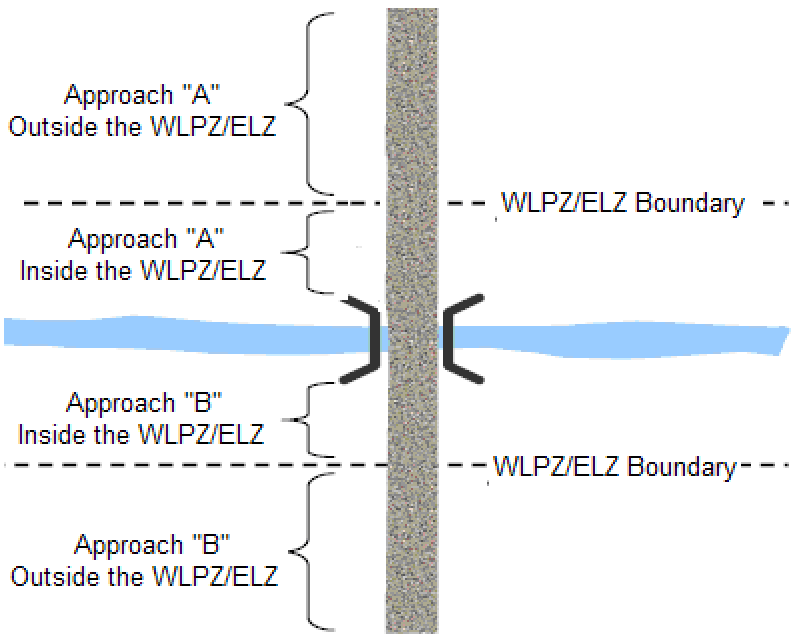



Figure 2. Typical Protocol Survey Area including approach areas A and B inside and outside the WLPZ/ELZ. Approach area A is always on the left looking downstream and B is always on the right; therefore the watercourse in the figure is flowing to the right.


Figure 3. Approach area A inside and outside the WLPZ/ELZ. Approach area A is always on the left looking downstream.

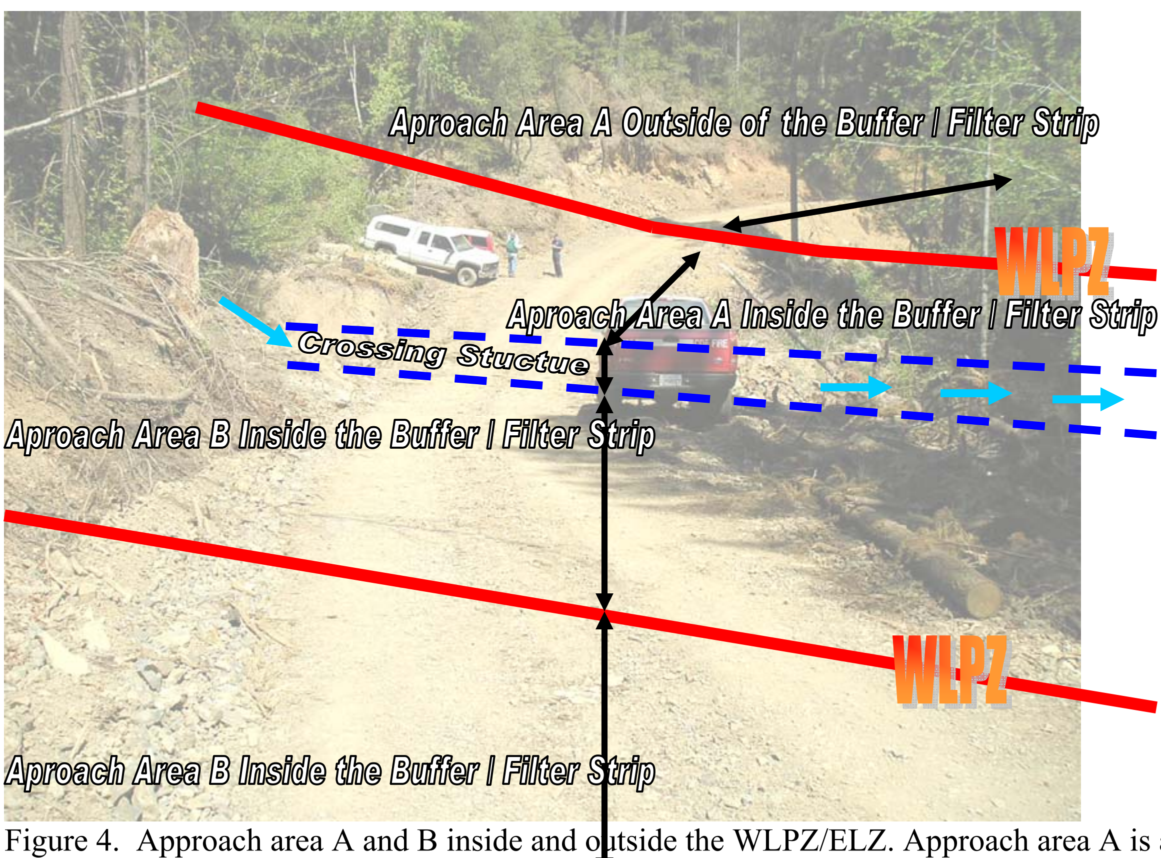



Figure 4. Approach area A and B inside and outside the WLPZ/ELZ. Approach area A is always on the left looking downstream and B is always on the right.

Approach A and B, the crossing and any water drafting approaches which extend beyond the approaches themselves will be evaluated. These seven areas will be referred to as follows throughout the monitoring procedure:

- Approach Area A -Outside the WLPZ/ELZ
- Approach Area A-Inside the WLPZ/ELZ
- Water Drafting - Approach Area-A, Inside the WLPZ/ELZ
- Crossing Structure
- Approach Area B-Outside the WLPZ/ELZ
- Approach Area B-Inside the WLPZ/ELZ
- Water Drafting - Approach Area-B, Inside the WLPZ/ELZ

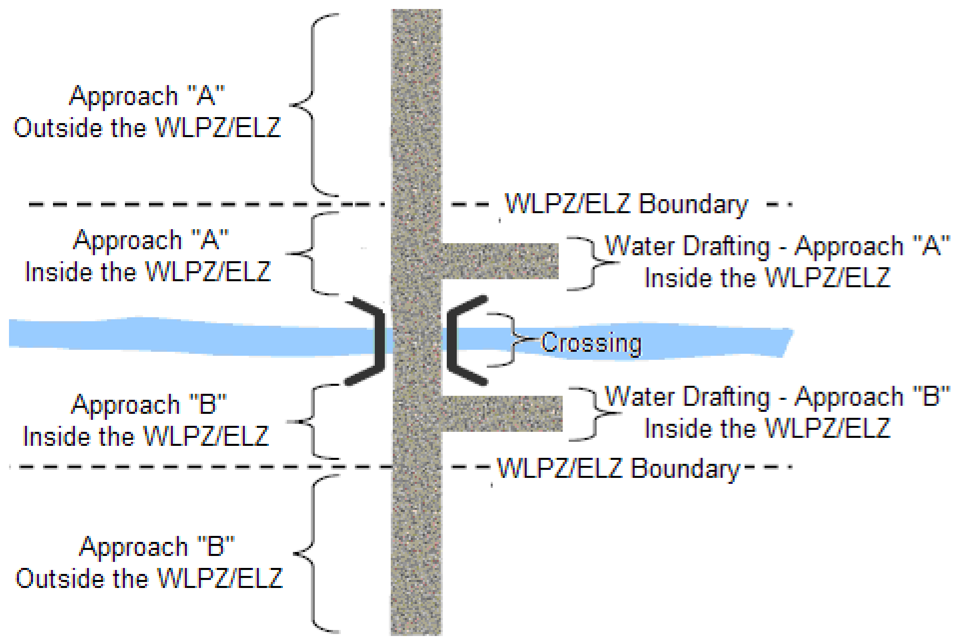



Figure 5. Typical Protocol Survey Area including approach areas A and B inside and outside the WLPZ/ELZ as well as water drafting approaches. Approach area A is always on the left looking downstream and B is always on the right; therefore the watercourse in the figure is flowing to the right.

