2004 Field Audit Report

Implementation Monitoring and Evaluation of South Dakota Forestry Best Management Practices

A Pollution Prevention Act grant project sponsored by:

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Executive Summary

Best Management Practices (BMPs) for the protection of water and soil resources during forestry and timber harvest activities were established by the State of South Dakota in 1980. BMPs were revised by the State of South Dakota in 1993, and again in 2003. Both the 1993 and 2003 revisions were adopted in the South Dakota Nonpoint Source Pollution Management Plan, and were approved by the US Environmental Protection Agency (EPA) under a provision of the Clean Water Act. Compliance with BMPs is not mandated by statute or regulation in South Dakota. Timber harvest operators, wood products companies, and land management agencies have nonetheless made a commitment to implement BMPs on a voluntary basis.

In 2001, the Black Hills Forest Resource Association (BHFRA) began a financial and technical partnership with the South Dakota Department of Environment and Natural Resources (DENR) for voluntary monitoring, evaluation, and training for BMP implementation. Training for foresters, logging professionals, and resource specialists was conducted under a grant agreement in 2001. Timber sale field audits to evaluate BMP compliance were conducted in 2001 as well. This commitment to continued monitoring and evaluation was renewed in 2004, when training workshops and field audits were again conducted through a partnership between BHFRA and DENR under a Pollution Prevention Act grant.

Audits are conducted by a diverse team of private- and public-sector resource professionals. A consensus-based approach is used to evaluate BMP compliance under a well-established system of rating criteria. Seven timber sales were audited in 2004; two on private land, two on state land or under state administration, and three on federal land.

The audit results, averaged across all timber sales, revealed that the BMP standards for application was met or exceeded on 92 percent of the total rated items. Ratings for BMP effectiveness confirmed adequate or improved protection of soil and water resources on 95 percent of the total rated items. In comparison, the 2001 audit results showed 82 and 84 percent compliance for application and effectiveness, respectively. No instances of gross neglect in BMP application were recorded during the 2004 audits. Among a total of 405 total rated items on all timber sales, one instance of major and prolonged effects on water quality was recorded.

The most common mistakes in BMP application pertained to stream crossing and culvert design and installation, and ensuring adequate design and installation of road surface drainage features. These issues were focal to the 2004 BMP training workshops, so continued improvement in compliance can be anticipated.

The audit and steering committees recommend continuing the system of audits and training on a three-year cycle, simplifying the current audit rating criteria, and evaluating the development of new BMPs for salvage timber sales and “legacy road” considerations.

ACKNOWLEDGEMENTS

This report presents the findings from the latest iteration in an ongoing program of implementation monitoring and evaluation, utilizing training and field audits, for water quality protection guidelines during forestry and timber harvesting operations. The program is the product of a financial partnership between the Black Hills Forest Resource Association (BHFRA) and the South Dakota Department of Environment and Natural Resources (DENR) under the Pollution Prevention Act of 1990. Special thanks are owed to Barry McLaury and Dr. Dennis Clarke of DENR for their help and support.

A larger partnership of professionals and volunteers is necessary to make this program a continuing success. Specifically, individuals were willing to lend their time to an interdisciplinary team encompassing the wildlife biology, fisheries biology, hydrology, geology, forestry, engineering, and logging professions, as well as from private individuals and interested groups, in order to complete the field audit portion of the program. Additionally, these and other individuals were gracious enough to serve on a steering committee charged with helping to guide various aspects of the audits and training sessions. Many thanks are owed to the following people for their generous contribution of time and expertise:

Steering Committee and Audit Team Members

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Shelly Deisch	SD Dept. of Game, Fish & Parks
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Gregory Josten	SD Dept. Agriculture, Div. Resource Conservation & Forestry
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Ron Koth	SD Dept of Game, Fish & Parks
Barry McLaury	SD Dept. of Environment and Natural Resources
Ernie Nauman	USDA Forest Service
Gene Norman	Neiman Timber Co.
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1. INTRODUCTION

The forests of the US cover about one-third of the nation's land-area and are precious resources in myriad respects. Among these is the maintenance of water quality. Forested watersheds collect precipitation, serving to filter and cleanse water as it traverses to underground aquifers and as surface runoff into streams, rivers, and lakes. About 80 percent of the Nation's scarce freshwater resources originate on forests, and well over half the US population depends on water supplies that originate on or are protected, in part, by forestlands[1].

The Black Hills of South Dakota have a long history of active logging and forest management and to this day support a vibrant infrastructure of forest industries. The Black Hills' watersheds act as recharge areas for several large regional aquifers, including the Deadwood, Madison, Minnelusa, and Inyan Kara formations. Many cities and communities throughout the State depend on these aquifers, as well as surface water runoff, for their municipal water supplies. Further, the streams and lakes of the Black Hills support a number of excellent fisheries, which are enjoyed by many local and visiting anglers alike.

Forestry and silviculture activities are classified as potential sources of nonpoint pollution under the Clean Water Act by the US Environmental Protection Agency (EPA). 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. NPS 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.[2]"

In other words, sediment transported through a watershed is referred to as "nonpoint" source pollution because its origin cannot easily be traced to a single point or area. An example of nonpoint source pollution from forestry activities might be improperly constructed stream crossings or structural failures in road drainage features, which can allow sediment to enter waterways during runoff events. However, these and other potential sources of water pollution are preventable if sound forestry and logging practices are employed. In recognition of the need to protect water quality during forestry operations, the State of South Dakota adopted Forestry Best Management Practices (BMPs).

BMPs are practices, actions, or activities that limit soil disturbance, prevent erosion, and protect sensitive areas. South Dakota's forestry BMPs were originally drafted in 1980, were revised in 1993, and again in December, 2003[3]. Both the 1993 and 2003 revisions were

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[1] USDA Forest Service. 2000. Water and the Forest Service. FS-660. Washington, DC.
[2] US Environmental Protection Agency
http://www.epa.gov/OWOW/NPS/ (2/17/04)
[3] South Dakota Department of Agriculture, Division of Resource Conservation and Forestry
http://www.state.sd.us/doa/Forestry/publications/ (3/22/05)

adopted in the South Dakota Nonpoint Source Pollution Management Plan[4], and were approved by the EPA under a provision of the Clean Water Act.

Compliance with BMPs during forestry operations is not mandated by statute or regulation in South Dakota or federally. Therefore, implementation of BMP standards takes place on a voluntary basis among private companies and public agencies who share a commitment to careful stewardship of forest resources. In extending a further commitment, the BHFRA and its membership partnered with the SD DENR and the SD Department of Agriculture's Division of Resource Conservation and Forestry (RC&F) through the EPA's Pollution Prevention grant program to conduct series of BMP training sessions and timber sale field audits. Foresters, loggers, road construction operators, and others involved with the development and oversight of timber harvest received training from professionals qualified in BMP principles, requirements, and implementation techniques. Audits were conducted to assess BMP implementation and identify common mistakes during timber sale operations on both public and private land ownerships. The audit results are, in turn, fed back into the next round of training in a system designed for continuous improvement.

Field audits were conducted for the first time in 2001, although training had been offered in prior years through partnerships between BHFRA, RC&F, and Black Hills Women in Timber. The 2001 results showed a strong commitment and good success among both private enterprise and public agencies toward BMP implementation[5]. Operators were found to have met or exceeded BMPs with an average of 82 and 84 percent of the total possible score on application and effectiveness, respectively. Common mistakes arose with respect to proper culvert sizing and installation, road drainage and maintenance, and designation of Streamside Management Zones (SMZs). The 2001 audit team and steering committee attributed many of these mistakes to unclear language or illustrations in the BMP manual, and the need for further training.

Training was conducted in June, 2004 at two Black Hills locations. Drawing on monitoring and evaluation from the 2001 audits, the focus of these sessions was stream crossings, culverts, roads, and SMZs. Approximately 100 logging and forest management professionals attended the training workshops. Dr. John Garland, a logging and engineering specialist at Oregon State University, Dr. John Ball, forestry specialist at South Dakota State University, and Stacy Reed, Stormwater Program Coordinator at SD DENR addressed the various aspects of BMP importance and proper application of practices in the targeted respects.

Timber sale field audits were conducted during August and September, 2004 by a multidisciplinary and interagency team of scientists, managers, natural resource professionals, and stakeholders. Seven timber sales were audited, evaluating both the application and effectiveness of nearly 100 separate elements of the BMP standards at each site. An equal representation of timber sales were audited from state, federal, and private

[4] South Dakota Department of Environment and Natural Resources. http://www.state.sd.us/denr/DFTA/WatershedProtection/WQInfo.htm (3/30/04)

[5] Lee, W.K., and Everett, A.M. 2001. Silviculture BMP Field Audit Report. Rapid City, SD. Web: http://www.state.sd.us/denr/DFTA/WatershedProtection/WQInfo.htm (3/30/04)

land. In order to begin assessing the long-term effectiveness of the BMPs, one audit revisited a timber sale included in the 2001 audits.

