

Colorado Forestry Best Management Practices

Forest Stewardship Guidelines for Water Quality Protection

2014 Field Monitoring Report



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August 2017



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Executive Summary

Water is a vital resource in Colorado that must be protected from nonpoint source pollution. In an effort to proactively protect water quality, Colorado has implemented Best Management Practices (BMPs) for various land use activities, including forestry-related activities. Forestry BMPs are a set of suggested water-quality protection measures and guidelines that provide direction on methods to mitigate potential water quality impacts from activities such as road construction, protecting Streamside Management Zones (SMZs), timber harvesting actions, pesticide and fertilizer use, construction of stream crossings and fire management actions. Compliance with BMPs is voluntary in Colorado, and administered within a non-regulatory framework.

In September/October 2014, an interdisciplinary team visited six timber-harvest sites along the northern Front Range of Colorado to assess Colorado forestry BMP application and effectiveness. Sites were selected from a combination of federal, private and state lands. Each site was evaluated according to written criteria in a CSFS-generated Field Monitoring Rating Guide on BMP implementation and effectiveness.

The 2014 monitoring efforts found that the general application of BMPs was met or exceeded 82 percent of the time. In addition, major departures from the application of BMPs only occurred 3 percent of the time, with gross neglect of BMPs found in 2 percent of evaluated standards at these sites. Also, BMPs were found to be effective overall in providing adequate or improved resource condition 84 percent of the time. Minor and temporary adverse effects were observed 16 percent of the time, but with no major and prolonged effects observed on any sites.

Federal timber sales scored the highest in proper BMP application, having met or exceeded BMP standards 92 percent of the time. Only minor departures occurred on federal sites for the remaining 8 percent of BMP applications. Private and state sites scored 71 and 89 percent, respectively, in meeting or exceeding BMP standards. Most departures from BMP application on private (18 percent) and state (11 percent) lands were minor. Similarly, major departures from proper BMP application were not observed for the sale on state land, and occurred 6 percent of the time on private ownerships, in addition to gross neglect 5 percent of the time on private ownerships.

BMP effectiveness on federal forestlands was adequate or improved conditions 97 percent of the time. Minor

and temporary effects accounted for the other 3 percent on federal sites. Private and state sites scored 72 and 90 percent, respectively, in adequately protecting or improving conditions. Minor and temporary effects were observed in 27 and 10 percent of cases, respectively, on private and state lands. Minor/prolonged or major/temporary effects were only seen on private lands, and there only 1 percent of the time.

Based on the findings of the 2014 assessment, the monitoring team made several recommendations to address specific questions or concerns related to SMZs, sale/treatment boundary spatial limits for monitoring, stream types and ongoing monitoring.

In summary, the 82 percent implementation level and 84 percent effectiveness levels are very good, albeit lower than past years. Forestry BMPs continue to be the leader in water quality protection.

Acknowledgments

As part of its continuing efforts to protect water quality through the monitoring of BMPs during forestry and silviculture operations, the Colorado State Forest Service (CSFS) facilitated coordination of 2014 BMP field monitoring actions. As part of an ongoing effort, the Field Audit Program began in 2008 with the initiation of the first audit. In 2011, a follow-up re-audit report was written to document the effectiveness of several BMPs on four of the six original sites. The most recent previous CSFS-led field audit was conducted in 2012.

The following individuals served on the 2014 field monitoring team:

- Joan Carlson, U.S. Forest Service
- Casey Cooley, Colorado Parks and Wildlife
- Rich Edwards, Colorado State Forest Service
- Jonas Feinstein, Natural Resources Conservation Service
- Randy Frank, Jefferson County Open Space
- Peter Ismert, U.S. Environmental Protection Agency
- Veta Mitchell, Colorado Tree Farmers
- Peter Monahan, U.S. Environmental Protection Agency
- Henry Provencio, U.S. Forest Service
- Brett Roller, Colorado Tree Farmers
- Carl Spaulding, Colorado Timber Industry Association
- John Stednick, Colorado State University
- Greg Sundstrom, Colorado State Forest Service
- Josh Van Vlack, Wyoming State Forestry

The CSFS is grateful to all of these individuals and their agencies/organizations for contributing to the CSFS 2014 forestry BMP field monitoring efforts. Although confidentiality of contractors and landowners is maintained throughout the report for all audited sites, the CSFS also wants to acknowledge their valuable assistance and cooperation.

Technical editing assistance for this report was provided by Dr. John D. Stednick, Warner College of Natural Resources, Colorado State University, and Susan Matthews, CSFS Forest Management Division. Images for this report were provided by CSFS Outreach Division; Rich Edwards, CSFS; and Peter Ismert, U.S. Environmental Protection Agency. Editing and design assistance were provided by Kim Mueller, Lisa Mason and Ryan Lockwood of the CSFS Outreach Division.

Introduction

The forested lands of Colorado produce almost all of the state's fresh water and include the headwaters of seven major rivers. Within the state, at least 80 percent of the population relies on these surface waters for their domestic water supply. This water also provides for irrigation, livestock, recreation and industrial uses, and support important fisheries. Therefore, it is essential that landowners and managers take the necessary measures to maintain surface water quality.

Timber is harvested from federal, private and state forestlands in Colorado. The U.S. Environmental Protection Agency (EPA) classifies forestry and silviculture activities as potential sources of nonpoint source (NPS) pollution under the Clean Water Act. The EPA defines nonpoint source pollution as follows:

“Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Nonpoint source pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water.”

Excessive sediment entering waterways, usually from roads and forestry/logging-operation skid trails, is the most significant NPS pollution generated by forestry and silviculture activities. Common timber harvesting practices include the construction and use of forest roads, skid trails

and landings. Such activities remove vegetative cover and can result in soil compaction, thus reducing precipitation infiltration rates into the ground. If improperly planned, located or constructed, these changes to the landscape can intercept other surface waters, concentrating surface flows and transporting sediment over land and into receiving waters. However, these potential sources of pollution are preventable if proper forestry and timber harvest management practices are implemented.

Forestry BMPs are a set of water-quality protection measures and guidelines. BMPs provide direction on project planning, road construction and maintenance, SMZs, timber harvesting actions, hazardous substances, stream crossings and fire management. The implementation of BMPs can limit the NPS pollution that forestry operations produce. Compliance with forestry BMPs is voluntary in Colorado and is administered within a non-regulatory framework. BMP implementation monitoring serves as an acceptable surrogate for water-quality monitoring, which is a more quantitative, time-consuming and expensive approach.

The Colorado Timber Industry Association (CTIA) and the CSFS first developed “Colorado Forest Stewardship Guidelines to Protect Water Quality, Best Management Practices (BMPs) for Colorado” in 1998. The CTIA, CSFS, Colorado NPS Task Force and EPA provided the funding for the publication, which is now out of print.

Following the inaugural 2008 BMP field audit, the CSFS received funding from the Colorado Water Quality Control Division of the Colorado Department of Public Health and Environment, to update forestry BMPs for Colorado. The resulting publication, “Forestry Best Management Practices to Protect Water Quality in Colorado, 2010,” is available in print at all CSFS locations throughout the state and online at

<http://static.colostate.edu/client-files/csfs/pdfs/ForestryBMP-CO-2010.pdf>

In addition, “Colorado Forestry Best Management Practices: Forest Stewardship Guidelines for Water Quality Protection, 2012 Field Audit Report” is available online at http://static.colostate.edu/client-files/csfs/pdfs/BestMgmtPractices2012FieldAuditReport_www.pdf

The Colorado forestry BMP monitoring process is designed to represent BMP compliance across the state. The 2010 Colorado Statewide Forest Resource Assessment identifies 24.4 million acres of forest and woodlands in the state, with nearly 68 percent in federal ownership. Approximately 186,000 private landowners control another 30 percent,

or 7.1 million acres, of the state’s forested landscapes. Colorado’s NPS 2012 Management Plan states that “nearly 37 percent of the total surface land and water of the state is federally owned, largely in headwaters areas”; however, much of Colorado’s timber harvesting takes place on privately owned lands. Consequently, BMP monitoring sites on timber sales were selected from each major landowner group in the state: federal, private and state.

Using field monitoring rating guide criteria (Appendix A) generated initially by the CSFS and the BMP audit implementation steering committee in 2008, each site was again to be evaluated on key components of the timber sale, including planning, roads, SMZs, timber harvesting, hazardous substances, stream crossings and fire management. BMP compliance was to be evaluated on the basis of two criteria for each practice: application and effectiveness. The application rating indicated the degree of compliance with suggested BMP methodology, and the

effectiveness rating established whether the practice, as applied, was sufficient to achieve the intended protection of water resources.

The 2014 Colorado forestry BMP monitoring effort was the third comprehensive BMP monitoring for the state. Monitoring was conducted on a total of six timber harvest sites (three on private properties, two on National Forest land, and one on state land) by a team of resource professionals in the fields of engineering, forestry, geology, hydrology, soil science and wildlife management from federal, state, local and private sectors. Academics, industry experts and landowners were also represented on the team.

The BMP field monitoring was partially funded through a USDA Forest Service State and Private Forestry grant. This report details the findings of the 2014 forestry BMP monitoring efforts.

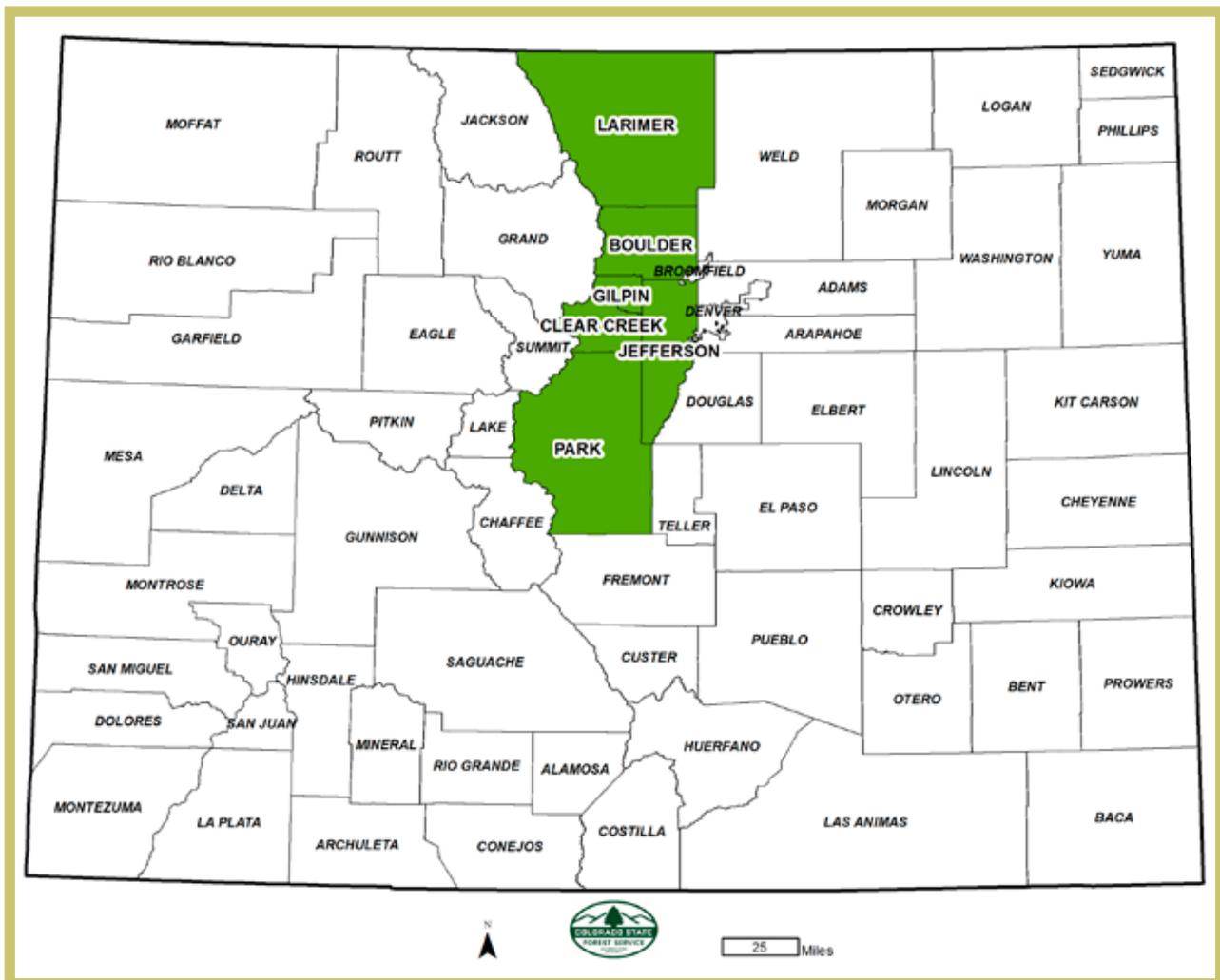


Figure 1: Counties that participated in the 2014 Colorado Forestry BMPs Field Audit

Monitoring Objectives

The role of the 2014 monitoring team was to evaluate voluntary compliance to BMP standards detailed in the 2010 CSFS publication “Forestry Best Management Practices to Protect Water Quality in Colorado.” The overall goal was to proactively monitor the implementation of the state forestry BMPs and evaluate the effectiveness of each on a set of sample sites. The 2014 monitoring report objectives included:

1. Monitor timber harvesting and fuel practices on federal, state and private lands to assess:
 - a. the implementation level of forestry BMPs
 - b. the effectiveness level of forestry BMPs
2. Make recommendations for monitoring or manual changes based on these results
3. Make recommendations for future classes on continuing education for landowners, loggers and resource professionals

Monitoring Process

Site Selection

The CSFS selected sites from a pool of timber sales and service agreements (timber harvesting or fuels reduction) on federal, private and state forestlands. To establish equal representation of each of these landowner groups and to focus on forest operations with the greatest potential to affect water quality, baseline criteria were used to select operations from a list of potential sites. Following are the baseline criteria:

1. Forest operation has the potential to affect water quality.
2. Minimum of 1,000 board feet (2 units) per acre was harvested or masticated.
3. Forest operation was completed within the last two years.
4. Forest operation was located in Boulder, Clear Creek, Gilpin, Jefferson, Larimer or Park (only portions north of U.S. Highway 285, west to Kenosha Pass) counties.

The minimum requirement of 1,000 board feet harvested per acre was used to ensure that operations with minimal activity and thus minimal potential to affect water resources were not selected. In addition, many of the forest operations in the state occur in areas where little or no surface water or other sensitive hydrologic resources are present. While many BMPs are applicable to such forest operations, the monitoring focused on operations with potential to affect water quality. This selection method created bias in the results, as monitoring took place where operations were likely to result in departures from the BMPs.

For 2014, the location criteria represent counties within three CSFS districts (Boulder, Fort Collins and Golden; see Figure 1). Previous monitoring has been conducted in other areas of the state. The long-term intent is to eventually cover all forested areas within Colorado that satisfy the first three criteria of site selection.

Overview of Selected Sites

Site nominations were solicited from two USDA Forest Service supervisor offices, three CSFS district offices, and the CTIA Executive Committee and local membership list. One state site was eliminated during the audit because it did not have the potential to affect water quality as originally thought. Another recently harvested site on private land (#1; see Appendix A) was selected as a replacement on the final day of the audit because it satisfied all baseline criteria.



Figure 2: The sale administrator briefs the monitoring team and answers questions prior to a site visit. Photo: Rich Edwards, CSFS

Monitoring Procedure

Site visits were conducted over four days, and the monitoring team spent approximately two to three hours on each area. Seven of the 13 monitoring team members had participated in at least one prior BMP monitoring effort and/or federal BMP consistency review in one or more states in the previous six years. This allowed significant cross-training of newer team members and helped improve understanding of rating criteria and applicability of the guide.

Personnel directly associated with each timber sale (either the compliance forester or sale administrator) briefed the monitoring team on details of the harvest at each location. Areas of particular importance, such as SMZs, roads and landing areas near the riparian corridor were identified, as were sale administration details. The monitoring team was given an opportunity to inspect the area. No effort was made to inspect each acre of the harvested area or each mile of road/trail; rather, monitoring focused on the critical portions of the timber sale where proper BMP application was most important.

After inspecting these areas, the monitoring team reconvened to evaluate the applicable BMPs for each site through observation and discussion. After reaching consensus on applicability, an on-site team leader recorded the application and effectiveness rating for each of the BMP items. A different member of the

monitoring team acted as team leader at each location. The BMP Field Monitoring Data and Rating Guide Criteria are attached (Appendix A).

The rating process conducted for each BMP item begins with establishing whether the BMP in question is applicable to the harvest activities under consideration (see Figure 5).



Figure 3: The monitoring team inspects skid trails and the Streamside Management Zone (SMZ). Photo: Peter Ismert, U.S. EPA



Figure 4: The monitoring team works on reaching consensus on BMP application and effectiveness ratings. Photo: Peter Ismert, U.S. EPA

Due to privacy issues, ownership and specific locations of the selected sites are not identified in this report. A different logging company (also not identified) harvested each site, except for the two federal sales #1 and #2 (Appendix A), which were harvested by the same contractor.

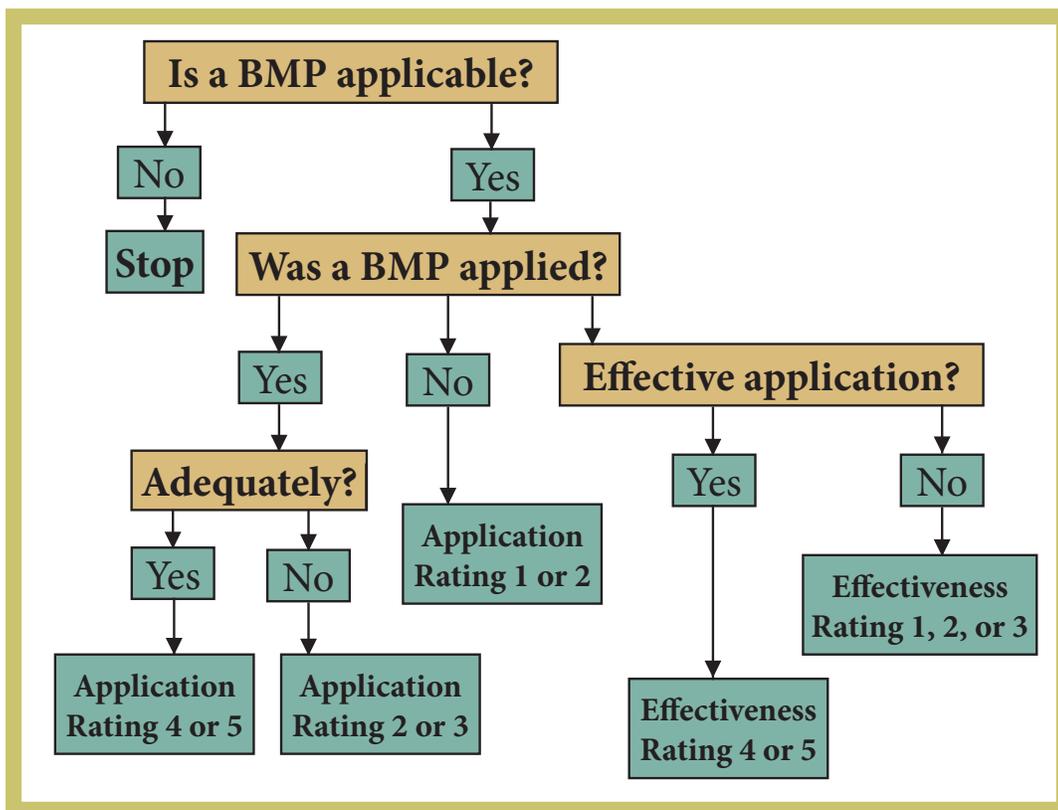


Figure 5: Colorado BMP Audit Ranking System

For example, not all harvest sites require the construction of temporary roads. In these cases, the BMPs that pertain to temporary roads are not applicable. Once the monitoring team establishes that a given BMP is applicable, the application rating for the BMP is determined, based on written criteria (Table 1).

Table 1: BMP Application Ratings and Criteria

Rating	Criteria
5	Operation exceeds requirements of BMP.
4	Operation meets the standard requirement of BMP.
3	Minor departure from BMP.
2	Major departure from BMP.
1	Gross neglect of BMP.

The monitoring team then evaluated the BMP effectiveness, which determined whether the BMP was successful in protecting water quality, again based on written criteria (Table 2).

Table 2: BMP Effectiveness Ratings and Criteria

Rating	Criteria
5	Improves protection of soil and water resources over pre-project conditions.
4	Adequate protection of soil and water resources.
3	Minor and temporary impact to soil and water resources.
2	Major and temporary or minor and prolonged impacts to soil and water resources.
1	Major and prolonged impacts to soil and water resources.

Definition of Effectiveness Terms

- Adequate:** Small amount of material eroded, but does not reach draws, channels or floodplain
- Minor:** Some material erodes and is delivered to stream or annual floodplain
- Major:** Material erodes and is delivered to stream or annual floodplain
- Temporary:** Impacts last less than one season
- Prolonged:** Impacts last more than one year

Table 3: Colorado Forestry BMP 2014 Field Monitoring Application Results, by Land Ownership

Ownership	Exceeded BMP	Met BMP Standard	Minor Departure	Major Departure	Gross Neglect	Total
Federal	2	57	5	0	0	64
	3%	89%	8%	0%	0%	100%
Private	1	62	16	5	4	88
	1%	70%	17%	6%	6%	100%
State	0	25	3	0	0	28
	0%	89%	11%	0%	0%	100%
Total	3	144	24	5	4	180
	2%	80%	13%	3%	2%	100%

Table 4: Colorado Forestry BMP 2014 Field Monitoring Effectiveness Results by Land Ownership

Ownership	Improved Conditions	Adequate Protection	Minor and Temporary	Minor/Prolonged or Major/Temporary	Major and Prolonged	Total
Federal	0	62	2	0	0	64
	0%	97%	3%	0%	0%	100%
Private	0	63	24	1	0	88
	0%	72%	27%	1%	0%	100%
State	1	24	3	0	0	28
	4%	86%	10%	0%	0%	100%
Total	1	149	29	0	0	180
	1%	83%	16%	0%	0%	100%

Table 5: Comparison of BMP Application and Effectiveness Results, by Year Monitored

Application	Exceeded BMP	Met BMP Standard	Minor Departure	Major Departure	Gross Neglect
2008	3%	84%	11%	3%	0
2012	2%	84%	10%	4%	0
2014	2%	80%	13%	3%	2%

Effectiveness	Improved Conditions	Adequate Protection	Minor and Temporary	Minor/Prolonged or Major/Temporary	Major and Prolonged
2008	1%	81%	15%	3%	0
2012	2%	86%	12%	0	0
2014	1%	83%	16%	0	0

As monitoring sites were visited, the team kept notes about how the 2010 publication “Forestry Best Management Practices to Protect Water Quality in Colorado” might be improved when updated to the next revision, and how future monitoring processes might be conducted. Those findings are included in the “Recommendations” portion of this report.

the highest application rates, having met or exceeded BMP standards 92 percent of the time.

BMPs were deemed effective at providing adequate protection for or improving water resource conditions 84 percent of the time (Table 4). BMP effectiveness on federal and state forestlands occurred 97 percent and 90 percent of the time, respectively. Forest operations on private lands scored lower, with 72 percent experiencing adequate or improved conditions. “Minor and temporary” effects were observed for 27 percent and 11 percent of BMPs, respectively, for private and state lands. Minor/prolonged

Limitations of the Monitoring Process

As previously stated, time and resource limitations prohibit the evaluation of each forest operation from initiation to completion for compliance with BMPs. Instead, the monitoring process is designed to act as a “spot check,” which is limited to areas of the operation that have the greatest potential to affect water quality. The timing of monitoring in the life of the operation also is limited, in that monitoring cannot simultaneously examine the pre-bid or sale, ongoing harvest/treatment and post-bid or sale activities to which BMPs apply. Evaluation of BMPs relating to time was based on implementation to date, where final results were not yet realized. For example, at sites where grass seed mixtures had been applied but germination had not yet occurred, it was generally assumed that the grass would germinate successfully.

Field Monitoring Results

In 2014, BMPs were met or exceeded 82 percent of the time (147 out of 180 rated items – see Table 3). Minor departures occurred 13 percent of the time, and private lands had the highest occurrence of departures. Major departures, which represented five counts or 3 percent of the total, occurred only on private land. Gross neglect of any BMP was found in only 2 percent of all rated BMPs and occurred only on private land. Federal timber sales scored

or major/temporary effects were only seen on private lands, and there only 1 percent of the time. Major/prolonged effects were not observed on any forestland during this monitoring period.

In general, BMPs were properly applied and effective in most cases in 2014. Table 5 illustrates the 2014 BMP application and effectiveness rating results for all landowners, compared to the results of the previous 2008 and 2012 monitoring periods. The application results remained relatively consistent between the first two periods. In comparison, minor departures and gross neglect of BMP application increased slightly in the 2014 results. In addition, the effectiveness results improved slightly between 2008 and 2012, with more BMPs providing adequate or improved conditions. However, effectiveness results decreased again in 2014. It should be noted that minor/temporary, major/temporary or major/prolonged effects were reduced to zero in both 2012 and 2014.

Based on the 2014 Forestry BMP audit, the following observations were made. The order parallels the BMP Guidance document.

Planning

Sanitary guidelines for the construction of camps

Camping was not an issue on any of the monitored sites. Sale operators and their employees were mostly locally based and only overnights at one of the monitored sites.

Roads

Road design and location

Existing roads were used wherever possible on most of the sites. Sites with newly constructed or reconstructed roads met BMP requirements and adequately protected soil and water resources. All of the departures from BMPs occurred on pre-existing roads, and were minor in nature.

Road construction/reconstruction

Where road construction/reconstruction occurred, proper techniques were used to construct only to the extent necessary and to provide for adequate drainage and safety. In general, earth-moving activities were minimized during wet periods and erodible soils were stabilized. One minor departure on private land involved not keeping erosion/sediment control work current on a recently constructed section of road in a harvest unit.

Road drainage

Road drainage was quite variable across the sites visited. Federal sites were rated adequate to excellent in both application and effectiveness of BMPs. Private and state sites were rated adequate to fair. The most common drainage issues for the private sites were related to road surface (e.g. drain dips), improper relief culvert design, lack of outlet energy dissipaters and inadequate filtration zones. The one state site monitored yielded some minor issues that were mainly related to relief culvert design.

Road maintenance

Most of the sites met the requirements of the maintenance BMPs and provided for adequate protection of soil and water resources. This included minimizing road grading, avoiding “cutting the toe” of cut slopes (i.e., potentially destabilizing the bank above the road), and leaving any abandoned roads in sufficient condition to provide adequate drainage. Minor departures with minor and temporary impacts were noted on one of the federal sites with regard to a partially plugged culvert needing attention and side-casting of road material into a stream. In addition, one of the private sites had a minor departure and impacts in maintaining some of the in-road diversion structures. A second private site had a minor and temporary impact to the soil and water resources due to use of the road during wet periods.

Streamside Management Zone (SMZ) Delineation

The highest proportion of departures in BMP application (ranging from minor departure from BMP to gross neglect of BMP) and effectiveness (ranging from minor and temporary, to major and temporary, to minor and prolonged impacts to soil resources) occurred in this monitoring category. The state site scored the highest related to SMZs, with more than sufficient ground cover actually improving the protection of soil and water resources.

One of the federal sites excluded SMZs from the observed harvest entry with plans to address these areas in a future treatment. The second federal site had minor departures on several BMPs. A wetland within the sale area, although designated, consisted of some observed areas with the buffer SMZ distance as low as 25 feet (7.6 m), and ranging from 25 to 60 feet (7.6 to 18.3 m). In addition, one relatively steep and prominent ephemeral draw had no buffer identified and all large conifers were removed. However, designated crossings were used to limit soil impacts.

All of the major departures and gross neglect of BMPs in this category occurred on one private site. Major departures from BMPs on this site included: not maintaining sufficient ground cover, not retaining an adequate number of standing trees (including larger trees to provide habitat and as a source of large woody material), and allowing side-cast material to be deposited into the stream. Gross neglect of BMPs in this category included: inadequate SMZ width identified (i.e., “0” feet), SMZ not properly marked, allowing equipment operation in SMZ, and not excluding slash from the streambed. Effectiveness ratings of minor and temporary impacts to soil and water resources were given to all of the BMP application departures listed above except for the allowing of equipment operation in the SMZ, which was given a major and temporary impact to soil and water resources.

The two other private sites rated higher, with one site meeting all requirements of BMP application along with adequately protecting the site’s soil and water resources for all effectiveness ratings. The third private site had a minor departure in not properly marking the SMZ; however, the average width of the SMZ, in this case, was observed by the team to be approximately 150 feet (45.7 m). This extra SMZ width of three times the minimum standard was deemed to improve the protection of soil and water resources over pre-project conditions.

Stream Crossings and Stream Bank Protection

None of the monitoring sites contained applicable BMPs of this category.

Installation of Stream Crossings

None of the monitoring sites contained applicable BMPs of this category.

Timber Harvesting, Thinning, Slash Treatment and Revegetation

Harvest design

All harvest sites used suitable locations, areas/sizes and number of landings. The federal and state sites, as well as two private sites, used suitable logging systems for the topography when designing and locating skid trails to minimize soil disturbance. The other private site had a minor departure in applying the BMP for utilizing a suitable logging system for topography, soil type and season of operation, and a major BMP departure in designing and locating skid trails. Both BMP application departures for

this site were given a “minor and temporary” impact rating to soil and water resources for their effectiveness.

Other harvesting activities

All harvest sites provided adequate drainage for landings and avoided tractor skidding on unstable, wet or easily compacted soils and on slopes greater than 40 percent, unless they were not causing excessive erosion. Both federal sites, two private sites and the state site provided adequate drainage for skid trails and used skidding operations that minimized soil compaction and displacement. One private site had a minor departure in applying the BMP for skidding operations that minimize compaction and displacement of soil, and a major departure in providing adequate drainage for skid trails. Both BMP application departures for this site were given a “minor and temporary” impact rating for their effectiveness to address soil and water resources.

Slash treatment and site preparation

Scarification (e.g., disturbing the soil intentionally to expose bare earth to encourage precipitation infiltration, moisture retention and thus seed germination), was used on the two federal sites and two of the three private sites. Furthermore, only one federal and one private site used scarification on steep slopes. All scarification applications and effectiveness ratings met the requirements of the BMPs and adequately protected the soil and water resources. These scarified sites implemented the particular BMPs only to the extent necessary to meet resources management objectives and in a manner that minimized erosion. All sites treated their slash so as to preserve the surface soil horizon and limited their activities to frozen or dry conditions to minimize soil compaction and displacement. Only one private site had a minor BMP departure from leaving adequate slash material to slow runoff, return soil nutrients and provide shade to help seedling trees become established. The effectiveness, in this case, was rated at a minor and temporary impact to soil and water resources.

Revegetation of disturbed areas

Grass seeding was used in many areas of the monitored sites. Generally, seeding rates were observed to be adequate. One federal site was in the process of being revegetated in disturbed areas; another private site had not yet seen completion of revegetation efforts, with the intention to broadcast seed in the late fall. Both of these sites may need to be revisited to assess both BMP application and effectiveness ratings.

Pesticides, Fertilizers and Chemicals

Fertilizers were not used on any of the sites visited. Pesticides were only used on one of the private sites (i.e., for noxious weeds). All label instructions were followed and the BMP application standard was met, adequately protecting the soil and water resource. Two of the three private sites and the state site had hazardous materials spill-contingency plans in place at the time of their field operations. On one private site, fueling of equipment was all performed off-site. Both federal sites, one private site and the state site all had properly designated sites selected for servicing and refueling to prevent contamination of waters from accidental spills. A minor BMP application departure of hydraulic/oil fluid was noted on one of the private sites in several areas. Effectiveness was evaluated to be adequate due to the large distance of the minor spills from any water sources.

Fire Management

Protection of soil and water from the effects of prescribed burning

One of the federal sites, one of the private sites and the state site had no ratings in this category because prescribed fire was not utilized, nor did wildfires occur. One federal site and two of the three private sites included prescribed fire (i.e. pile burning), and BMP application requirements were met on each. Effectiveness was adequate on all sites using prescribed burning.

Stabilization of fire suppression-related work damage

This BMP was not applicable on any of the sites because no fire suppression-related activities occurred.

Emergency rehabilitation of watersheds impacted by wildfires

This BMP was not applicable on any of the sites because no emergency rehabilitation of watershed activities occurred.

Summary

Based on 2014 monitoring efforts, proper application of BMPs in forestry and logging operations in Colorado occurred at a rate of 82 percent, with an effectiveness rate of 84 percent. The monitoring team is generally pleased with these levels. The team made several recommendations (below) in an effort to improve implementation and effectiveness rates. As we deal with continuing statewide forest insect and disease issues, an increase in the incidence of destructive and relatively high-intensity wildfires, and an improving forest products industry infrastructure, the number of acres being harvested and/or treated in Colorado likely will increase. It is essential to continually evaluate and adjust BMPs as new issues and information are presented, to help protect soil resources and water supplies that have the potential to be adversely affected by forestry and logging practices.

Recommendations

During the audit, several BMPs required clarification or expansion, and additional BMPs also were suggested. The following recommendations were made for future BMP guide documents and monitoring efforts:

- Many of the BMP application departures and effectiveness impacts in 2012 and 2014 occurred in SMZs. In particular, one private site in 2014 yielded the lowest application and effectiveness ratings recorded to date, including four practices recorded as “gross neglect of BMP.” As recommended in the past, it appears that additional, focused outreach and training in the subject-matter area of SMZs is needed for forestry/logging operators, landowners and managers.
- More specific guidance is needed for forestry contractors, logging operators, landowners and managers on stream types (i.e., perennial, intermittent and ephemeral), and operational guidance should be provided to address acceptable activities within SMZs.
- Because two of the six sites (one federal and one private) indicated that some level of ongoing monitoring was necessary in order to reassess re-vegetation efforts and progress, BMP monitoring guidelines should account for follow-up efforts as needed.

- A separate “Fire Management” category should be added to Colorado’s forestry BMP field handbook in order to reflect observations in this report and address this area when the handbook is updated. These changes will better facilitate handbook use during monitoring and allow for easier general reference.
- Supplemental guidance should be provided for SMZ width, especially with regards to various slopes. Other states have more specific guidance for SMZ width, depending on side-slope gradient.
- The monitoring team should be given guidance on sale/treatment boundary spatial limits of BMPs to be inspected within a given site on field monitoring form. Some confusion has occurred over the years regarding whether the team needs to be concerned with areas outside of site boundaries (e.g., between the site boundary and a county road).
- Language should be added in the updated BMP field handbook regarding the use of existing landing and skid trail-areas to minimize soil disturbance.
- Additional outreach and training should continue to be provided to forestry contractors, logging operators, landowners and land managers on all forestry-related BMPs.
- Forestry BMPs must continue to be available to various user groups through online resources and meetings.

Appendix A

2014 Forestry BMP Field Audit Data and Rating Guide Criteria

Land Ownership/ Timber Sale Identification	Federal Sale #1		Federal Sale #2		Private Sale #1		Private Sale #2		Private Sale #3		State Sale #1	
	Application	Effectiveness	Application	Effectiveness								
PLANNING												
Sanitary Guidelines for the Construction of Camps												
Adequate sewer and soil waste considerations on site to protect water quality if camps are present.	NA	NA	4	4	NA	NA	NA	NA	NA	NA	NA	NA
ROADS												
Road Design and Location												
Design roads to minimum standard necessary to accommodate anticipated use and equipment.	4	4	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Minimize number of roads necessary.	4	4	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Use existing roads unless aggravated erosion will be likely.	4	4	4	4	4	3	3	3	3	3	4	4
Avoid long, sustained, steep road grades.	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Locations avoid high-hazard sites (i.e., wet areas and unstable slopes).	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Minimize number of stream crossings.	NA	NA	NA	NA								
Choose stable stream crossing sites.	NA	NA	NA	NA								
Locate roads to provide access to suitable log landing areas.	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Locate roads a safe distance from streams when they are parallel.	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Keep roads outside of Stream Management Zones.	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA

	Application	Effectiveness										
Road Reconstruction												
Construct/reconstruct only to the extent necessary to provide adequate drainage and safety.	4	4	4	4	NA	NA	NA	4	4	4	4	4
Minimize earth moving activities when soils appear excessively wet.	4	4	4	4	NA	NA	NA	4	4	4	NA	NA
Keep slope stabilization, erosion, sediment control work as current as possible, including “slash filter windrows”.	4	4	NA	NA	NA	NA	NA	3	4	4	NA	NA
Cut and fill slopes at stable angles.	4	4	NA	NA								
Stabilize erodible soils (i.e., seeding, benching, mulching).	4	4	NA	NA								
Avoid incorporating woody debris in road fill.	NA	NA										
Leave existing rooted trees and shrubs at the toe of fill slope.	4	4	NA	NA								
Balance cuts and fills or use full bench construction.	4	4	NA	NA								
Sediment from borrow pits and gravel pits minimized.	NA	NA										
Excess materials placed in location that avoid entering stream.	NA	NA										
Avoid excavation into ground water.	NA	NA										
Exclusion of side-casting of road material into a stream, lake, wetland or other body of water.	NA	NA										
Road Drainage	Application	Effectiveness										
Vary road grade to reduce concentrated drainage.	NA	NA	NA	NA	NA	NA	NA	NA	3	4	NA	NA
Provide adequate road surface drainage for all roads.	5	4	4	4	3	3	3	3	3	3	4	4
Space road drainage outlets so peak runoff will not exceed capacity of drainage outlets.	4	4	NA	NA								

For in sloped roads, plan ditch gradients of generally greater than 2%, but no more than 8%.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Construct drain dips deep enough into the sub grade so that traffic will not obliterate them.	5	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	NA	NA	NA	NA	NA	NA
Install culverts at original gradient, otherwise rock armor or anchor downspouts.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Design all relief culverts with adequate length and appropriate skew. Protect inflow end from erosion. Catch basins where appropriate.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	NA	NA	NA	3	NA	NA	3
Provide energy dissipaters at drainage structure outlets where needed.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	3	NA	NA	NA	3	NA	NA	3
Route road drainage through adequate filtration zones before entering a stream.	4	4	NA	NA	NA	4	3	NA	NA	3	3	4	NA	NA	3	4	NA	3
Road Maintenance	Application	Effectiveness	Application	Application	Effectiveness	Application	Effectiveness	Application	Application	Effectiveness	Application	Effectiveness	Application	Application	Effectiveness	Application	Effectiveness	Application
Maintain erosion control features (dips, ditches and culverts functional).	3	3	4	4	NA	NA	NA	NA	NA	3	3	NA	NA	NA	4	NA	NA	4
Avoid use of roads during wet periods.	4	4	4	4	4	4	3	NA	NA	4	4	4	4	4	4	4	4	4
Grade roads only as necessary to maintain drainage.	4	4	4	4	4	NA	NA	NA	NA	NA	NA	4	4	4	4	4	4	4
Avoid cutting the toe of cut slopes.	4	4	4	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	NA	NA	4
Exclusion of side-casting of road material into a stream.	3	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Abandoned roads in condition to provided adequate drainage without further maintenance.	4	4	4	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Streamside Management Zone Designation	Application	Effectiveness										
	Application	Effectiveness										
Adequate SMZ width identified.	NA	NA	3	4	5	4	4	4	1	3	4	4
SMZ properly marked.	NA	NA	3	4	3	4	4	4	1	3	4	4
Maintain or provide sufficient ground cover.	NA	NA	4	4	4	4	4	4	2	3	4	5
Equipment operation in SMZ allowed only per approved practices.	NA	NA	4	4	NA	NA	NA	NA	1	2	4	4
Exclusion of burning in SMZ.	NA	NA	4	4	4	4	4	4	4	4	NA	NA
SMZ retention tree requirements met. (Larger trees retained to provide habitat and a source of large woody debris).	NA	NA	3	4	NA	NA	4	4	2	3	4	4
Exclusion of side-casting of road material into a stream, lake, wetland or other body of water during road maintenance.	NA	NA	4	4	NA	NA	NA	NA	2	3	NA	NA
Exclusion of slash in streams, lakes or other bodies of water.	NA	NA	4	4	NA	NA	4	4	1	3	4	4
SMZ protected during site preparation activities.	NA	NA	NA	NA	NA	NA	4	4	NA	NA	NA	NA
Stream Crossings and Stream Bank Protection	Application	Effectiveness										
Proper permits for stream crossings obtained.	NA	NA										
Cross streams at right angles, if practical.	NA	NA										
Proper sizing for stream crossing structures.	NA	NA										
Direct road drainage away from stream crossing site.	NA	NA										
Avoid unimproved stream crossings. Use temporary log stream crossings if necessary.	NA	NA										

Installation of Stream Crossings	Application	Effectiveness										
Minimize stream channel disturbance.	NA	NA										
Erodible material not placed in stream channels.	NA	NA										
Stream crossing culverts conform to natural streambed and slope.	NA	NA										
Culverts placed slightly below stream grade.	NA	NA										
Prevent erosion of stream crossing culverts and bridge fills (i.e. armor inlet and outlet).	NA	NA										
Minimum cover for stream crossing culverts provided.	NA	NA										
Stream diversions carefully planned to minimize downstream sedimentation.	NA	NA										
TIMBER HARVESTING, THINNING, SLASH TREATMENT AND REVEGETATION	Application	Effectiveness										
Harvest Design												
Suitable logging system for topography, soil type and season of operation.	4	4	4	4	4	4	4	4	3	3	4	4
Design and locate skid trails to minimize soil disturbance.	4	4	4	4	4	4	4	4	2	3	4	4
Suitable location, size, and number of landings.	4	4	4	4	4	4	4	4	4	4	4	4
Other Harvesting Activities	Application	Effectiveness										
Skidding operations minimizes soil compaction and displacement.	4	4	4	4	4	4	4	4	3	3	4	4
Avoid equipment/skidding on unstable, wet or easily compacted soils and on slopes that exceed 40% unless not causing excessive erosion.	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
Appropriate drainage for landing.	4	4	4	4	4	4	4	4	4	4	4	4

FIRE MANAGEMENT	Application	Effectiveness								
Protection of Soil and Water from Prescribed Burning Effects Soil productivity is maintained, erosion is minimized. Ash, sediment, nutrients and debris are prevented from entering surface water. SMZ is maintained with no piling and/or burning permitted within SMZ.	NA	NA	4	4	4	4	4	4	NA	NA
Stabilization of Fire Suppression Related Work Damage Areas impacted by fire suppression activities have been stabilized.	NA	NA								
Emergency Rehabilitation of Watersheds Impacted by Wildfires Corrective measures have been applied to minimize the loss of soil productivity, deterioration of water quality, and threats to life and property, both on-site and off-site.	NA	NA								
COMMENTS: <i>Federal Sale #1:</i> May need to add some guidelines for patch size and water quantity. <i>Federal Sale #2:</i> Replanted with Douglas-fir, ponderosa pine, and white pine. <i>Private Sale #3:</i> 300 feet of new road built. <i>State Sale #1:</i> Some soil movement due to major flood event in 2013. Post-harvest blowdown of ~400 trees.										

Appendix B

Site Information and Ranking Criteria Field Form

CO - BMP1
2014

BMP FIELD Monitoring SITE INFORMATION and RANKING CRITERIA

Site Number: _____

Meets Selection Criteria: Y/N _____

High Hazard: Y/N _____ : Riparian _____ Matrix _____

Site Name: _____

Owner(s): _____

Legal Description: RNG. _____ TWP. _____ SEC. _____ County: _____

Primary Drainage: _____ Month/Year Harvested: _____

Stream Within 200 Ft.? Y / N Name: _____ Bankfull Width: _____

Unit Size (Ac): _____ Volume Removed (MBF): _____

Road Construction: YES _____ (If yes, when) _____ NO _____ Length: _____

Road Reconstruction: YES _____ (If yes, when) _____ NO _____ Length: _____

Slash Disposal Complete: _____ Method: _____

Logging Method: _____

Slope: 0-5% _____; 5-20% _____; 20-40% _____; 40%+ _____

Parent Material: _____

Soil Erodibility: High _____ Medium _____ Low _____

Harvest in SMZ: Y / N

Comments:

FIELD MONITORING

Date: _____

Team Leader/Recorder: _____

Team Members:

Observers Present:

Rating Guide

APPLICATION

- 5—Operation Exceeds Requirements Of BMP
- 4—Operation Meets Requirements Of BMP
- 3—Minor Departure From BMP
- 2—Major Departure From BMP
- 1—Gross Neglect Of BMP

EFFECTIVENESS

- 5—Improved Protection of Soil and Water Resources Over Pre-Project Condition
- 4—Adequate Protection of Soil and Water Resources
- 3—Minor and Temporary Impacts on Soil and Water Resources
- 2—Major and Temporary or Minor and Prolonged Impacts on Soil and Water Resources
- 1—Major and Prolonged Impacts on Soil and Water Resources

DEFINITIONS (BY EXAMPLE)

- Adequate— Small amount of material eroded; material does not reach draws, channels, or floodplain
- Minor— Erosion and delivery of material to draws but not stream
- Major— Erosion and subsequent delivery of sediment to stream or annual floodplain
- Temporary— Impacts lasting one year or less; no more than one runoff season
- Prolonged— Impacts lasting more than one year

NR – Not Reviewed NA – Not Applicable

Colorado Forest Practices Review Worksheet

Recommended Best Management Practices	Application to Site (Y/N)			Comments
	Application	Effectiveness		
TIMBER SALE PLANNING (Guidelines page reference*)				
SANITARY GUIDELINES FOR THE CONSTRUCTION OF CAMPS				
	1. Adequate sewer and soil waste considerations on site to protect water quality if camps are present. (*page 20)			
ROADS BMPs Applicable to:				
	+ New Road Construction	# Existing Roads	~ Reconstruction	
ROAD DESIGN AND LOCATION				
~+	1. Design roads to minimum standard necessary to accommodate anticipated use and equipment. (*page 5)			
~+	2. Minimize number of roads necessary. (*page 4)			
#	3. Use existing roads unless aggravated erosion will be likely. (*page 4)			
+	4. Avoid long, sustained, steep road grades. (*page 7)			
+	5. Locations avoid high-hazard sites (i.e., wet areas and unstable slopes). (*page 5)			
+	6. Minimize number of stream crossings. Number _____. (*page 6)			
+	7. Choose stable stream crossing sites. (*page 5)			
+	8. Locate roads to provide access to suitable log landing areas. (*page 5)			
+	9. Locate roads a safe distance from streams when they are parallel. (*page 5)			
+	10. Keep roads outside of Stream Management Zones. (*page 5)			
ROAD CONSTRUCTION / RECONSTRUCTION				
~#	1. Construct/reconstruct only to the extent necessary to provide adequate drainage and safety. (*page 6)			
~#+	2. Minimize earth moving activities when soils appear excessively wet. (*page 6)			
+~	3. Keep slope stabilization, erosion, sediment control work as current as possible, including "slash filter windrows". (*page 6)			
+~	4. Cut and fill slopes at stable angles. Slope ratio: _____. (*page 7)			
+~	5. Stabilize erodible soils (i.e., seeding, benching, mulching). (*page 7)			
+~	6. Avoid incorporating woody debris in road fill. (*page 7)			
+~	7. Leave existing rooted trees and shrubs at the toe of fill slope. (*page 7)			

+~	8. Balance cuts and fills or use full bench construction. (*page 8)			
+~	9. Sediment from borrow pits and gravel pits minimized. (*page 8)			
+~	10. Excess materials placed in location that avoid entering stream. (*page 8)			
+~	11. Avoid excavation into ground water. (*page 8)			
+~	12. Exclusion of side-casting of road material into a stream, lake, wetland or other body of water. (*page 8)			
	<u>ROAD DRAINAGE</u>			
+	1. Vary road grade to reduce concentrated drainage (*page 8)			
+~#	2. Provide adequate road surface drainage for all roads. (*page 8)			
+~	3. Space road drainage outlets so peak runoff will not exceed capacity of drainage outlets. (*page 8)			
+~	4. For in sloped roads, plan ditch gradients of generally greater than 2%, but no more than 8%. (*page 9)			
+~	5. Construct drain dips deep enough into the sub grade so that traffic will not obliterate them. (*page 9)			
+~	6. Install culverts at original gradient, otherwise rock armor or anchor downspouts. (*page 10)			
+~#	7. Design all relief culverts with adequate length and appropriate skew. Protect inflow end from erosion. Catch basins where appropriate. (*page 10)			
+~#	8. Provide energy dissipaters at drainage structure outlets where needed. (*page 10)			
+~#	9. Route road drainage through adequate filtration zones before entering a stream. (*page 10)			
	<u>ROAD MAINTENANCE</u>			
+~#	1. Maintain erosion control features (dips, ditches and culverts functional). (*page 11)			
+~#	2. Avoid use of roads during wet periods. (*page 11)			
+~#	3. Grade roads only as necessary to maintain drainage. (*page 11)			
#	4. Avoid cutting the toe of cut slopes. (*page 11)			
+~	5. Exclusion of side-casting of road material into a stream. (*page 11)			
+~#	6. Abandoned roads in condition to provide adequate drainage without further maintenance. (*page 11)			
	<u>STREAMSIDE MANAGEMENT ZONE DESIGNATION</u>			
	1. Adequate SMZ width identified, avg. width _____ (*page 13)			
	2. SMZ properly marked? (*page 13)			
	3. Maintain or provide sufficient ground cover. (*page 14)			
	4. Equipment operation in SMZ allowed only per approved practices. (*page 14)			
	5. Exclusion of burning in SMZ (*page 8).			

	6. SMZ retention tree requirements met. (Larger trees retained to provide habitat and a source of large woody debris). (*page 15)			
	7. Exclusion of side-casting of road material into a stream, lake, wetland or other body of water during road maintenance. (*page 8)			
	8. Exclusion of slash in streams, lakes or other bodies of water. (*page 15)			
	9. SMZ protected during site preparation activities (*page 14)			
	<u>STREAM CROSSINGS AND STREAM BANK PROTECTION</u>			
~+	1. Proper permits for stream crossings obtained. (*page 25)			
~+	2. Cross streams at right angles, if practical. (*page 25)			
~+	3. Proper sizing for stream crossing structures. (*page 25)			
~+	4. Direct road drainage away from stream crossing site. (*page 25)			
~+	5. Avoid unimproved stream crossings. Use temporary log stream crossings if necessary. (*page 26)			
	<u>INSTALLATION OF STREAM CROSSINGS</u>			
~+	1. Minimize stream channel disturbance. (*page 26)			
~+	2. Erodible material not placed in stream channels (*page 26)			
~+	3. Stream crossing culverts conform to natural streambed and slope. (*page 26)			
~+	4. Culverts placed slightly below stream grade. (*page 26)			
~+	5. Prevent erosion of stream crossing culverts and bridge fills (i.e., armor inlet and outlet). (*page 26)			
~+	6. Minimum cover for stream crossing culverts provided. (*page 11)			
+~	7. Stream diversions are carefully planned to minimize downstream sedimentation. (*page 2, 10, 26)			
TIMBER HARVESTING, THINNING, SLASH TREATMENT AND REVEGETATION				
	<u>HARVEST DESIGN</u>			
	1. Suitable logging system for topography, soil type and season of operation. (*page 16)			
	2. Design and locate skid trails to minimize soil disturbance. Use existing areas wherever possible. (*page 19)			
	3. Suitable location, size, and number of landings. Use existing areas wherever possible. (*page 19)			
	<u>OTHER HARVESTING ACTIVITIES</u>			
	1. Skidding operations minimizes soil compaction and displacement. (*page 19)			

	2. Avoid tractor skidding on unstable, wet or easily compacted soils and on slope that exceed 40% unless not causing excessive erosion. (*page 19)			
	3. Adequate drainage for landing. (*page 20)			
	4. Adequate drainage for skid trails. (*page 20)			
	<u>SLASH TREATMENT AND SITE PREPARATION</u>			
	1. Scarify only to the extent necessary to meet resource management objective. (*page 21)			
	2. Treat slash so as to preserve the surface soil horizon. (*page 21)			
	3. Adequate material left to slow runoff, return soil nutrients and provide shade for seedlings. (*page 21)			
	4. Activities limited to frozen or dry conditions to minimize soil compaction and displacement. (*page 21)			
	5. Scarification on steep slopes in a manner that minimizes erosion. (*page 21)			
	<u>REVEGETATION OF DISTURBED AREAS</u>			
	1. Practices have been completed to ensure adequate revegetation in disturbed areas. (*page 18, 19, 21)			
PESTICIDES, FERTILIZERS AND CHEMICALS				
	1. Know and comply with regulations governing the storage, handling, etc. of hazardous substances. (*page 23)			
	2. Proper sites were selected for servicing and refueling to prevent contamination of waters from accidental spills. (*page 24)			
	3. Pesticide materials have been properly applied and effects monitored. (*page 23)			
	4. Fertilizers have been properly handled and applied so as to reduce possible adverse effects on water quality. (*page 23)			
FIRE MANAGEMENT				
	<u>PROTECTION OF SOIL AND WATER FROM PRESCRIBED BURNING EFFECTS</u>			
	1. Soil productivity is maintained, erosion is minimized. Ash, sediment, nutrients and debris is prevented from entering surface water. SMZ is maintained. (*page 27)			
	<u>STABILIZATION OF FIRE SUPPRESSION RELATED WORK DAMAGE</u>			
	1. Areas impacted by fire suppression activities have been stabilized. (*page 27)			
	<u>EMERGENCY REHABILITATION OF WATERSHEDS IMPACTED BY WILDFIRES</u>			
	1. Corrective measures have been applied to minimize the loss of soil productivity, deterioration of water quality, and threats to life and property, both on-site and off-site. (*page 27)			
ADDITIONAL COMMENTS: (include significant weather events since the harvest if known)				



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