## Approaches to Stream Crossings

As indicated above, there are two approaches ("A" and "B") for each crossing location. Each of these approaches will be evaluated in the protocol. Also indicated above, the limits of the crossings are determined by measuring the distance, from bankfull, on the road surface, equivalent to three (3) times the WLPZ/ELZ width or 300 feet, whichever is less.

If within this distance, there are topographic features or a change in grade that prohibits road drainage from draining to the subject watercourse, the upland boundary of the protocol survey area is established at that point. This change is not applicable for drainage facilities including waterbreaks or rolling dips and the change must be continuous throughout the remainder of the measured distance.

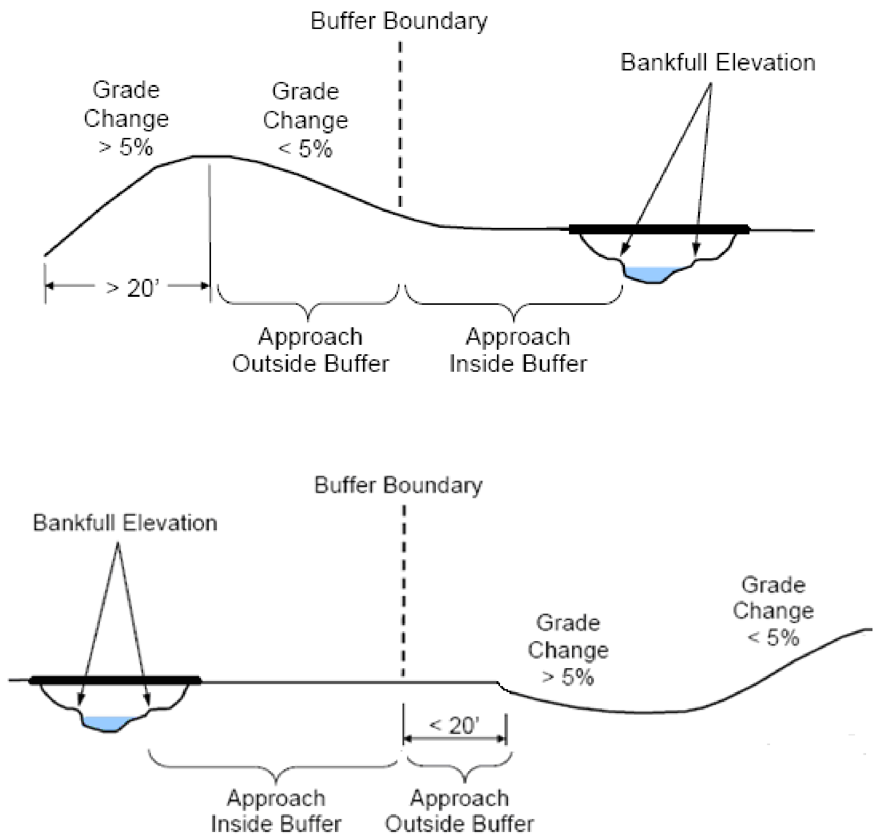



Figure 6. Graphical examples that result in a change in grade that prohibits road drainage from draining to the subject watercourse resulting in, the upland boundary of the protocol survey area being established at that point less than what is described above.

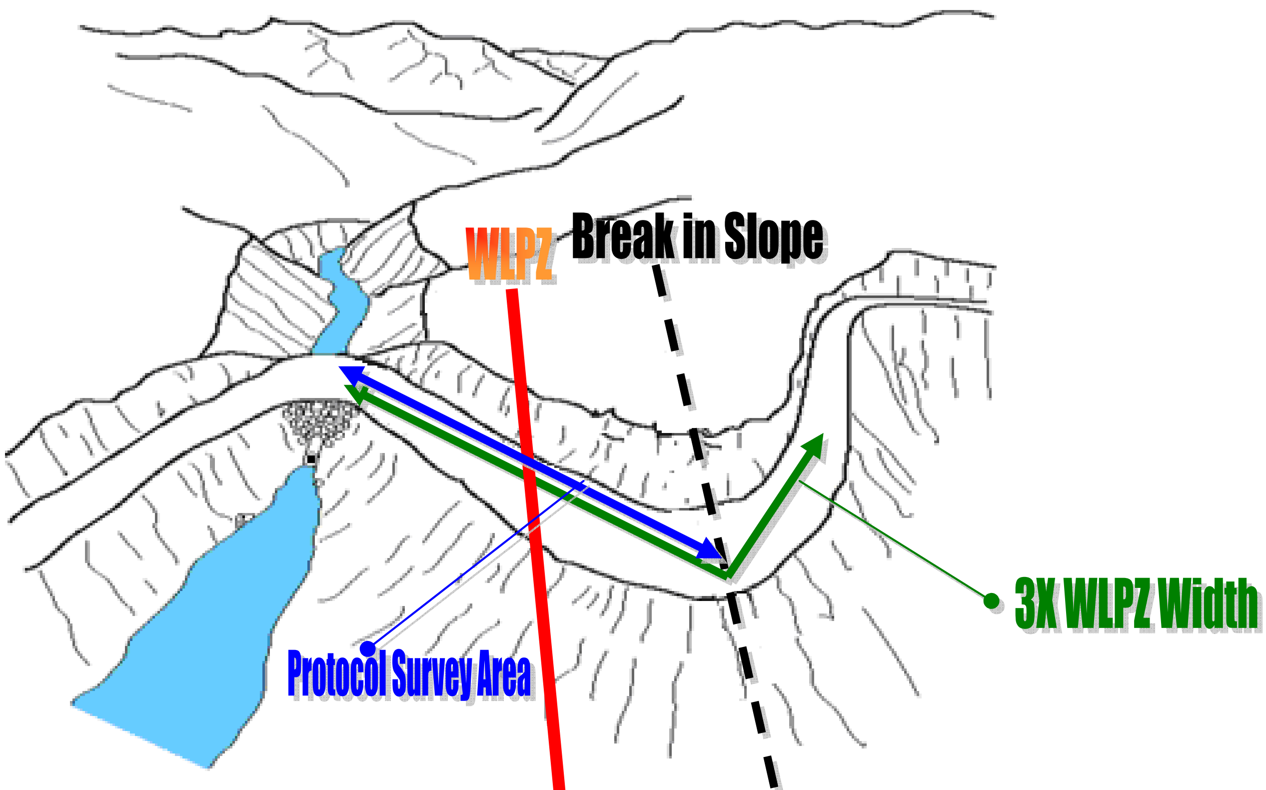



Figure 7. Graphical example that results in a change in topography that prohibits road drainage from draining to the subject watercourse resulting in, the upland boundary of the protocol survey area being established at that point less than what is described above.

Another situation, pertaining to adjacent watercourse crossings may occur relative to approach A and B resulting in modification to the standard three (3) times the WLPZ/ELZ width or 300 feet, whichever is less rule. The scenarios and solutions are:

1. Where two crossings are located very close to one another (e.g., a road crosses two forks/branches of a stream upstream of their confluence) and if both stream crossings are to be included, then it is appropriate to split the distance in half. For example, if there is 100 ft between crossings, use 50 ft for each approach.