The Black Hills of South Dakota represent one of the most time-honored success stories of forestry and forest management in the United States. For over 100 years, land managers have balanced environmental stewardship and sustainable harvests within this unique ponderosa pine ecosystem. Integral to the maintenance of this winning relationship is the protection of surface and ground water quality. The South Dakota Silviculture Best Management Practices (BMPs) are a proven-effective tool with which nonpoint source ground and surface water pollution is consistently prevented. The rivers and streams of the Black Hills support many municipal and industrial water needs, as well as prized fisheries and healthy aquatic ecosystems. Continuing and advancing BMP implementation helps sustain these uses, as well as ensuring conformance with Total Maximum Daily Load objectives set forth by the SD DENR.

1.1 OBJECTIVES OF THE 2004 TRAINING AND AUDITS

- Provide continued and enhanced BMP training:
    - Develop new BMP education materials as needed;
    - Facilitate better understanding of BMP requirements among the individuals, businesses, organizations, and agencies responsible for their implementation;
    - Specifically address the opportunities for improving BMP application and effectiveness identified in the findings and recommendations from previous monitoring and evaluation audits;
    - Familiarize participants with revisions to the SD BMP manual developed by RC&F, DENR, and EPA;
    - Introduce concepts of state regulations on Stormwater Discharge and permitting;
    - Provide training session attendees an opportunity to supply feedback on improving BMP standards and application;
- Continue the self-monitoring and evaluation process of on-the-ground BMP implementation:
    - Audit six timber sales from an equal representation of forestland ownerships;
    - Administer audits to reflect recommendations made during the 2001 audits;
    - Involve a broad multidisciplinary and interagency team of scientists, resource professionals, and stakeholders in performing the audits;
    - Evaluate and explore the use of commonly recognized scientific metrics to describe baseline and post-harvest water quality conditions.

2. AUDIT PROCESS

2.1 AUDIT PROCEDURES:

The audit process was developed by the 2001 steering committee. The steering committee used audit procedures from Montana, which had been in place for many years as a template,

and adhered strictly to the text of the SD BMPs to establish the items to be rated at each site. However, the sheer volume of practices to rate, duplication and ambiguity among practices, and time-sensitive practices to which a meaningful rating cannot always be assigned made the audit process difficult and cumbersome.

One charge of the 2004 audits was to evaluate, on the recommendation of the 2001 team, the potential for making the audit procedure simpler and its results more accurate. After exploring several different approaches, it was decided that meaningful changes to the audit procedure could not be accomplished without significant work above and beyond the scope of this project. Maintaining consistency between the audit procedure and the BMPs themselves is of paramount importance. However, the BMPs were not designed to translate directly into audit rating items. The process of consolidating the audits into fewer rating items while continuing to faithfully carry forward the letter and intent of the BMPs would have been a complex undertaking. Therefore, the 2004 audits were conducted using the same procedures developed for the 2001 audits. Readers should note that the 2003 revisions to the BMPs were not incorporated with the 2004 audit criteria, principally because operators had not yet received training to introduce the updated BMP provisions.

2.2 SITE SELECTION

The steering committee reviewed numerous timber sales using maps and descriptions of hydrologic and timber sale harvest design features provided by landowners and sale administrators. Site selection was guided by the following criteria:

- Harvest operations were completed within the last two years.
- A minimum of 2000 board-feet per acre was harvested at the site.
- Harvest site contains live water in the form of a stream or creek, or has other significant water resources.
- One of the sites should be a re-audit of a site from 2001.
- One of the sites should be a currently active timber sale.
- The overall selection of sites should equally represent private, federal, and state ownerships.

The Black Hills region's arid climate ensures that the occurrence of live water or other sensitive hydrologic features within a timber sale are somewhat rare. A majority of timber sales that take place in the Black Hills have relatively little opportunity to directly affect surface water. Therefore, the audit selection criteria place some bias upon the audit results by including only those timber sales carrying the potential to directly affect water quality.

Although the project objective was to audit six timber sales, seven timber sales were selected. The geographic proximity of several sales in the northern Black Hills allowed the audit team an opportunity to add one additional timber sale. The names and ownerships of the selected sales are displayed in Table 1, and their general locations are displayed in Figure 1. The Crawford timber sale was examined during the 2001 audits, and was selected to fulfill the criteria of revisiting a previously audited site. The Crawford timber sale salvaged burned trees in the wake of the Jasper wildfire of 2000. At the time of the 2001 audits, the sale was selected because of the unique challenges presented by heightened soil erosion potential after

a wildfire. The Black Hills Power timber sale had harvest operations ongoing at the time of the audit, thereby fulfilling the criteria to audit one currently active sale. The Needles II timber sale also had harvest operations ongoing, but harvest operations had been completed for several months prior on the portion of the sale examined during the audit. The remaining sales best met the criteria for important hydrologic features, volume harvested, and desired ownership representation. Most harvest operations were conducted with ground-based harvesting and log yarding equipment, as is typical of most timber sales in the Black Hills region. The Sturgis Community Watershed sale was administered by foresters with the State of South Dakota RC&F, although the property is owned by the City of Sturgis.

Table 1. 2004 Forestry BMP field audit sites.

Timber Sale Name	Land Ownership	Completion Date
Barnes Canyon	State of SD - Custer State Park	March, 2003
Black Hills Power	Private	Active
Crawford	US Forest Service	January, 2000
Hearst Subdivision	BLM	December, 2003
Needles II	US Forest Service	Active, but not in audited area
Tope	Private	January, 2004
Sturgis Watershed	City of Sturgis	January, 2003

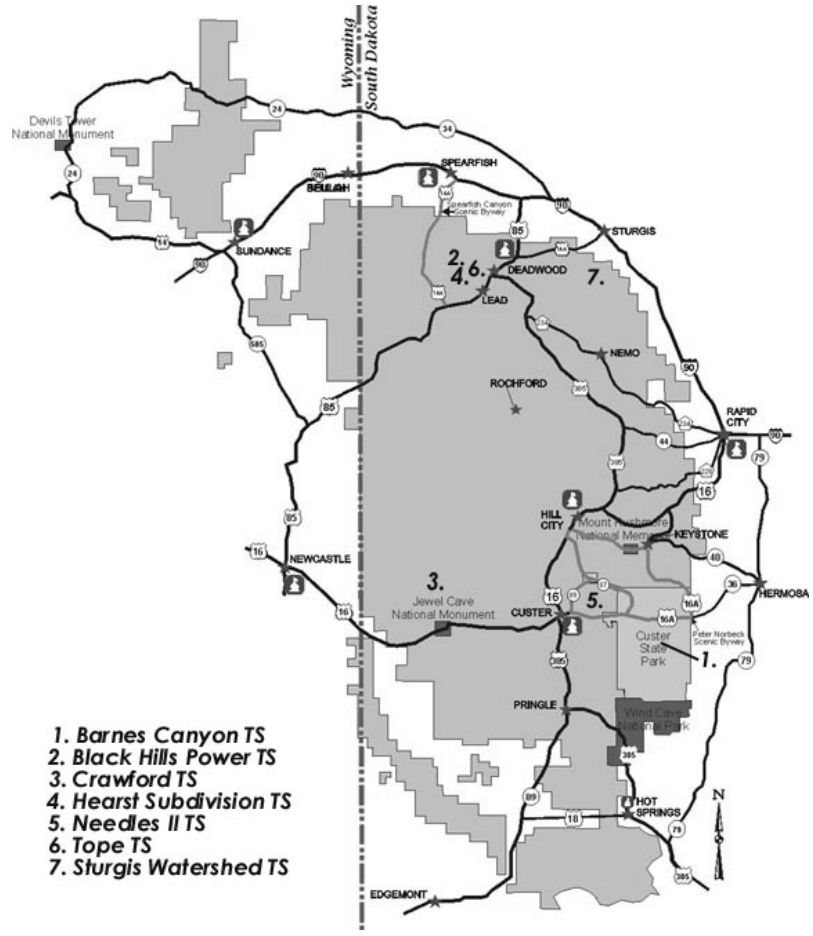

Figure 1. 2004 South Dakota Forestry BMP field audit sites.