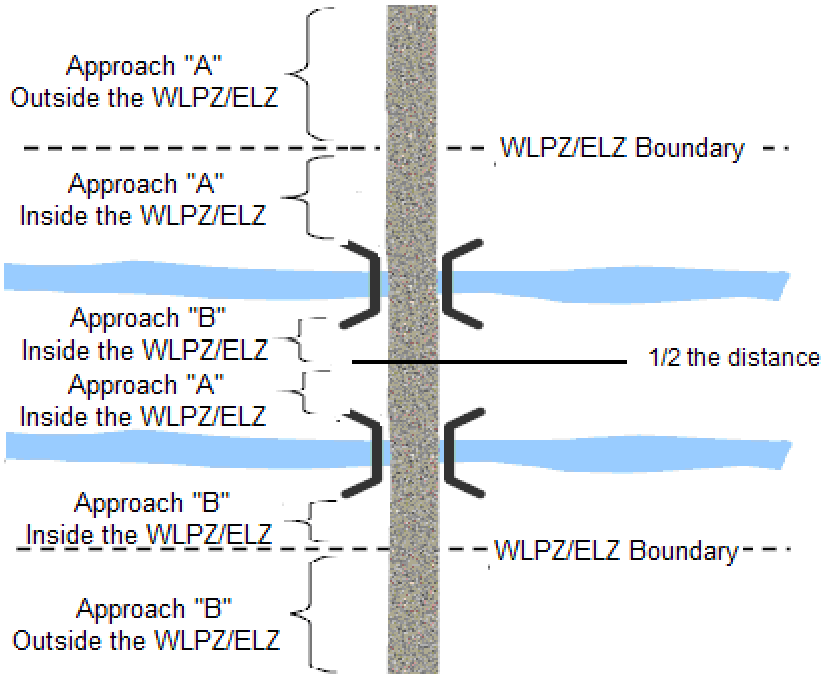



Figure 8. Example of where two crossings are located very close to one another and both are subjected to the protocol.

2. Where two crossings are located very close to one another (e.g., a road crosses two forks/branches of a stream upstream of their confluence) and only one crossing is to be included, then it is appropriate to use the normal procedure, but stop at the second stream. For example, if there is 100 ft between crossings, use 100 ft for each approach if the study area is greater than 100 feet.

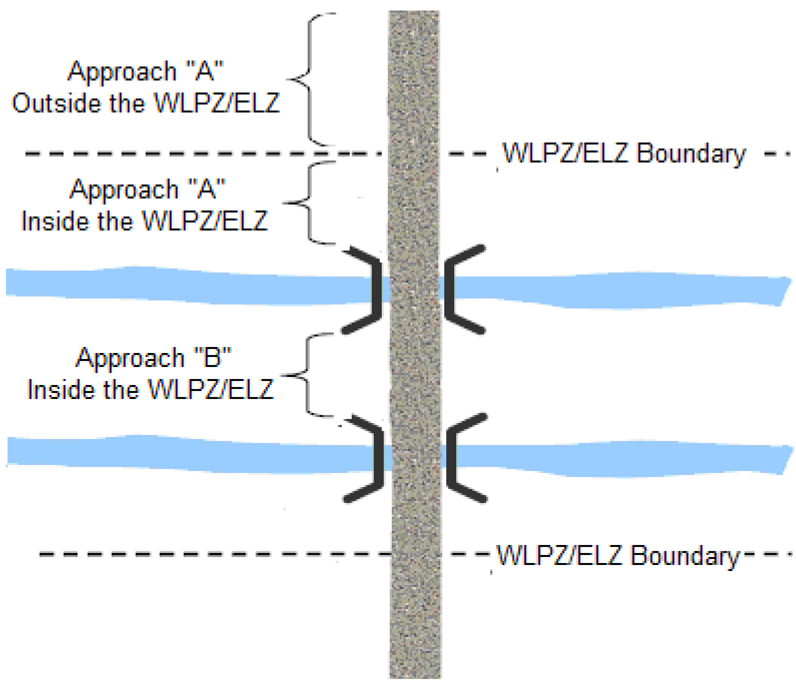



Figure 9. Example of where two crossings are located very close to one another and southern crossings is not subjected to the protocol.

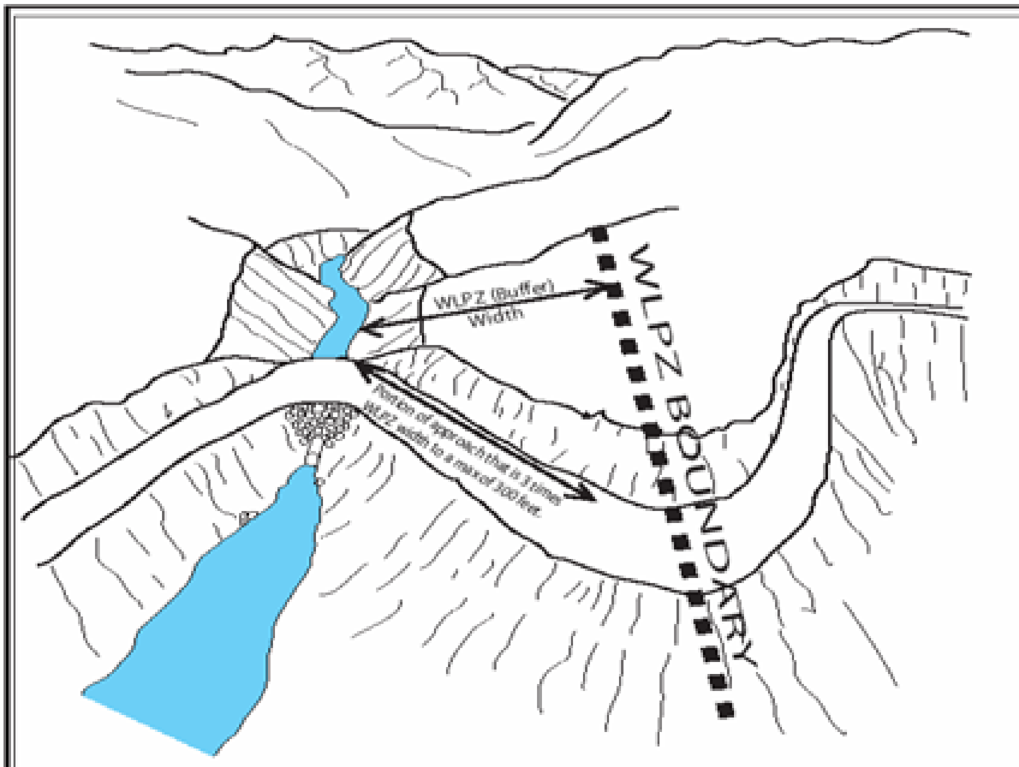
Situations may also arise where two road may merge or one road may split on one approach or within the protocol survey area. In these cases, the road exhibiting the greatest amount of soil movement shall be evaluated utilizing the protocol. The fact that the road splits or merges with another should be documented on a sketch or with photographs.

## <u>Approach Area Inside the WLPZ/ELZ</u>

The approach area inside the WLPZ/ELZ originates at the outer edge of the stream's bankfull width and extends to the outer edge of the WLPZ/ELZ as flagged on the ground or stated in the plan. The entire road segment between the bankfull edge of the channel and the upland edge of the WLPZ/ELZ comprises the approach area inside the zone.

*Instances Where Approach Does Not Leave WLPZ For Long Distances*

If the approach does not exit the WLPZ/ELZ for a lineal distance greater than three times the WLPZ/ELZ width, the maximum distance for evaluation shall be three times the buffer filter strip width or 300 feet, whichever is less. Distances are measured from bank full. There will be no responses to the questions pertaining to the approach outside of the WLPZ/ELZ as one does not exist within the protocol survey area.




In instances where the approach does not exit the WLPZ/ELZ for long distances, the portion of approach that is three times the WLPZ/ELZ width to a maximum of 300 feet shall be evaluated.

Figure 10. Graphical depiction of a road that does not exist the WLPZ within three (3) times the WLPZ width or 300 feet as measured from bankfull.

*No Approach Inside Buffer/Filter Strip (Class III Watercourses).*

Class III watercourses (14 CCR 916.5, 936.5, 956.5) with “Low” EHR (14 CCR 912.5, 932.5, 952.7) and side slopes less than 30% may not have a WLPZ or ELZ pursuant to 14 CCR 916.4, 936.4, 956.4(c)(1). In these cases, there will be no approach inside the WLPZ/ELZ for the sampled crossing.

**Approach Area Outside the WLPZ/ELZ**

The approach area outside the WLPZ/ELZ originates at the upland edge of the WLPZ/ELZ and extends inland perpendicular to the bank to a point where road runoff drains away from the watercourse crossing. This excludes road drainage facilities (eg. waterbreaks or rolling dips).

The approach area outside the WLPZ/ELZ is limited to upland edge of the protocol survey area discussed above. Also as indicated above, if the approach does not exit the WLPZ/ELZ for a lineal distance greater than three times the WLPZ/ELZ width, the sampled crossing does not have an approach outside the WLPZ/ELZ and no data will be collected for that area.

Class III watercourses (14 CCR 916.5, 936.5, 956.5) with “Low” EHR (14 CCR 912.5, 932.5, 952.7) and side slopes less than 30% may not have a WLPZ or ELZ pursuant to 14 CCR 916.4, 936.4, 956.4(c)(1). Where there is no WLPZ or ELZ, default to 25 feet as measured from bankfull.

**Crossing Structure**

The crossing structure includes only those parts of the structure that are within the bankfull width of the channel. Structures or parts thereof that are outside the bankfull width of the channel must be considered part of the approaches for the purposes of the protocol.

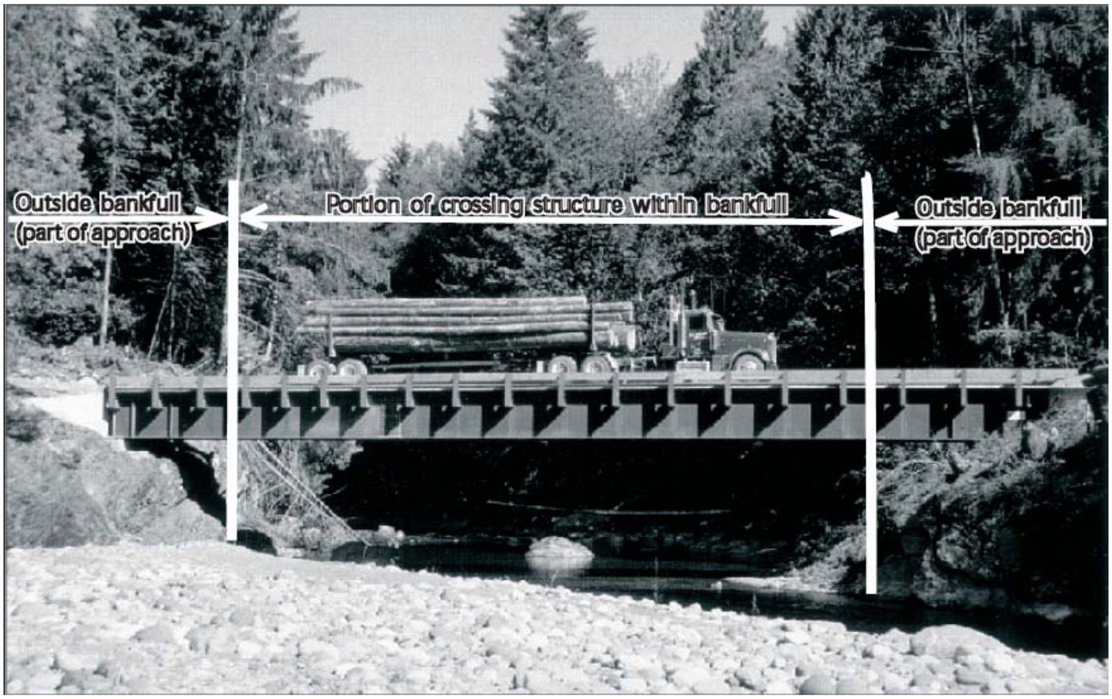



Figure 11. The ends of the bridge pictured above are outside of the crossing area as illustrated by the lines.

Figure 12. The fill material from the hinge points to the dashed lines is considered part of the approach. The crossing itself is only the area between the dashed lines.

**Water Drafting - Approach**

Constructed water drafting approaches at watercourse crossings are common place. These constructed features are usually designed to allow a water truck to leave the roadway and pull or back onto a short spur where it is parked to facilitate water drafting activities. These water drafting approaches may be dirt pads or rocked.

Theoretically, there could be up to four of these at any one crossing location. However, usually there is only one and on rare occasion two. If there is more than one per approach area (i.e. “A” or “B”) than determine which one is contributing the greatest amount of sediment and answer the protocol questions for that one water drafting site within the particular approach being evaluated. This being said, there could be two separate water drafting approaches evaluated if one occurred in approach area A and one in B.

Figure 13. A water drafting approach on approach area A, inside the WLPZ/ELZ.

**Photography**

1. Record the date and time directly on photo with the camera software.

2. On the photograph field form (Figure 14), record the following information:
   - THP number
   - Crossing number
   - GPS location
   - Date
   - Photographer's name
   - Brief narrative text describing each individual image (one line maximum)
   - Distance and bearing to effectiveness problem area (if necessary)
   - Where and What to Photograph

3. Photographs to take for each crossing:
   - View of crossing looking in the upstream direction (outlet end).
   - View of crossing looking in the downstream direction (inlet end).
   - View from approach A side.
   - View from approach B side.

4. Photograph noteworthy features (i.e., where there is evidence of significant problems with Forest Practice Rule implementation or effectiveness, such as fill slope failure, sediment deposition related to the crossing, etc.). A sketch diagram showing view location for the photo shall be included for these additional photo(s) [see sketch drawing protocols below and use 8.5 inch x 11 inch grid paper (page 4)].

5. Where multiple visits to a crossing site are likely and there is a significant effectiveness problem, record the approximate distance and bearing to midpoint of the effectiveness problem area, so that subsequent photographs can be taken from approximately the same location.

## IMMP PHOTOGRAPHIC REPORT

CAL FIRE · California Department of Fish and Game · Regional Water Quality Control Boards · California Geological Survey

| Page | Of | Date | Protocol No. (enter code G1) | Plan No. | Crossing No. | Photographer: |
|---|---|---|---|---|---|---|

| Participants: | GPS Location Latitude N | GPS Location Longitude W | Crossing Type (enter code GC-110) |
|---|---|---|---|

| Overall Letter Grade For Crossing (enter code O-269)<br>A = Excellent, B = Good, C = Fair, D = Poor, F = Fail | Overall Letter Grade For Approaches (enter code O-270)<br>A = Excellent, B = Good, C = Fair, D = Poor, F = Fail |
|---|---|

NARRATIVE DESCRIPTION OF PHOTOGRAPHS / SKETCHES

VIEW LOOKING UPSTREAM TOWARDS CROSSING OUTLET

Insert Picture Here

Notes:

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):
PHOTO FILE NO.

VIEW LOOKING DOWNSTREAM TOWARDS CROSSING INLET

Insert Picture Here

Notes:

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):
PHOTO FILE NO.

VIEW FROM APPROACH A SIDE

Insert Picture Here

Notes:

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):
PHOTO FILE NO.

VIEW FROM APPROACH B SIDE

Insert Picture Here

Notes:

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):
PHOTO FILE NO.

MISCELLANEOUS PHOTOGRAPHS

Insert Picture Here

Notes:

DISTANCE AND BEARING FROM CROSSING MIDPOINT (FEET):
PHOTO FILE NO.

Figure 14. Blank photograph field form.

## Sketch Drawing of Crossings

No sketch is necessary if no significant problem deemed by the review team members.

If the team members identify a significant problem with the crossing, then a sketch shall be drawn to illustrate the nature of the problem. The nature of the problem may be different for each agency and the sketch should capture the aspects of the problem for each agency (for example fish passage versus sediment delivery).

Sketch should be at a scale that includes the entire crossing and associated erosion features (if present).

Scale, north arrow, date, THP number should be indicated on the sketch.