2.3 RATING SYSTEM

The ratings and criteria employed in the scoring of audit sites are displayed in Table 2. Just as with the 2001 audits, this format follows that of the Montana BMP audit procedures. At each site, nearly 100 separate BMP practices are evaluated (see Appendix A for audit rating items). Each practice is given a two-part rating based on application and effectiveness. Application is simply the assessment of whether or not an individual practice was applied, and if so, the degree to which the application meets with the standard of the BMP. Effectiveness is the assessment of whether the application of each practice was successful in protecting soil and water resources. The two-part rating system allows both an assessment of the harvest operators' skill in successfully applying BMPs, as well as whether the BMPs themselves are having the desired effect if properly applied.

Table 2. Ratings and criteria used in the South Dakota Forestry BMP field audit procedure.

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

Effectiveness	
Rating	Criteria
5	Improves 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, impact on soil and water resources.
1	Major and prolonged impact on soil and water resources

Definitions	
Adequate	Small amounts of material eroded. Material does not reach draws, channels or floodplains.
Minor	Some material erodes and is delivered into dry draws, but not into a stream.
Major	Material erodes and is delivered into stream or annual floodplain.
Temporary	Impacts last less than one season.
Prolonged	Impacts last more than one year.

Figure 2 displays the rating procedure used during the field audits. The procedure begins with establishing whether or not a given practice is applicable to the timber sale in question. For example, several BMPs relate to the construction and closure of temporary roads, but not all timber sales involve the use of temporary roads. In an instance where the BMP is determined not applicable, the rating process stops. Where a BMP's applicability is established, the rating process moves on to evaluating the application of the practice, and its effectiveness.

Each rating of each audit item for both application and effectiveness was established on a consensus basis among all members of the audit team. While the audit team members occasionally have differences of opinion on rating values, discussion yielded consensus in all instances.

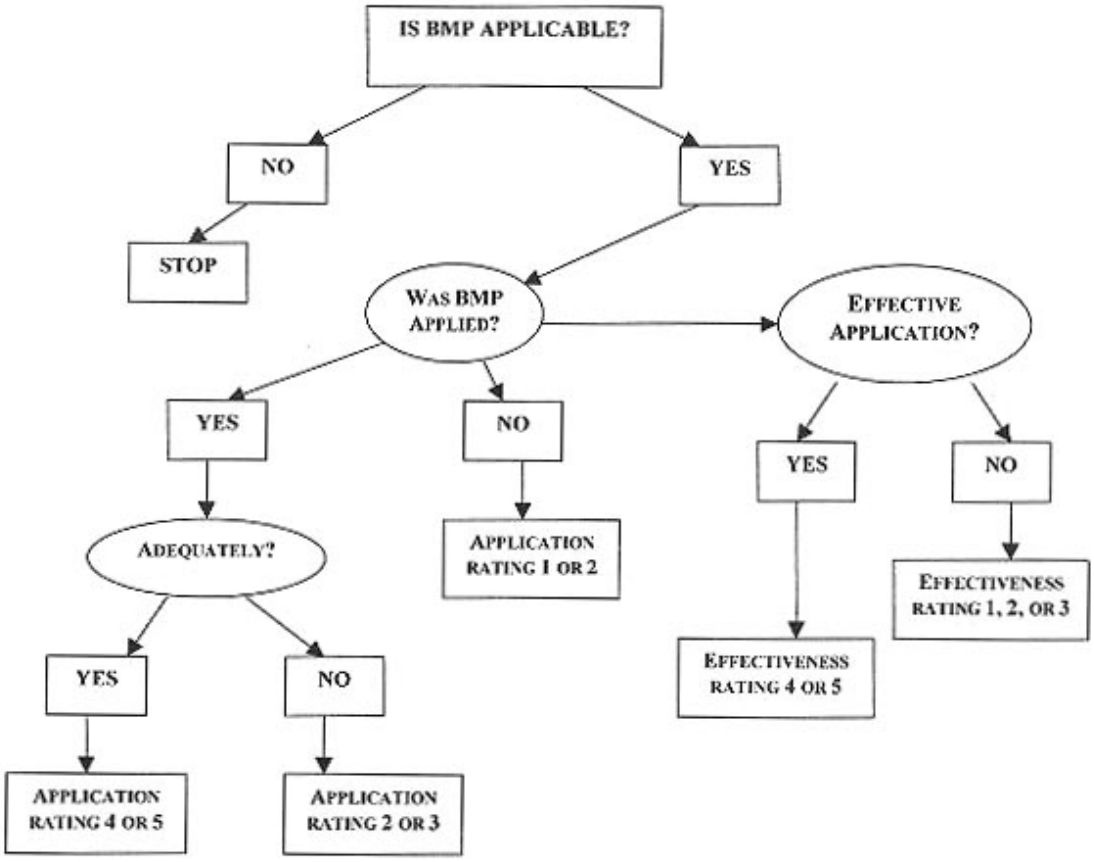

Figure 2. Forestry BMP field audit rating process.

2.4 LIMITATIONS OF THE AUDIT PROCESS

The audit process is thorough, objective, and faithful to the letter and intent of the BMPs. However, the reader should be aware of its limitations.

First, limitations of time and resources prohibit examining every acre of each timber sale audited. The audits are, rather, a spot-check of areas of particular interest. Audit team members identified key areas and features, such as stream crossings, riparian areas, wetlands, log landings, roads, skid trails, and so forth, which were favored for inspection over areas where the potential for soil and water resource impacts are minimal.

Second, the audits are a visual review at a specific point in time. The audit team's evaluation can only reflect and record its direct observations. Ratings of BMP application and effectiveness are qualitative measures, arrived upon by consensus among professionals and

based upon the rating criteria. They are not based upon precise scientific measurements, such as pH, turbidity, or dissolved oxygen, which one might collect as water quality monitoring parameters. Furthermore, on active sales, only those practices applicable to ongoing activities were assessed; those practices relating to sale closure items (such as grass seeding or other post-sale means of soil stabilization) were not assessed because they were not observable at the time the audit took place. Conversely, on sales where harvest operations have been completed, BMPs relating to ongoing harvest activities are not assessed, and neither are assessments projected about long-term effectiveness.

Third, not all measures of effectiveness are within the control of the timber sale operator applying the BMPs. For instance, the establishment of ground cover vegetation on disturbed areas is an important practice, and was followed routinely. However, dry climate conditions in recent years have inhibited seed germination. The effectiveness of certain practices can also be compromised by third-party damage outside the control of the timber sale operator. One example might be excessive recreational traffic over a road surface during periods of high moisture, which can damage road drainage structures and result in sediment erosion. The audit team did its best to rate these items when sufficient information was available to complete a fair evaluation, but in some instances was not able to do so.

Finally, nothing about the timber sale audit procedure, whether with respect to site selection or audit ratings, is intended to provide a statistically significant sample. No stratified or randomized sampling methodology was applied to either the timber sale site selection or individual sale audit processes; in fact, quite the opposite. The timber sale site selection process carries intentional bias toward those sale areas with the greatest potential to affect water resources. Similarly, the audit data carries intentional bias toward areas and features within the timber sale where the potential for impacts is greatest. The likelihood is therefore that, if ever a true random sample were collected, the audit results presented here would be shown to under-represent BMP application and effectiveness.

3. AUDIT RESULTS

The total number of rated items was tabulated for all timber sales audited, excluding inapplicable items or those for which a rating could not be established. Among these, the simple incidence of each of the five individual ratings for application and effectiveness, according to the definitions in Chapter 2.3 of this document, was compiled. For example, among application scores across all timber sale ownerships, the score of “meets BMP” was recorded 367 times out of 405 total rated items. Appendix A of this report contains individual rating values on each timber sale.

Tables 3 and 4 summarize the audit results for BMP application and effectiveness scores recorded in the 2004 timber sale field audits, displayed both in a breakdown among land ownership categories and in aggregation. These values reflect the results from all operations categories among timber sales audited, whether operations were ongoing, recently completed, or long-complete. Refer to Chapter 2.2 of this document for further explanation of audit site selection.

The audited sales scored highly in both application and effectiveness across all ownerships. Timber sales on State land (or under State administration, as in the Sturgis Watershed Sale) scored highest among application, meeting or exceeding BMP standards on 95 percent of the total rated points. No instances of gross neglect in BMP application were cited on any timber sale. Two instances of major departures from BMP application were recorded. Across all ownerships, BMP application standards were met or exceeded on 371 of 405 total rated items.

Table 3. 2004 South Dakota Forestry BMP field audit results for incidence of Application scores across land ownership categories.

Ownership Category	Gross Neglect	Major Departure	Minor Departure	Met BMP Standard	Exceeded BMP	Total Rated
Private	0	1	11	87	1	**100**
(Percent)	(0%)	(1%)	(11%)	(87%)	(1%)	
State	0	1	6	129	1	**137**
(Percent)	(0%)	(1%)	(4%)	(94%)	(1%)	
Federal	0	0	15	151	2	**168**
(Percent)	(0%)	(0%)	(9%)	(90%)	(1%)	
Total	**0**	**2**	**32**	**367**	**4**	**405**

Table 4. 2004 South Dakota Forestry BMP field audit results for incidence of Effectiveness scores across land ownership categories.