At a minimum the sketch should include enough information to be able to construct cross sections through the problem area. This may include:

- Top of cut banks, bottom of cut banks, cut bank gradient or angle.
- Top of fill slope, bottom of fill slope, fill slope angle or gradient.
- Natural slope gradient.
- Road width, culvert diameter, channel width, rock sizes, dimensions of erosion features.

If necessary a sketch cross section that illustrates the problem area should also be drawn in the field. The cross section should match the sketch map scale with no vertical exaggeration.

## Monitoring Tips

1) Layout of the Crossing feature before beginning to answer questions.

   Using the diagrams, in this manual, lay out the crossing feature site by locating the boundaries of the:
   - bankfull channel
   - protocol survey area
   - location where WLPZ/ELZ crosses the road
   - approach area outside the WLPZ/ELZ
   - beginning and end of the crossing structure

   This will greatly simplify the assessment process.

2) Stay true to the Questions

   Report only what can actually be seen at the time you are on the site. Do not speculate as to what may be or might have been unless asked to do so by the individual question being answered.

3) Dealing with an issue in multiple approach areas.

   When evaluating on the ground conditions and choosing which condition to report, always report on the most severe problem. However, if a given problem crosses through several areas, follow it through to its conclusion. Then report it in the area in which it is first discovered.

> Example:
> A rut extending from Approach Area A-Outside the WLPZ/ELZ through Approach Area A-Inside the WLPZ/ELZ to the stream would only be reported in answer to the questions in Approach Area A-Outside the WLPZ/ELZ. To report the same rut again in approach Area A-Inside the WLPZ/ELZ would be reporting the same rut twice. Therefore, only different problems would be reported in Approach Area A-Inside the WLPZ/ELZ.

The objective is to prevent double reporting of a given problem.

# APPENDIX A - DEFINITIONS

Many of the terms used in this protocol have generally accepted definitions. However, in many cases, the forestry community recognizes a number of definitions for these terms. To facilitate consistency in monitoring while meeting the reporting needs of the participating state agencies, the following definitions will be used for the purposes of this protocol.

**Aggrading** means a stream channel in which the streambed is rising in elevation due to the deposition of sediment and other natural materials.

**Aggradation** refers to the accumulation of sediments on a surface which thereby raise its level.


**Approach A** The haul road or skid trail approach on the left side of the stream crossing when looking down stream. The portion inside the WLPZ/ELZ is evaluated separately from the portion inside the WLPZ/ELZ.

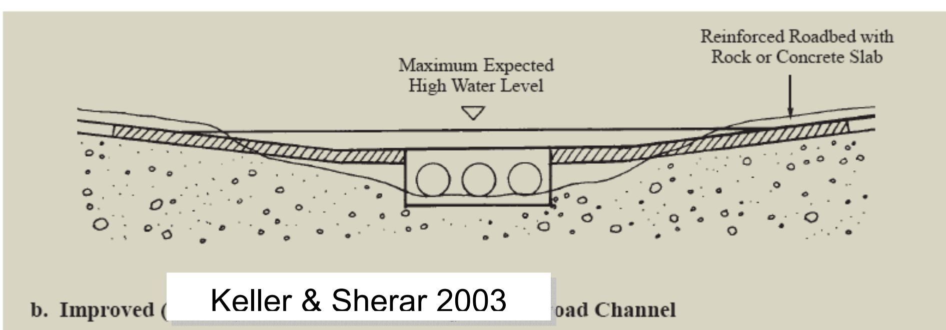
**Approach B** The haul road or skid trail approach on the right side of the stream crossing when looking down stream. The portion inside the WLPZ/ELZ is evaluated separately from the portion inside the WLPZ/ELZ.

**Approach A/B Inside the WLPZ/ELZ** originates at the outer edge of the stream's bankfull width and extends to the outer edge of the WLPZ/ELZ.

**Approach A/B Outside the WLPZ/ELZ** originates at the upland edge of the WLPZ/ELZ and extends inland perpendicular to the bank to a point where road runoff drains away from the watercourse crossing. This approach is limited to the area that is outside of the WLPZ/ELZ and is within the protocol survey area. For Class III watercourses with no protection zone, limit the approach to 25 feet.

**Arch, bottomless**

**Arizona Crossing/Vented Ford**




**Bankfull Width** References 14 CCR 895.1.

**Bridge, Closed Top** A bridge with a continuous surface structure that would prevent soil and related debris from falling through the surface structure into the water below.

**Bridge, Open Planked Top** A bridge with a discontinuous surface structure that would permit soil and related debris to fall through into the water body below.

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**Critical Dip** A dip in the road, usually installed in the crossing fill, which would prevent diversion of the stream course down the road should the crossing structure become obstructed.

**Crossing Structure** The crossing structure refers to the structural components of the crossing device such as culverts, timbers, poles and manufactured portions of abutments.

Crossing structures composed primarily of smaller culverts covered with fill material are defined as extending the bankfull width of the water body and include fill material and rip rap within this length, but not beyond.

Crossing structures composed of manufactured materials such as very large, bottomless culverts, timber, metal or concrete spans and timber, concrete or laid up stone abutments are defined as extending the bankfull width of the water body and include any fill material with the bankfull width but not beyond.

Fill material, rip rap and manufactured portions of bridges and abutments outside the bankfull width of the water body are considered part of the approaches

**Crossing Structure, Open Bottom** A bottomless crossing structure such as a bridge or an arch culvert which leaves the natural stream bottom intact and available to the stream biota.

**Crossing Structure, Closed Bottom** A crossing structure such as a culvert of metal, concrete, wood or other material which covers the natural stream bottom.

**Crowned** A crowned road surface is one which slopes gently away from the centerline of the road and drains to both sides of the crown. The inside half of the road drains inward to the cutbank and ditch, while the outside half drains out across the fillslope.

**Current road/skid trail status** refers to what the road was designated as or proposed as within the current plan.

**New** – the road being evaluated was proposed for construction in the plan referenced in question G-2 of the protocol.

**Existing** – the road was identified as either a seasonal or perment road in the plan referenced in question G-2 of the protocol.

**Reconstructed –** through forensic evidence observed on the ground or as detailed in the plan referenced in question G-2 of the protocol activities occurred on the road that is consistent with “Reconstructed Road” as defined pursuant to 14 CCR 895.1.

**Abandoned** – Means that proactive measures have been applied to effectively remove the road from the permanent road network.

**Cut and Fill** A method of road construction in which a road is built by cutting into the hillside and spreading the soild materials in low spotes and as sidecast along the rout.

**DFG 1600 agreement** equates to any type of streambed alteration agreement made between the California Department of Fish and Game and the timberland owner. This agreement may be programmatic or specific depending on the Fish and Game code section utilized.

**Ditch** A long narrow drainage depression, usually at the side of a trail or roadway, either excavated or formed by erosion.

**Erosion Hazard Rating (EHR)** References 14 CCR 895.1.

**Ephemeral** streams flow only for very short durations following rain or snow melt events.

**Ford, Concrete Apron** This type of ford is constructed of concrete slaps or prefabricated concrete slabs which form the running surface.


**Ford, Dry** This type of ford crossing is one that is not proposed within the plan as being wet at the time of use. As such, there is no road surfacing utilized at the crossing location. This ford resembles a native surfaced ford crossing with the exception that it has a rocked outfall.

**Ford, Native Surface** This type of ford crossing is commonly utilized in Class III watercourses that are proposed for use when water is not present. Commonly language in the plan will require that the crossing be "dipped" upon completion of use.

**Ford, Wet** Regardless of plan specification, if the crossing has a rocked running surface and a rock armored outfall, it qualifies as a wet ford crossing for purposes of this protocol.

**Full Bench Road** A road construction technique in which the bench cut width is the same as the road width, and no full is used in construction.

**Gully** An erosion channel cut into the soil along a line of water flow with a minimum depth of 6 inches and a minimum length of 12 feet. The length requirement does not apply if the gully terminates in a water body before reaching twelve feet in length. Gully erosion produces channels larger than rills. (Schwab et al. Soil and Water Engineering 1993 and Soil Survey Manual, USDA 1993).