Ownership Category	Major & Prolonged Impacts	Minor/Prolonged Or Major/Temporary Impacts	Minor & Temporary Impacts	Adequate Protection	Improves Pre-project Conditions	Total Rated
Private	0	1	6	93	0	**100**
(Percent)	(0%)	(1%)	(6%)	(93%)	(0%)	
State	1	0	4	132	0	**137**
(Percent)	(1%)	(0%)	(3%)	(96%)	(0%)	
Federal	0	2	6	154	6	**168**
(Percent)	(0%)	(1%)	(4%)	(92%)	(4%)	
Total	**1**	**3**	**16**	**379**	**6**	**405**

Timber sales on state and federal land were tied for the highest among effectiveness scoring with adequate or improved protection of water and soil resources 96 percent of the total rated items. One instance of major and prolonged impacts was recorded among all timber sales audited. Three instances of minor and prolonged or major and temporary impacts were recorded among all timber sales audited. Across all land ownership categories, BMP effectiveness standards were met or exceeded on 385 of 405 total rated items.

Figures 3 and 4 display the audit results for BMP application and effectiveness, respectively, aggregated across all land ownership categories as a percentage of the total rated items. BMPs were found to have been met or exceeded application standards in 92 percent of the rated instances, and found to provide adequate or improved protection of soil and water

resources in 95 percent of rated instances. Both application and effectiveness ratings exceeded BMP requirements and improved upon pre-project conditions with an incidence rating of one percent. Effectiveness scores for adequate protection are, overall, slightly higher than their corresponding scores for BMP application. Departures from the BMPs made up eight percent of the rated items for application, and five percent of the rated items for effectiveness. Although two major departures were cited in BMP application (Table 3), these account for less than one-half percent of the total rated items. Similarly, one instance of major and prolonged impacts was cited in BMP effectiveness (Table 4), but accounts for less than one-quarter percent of the total rated items.

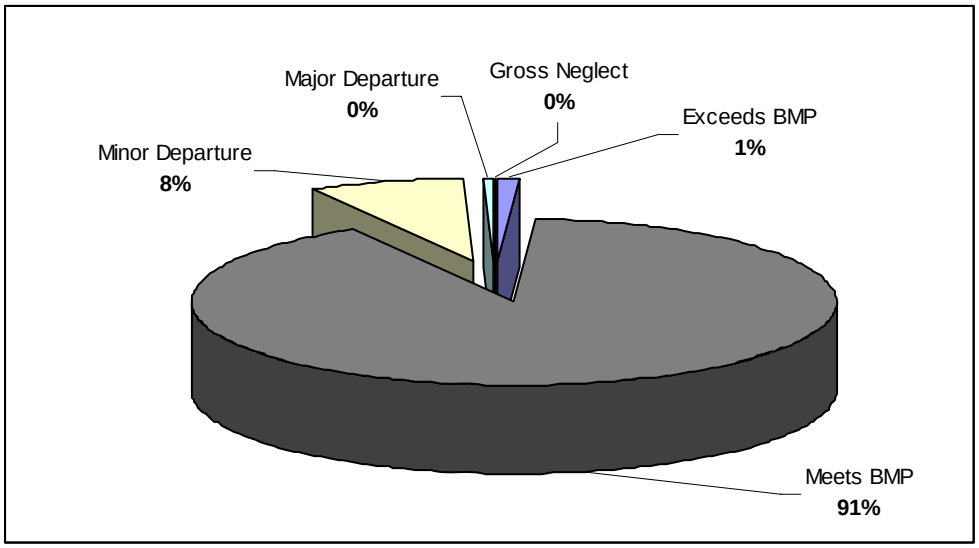

Figure 3. 2004 South Dakota Forestry BMP field audit results as aggregate incidence of Application scores relative to total rated items across all land ownerships.

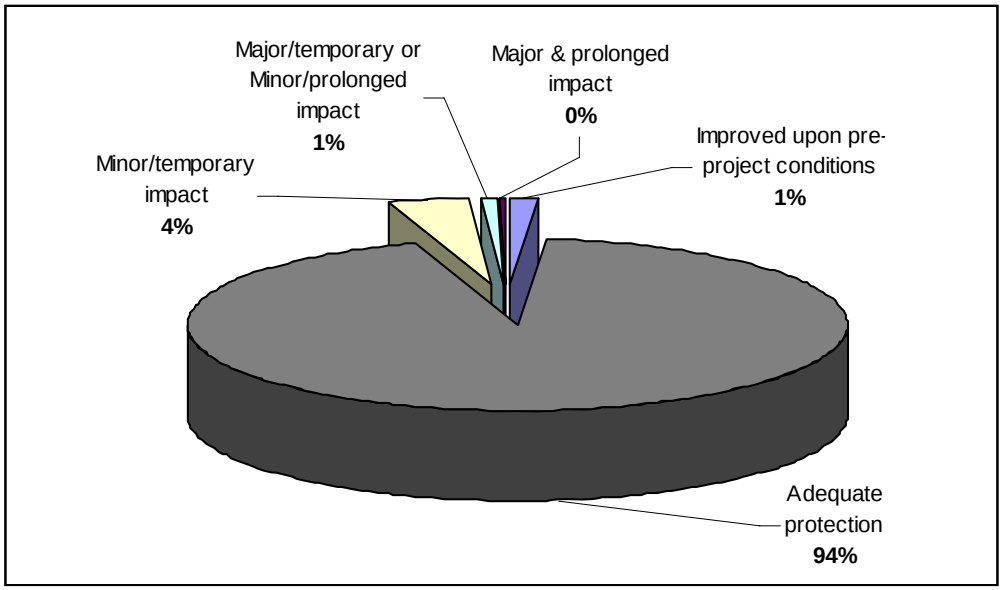

Figure 4. 2004 South Dakota Forestry BMP field audit results as aggregate incidence of Effectiveness scores relative to total rated items across all land ownerships.

The 2004 audit examined one active timber sale, five recently completed (less than two years) timber sales, and revisited one timber sale which had been audited in 2001. Refer to Table 1 and Figure 1 of this document for specific audited timber sales, their locations, and completion dates. The selection of timber sales at varying stages of completion was intended to begin building monitoring data which will help evaluate BMP application and effectiveness at varying temporal scales throughout the life of a timber sale. Tables 5 and 6 present the audit results for incidence of Application and Effectiveness scores, respectively, by sale completion category.

Table 5. 2004 Forestry BMP field audit results for incidence of Application scores across timber sale completion categories.

Timber Sale Completion	Gross Neglect	Major Departure	Minor Departure	Met BMP	Exceeded BMP	Total
Active	0	0	6	46	1	**53**
(percent)	(0%)	(0%)	(11%)	(87%)	(2%)	
Recent	0	2	23	281	2	**308**
(percent)	(0%)	(1%)	(7%)	(91%)	(1%)	
Revisited	0	0	3	40	1	**44**
(percent)	(0%)	(0%)	(7%)	(91%)	(2%)	

Table 6. 2004 Forestry BMP field audit results for incidence of Effectiveness scores across timber sale completion categories.

Timber Sale Completion	Major & Prolonged Impacts	Minor/Prolonged or Major/Temporary Impacts	Minor & Temporary Impacts	Adequate Protection	Improves Pre-project Conditions	Total
Active	0	0	2	51	0	**53**
(percent)	(0%)	(0%)	(4%)	(96%)	(0%)	
Recent	1	3	13	291	0	**308**
(percent)	(0%)	(1%)	(4%)	(94%)	(0%)	
Revisited	0	0	1	37	6	**44**
(percent)	(0%)	(0%)	(2%)	(84%)	(14%)	

The revisited timber sale scored highest in both application and effectiveness, in fact exceeding the BMP standards and improving upon pre-project conditions in several instances. The active timber sale scored lowest in BMP application, but ranked second in BMP effectiveness and exhibited no major departures. Timber sales that had been recently completed (less than two years) ranked second in BMP application and lowest in BMP effectiveness, although 94 percent effectiveness was achieved.

4. DISCUSSION

Compared with the 2001 audit results[5], which reported an average accomplishment of 82 percent meeting or exceeding BMP application standards and 84 percent meeting or exceeding BMP effectiveness standards, the 2004 audits show an improvement of 10 and 11 percent, respectively. The incidence of minor departures from the BMPs has declined from 17 and 13 percent for application and effectiveness, respectively, in the 2001 audits to eight and four percent, respectively, in the 2004 results. The incidence of major departures from BMP application has declined from a total of 5 instances (1 percent) in 2001 to a total of 2 instances (>1 percent) in the 2004 results. The incidence of major and temporary/minor and prolonged impacts has declined from a total of 10 instances (3 percent) in 2001 to a total of 3 instances (1 percent) in the 2004 results. No instances of major and prolonged impacts with respect to BMP effectiveness were recorded in 2001; one such instance was recorded in the 2004 audits and was related to improper culvert installation.

Some of the common problems from the 2001 audits appear to have been remedied through training and experience. For instance, proper culvert installation was problematic in the 2001 audits with specific respect to "perched" culvert inlets which would not allow fish passage. The 2004 results, while still citing some significant departures related to culvert installation, did not reveal an instance where "perched" inlets were a problem. Similarly, the 2001 audits revealed several instances where operators failed to designate a Streamside Management Zone. While the 2004 results found some discrepancies with particular elements of SMZ designation, in no instance was a failure to designate an SMZ cited. These are important elements of progress toward improved BMP implementation.

In both the 2001 and 2004 results, effectiveness scores are generally higher than application scores. This indicates that, while human error will likely always cause some deviations from the letter of the BMPs, the most important practices are routinely followed, and in only rare instances do significant negative impacts on soil and water resources actually result. Operators have been trained to identify situations wherein the potential for water quality impacts is greatest, and are taking care to implement preventive measures in these situations.

Drawing precise comparisons among active, recently completed, and revisited timber sales is difficult at this time because limited data are available. However, the absence of major departures and major impacts within the single active timber sale audited is a telling aspect. The Black Hills Power timber sale area was characterized by steep terrain and contained both perennial and ephemeral streams, creating a heightened potential for timber sale activities to adversely impact water quality. The absence of major departures or major impacts indicates that sediment was not delivered to either of the stream courses. From this, one can begin to judge that the BMPs are effective while harvest operations are ongoing in addition to after harvest activities are complete. The minor departures cited were mostly related to culvert sizing and installation. One culvert was uniquely constructed from formed concrete, and the up-slope road surface approach was armored with hexagonal-cell (gravel-filled) geotextile material in order to prevent any sediment entry into the stream. While these measures were exceptional, the culvert did not meet the BMP requirement for having been sized to accommodate a 25-year frequency runoff event. Another culvert, a conventional corrugated metal pipe, was installed correctly but the road surface approach did not provide the drainage

or a vegetative filter strip that fully met the BMPs. However, drainage was still sufficient to ensure that sediment had not reached the annual floodplain of the stream at the time of the audit, thus resulting in only a minor departure.

Comparisons between recently completed timber sales and the Crawford salvage timber sale revisited from the 2001 audits enjoy the benefit of a directly comparable data set. The Crawford sale scored highest in BMP application and effectiveness compared with active and recently completed sales; BMPs were met or exceeded on 93 percent of rated application items and 98 percent of rated effectiveness items on the Crawford sale. The departures recorded as having minor and temporary effects in 2001 were in fact confirmed to have been abated over time. The potential for sediment runoff was improved (decreased) over pre-project conditions in several instances, because additional erosion control features had been installed where none existed prior and revegetation of the timber sale area was accelerated with grass seeding. Skid trail location and erosion control was so effective that skid trail locations were only discernible on the 2004 audits by noting the presence of waterbars.

Some common mistakes can be identified among the 2004 results for future training emphasis. Road design and drainage structure installation was one recurring source of deviation from the BMPs. Inadequate placement of drainage features up-slope from stream crossings to divert water flow through vegetative filters occurred as well. Some deviations from BMPs involved the failure to armor (with riprap or other means) culvert inlets or outlets, allowing some sediment to erode from around the culvert. Proper culvert sizing was also a concern, but it should be noted that inadequate or confusing explanations in the BMPs may be the source of much of the confusion in this matter. Care was taken in all instances to avoid or operate carefully within SMZs, but these areas were not always formally designated either on the ground or on a sale area map. Based on improvements stemming from past training efforts, performance in the above respects should be anticipated to improve because many were specifically targeted during the June, 2004 training sessions.

“Legacy roads” are one element of timber harvest operations that have a consistent bearing upon BMP compliance evaluations. Legacy roads are existing roads which were constructed as a product of historic activities, such as mining, recreation, or timber harvest, and may or may not have been located and constructed in a manner consistent with BMPs. While forest managers everywhere must face concerns with legacy roads, historic settlement and land use patterns make the Black Hills somewhat unique in breeding the heightened regularity with which these issues arise. The most common legacy road design concern is one located within a permanent or ephemeral drainage feature, such as a stream corridor or dry draw. Roads located in this fashion may always be a potential source of sediment if they are not properly maintained. The question confronting any resource manager in such an instance is whether obliterating the existing road and relocating it elsewhere would cause more or less net environmental damage than leaving it in its existing location and correcting deficiencies in road drainage or stream crossing features. The BMPs do not address this issue with much specificity, and therefore, deductions are often incurred through the audit process when “fixing” the problem may in fact have meant more site disturbance and erosion potential.

In addition to identifying departures for future training emphasis, the 2004 audits revealed that managers and operators are excelling in several elements of BMP implementation. Erosion control on skid trails using slash barriers, water bars, and the reestablishment of vegetative cover was practiced consistently and in some cases exceeded standards. Although results varied somewhat by sale ownership, managers and operators are also doing well to use the minimum number of roads and minimum road standards necessary to access timber to be harvested. Overall, a great majority of the rated items went without deviation from the BMPs across all seven timber sales audited (Appendix B).

5. RECOMMENDATIONS

5.1 RESPONSE TO PRIOR RECOMMENDATIONS

The 2001 audit and steering committee members made a number of recommendations which bear revisiting at this time. Foremost, the team recommended continuing the audits and training on a two-year cycle. The 2004 audits and training have carried forward this commitment to continued monitoring, evaluation, and improvement. However, experience has shown that a three-year cycle of training may be more feasible and appropriate than the initially recommended two-year cycle. As mentioned previously in this report, timber sales with live surface water or other sensitive hydrologic features are somewhat rare in the Black Hills. Extending the interval of audits would aid in deepening the pool of timber sales from which to select audit sites. With respect to the interval of training completion, it is important to both maintain operators' skills in BMP implementation and to allow enough time between workshops to accurately identify skills or issues in need of further training emphasis. Extending the training interval by one year seems likely to strike a better balance between these two concerns.

The 2001 team recommended numerous refinements to the overall site selection process. These included the development of a centralized database to track completed timber sales in the state, variety in the seasonal timing of timber harvest operations among the selected sales, and variety in the representation of timber purchasers audited among those operating in the Black Hills. These recommendations have been acted upon, in part. The 2004 audit sites included a good variety of seasonal harvest operations, as well as a variety of timber purchasers. Continued attention to these two elements is necessary and might, in the future, include variation in the timing of the audits to specifically address BMPs associated with winter harvest operations. The development of a centralized timber sale database has not been addressed, and does not seem likely to take place in the near future. This recommendation was designed to insure against bias in the nomination of timber sales for BMP audit sites. There is no evidence of such bias, although a better representation of timber sales operated by small logging and sawmill companies may be desirable in the future.

Revising the BMP rating guide to include fewer and more pertinent rating items was also recommended in the 2001 report. The 2004 grant agreement included a small amount of funds to examine this possibility. However, it was quickly discovered that such a revision

would be impossible to accomplish with the time and resources allotted in the grant agreement. Audit criteria must remain consistent with the letter and intent of the BMPs, and revisions to the rating guide are not defensible without a greater measure of effort than could be justified under this project. The State of Montana, upon whose forestry BMPs the South Dakota guide was originally based, has performed a revision to its rating guide toward a more simplified format which might be considered for use as a template.

Increasing the involvement of forest landowners in the BMP program was recommended by the 2001 team. This recommendation was accomplished, in part, by including a representative of the South Dakota Tree Farm Association in the 2004 audits and steering committee activities. Discussions are ongoing among the project sponsor and SD Tree Farm to gauge interest in a BMP training session specifically targeted for members of the Association. Such workshops would take place under auspices other than this grant, but are nonetheless important to insuring the continued success of the BMP program.

Some recommendations were offered in the 2001 report regarding the make-up of the audit team, with a representative from applicable professional disciplines and interests. These recommendations were implemented with the 2004 timber sale audits, and also included the addition of conservation organization representatives from the Black Hills Fly Fishers.