**Human Activities** For protocol purposes, any human activity unrelated to the timber harvesting operation. Generally refers to recreational activities such as ATV, mountain bike, horseback riding etc but also includes use of roads for residential access or other non-harvest related activities.

**Hydrologic Soil Type** A set of classes pertaining to the relative infiltration rate of soil under conditions of maximum yearly wetness. Generally expressed as Group A = Gravel/Sand, Group B/C = Loams, Group D = Silts/Mucks.

**Insloped Road** A road surface that is sloped in toward the cutbank. Insloped roads usually have an inboard ditch that collect runoff from the road surface and cutbank.

**Intermittent** During dry periods the stream may cease to flow entirely or may be reduced to a series of separate pools.

**Land, Industrial Forest** Land owned by individuals or businesses such as sawmills, paper companies, involved in processing logs and roundwood into primary forest products such as lumber and paper.

**Land, Non Industrial Private Forest** Land owned by private individuals or groups not directly associated with primary forest industries. The timberland owner owns less than 2,500 acres.

**Land, Public Forest** Land owned and managed by a town, county, or state agency or entity.

**Leaching/Weeping** A form of sedimentation usually associated with a culvert or bridge abutment. Usually occurring where water flows along the outside of a culvert or through gravel, large fill or openings in bridge abutments washing out fine fill and eventually larger material.

**Logging Road** See 14 CCR 895.1

**Maintenance** Reference 14 CCR 1050(a)

**Mechanical Deposition** Soil or fill material pushed into the stream channel by machinery which is beyond the design.

**Mulch** Material placed or spread on the surface of the ground to protect it from raindrop, rill and gully erosion. Mulches include wood chips, straw, wood fiber and a variety of other natural and synthetic materials.

**Other Land Use** Land uses unrelated to forestry such as recreation, sports, residential, agriculture, mining, etc.

**Outsloped** A road surface that is sloped out away from the cutbank toward the road's fill slope. Outsloped roads may or may not have an inboard ditch.

**Perennial** A stream with flowing water nearly year-round during a typical year.

**Petroleum or Petroleum Residue** means oil staining or pooling of oil. It may also include grease, transmission fluid or hydraulic fluid.

**Pipe Arch**

**Piping** Erosion of fill material as from a bridge abutment or around a culvert as a result of water flowing through the abutment or outside the culvert and carrying entrained soil particles resulting in tunnels or "pipes" through the fill material potentially resulting in collapse and further erosion of the fill material. (Survey Manual, USDA 1993)

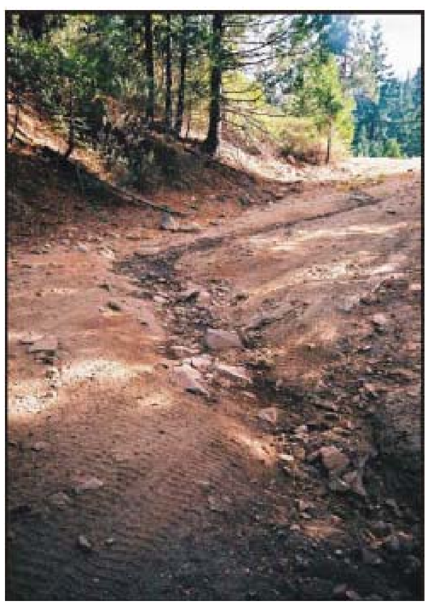
**Pond or lake** See 14 CCR 895.1

**Principles/Practices** Rules, plan design, and/or added plan mitigations and implementation. The principles and pracices should not be judgemental or what based on what would be reasonable/feasible, but instead should be based on what was stated in the plan or provided for by the all rules applicable to the approaches or crossing being evaluated.

**Protocol Survey Area** is the area subject to evaluation by this protocol. It size is dependent on the prescribed WLPZ/ELZ width and is measured from bankfull. It is determined and measured as a distance on the road surface equivalent to three (3) times the WLPZ/ELZ width or 300 feet, whichever is less, on each side of the watercourse crossing.

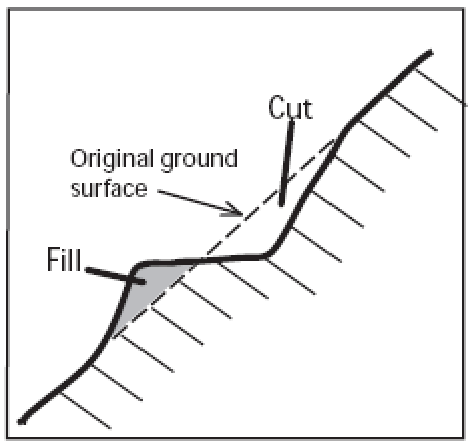
**Quality Control** Activities or data recorded for the purpose of assuring accuracy and consistency of the monitoring process.

**Rill** An erosion channel cut into the soil along a line of water flow often resembling a braided stream pattern with a minimum depth of 1 inch, a minimum length of 12 feet, and a depth change of at least 25% over the 12 foot length. The length requirement does not apply if the rill terminates in a water body before reaching twelve feet in length. Rill erosion is the detachment and transport of soil by a concentrated flow of water. Rill erosion is the predominate form of erosion under most conditions (Schwab et al. Soil and Water Engineering 1993) (Packer P.E. 1967 "Criteria for designing and locating logging roads to control sediment" Forest Science Vol. 13No 1.). A rill becomes a gully when the depth exceeds 6 inches. (See: Gully)

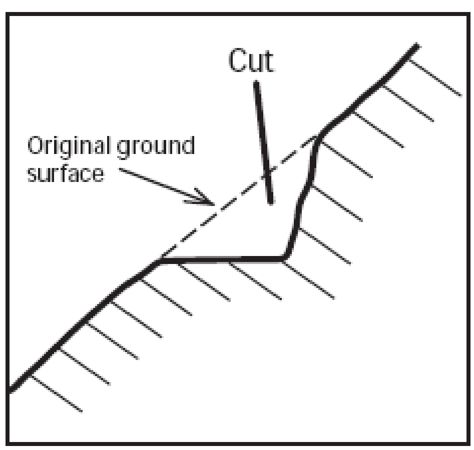


**Road/Trail Inverted Below General Grade of Adjoining Land** is a term used in the protocol to describe the road prism within the approaches. It usually occurs in flat topography through continued use and grading of the road.

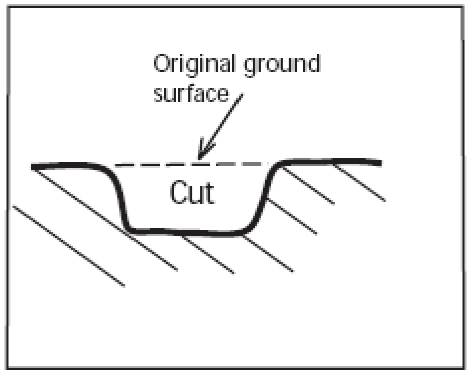
**Road/trail profile created by cut and fill construction.**



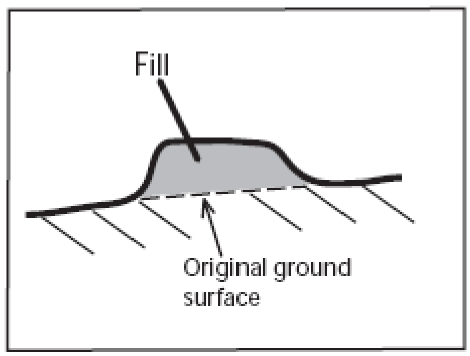

**Road/trail profile created by full bench construction.**



**Road/trail created by through cut.**




**Road/trail profile created by through fill.**




**Road type** refers to the road classification, which is required to be mapped in a THP pursuant to 14 CCR 1034(x)(4)

**Permanent road** – References 14 CCR 895.1
**Seasonal road** – References 14 CCR 895.1
**Temporary road** – References 14 CCR 895.1
**Skid Trail** – References "tractor road" per 14 CCR 895.1

**Rut** Elongated depressions in a trail or roadway caused by dragged logs or wheels or tracks of harvesting machinery and often exacerbated by erosion from uncontrolled runoff waters. Continuous ruts with lengths equal to or greater than the lesser of one wheel circumference or 12 feet will be recorded for this protocol. Ruts ending within the bankfull channel width of the stream will be recorded regardless of length.