The 2001 report offered numerous suggestions on improving the field BMP guide and targeting the subject matter of future training sessions toward remedying mistakes in BMP implementation. These included:

1. Develop a clear statement of purpose for the BMP Guide.
2. "How to" determine culvert size, properly install culverts, and culvert maintenance.
3. "How to" build effective rolling dips, cross drains, and water bars including a recommendation for ideal spacing between structures.
4. "How to" adequately close trails and temporary roads.
5. "How to" select appropriate grass seed mixtures for different soil types.
6. Develop and incorporate noxious weed control standards.
7. Include NRCS-approved seed mixtures.
8. Develop and incorporate BMPs for fire salvage logging situations.
9. Refine the definition and recommendations in the BMP guide regarding SMZ management.
10. Develop and incorporate an easily understood stream classification system.
11. Include contact information with which landowners can obtain professional forestry consultation.
12. Include a glossary of terms.
13. Refer landowners to the SD Department of Agriculture for information about pesticide application and licensing.

With the exception of items 7. and 8., these recommendations were incorporated into the 2003 revision of the BMP field guide[3]. Approved seed mixtures from the USDA Natural Resources Conservation Service (NRCS) are modified frequently by the agencies, which would quickly render information in the BMP manual outdated. NRCS approved seed

mixtures were therefore not included with the 2003 BMP revision. The development of practices specifically for salvage logging was not addressed within the scope of the BMP manual revision. The Crawford salvage timber sale was originally audited in 2001 and was revisited on the 2004 audits. Departures were noted in the 2001 audits regarding the transportation of ash down slope and into drainages. However, on the 2004 revisit, skid trails and temporary roads were successfully reseeded and water control structures were functioning properly. Little evidence of soil displacement or adverse watershed impacts was present. The 2001 and 2004 results suggest that existing BMPs are largely effective for salvage operations in preventing long-term impacts, but developing practices to prevent short-term effects, at least prior to the establishment of vegetative ground cover, may be a prudent measure to undertake in future BMP projects.

The 2001 audit team recommended developing a process by which to remedy major departures from the BMPs, once identified. For a variety of logistical reasons, this recommendation has not been addressed.

Finally, the 2001 report recommended actively encouraging landowners, logging and road building contractors to attend BMP audits. Due to scheduling conflicts and work demands, this recommendation is consistently difficult to implement. However, a continued emphasis is merited.

5.2 2004 AUDIT TEAM RECOMMENDATIONS

- Continue the voluntary BMP audit and training program on a three-year cycle.
    - Perform audits and training in 2007.
    - In addition to logging contractors, road building contractors, foresters, and agency specialists, include private forest landowners in the targeted audience for future BMP training. Workshops targeted toward forest landowners may be more effective if held separately from those targeted at resource professionals.
    - Consider offering training such that workshops take place after the 2007 audit data are collected, in order to better refine the training emphasis items. If this is not possible, items identified from the 2004 audit data as those in need of continued emphasis include the following:
        - Proper culvert sizing and installation.
        - Road design, drainage, and maintenance.
        - Stream and watercourse classification.
        - SMZ designation.
- Ensure a variety of timber harvest operations are selected for audit sites, including the following:
    - Representation from state, federal, and private land ownerships. Equal representation among these ownership categories was important during the initial stages of the audit process, but may be less important in future audits. State-administered sales, for instance, are not as numerous as are federal and private sales.
    - A variety of timber sale purchasers should be represented among the selected audit sites, including large and small timber companies alike.

    - Variety in seasonal timber sale operations should be represented among the selected audit sites. Consider auditing one or more active sales during winter operations. Consider revisiting another 2001 audit site in the 2007 audits.
- An effective and practical BMP team includes a soil scientist and/or geologist, hydrologist, forester, engineer, a fish or wildlife biologist, the timber sale landowner or agency representative, the timber sale logging contractor/road builder, the timber sale administrating forester where applicable, an independent non-industry forest landowner, and a representative from a conservation or wildlife organization.
- Evaluate simplifying the audit rating criteria; specifically, evaluate the audit form currently utilized in the state of Montana for adaptation to South Dakota.
- Evaluate researching and developing BMPs applicable to salvage harvest operations, including data from 2001 and 2004 audit results for the Crawford salvage timber sale.
- Evaluate including direction within the BMPs pertaining to "legacy roads," including considerations in evaluating the merits of road relocation versus retention of existing road location with the addition of further erosion protection and road drainage features.

APPENDIX A

South Dakota Forestry Best Management Practices

2004 Timber Sale Field Audit Data
and
Rating Guide Criteria

APPENDIX A

South Dakota Forestry Best Management Practices
2004 Field Audit Data and Rating Guide Criteria

Timber Sale Name	Barnes Canyon		Sturgis Watershed		Tope		Black Hills Power		Hearst		Needles II		Crawford (Re-visit)	
Land Ownership/Management	State of SD, CSP		City of Sturgis/State		Private		Private		BLM		Forest Service		Forest Service	
ROADS	App.	Eff.	App.	Eff.	App.	Eff.	App.	Eff.	App.	Eff.	App.	Eff.	App.	Eff.
A.ROADS: Planning and Location 1. The number of roads constructed was minimized through comprehensive road planning, recognizing intermingled ownership and foreseeable future uses. Existing roads were used where practical, unless use of such roads would cause or aggravate an erosion problem.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. Erodable soils and unstable areas were identified. Appropriate road surface materials were located.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3. Roads fit the topography (located on natural benches and follow natural contours). Long, steep road grades and narrow canyons are avoided.	4	4	4	4	NA	NA	4	4	NA	NA	4	4	NA	NA
4. Roads are located on stable geology, and avoid wet areas (moisture-laden or unstable toe slopes, swamps, wet meadows, wetlands, and natural drainage channels).	4	4	4	4	NA	NA	4	4	NA	NA	4	4	NA	NA
5. Roads running parallel to stream channels are located a safe distance from streams. An adequate streamside management zone (SMZ) or other appropriate management techniques to trap sediment and prevent its entry into the stream were used.	4	4	4	4	NA	NA	3	4	4	4	4	4	NA	NA
6. Minimize the number of stream crossings and choose stable stream crossing sites.	4	4	4	4	NA	NA	4	4	4	4	4	4	NA	NA

7. Roads are located to provide access to suitable (flat and well-drained) log landing areas. Landings and roads are located a safe distance from streams. Sediment traps were utilized where needed.	4	4	4	4	NA	NA	4	4	4	4	4	4	NA	NA
B.ROADS: Design														
1. Design roads and drainage facilities to prevent potential water quality problems from road construction.	4	4	4	4	4	4	4	4	NA	NA	4	4	4	5
2. Design roads to the minimum standard necessary to accommodate anticipated use and equipment.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3. Design roads to balance cuts and fills or use side cast or end haul where stable fill construction is not possible.	4	4	4	4	NA	NA	4	4	4	4	NA	NA	NA	NA
4. Design roads for minimal disruption of drainage patterns. Vary road grades to reduce concentrated flow in road drainage ditches, culverts, and on fill slopes and road surfaces.	4	4	3	3	2	3	NA	NA	4	4	4	4	4	4
5. Design stream crossings for adequate passage of fish if present, minimum impact on water quality, and for a minimum 25-year frequency runoff.	4	4	4	4	4	4	3	4	4	4	4	4	4	4
C. ROADS: Drainage from Road Surface														
1. Provide adequate drainage from the surface of all permanent and temporary roads; techniques include but aren't limited to outsloped, crowned, drain dips, and insloped/ditched/crossdrained road surfaces. Space road drainage features so peak drainage flow on the road surface or in ditches will not exceed the capacity of the individual drainage facilities.	3	3	4	4	4	4	4	4	3	3	3	2	4	5
a. Outsloped roads provide means of dispersing water in a low-energy flow from the road surface. Outsloped roads are appropriate when fill slopes are stable, drainage will not flow directly into stream channels, and transportation safety considerations can be met.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
b. Inslope road ditch gradients are steep enough (generally < 2% but > 8%) to prevent sediment deposition and ditch erosion, with consideration to soil stability.	NA	NA	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

c. Drain dips are constructed properly, including installing them deep enough into the subgrade so that traffic will not obliterate them.	4	4	4	4	4	4	NA	NA	3	3	4	4	4	4
2. Skew ditch relief culverts ~20 to 30 degrees toward the inflow from the ditch to improve inlet efficiency. Protect the upstream end of cross-drain culverts from plugging.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Where possible, install ditch relief culverts at the gradient of the original ground slope; otherwise armor outlets with rock or anchor downspouts to carry water safely across the fill slope.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Provide energy dissipaters where necessary at the downstream end of ditch relief culverts. Crossdrains, culverts, water bars, dips, and other structures should not discharge onto erodable soils or fill slopes without outfall protection.	4	4	4	4	NA	NA	NA	NA	NA	NA	4	4	NA	NA
5. Prevent downslope movement of sediment by using catch basins, drop inlets, changes in road grade, headwalls, or recessed cut slopes.	4	4	4	4	4	4	NA	NA	NA	NA	4	4	4	4
6. Rout road drainage through the SMZ, filtration fields, or other sediment settling structures. Install road drainage features above stream crossings to route discharge into filtration zones before entering a stream.	3	3	4	4	3	3	3	3	3	3	3	2	4	4
D. ROADS: Construction														
1. Keep slope stabilization, erosion, and sediment control work as current as possible with road construction. This includes installing drainage features as part of the construction. Complete or stabilize road sections within the same operating season, ensuring that drainage features are fully functional prior to spring or fall runoff and that major road sections are not left in an unstable condition over winter.	4	4	4	4	NA	NA	NA	NA	NA	NA	4	4	3	3
2. Stabilize erodable, exposed soils by seeding, compacting, riprapping, benching, mulching, or other suitable means prior to runoff.	4	4	4	4	NA	NA	NA	NA	NA	NA	4	4	4	5
3. Windrow slash as a sediment filter at the toe of potentially erodable fill slopes, particularly near stream channels, during road construction. Limit size of filter windrows so as not to impede wildlife movement.	NA	NA	4	4	NA	NA	NA	NA	NA	NA	NA	NA	3	4

4. Minimize earth-moving activities when soils appear excessively wet. Do not disturb roadside vegetation more than necessary to maintain slope stability and to serve traffic needs..	4	4	4	4	NA	NA	4	4	4	4	4	4	NA	NA
5. Construct cut and fill slopes at stable angles.	4	4	4	4	NA	NA	4	4	4	4	NA	NA	NA	NA
6. Avoid incorporating potentially unstable woody debris in the fill portion of the road prism. Where possible, leave existing rooted trees or shrubs at the toe of the fill slope to stabilize the fill.	4	4	4	4	NA	NA	4	4	NA	NA	NA	NA	NA	NA
7. Consider road surfacing to minimize erosion.	4	4	4	4	4	4	4	4	4	4	4	4	NA	NA
8. Place debris, overburden, and other waste materials associated with construction and maintenance activities in a location to avoid entry into streams. Include these waste areas in soil stabilization planning for the road.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
9. Minimize sediment production from borrow bits and gravel sources through proper location, development, and reclamation.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
10. When using existing roads, reconstruct only to the extent necessary to provide adequate drainage and safety; avoid disturbing stable road surfaces.	4	4	4	4	4	4	4	4	3	4	4	4	4	5
E. ROADS: Maintenance														
1. Grade road surfaces only as often as necessary to maintain a stable running surface and to retain the original surface drainage.	4	4	4	4	3	4	4	4	4	4	4	4	NA	NA
2. Maintain erosion control features through periodic inspection and maintenance, including cleaning dips and crossdrains, repairing ditches, marking culvert inlets to aid in location, and clearing debris from culverts.	4	4	3	3	4	4	4	4	4	4	4	4	NA	NA
3. Avoid cutting the toe of cut slopes when grading roads or pulling ditches.	4	4	4	4	4	4	NA	NA	4	4	4	4	NA	NA
4. When plowing snow for winter timber harvests, provide breaks in snow berms to allow road drainage.	4	4	NA	NA	NA	NA	NA	NA	4	4	NA	NA	NA	NA
5. Haul all excess material removed by maintenance operation to safe disposal sites and stabilize these sites to prevent erosion. Avoid sidecasting material into streams or locations where erosion will carry material into streams.	4	4	4	4	NA	NA	NA	NA	NA	NA	4	4	NA	NA

6. Avoid using roads during wet periods if such use would likely damage the road drainage features.	4	4	4	4	NA	NA	4	4	NA	NA	4	4	NA	NA
7. Upon completion of seasonal operations, the road surface should be crowned, outsloped, insloped or water-barred. Remove berms from the outside edge where runoff is channeled.	4	4	4	4	NA	NA	NA	NA	4	4	4	4	NA	NA
8. Leave abandoned roads in a condition that provides adequate drainage without further maintenance. Close these roads to traffic; reseed and/or scarify, and, if necessary, recontour and provide water bars or drain dips	4	4	3	4	NA	NA	NA	NA	NA	NA	NA	NA	4	4
TIMBER HARVESTING, STREAMSIDE MANAGEMENT, AND SITE PREPARATION														
A. Harvest Design														
1. Plan a timber harvest with consideration for the land owner's objective and the potential effect on water quality and beneficial water uses.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. Use logging systems that fit the topography, soil type, and season, while minimizing soil disturbance to economically accomplish silvicultural objectives.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
3. Use a yarding system that is economical and minimizes road densities.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
4. Use log forwarding where it is economical and minimizes road densities.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA
5. Design and locate skid trails and skidding operations to minimize soil disturbance. Using designated skid trails is one means of limiting site disturbance and soil compaction. Consider the potential for erosion and possible alternative yarding systems prior to planning tractor skidding on steep or unstable slopes.	4	4	4	4	4	4	4	4	4	4	4	4	4	5

6. Locate skid trails to avid concentrating runoff and provide breaks in grade. Locate skid trails and landings away from natural drainage systems and divert runoff to stable areas. Limit the grade of constructed skid trails on geologically unstable, saturated, highly erosive, or easily compacted soils to a maximum of 30%. Use mitigating measures, such as water bars and grass seeding, to reduce erosion on skid trails.	4	4	4	4	3	3	4	4	4	4	3	4	5	5
B. Streamside Management														
1. Designate SMZs to provide stream shading, soil stabilization, sediment and water filtering effects, and wildlife habitat. The SMZ encompasses a strip at least 50 feet wide on each side of a stream, measure from the ordinary high-water mark or definable bank. The width of the SMZ should extend beyond the 50-foot minimum to include wetlands along a stream bottom and to provide additional protection in areas of steep slopes or erosive soils. Consult with forestry professionals, soil and water conservation specialists, or biologists if assistance is needed in setting appropriate SMZ boundaries.	3	4	4	4	3	4	4	4	4	4	4	4	4	4
2. Consider the following practices when harvesting timber in SMZs:														
a. Retain hardwood trees, seed trees, sub-merchantable trees and shrubs adjacent to streams	4	4	NA	NA	4	4	4	4	4	4	4	4	NA	NA
b. Retain trees necessary for bank stabilization and as future sources of large woody debris in the stream channel.	4	4	NA	NA	4	4	4	4	4	4	4	4	NA	NA
c. When clearcutting up to the stream edge, consider the length of stream channel opened to the sun. Where possible, keep continuous openings under 600 feet of stream length.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
d. Recognize that in some soil and drainage types, clearcutting can cause marked increases in the water table, cold air ponding, and grass/shrub competition. All of these factors can inhibit conifer regeneration. Some mature trees may need to be left on these sites to ensure conifer reestablishment.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

e. Maintain or provide sufficient ground cover to trap sediment. Whole-tree or tree-length yarding can reduce the need for slash disposal in the SMZ.	4	4	NA	NA	4	4	4	4	4	4	4	4	NA	NA
f. Steep slopes containing material that may roll down-slope and fall into a stream during burning should receive special attention. Trees logged along streams may be high-stumped to help prevent this debris build up in streams. Other mechanical methods may be necessary to prevent debris entering the stream.	4	4	NA	NA	NA	NA	4	4	NA	NA	NA	NA	NA	NA
g. A slash-free zone may be necessary to maintain streamside vegetation if site preparation will involve burning on steep ground adjacent to the SMZ.	4	4	NA	NA	NA	NA	4	4	NA	NA	NA	NA	NA	NA
h. Hand treatment of slash and the retention of slash above the high water may be necessary to trap sediment.	4	4	NA	NA	4	4	4	4	NA	NA	4	4	NA	NA
i. Landings may be placed in the SMZ as a last resort. However, care must be take to prevent debris and sediment from entering streams.	5	4	NA	NA	4	3	4	4	4	4	4	4	NA	NA
3. Minimize operation of wheeled or tracked equipment within the SMZ, and avoid equipment operation in wetlands, except when the ground is frozen. Do not operate equipment on stream banks.	4	4	NA	NA	4	4	4	4	4	4	4	4	4	4
4. Use directional falling for harvest operations in the SMZ or wetlands. Avoid falling trees or leaving slash in streams or water bodies. Limb or top trees above the high water mark, and remove slash from stream and store above high water mark.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
5. Suspend the lead end of a log during skidding whenever possible, and use cables to end-line logs out of SMZs and wetlands when using ground skidding systems.	4	4	NA	NA	4	4	NA	NA	4	4	4	4	4	4
6. Avoid decking logs within the ordinary high-water mark of any stream	4	4	4	4	4	4	NA	NA	4	4	4	4	4	4
C. Other Harvesting Activities														