**Sedimentation, Deposit to a water body** Soil or fill material, not specified in the design, that is considered to have entered the water body when it has been deposited within the bankfull width of the stream channel or below the normal high water level of lakes or within the boundaries of wetlands whether or not water is present at the time of sampling.

**Sedimentation, Measurable Amounts** A soil or fill material deposit which is observable below the bankfull elevation of the channel at the time of sampling, and attributable to the logging operation and when measured would round to 1 cubic yard or more.

Examples include, but are not limited to deposits associated with a terminating rill or gully or a mechanical addition.

**Sedimentation, Trace amounts** A soil or fill material deposit which is observable below the bankfull elevation of the channel at the time of sampling and attributable to the logging operation, but insufficient in volume to be readily measurable or if measured would round to less than 1 cubic yard.

**Sheet Erosion** Sheet erosion is the more or less uniform removal of thin layers of soil from an area without the development of conspicuous water channels. It is often characterized by exceedingly numerous, tiny erosion channels and or soil, pedestals as the general soil layer is washed away. Sheet flow must cover a contiguous area of two square feet and be continuous for a minimum of 12 feet in length to be recorded. Sheet flow terminating within the bankfull channel need not meet the length requirement. See also Pedestals (Soil Survey Manual, USDA 1993)

**Skid Trail** A cleared trail used by skidders or forwarders to drag or carry logs or other roundwood from the stump to the landing area where they are transferred onto trucks for further transportation over haul roads. Also see tractor road under 14 CCR 895.1.

**Slope length** is slope distance measured in whole feet along the centerline of the haul road or skid trail between the beginning and ending points indicated in the various protocol questions.

**Stream Channel** see watercourse pursuant to 14 CCR 895.1.

**Temporary (Temp.) crossing** A crossing that is intended for use during the current timber operation. These crossings are designed to facilitate the anticipated flow of water during the period of use.

Type include:

Humboldt – A drainage structure made out of logs laid in and parallel to a stream channel and then covered with soil.

Spittler – A drainage structure made out of logs, which are cabled together, and laid in and parallel to a stream channel. A pipe is first installed, and then bundles of logs are placed around the pipe. Fabric, then straw is placed on top of the logs followed by soil to make the running surface.

Temporary Culvert with Log and Rock Fill – On perennial streams, low gradient with continuous flow, temporary modified Spittler type crossing have been utilized. Pipes are placed across the active channel, logs are then used to fill the voids, followed by a rock cap. Each bundle of logs used in the fill are cabled together to facilitate removal.

Temporary Culvert with Rock Fill – On perennial streams, low gradient streams, temporary rock fill with the incorporation of numerous small diameter pipes may be used.

**Through-cut** A road cut through a hillslope or, more commonly, a ridge, in which there is a cutbank on both sides of the road.

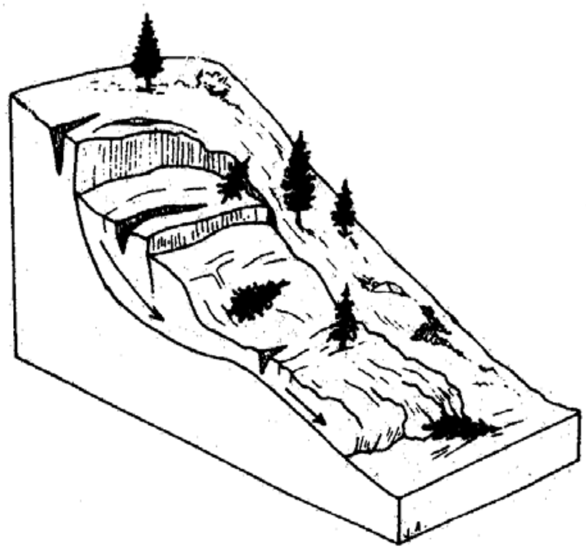
**Through-fill** A road which is entirely composed of fill material and is commonly elevated above the surrounding area.

**Weather: Extreme Events** Examples of extreme weather events include, but are not limited to: high intensity rainfall or rain on snow events.

**Water Drafting Approach** – means a pad or spur road constructed adjacent to the watercourse, so that the water truck can pull into or back off of the road surface to facilitate water drafting activities.

# APPENDIX B – REFERENCE FOR G-14

LANDSIDE TYPE DEFINITIONS

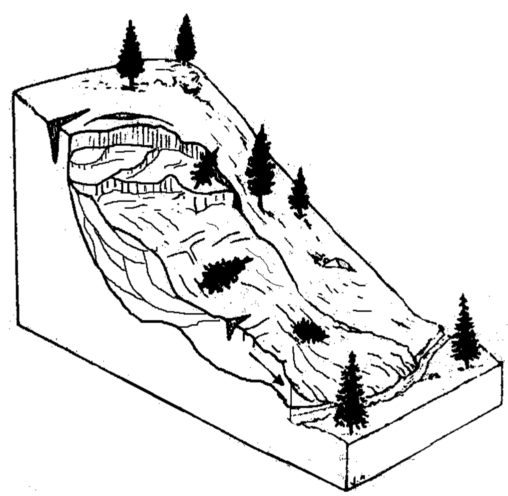


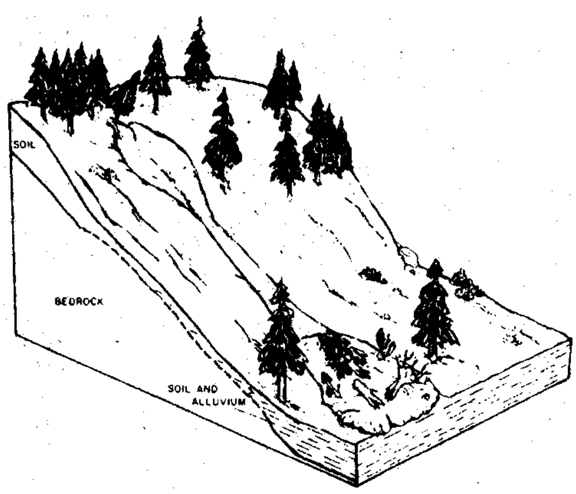
ROCK SLIDE: A slide involving bedrock in which much of the original structure is preserved. Strength of the rock is usually controlled by zones of weakness such as bedding planes or joints. Movement occurs primarily by sliding on a narrow zone of weakness as an intact block. Typically these landslides move downslope on one or several shear surfaces, called slide planes. The failure surface(s) may be curved or planar.

diagram by J. Appleby, R. Kilbourne, and T. Spittler after Varnes, 1978

EARTH FLOW: A landslide composed of fine grained soil, consisting of surficial deposits and deeply weathered, disrupted bedrock. The material strength is low through much of the slide mass, and movement occurs on many discontinuous shear surfaces throughout the landslide mass. Although the landslide may have a main slide plane at the base, many internal slide planes disrupt the landslide mass leading to movement that resembles the flow of a viscous liquid.

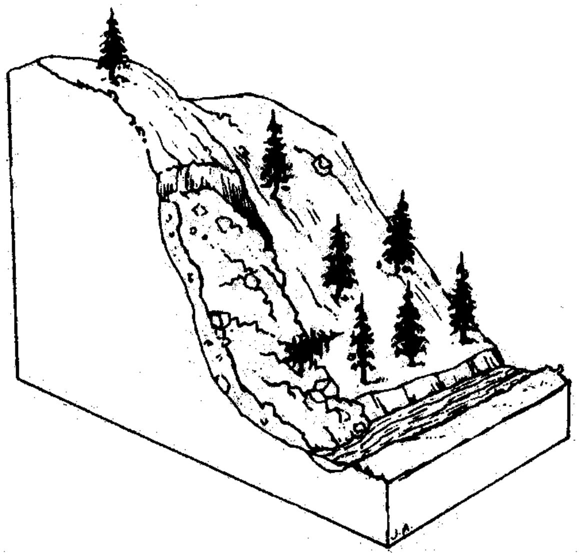
diagram by J. Appleby, and R. Kilbourne, after Varnes,






DEBRIS FLOW: A landslide in which a mass of coarse-grained soil flows downslope as a slurry. Material involved is commonly a loose combination of surficial deposits, rock fragments, and vegetation. High pore water pressures, typically following intense rain, cause the soil and weathered rock to rapidly lose strength and flow downslope.

diagram by J. Appleby, and R. Kilbourne, after Varnes,



DEBRIS SLIDE: A slide of coarse grained soil, commonly consisting of a loose combination of surficial deposits, rock fragments, and vegetation. Strength of the material is low, but there may be a very low strength zone at the base of the soil or within the weathered bedrock. Debris slides typically move initially as shallow intact slabs of soil and vegetation, but break up after a short distance into rock and soil falls and flows.

diagram by J. Appleby, and R. Kilbourne, after Varnes, 1978

DEBRIS SLIDE SLOPE: Debris slides and debris flows are commonly found on a landform called a DEBRIS SLIDE SLOPE, which represents the coalesced scars of numerous landslides that are too small to depict on a geologic map. These landforms are generally very steep, and have developed in areas of weak bedrock mantled with loose, thin soils and covered with sparse vegetation.

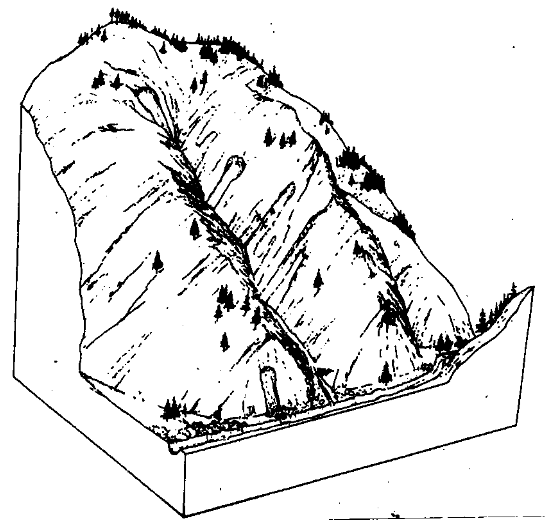
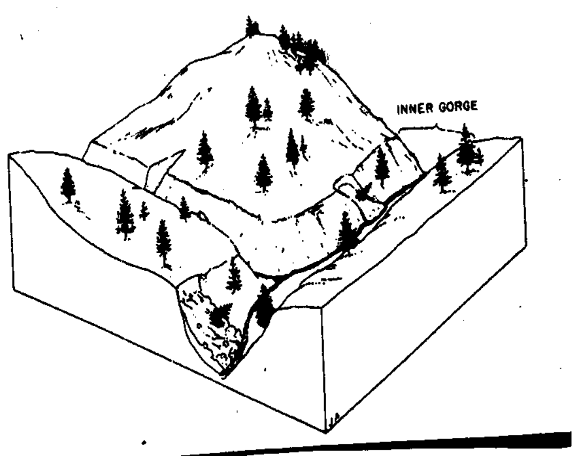


diagram by J. Appleby, and R. Kilbourne, after Varnes,



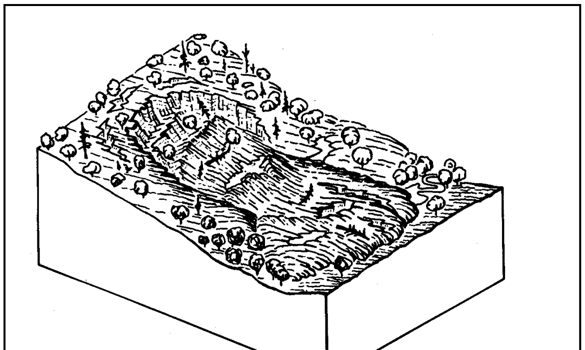

INNER GORGE: A landform formed by coalescing scars originating from mass wasting and erosional processes caused by active stream erosion. The landform is identified as that area of stream bank situated immediately adjacent to the stream, having a slope generally of over 65% and being situated below the first break in slope above the channel.

diagram by J. Appleby, and R. Kilbourne, after Varnes,

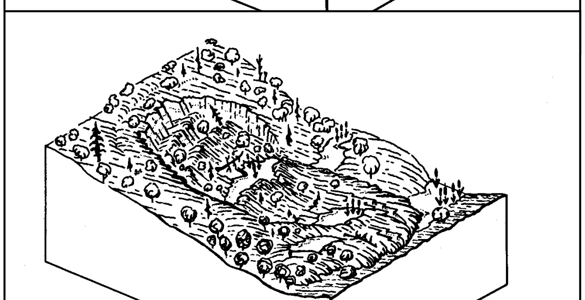
# APPENDIX C – REFERENCE FOR G-14

**DEFINITION OF LANDSLIDE ACTIVITY**

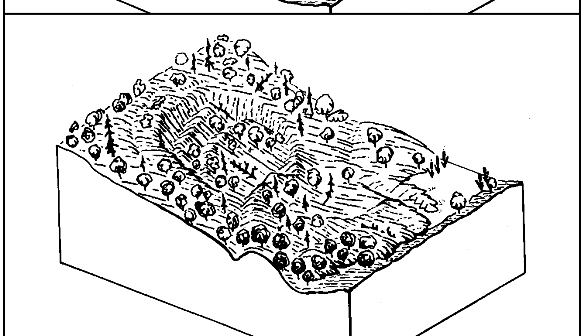
**(diagrams from Wieczorek, 1984)**



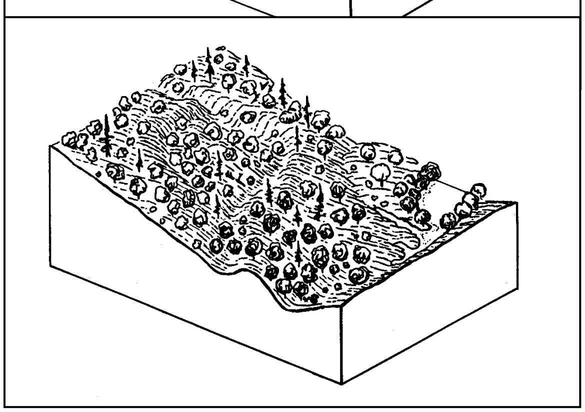
Active or Historic: The landslide appears to be currently moving or movements have been recorded in the past. Fresh cracks, disrupted vegetation or displaced or damaged man-made features indicate recent activity. Water may be ponded in depressions created by rotation of the slide mass or blockage of stream drainage.



Dormant-young: The landforms related to the landslide are relatively fresh, but there is no record of historic movement. Cracks in the slide mass are generally absent or greatly eroded; scarps may be prominent but are slightly rounded. Depressions or ponds may be partly filled in with sediment, but still show phreatophytic vegetation.



Dormant-mature: The landforms related to the landslide have been smoothed by erosion and re-vegetated. The main scarp is rounded, the toe area has been eroded and some new drainages established within the slide area. Benches and hummocky topography on the slopes are subdued and commonly obscured by dense, relatively uniform vegetation.



Dormant-old: The landforms related to the landslide have been greatly eroded, including significant gullies or canyons cut into the landslide mass by small streams. Original headscarp, benches and hummocky topography are now mostly rounded and subtle. Closed depressions or ponds now filled in. Vegetation has recovered and mostly matches the vegetation outside the slide boundaries.