1. Tractor skid when compaction, displacement, and erosion will be minimized. Avoid tractor or wheeled skidding on unstable, permanently or seasonally wet, or easily compacted solid and on slopes that exceed 40% unless operation can be conducted without causing excessive erosion. Avoid skidding on highly erodable soils or with the blade lowered.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. For each landing, skid trail, or fire trial, provide and maintain a drainage system to control the dispersal of water and to prevent sediment from entering streams	4	4	4	4	4	4	3	4	4	4	4	4	4	4
3. Install necessary water bars on tractor skid trails: appropriate spacing between bars is determined by the soil type and slope of the skid trails. Timely implementation is important.	4	4	NA	NA	NA	NA	4	4	4	4	4	4	4	4
4. When natural revegetation is inadequate to prevent accelerated erosion, before the next growing season, apply seed or construct water bars on skid trails, landings and fire trails. A light ground cover of slash or mulch will retard erosion.	4	4	4	4	4	4	5	4	4	4	4	4	4	4
D. Slash Treatment and Site Preparation														
1. Rapid reforestation of harvested areas is encouraged to establish protective vegetation.	4	4	4	4	4	4	4	4	4	4	NA	NA	4	4
2. Attention must be given to SDCL 21-10-26 & 21-10-27 when dealing with the treatment of logging slash.	4	4	4	4	4	4	NA	NA	4	4	4	4	4	4
3. Use brush blades on dozer when piling slash. Avoid use of dozers with angle blades. Site preparation equipment producing irregular surfaces is preferred. Care should be taken to preserve the surface soil horizon.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Minimize or eliminate elongated exposure of soils up and down the slope during mechanical scarification.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Scarify the soil only to the extent necessary to meet the reforestation objective of the site. Some slash and debris should be left to slow surface runoff, return soil nutrients, and provide shade for seedlings.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Carry out brush piling and scarification when soils are frozen or dry enough to minimize compaction and displacement.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

7. Carry out scarification on steep slopes in a manner that minimizes erosion. Alternate methods of site preparation should be considered on slopes greater than 40 percent.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8. Stabilize or reclaim landings and temporary roads on completion of use.	4	4	4	4	4	4	NA	NA	NA	NA	NA	NA	4	4
9. Remove all logging machinery debris and deposit it at a proper disposal site.	4	4	4	4	4	4	NA	NA	4	4	4	4	4	4
10. Limit water quality impact of prescribed fire by constructing water bars in firelines; not placing slash in drainage channels; maintaining the streamside management zone; and avoiding intense fires unless needed to meet management goals.	NA	NA	NA	NA	NA	NA	NA	NA	4	4	NA	NA	NA	NA
STREAM CROSSINGS ***A. CROSSINGS: Legal Requirements***														
1. Attention given to SDCL 34A-2-33, 34A-2-11, & 34A-2-93 when dealing with the possibility of pollution of surface waters. Rules have been promulgated by the DENR pursuant to the previously stated laws and are located in Appendix B.	4	4	NA	NA	NA	NA	4	4	4	4	4	4	NA	NA
B.CROSSINGS: Design Considerations														
1. Design stream crossings at right angles to the main channel if practical. Adjust the road grade to reduce the concentration of water carried by drainage ditches to stream crossings. Direct drainage flows through a SMZ and away from the stream crossing site.	4	4	4	4	4	4	3	3	3	3	4	4	NA	NA
2. Avoid unimproved stream crossings. When a culvert or bridge is not feasible, locate drive-troughs on a stable, rocky potion of a stream channel.	4	4	NA	NA	4	4	4	4	4	4	4	4	3	4
C.CROSSINGS: Installation														

1. Minimize stream channel disturbances and related sediment problems during road construction and installation of stream crossing structures. Use silt fencing, straw bales, or other methods to prevent soil and other debris from entering streams during construction until disturbed soil has been stabilized. It may be necessary to install silt fencing across channels downstream from construction to prevent migration of sediment. This basin will need to be cleaned out and removed after the construction site has stabilized. Do not place erodable material in stream channels. Remove stockpiled material from high water zones. Locate temporary construction bypass roads in locations where the stream course will have minimal disturbance. Time construction activities to protect fisheries and water quality.	4	4	4	4	3	2	4	4	NA	NA	3	4	NA	NA
2. When using culverts to cross small streams, install those culverts to conform to the natural stream bed and slope on all perennial streams and on intermittent streams that support fish or that provide seasonal fish passage. Place culverts slightly below normal stream grade to avoid culvert outfall barriers. Do not alter stream channels upstream from culverts unless it is necessary to protect fill or to prevent culvert blockage.	4	4	NA	NA	4	4	4	4	NA	NA	4	4	NA	NA
3. Install culverts to prevent erosion or fill. Compact the fill materiel to prevent seepage and failure. Armor the inlet and/or outlet with rock to other suitable material where needed.	4	4	2	1	4	4	4	4	4	4	3	4	NA	NA
4. Consider “dewatering” stream crossing sites during culvert installation.	4	4	4	4	NA	NA	NA	NA	NA	NA	3	3	NA	NA
5. Use 1-foot minimum cover for culverts 18 to 36 inches in diameter, and a cover of one-third diameter for larger culverts to prevent crushing by traffic.	4	4	4	4	4	4	4	4	4	4	3	4	NA	NA
6. Use culverts with a minimum diameter of 15 inches for permanent stream crossings and cross drains.	4	4	4	4	4	4	4	4	4	4	4	4	NA	NA
WINTER LOGGING														
A. WINTER: General														

1. Consider snow road construction and winter harvesting on sites characterized by wet meadows, high water tables, sensitive riparian conditions or other potentially significant soil erosion and compaction hazards.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5	4	4	4
2. Conduct winter logging operations when the ground is frozen or snow cover is adequate to minimize site disturbance. Be perpared to suspend operation if conditions change rapidly and before the erosion hazard becomes high.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	4	4	4	4
3. Consult with operators experience in winter logging techniques.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	4	4	4	4
B. WINTER: Road Construction and Harvesting Considerations														
1. For road systems across areas of poor foundation, consider hauling only during frozen periods. During cold weather, plow any snow cover off the roadway to facilitate deep freezing of the road grade prior to hauling.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	4
2. Before logging, mark existing culvert locations. During and after logging, make sure all culverts and ditches are open and functional.	4	4	NA	NA	NA	NA	NA	NA	4	4	NA	NA	NA	NA
3. Use compacted snow for read beds in unroaded, wet or sensitive sites. Construct snow roads for single-entry harvests or for temporary roads.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4. Designate or mark all stream courses, including small streams, prior to snowfall. Conduct activities in streamside zones so that ground disturbance is minimized. Following completion of snow road use, restore stream crossings to near pre-road condition to prevent ice dams. Do not use the stream channel for the roadway except for crossings.	4	4	NA	NA	NA	NA	NA	NA	4	4	4	4	4	4
5. Prior to felling in wet unfrozen soil areas, use tractors or skidders to compact the snow for skid road locations. Avoid steeper areas where frozen skid trails maybe subject to erosion the next spring.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6. Return the following summer and build erosion barriers on any trails that are steep enough to erode.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	4	4	4	4
7. Do not leave slash and tops in streams	4	4	NA	NA	NA	NA	NA	NA	4	4	4	4	4	4
HAZARDOUS														

SUBSTANCES														
A. HAZ: Legal Requirements														
1. Attention is given to SDCL 38-19 & ARSD 12; 44 fertilizer rules; SDCL 38-20A, 38-21 & ARSD 12;:56 pesticides rules	4	4	4	4	NA	NA	4	4	NA	NA	4	4	NA	NA
B. HAZ: General														
1. Know and comply with regulations governing the storage, handling, application (Including licensing of applicators), and disposal of hazardous substances.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
2. Do not transport, hand, store, load, apply or dispose of hazardous substances in such a manner as to pollute water supplies or waterways, or cause damage or injury to land, human, desirable plants, or animals.	4	4	4	4	4	4	3	4	4	4	4	4	4	4
3. Develop a contingency plan for hazardous substance spills, including cleanup procedures and notification of DNR. Notification of the Department of Agriculture is required regarding spills of pesticides or fertilizers.	4	4	4	4	4	4	4	4	4	4	4	4	4	4
C.HAZ: Pesticides														
1. Use an integrated approach to weed and pest control, including manual, biological, mechanical, preventive and chemical means.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2. Prevent the entry of hazardous substances into surface waters.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. To enhance effectiveness and prevent transport into streams, apply chemical during appropriate weather conditions (calm and dry) and during the optimum timer for control of the target pest or weed.	4	4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA