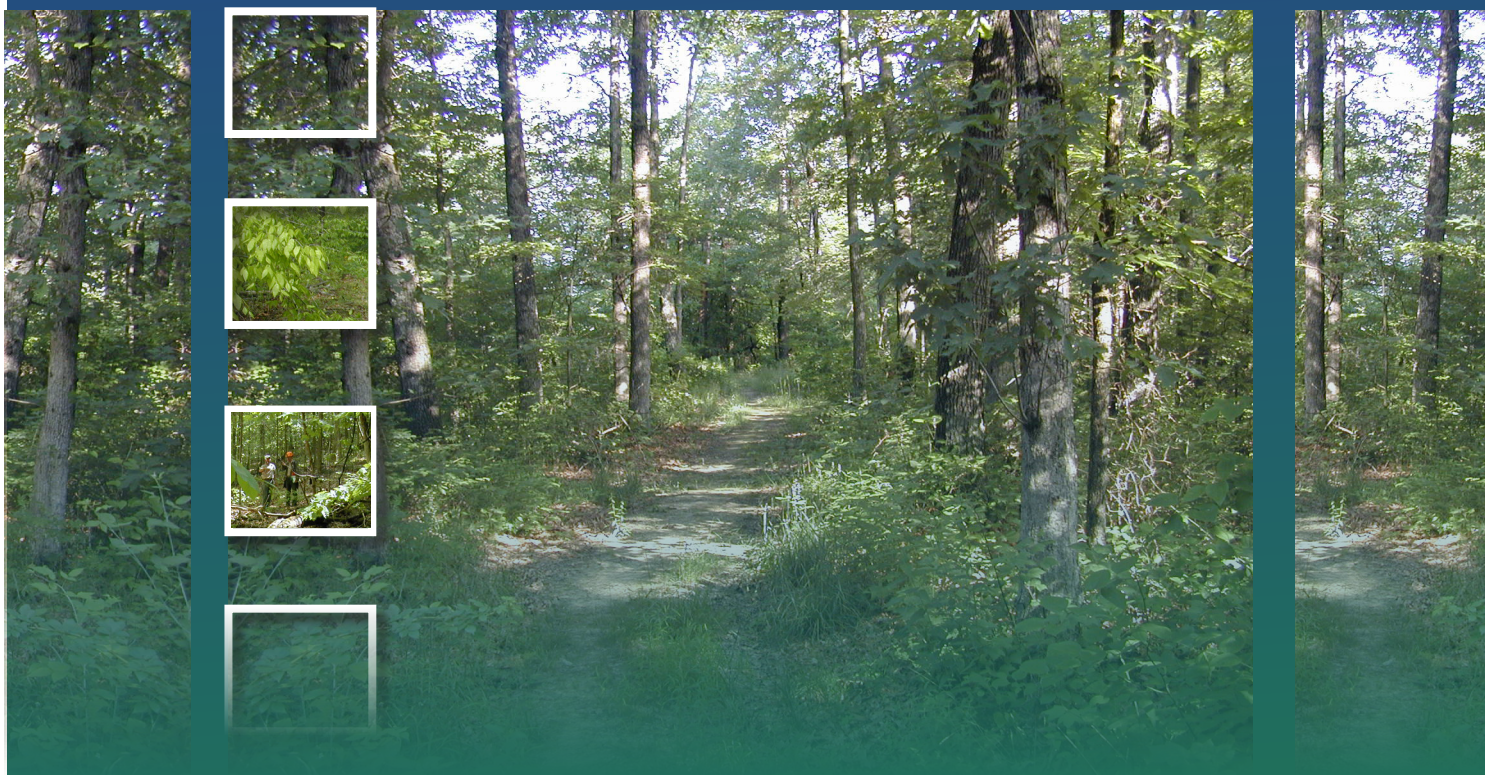
INDIANA DNR DIVISION OF FORESTRY

STATE FOREST PROPERTIES



1996 through 2009
Forestry Best Management Practices
Monitoring Results

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1996 through 2009 State Forest BMP Report

I. Executive Summary

Forestry BMP monitoring, as an internal audit by Division of Forestry personnel of all timber harvests on State Forest Properties began on November 1, 2000. The timber harvests being monitored were sold starting July 1, 1999 when Forestry BMPs were included on the timber sale contract and enforced, even though they had been commonly practiced before that date. The Statewide Forestry BMP program had conducted 4 rounds of monitoring before this time in which state properties had been monitored by monitoring teams that included DoF personnel as well as private and industry individuals interested in forestry in the state. This report includes 284 timber harvests monitored for Forestry BMPs between November 1, 1996 and December 31, 2009 ranging in size from 1 to 248 acres.

The overall rates for forestry BMPs on state forests since 1996 are 87% application and 93.6% effectiveness in protecting the soil and water quality of the 284 sites monitored. This means that 87% of the practices were applied as directed in the BMP guidelines, and another 12.4% were departures that were classified as minor departures as defined in the monitoring sheet (Appendix B). There have only been 78 major departures and they add up to only 0.63% of all practices monitored. Of the total 284 sites monitored on State properties only 1 application question has scored a "Total Negligence," 0.01%.

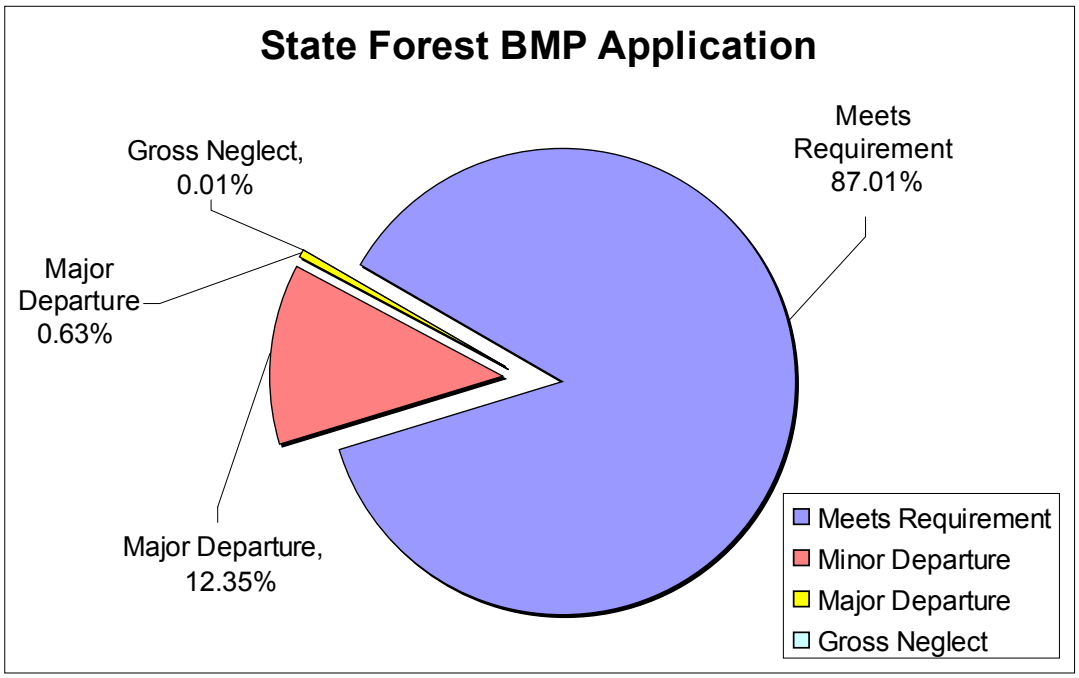


Figure 1: Overall State Forest BMP Application Percentages

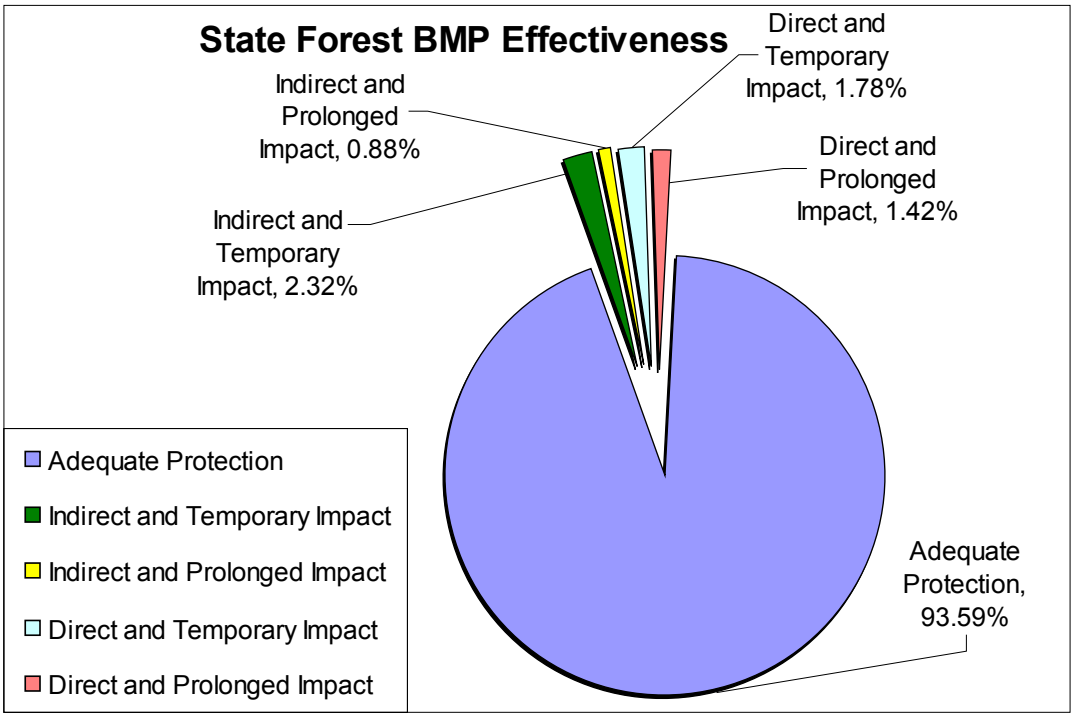


Figure 2: Overall State Forest BMP effectiveness percentages.

II. Introduction

Indiana contains 4.7 million acres of forestland (just over 20% of Indiana land base) providing many benefits to all of Indiana's people and wildlife. The State Forest system owns only 3.3%, 156,000 acres, of Indiana's forestland. However, this land is important to many Hoosiers who frequently use state forest properties for various forms of recreation including; hiking, biking, hunting, fishing and wildlife watching. Since state forestland is important to the public, it is imperative that harvesting carried out on the state forests is done in a way that reduces environmental impacts as much as possible. Although forests are known to be the best way to reduce nonpoint source pollution (NPS) to waterways, they can also be a source of pollutants. When forest soils are bared there is opportunity for NPS pollution to occur. Forestry Best Management Practices (BMPs) are the practices that are employed to protect forest soils and water quality during and after a harvest.

Forestry BMPs are a foundation for water quality protection and are guidelines for protecting water quality during forest operations. The purpose of BMPs is to minimize the impact of forest activities that may affect soil and water quality. This report is a summary of the application and effectiveness of BMPs for timber harvests conducted on state forests properties from the time they were officially placed in the contracts of all timber sales on state properties in July 1999 until the present. We will be reporting on data that covers all the BMP monitoring on State Forest Properties, looking at time trends and making comparisons.

From July 1999 to winter 2003, BMP monitoring on state forests was conducted with the Watershed Conservation (WC) Forester and/or the License Timber Buyer (LTB) Forester from the Special Programs Section of the Division of Forestry, the Administering Forester of the timber harvest being monitored, an Administering Forester from another property, and the Property Specialist that administered the timber harvest program. The Property Specialist stopped coordinating the monitoring as well as participating

in the monitoring of sites late in 2003. In October 2004, the Division of Forestry started to change the monitoring system to a sampling method, but was transitioning the system when a change in leadership halted the monitoring until new leadership was put in place, at which time we moved back to 100% monitoring. At the present time, we are monitoring 100% of the timber harvests after they are completed, but the monitoring team consists of a person from the State Forest BMP monitoring staff, and the Administering Forester of the timber harvest being monitored.

BMP Monitoring is a site evaluation based on the Indiana Logging and Forestry Best Management Practices: BMP Field Guide (BMP Field Guide) and Indiana's Forestry BMP Monitoring Worksheet. 58 BMP specifications are evaluated under the 5 forestry operation categories: 1) Forest access roads, 2) Log landings, 3) Skid trails, 4) Stream crossings, and 5) Riparian management zones. Each BMP specification is rated for application of the BMP and the effectiveness in protecting the water quality. Seven general questions are posed on the evaluation dealing with the root of the noted failures and successes, and records other land uses on the site that could affect water quality.

III. Methods

BMP Monitoring Objectives

The objectives of BMP monitoring are: 1) to assess the effectiveness of the BMP guidelines in minimizing soil erosion and stream sedimentation, 2) provide information on the extent of BMP implementation, past and current, 3) identify areas to focus future program training and educational efforts to improve BMP implementation and effectiveness, 4) identify BMP specifications which may need technical modification, and 5) identify improvements needed in future monitoring efforts.

B. Monitoring Team Selection

For State Forest Properties, we first tried to have the WC and LTB foresters come to every BMP monitoring, however there have been many sites in which one or the other was absent for either personal or professional reasons, but the monitoring continued, which kept a good balance for consistency in the monitoring and results without the monitoring falling behind. There is now a BMP Monitoring staff that fills this role that includes the LTB Forester and one or two intermittent positions who's focus is BMP monitoring.

The other participants would be the Administering Forester and an Administering Forester from another property, which balanced the team for input in the site evaluation of monitoring process and provide good training and discussion.

From July 1999 until 2003, the coordination of monitoring dates and people was carried out by the Property Specialist who would also attend the monitoring of every timber harvest, but this practice discontinued when administrative duties increased for that position and the coordination of the monitoring was passed to the LTB forester.

C. Site Selection

Every timber harvest conducted on state forest property is monitored if the timber was sold after July 1999 unless the harvest occurred in order to change the land use. For example, Ferdinand State Forest had a site where the timber was harvested before the area was cleared for a pipeline right-of-way, this kind of land use change makes it impossible to monitor for forestry BMPs.

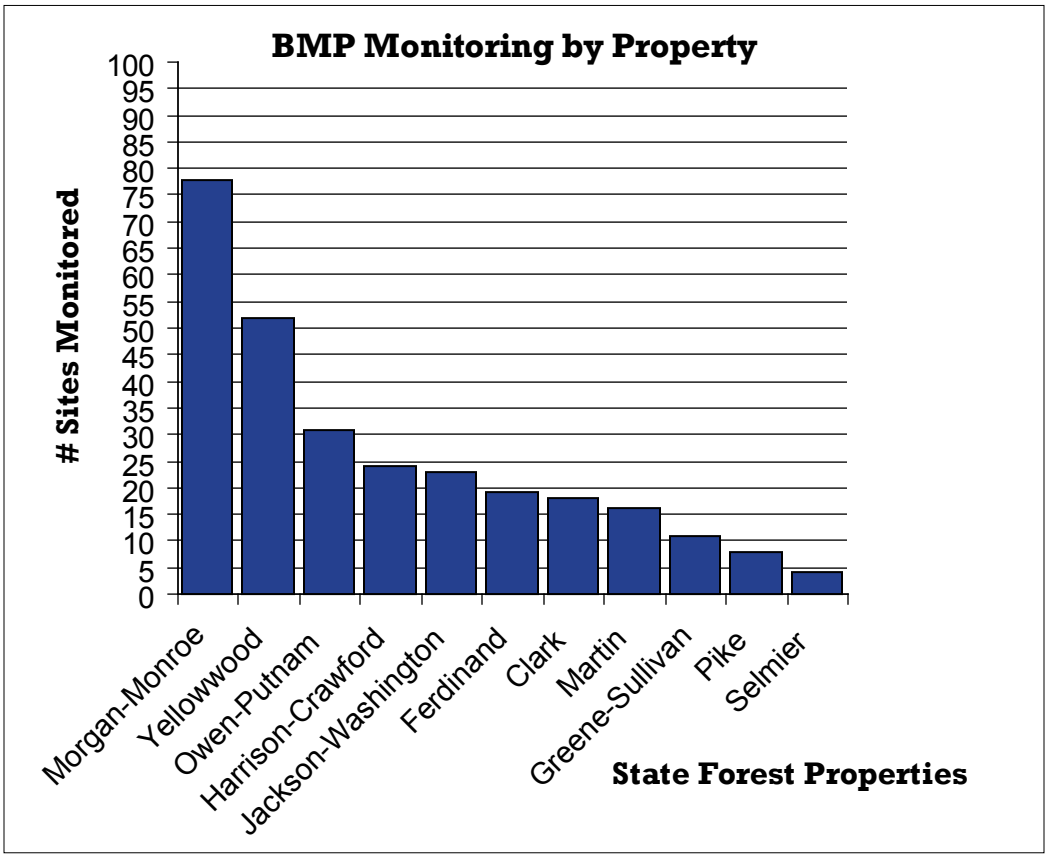


Figure 3: The number of harvests monitored at each property, with a total of 284 sites.

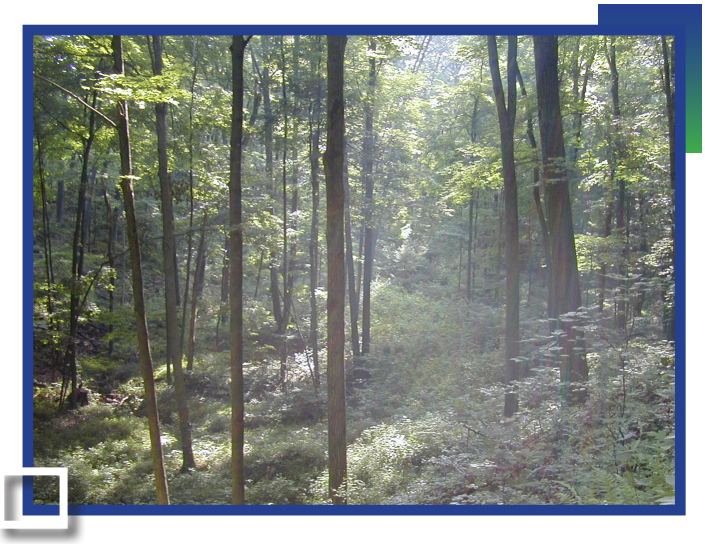
D. Monitoring Process

BMP monitoring is based on the evaluation of each specific practice for application and effectiveness. Application is the installation of a practice and the condition of the practice at the time of monitoring. Effectiveness is the level of success a practice has in the prevention of pollutants entering a water body or the level of impact the pollutant is having on the water body at the time of monitoring. It is possible to apply all of the BMPs properly and get a good score in application, but still have soil entering a stream, which would call for a lower score in effectiveness, and the opposite may be possible as well.

The monitoring on state forest properties follows the same format as all other forestry BMP monitoring in Indiana except that the team of monitors is made up of people from similar backgrounds. On any monitoring day, the team meets at the forest office and then goes to the field to conduct the BMP monitoring on a harvest that is already completed and closed. The team will walk each part of the harvest area covering all of the access roads, inspecting the log landings, skid trails, riparian management zones, and stream crossings as suggested in the Indiana BMP Monitoring Protocol, and comment on successes and departures from the BMP guidelines. Also, the person from the BMP Monitoring staff will walk all of the intermittent or larger streams in or adjacent to the timber harvest area.

Once on the site the state forest monitoring team will walk the area and its adjacent and interior intermittent or larger streams carrying maps of the site, the BMP monitoring form and the BMP Field Guide. This time allows each team member to evaluate the BMPs on the site for themselves. Once they have walked most of the area, the team will come together at the vehicle or other gathering place and discuss each question on the BMP monitoring form until they reach consensus on both scores for each question.

On state forest properties, the definition of intermittent streams is focused on streams that are 4 feet in width at the bed of the stream or marked as mapped intermittent streams on USGS quadrangle maps. This is done to more easily determine what streams would need to be monitored for stream crossings and what streams needed to have large woody debris, caused by the harvest removed. A better history and definition for streams that qualified as 4 feet is in Appendix A of this report.



IV. Results

A. Overall Application and Effectiveness

The BMP monitoring form includes 58 specifications that are evaluated on each site. 284 state forest sites have been monitored to date. Therefore when scores of 0's (questions not applicable) are taken out of the dataset there are a total of 12,437 questions answered in regards to BMP application and 12,439 questions for effectiveness of BMPs on State Forests. Overall BMP application on State Forest land is 87% with a 93.6% effectiveness rate. This means the BMPs that were needed were correctly implemented 87% of the time and were effective at protecting water quality from NPS 93.6% of the time.

When looking at application, 87% of the 12,437 questions were answered with a "1," which means that the practice met the BMP guidelines when it was needed. If an answer had a "0" in application, it meant that the practice was not needed on the site and was not included in counting the percentage of application. If there was a score of "2" or higher, then there were departures from the BMP guidelines to some degree, and they would include the other 13% of all the application scores that were tallied.

When looking at effectiveness, 93.6% of the total 12,439 questions were answered with a "1," which meant that there was adequate protection of the water resource by the BMP guidelines. If an answer had a "0" in application, it meant that the practice was not needed to protect water quality on the site and was not included in counting the percentage of effectiveness. If there was a score of "2" or higher, then there was a visible impact to water quality to some degree and that would be the other 6.4% of all the effectiveness scores that were tallied.

More detailed definitions can be found on the FORESTRY BMP MONITORING WORKSHEET (Appendix B).

B. BMPs by Category

1. Access Roads

Access road BMPs were correctly applied 95% of the time. All of the access road BMP specifications employed had a 98.7% effectiveness rate.

Table 1: Application and Effectiveness of BMP Specifications for Access Roads

Access Roads	% Application	% Effective
A1. Uses existing routes where appropriate	100.0	100.0
A2. Adequate buffer strip next to water courses and sensitive areas	95.2	98.4
A3. Avoids unstable gullies, seeps, very poorly drained areas	95.0	99.6
A4. Road grades are within standards	97.0	100.0
A5. Amount of roads minimized	99.6	100.0
A6. Stream crossings minimized	100.0	100.0
A7. Road excavation minimized	98.5	100.0
A8. Excavated and fill materials placed properly	98.8	99.2
A9. Roads constructed to drain well	85.2	97.7
A10. Appropriate road stabilization, drainage and diversions installed	82.0	95.8
A11. Water diversions functioning properly	89.5	96.9
A12. Runoff diverted onto stable forest floor areas	90.3	94.2
A13. Public road drainage system maintained	99.2	99.6
A14. Public road's drainage maintained	100.0	100.0
A15. Traffic barriers installed	96.5	99.2
Overall Access Road	95.0	98.7

The only specification needing greater attention in application is the installation of drainage diversions and road stabilization. Although this area only had an 82% application rate, there was a 95.8% effectiveness rate indicating virtually no visible impact to water quality due to these departures. Many of the access roads are permanent fire trails or other road that are used and maintained to varying degrees, thus some are more structurally stable while others have had the diversions worn down by use over long periods. An effectiveness problem seems to occur in old access roads where the main goal was to get water off of the road and put it into the streams in order to get the water away as soon as possible. The DoF has been working to correct these problems over the long term.

2. Log Landings

Log landing BMPs were correctly applied 89.9% of the time. All log landing BMP specifications employed were 98.5% effective at protecting the water resources of the site.

Table 2: Application and effectiveness of the BMP specifications for log landings

Log Landings	% Application	% Effective
Y1. Suitable number and size of landings	93.3	99.3

Y2. Landings located outside RMZ	95.7	99.3
Y3. Landings located on stable areas	95.4	100.0
Y4. Excavation of site minimized	92.6	99.3
Y5. Landings avoid concentrating or collecting runoff	76.6	97.9
Y6. Landing's runoff enters stable area	80.1	94.7
Y7. Proper water diversions in working order	85.0	96.3
Y8. Landing smoothed and soil stabilized	89.4	99.3
Y9. Landings free of fuel and lubricant spills and litter	91.8	98.6
Y10. Landing location suitable for equipment fueling and maintenance	98.9	100.0
Overall Log Landings	89.9	98.5

Correct drainage of landings was the main problem area in this category, with only 76.6% application rate, however the effectiveness rate for this specification was 97.9%. Therefore even though some of the landings concentrated or collected runoff, resources of this site were protected. There are also some departures, 80.1% in runoff entering stable area, however this is adequate in protecting forest soil and water resources with an effectiveness rate of 94.7%.

3. Skid Trails

Skid trail BMPs were correctly applied 77.5% of the time. All of the skid trail BMP specifications employed were 89.4% effective at protecting the water resources of the sites.

Table 3: Application and Effectiveness of BMP Specifications for Skid Trails.

Skid Trails	**% Application**	**% Effective**
S1. Uses of existing routes were appropriate	98.5	99.3
S2. Adequate buffer strip next to water courses and sensitive areas	75.0	85.9
S3. Avoids steep and long straight grades (>20% for >200')	76.7	94.9
S4. Avoids unstable gullies, seeps, poorly drained areas	79.7	91.1
S5. Amount of skid trails minimized	81.1	94.0
S6. Trail excavation minimized	88.3	96.8
S7. Appropriate drainage and diversions installed	43.2	80.0
S8. Water diversions in working order	80.1	89.5
S9. Runoff diverted onto stable forest floor areas	63.9	72.9
S10. Streams not used as skid trails (except for crossings)	89.3	90.1
Overall Skid Trail	77.5	89.4

Skid trails often are in rough areas with limited options for diversion installation and often there is debate as to whether or not diversions are necessary, thus the 43.2% application rate, but you will notice that there is still 80% effectiveness rate. Runoff diverted onto the stable forest floor areas has 63.9% application and a 72.9% effectiveness rate, with 49 out of 75 departures had indirect and temporary impacts, 16 were indirect and prolonged, 9 direct and temporary impacts, and one direct and prolonged impact was found. 224 out of a total of 280 sites having diversions on skid trails had no negative effect on water quality. Of the 56 sites with diversions that had effectiveness departures, 39 were indirect and temporary, 15 were indirect and prolonged, 1 was direct and temporary and 1 was determined to have direct and prolonged impact.

4. Stream Crossings

Stream crossing BMPs were correctly applied 79.2% of the time. All stream crossing BMP specifications employed were 81.3% effective at protecting the water resources of the sites.

Table 4: Application and Effectiveness of BMP Specifications for Stream Crossings

Stream Crossing	% Application	% Effective
X1. Number of crossings minimized	89.9	91.5
X2. Crossings minimize disturbance to the natural bed and banks	76.1	78.4
X3. Stream bank approaches properly designed and stabilized	61.4	69.3
X4. Water runoff diverted from road prior to crossing	58.6	59.8
X5. Crossing as close to 90 degrees as practicable	87.5	90.9
X6. Crossing does not unduly restrict water flow	81.8	84.1
X7. Soil has not been used as fill in the stream (except culverts)	85.2	85.2
X8. Ford constructed of non-erosive materials	94.6	93.2
X9. Fords have stable banks and stream beds	63.0	63.0
X10. Culverts are properly sized and installed	71.4	78.6
X11. Culverts clear of significant flow obstructions	78.6	85.7
X12. Temporary structures properly anchored	100.0	100.0
X13. Temporary structures and resulting obstructions removed	88.9	88.9
Overall Stream Crossing	79.2	81.3

Stream crossings are always dealing directly with water bodies, whether there are departures or not, there can be some impact to the water quality and, if there is an impact, it will almost always be direct. The likely impacts of stream crossings are why managers will often avoid using them if possible. The avoidance of stream crossings by sale administrators and loggers is reflected in the statistic for stream crossings, only 87 sites (31%) that had at least 1 stream crossing, out of 284 sites monitored. 41 sites with crossings had only 1 crossing, 13 sites with 2 crossings, 13 sites with 3 crossings, 2 sites with 4 crossings, 3 sites with 5 crossings, 3 sites with 6 crossings, one site with 7 crossings, and one site with 13 crossings to make a total of 167 crossings on state properties over a 13 year period. There were 8 sites for which the number of crossings and corresponding widths were not recorded.

Since stream crossings deal directly with intermittent or perennial streams, defined on state properties as 4' or wider streams, often state properties have stream crossings where on other property types these would have been classified as ephemeral crossings. Unmapped intermittent stream crossings numbered at 74 (44% of crossings) were on unmapped intermittent streams, this means they were classified as intermittent streams on the ground according to the 4' rule, but the USGS quadrangle maps did not map them as intermittent streams. There were 88 crossings on intermittent streams identified on the USGS maps. There were 5 crossings on perennial streams.

5. Riparian Management Zones

Riparian management zone (RMZ) BMPs were correctly applied 84.4 % of the time. All of the RMZ BMP specifications employed were 88.7% effective at protecting the water resources of the sites.

Table 5: Application and Effectiveness of BMP Specifications for Riparian Management Zones.

Riparian Management Zones	% Application	% Effective
Z2. Perennial and large intermittent streams clear of obstructing debris	63.6	66.1
Z3. Tree tops and cutoffs placed back from water course to prevent movement into streams during floods	87.0	92.7
Z4. RMZ free of excavated material and debris (other than above)	93.8	97.3
Z5. Less than 10% bare mineral soil exposed within RMZ (not including crossings)	98.5	99.2
Z6. Adequate tree stocking in primary RMZ next to perennial streams	98.1	98.1
Z7. RMZ free of roads and landings (except crossing)	73.8	92.7
Z8. Water diverted from roads before entering RMZ	88.0	92.2
Z9. Water diverted onto stable areas of the forest floor	88.6	91.2
Z10. Road and trail surfaces stabilized as needed within RMZ	92.7	93.2
Z11. Ephemeral channels free of excavated material	73.3	73.7
Overall Riparian Management Zones	84.4	88.7

Out of 284 sites, 259 had a water body of some type that had a RMZ. In specification Z2, "streams clear of obstructing debris," the application rate was 63.6% and the effectiveness rate was 66.1%. Of the 81 sites that had a departure in effectiveness 2 were indirect and temporary, 12 were direct and temporary and 67 were direct and prolonged. The nature of the debris would be prolonged unless it could be removed or mitigated in some way, mitigation by removing debris is standard recommendation. Roads and landings in the RMZ scored lower in application with a 73.8% but had 92.7% effectiveness. This suggests that although there were some roads and or landings located within the RMZ, that they were still protecting the water quality of the site. In Z11, "ephemeral channels free of excavated material" there were 72 departures in application, 66 of which were minor departures and 6 were major departures. There were 71 departures in effectiveness for Z11 specification, 39 departures had an indirect and temporary impact on soil and water quality, 30 indirect and temporary, and 2 direct and prolonged.

C. Yearly BMP Monitoring Trends

All monitoring rounds on state forest properties from 1996 to present were broken down to determine the overall application and effectiveness rates. Arranging the data in this manner can be helpful in determining the presence of any possible trends. In Figure 4 it is apparent that application and effectiveness rates are lower for all years following 1999. These lower numbers can be attributed to the change in the "4 foot rule" that occurred at the beginning of the 2000 monitoring year, and that internal BMP monitoring of state forest harvests was started that year. All monitoring prior to 2000 was completed by monitoring teams formed of people within and outside the DoF that volunteered for BMP monitoring on different types of land ownerships. These rounds of monitoring are better explained in the reports Indiana Forestry Best Management Practices Report of Findings; 1996, 1997, 1999, 2000, 1996-2003, 1999-2004, 1999-2005 1999-2006, 1999-2007, 1999-2008.

Table 6: Overall Application and Effectiveness of All BMP Monitoring Rounds.

Year	% Application rate	% Effectiveness rate	# sites (n)
1996	93.0	96.2	12
1997	93.5	95.8	7
1999	96.2	99.2	3
2000	87.1	94.6	15
2001	87.9	89.2	19
2002	89.6	94.6	25
2003	83.6	91.7	15
2004	83.5	92.2	20
2005	89.8	95.6	20
2006	92.6	96.0	25
2007	89.3	95.7	26
2008	84.0	92.9	47
2009	82.9	90.55	48
Overall	87.0	93.6	284

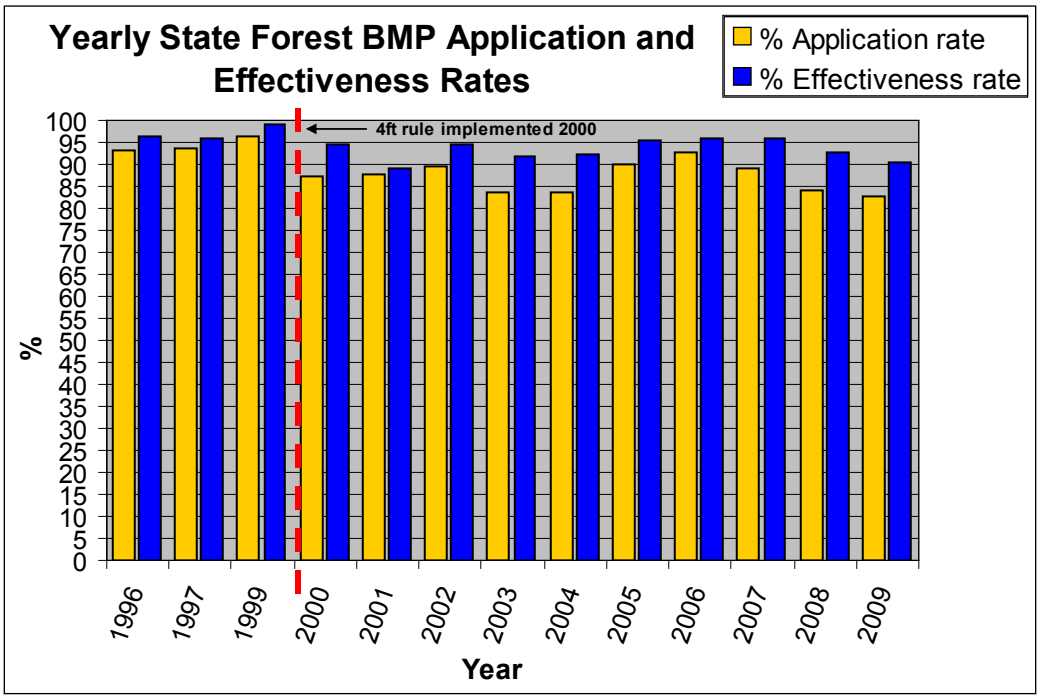


Figure 4: Overall application and effectiveness rates for each year of BMP monitoring. Application and effectiveness rates dropped sharply after implementing the 4 foot rule. (Appendix A).

D. Overall Site Ratings

On the final page of the monitoring form there is an opportunity for each site monitor to rank his or her overall subjective impression of the site's BMP application & effectiveness (Appendix B). Sites can be rated from 1 to 4 or any number in between. The ratings are decided by the following scale for application: 1=above average, 2=average, 3=poor, 4=total negligence. The rating scale for effectiveness is; 1= no visible impact, 2=slight, 3=moderate, 4=severe. Table 6 shows the average ratings for all the sites monitored on the state forests. The overall site rating is an average of the application and effectiveness ratings.

Table 7: The average site ratings for application, effectiveness and the overall site rating.

Overall Application	Overall Effectiveness	Overall Site Rating
1.49	1.54	1.52

On average the monitors found BMPs to be applied between average and above average. They also found effectiveness of sites, on average, to have between no visible impact and slight impact.

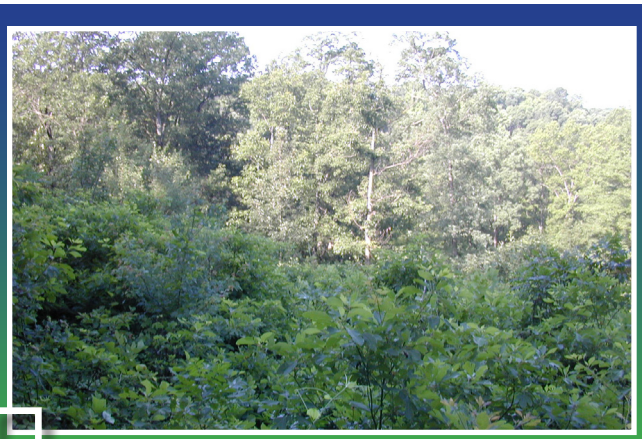
V. Discussion

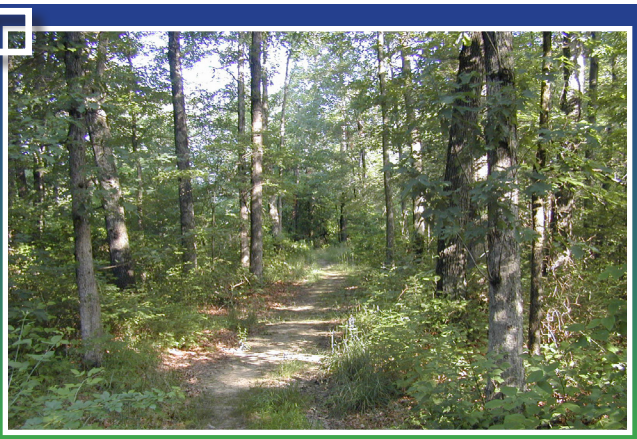
The overall BMP application rate was 87% at the time of this report. BMPs on state forest properties were also found to be 93.6% effective at protecting water quality. As the time trends show, as BMP monitoring became internal to the DoF, the application rate dropped, not because application of BMPs on state properties dropped, but because the standard of BMPs on state forest properties was being raised. The effectiveness scores have remained consistent over the years, which is evidence that BMPs were always practiced. Also, the implementation of the "4 foot rule" tightened the restriction of tops in the stream on state properties, which is always a 4 or 5 in effectiveness, but is often mitigated by being cleaned out soon after the monitoring, unless there is another reason the Administrating Forester has for keeping the top in the stream, such as stream restoration or wildlife habitat. A spreadsheet of sites with departures requiring mitigation is maintained, when mitigation takes place this is noted in the spreadsheet.

In looking at the application rate, the 1's (meets requirement) were at 87%; the 2's (minor departure) accounted for 12.4%; the 3's (major departures) accounted for 0.63%; and there was only 1 application score out of a total 12,437 with a score of 4 (total negligence) one in which environmental activists cut hydraulic lines and threw one 5-gallon gas can into a wildlife pond on Martin State Forest. In effectiveness 93.6 % in 1's (adequate protection) out of a total of 12,439, 2.3% in 2's (indirect and temporary impacts), 0.88% in 3's (indirect and prolonged), 1.8% in 4's (direct and temporary), and 1.4% in 5's (direct and prolonged). The high application and effectiveness scores show that there are many sound practices taking place on state forest timber harvest sites that are maintaining the integrity of the soil and water resources. When there are problems in either application or effectiveness, they are mostly minor and short term.

BMPs in access roads and log landings had little to no effect upon the water quality. Roads and landings are established with the knowledge that these are areas where the concentration and amount of repeated traffic will be highest. During site planning and layout managers will put roads and landings on the most stable areas outside RMZs (95.2% and 95.7% application, respectively). Sometimes site landform and characteristics force the roads to cross streams or be in a RMZ or force landings to be within a RMZ, in which case managers are more thoughtful and careful about how the harvest and closeout are carried out (98.4% and 99.3% effectiveness, respectively). The results of the monitoring show the above inferences to be true by having all of effectiveness scores in both categories above 95%.

77.5% of the application scores for skid trails were 1, but effectiveness scores of 1 account for 89.4% showing a difficulty in implementing some practices within the guidelines, but affecting water quality to some degree only 10.6% of the time. Skid trails can have a spectrum of disturbance levels depending on the amount of times the equipment drives over a particular point on the ground. For instance, the main trail just off the landing would have a higher disturbance level because all of the harvested logs have to be moved to the landing, where an area that is traveled over only twice, once to get to access logs and the other pulling the logs out, has a much lower level of disturbance. Also, skid trails go to areas that other equipment cannot access, so it may cross drainages, travel down or across hill slopes, or go into areas that





are wet most of the time, therefore, most of the application and effectiveness issues of a site are from skid trails. Also, most of the closeout practices are put in place with limited space as landforms and adjacent vegetation will often limit the equipment's ability to place structures where they would be most effective, which causes minor departures in application (21.6% of skid trail application scores are minor departures) with little to no effect on water quality.

Stream crossings are difficult to utilize without having some impact to water quality. The stream crossings cross some sort of water body, so any impact would be direct in effectiveness causing a 4 or 5 as an effectiveness score if anything goes wrong. Because of this fact, the DoF tries to avoid crossing streams if possible and still be able to access the site. Out of 284 sites, only 31% (87 sites) had stream crossings. Of those 87 sites with crossings there were a total of 167 crossings, 88 on mapped intermittent streams, and 74 on unmapped (4 foot rule) streams, and 5 on perennial streams. In the application of stream crossings, 79.2% of the practices were implemented within the guidelines, and 81.3% of the time had a 1 in effectiveness. As mentioned, stream crossings have a direct effect according to the definitions in the effectiveness scoring, so there is only one score (0.11%) of 2 and no scores of 3 in effectiveness, but 10.5% of the effectiveness scores had a 4 (direct and temporary impacts) and 8.1% had a score of 5 (direct and prolonged impacts). There was an average of 1.9 crossings for the 87 sites that had a crossing.

RMZs are much like stream crossings in that they are in close proximity to water bodies, if there is a problem it often leads to direct impacts to water quality, so managers often try to avoid placing high impact infrastructure like access roads or landings in RMZs unless they already exist; the evidence is that there were 259 sites with at least one RMZ and 183 of those sites had no roads or landings in them. Eleven of these sites had no information on roads or landings within the RMZ. Out of the 258 sites with at least 1 RMZ, there were no skid trails within the RMZ on 207 sites (74.9%). There were 69 sites that had skid trails within the RMZ . Of those 69 sites with skid trails within the RMZ, 30 had no impact to water quality, 14 sites had an indirect and temporary effect on water quality, 3 sites had an indirect and prolonged effect and 19 sites had a direct but temporary effect upon water quality, 3 sites had a direct and prolonged effect on water quality.

VI. Recommendations

- Concentrate on areas where problems are more common, such as skid trails, RMZs, and stream crossings.
- Continue to emphasize importance of diverting water before it concentrates on roads, landings, skid trails and enters streams and RMZs.
- Continue providing BMP educational information and programs for loggers and resource professionals that work on state properties. If there is an area of concern on state properties, focus training on that area.

VII. Conclusions

The Indiana Forestry BMP Guidelines are scrutinized and enforced on state forest properties more than any other general landowner category in the state of Indiana. When the internal inspections began, the application scores actually dropped due to the standards on the state forest properties being raised by things like the 4' rule. However, effectiveness in protecting water quality, which is the main goal of Indiana's Forestry BMPs, has always been high and continues at the time of this report.

Our state forest system has a diverse usage. It is the responsibility of the Division of Forestry to ensure that the forest resources are protected. Forestry BMPs are the means used to safeguard harvest sites by eliminating or reducing soil erosion on disturbed ground. Minimal soil erosion allows for quick recovery of the site because the topsoil is still in place to allow for natural succession to take place. Limited sedimentation to the surface waters of the forest protects or restores water quality.

Appendix A

BMP Definition Clarification – 4-Foot Rule

Background

The BMP Field Guide states "Remove felled tops and logging debris from the channels of perennial and large intermittent streams." On the BMP Monitor Sheet (expanded) the definition of the streams was further defined as "…wider than 6'…" The purpose of this was to identify a specified width **for monitoring purposes**, rather than leaving a vague descriptive term (e.g. large intermittent). It should be realized that BMPs are guidelines and in some instances even a 6 foot width may not be "large" and other situations where more narrow streams may be large from a hydrological standpoint. Foresters therefore are expected to interpret the local hydrology and make on-site determinations when applying BMPs. This is clearly true for this BMP standard.

At the start of BMP monitoring on State Forests it was decided to try to adhere to a tighter standard for streams on State Forests- hence the 4 foot standard for large intermittent streams. This would serve both as a demonstration of commitment to water quality, and as a demonstration and test of a tighter standard.

Variable stream width cropped up as a problem early in this process, requiring clarification of stream width. Streams would widen out over four feet then narrow back up to less than four feet. This created a burden of trying to find the last point upstream that a stream was four feet wide. To solve this, it was decided that to meet the four-foot rule, a stream had to be consistently four wide or wider. This solved some of the concerns, but there are still concerns such as what debris needs to be removed and where is a stream consistently four wide or wider.

Below is the latest attempt to clarify the four-foot rule. This covers both the definition of the stream and what debris is to be removed.

Removing Logging Debris from Streams—4-Foot Rule

To meet the BMP Field Guide guidelines for riparian zones that states "Remove felled tops and logging debris from the channels of perennial and large intermittent streams", the BMP Monitor Sheet has Item Z2 "Perennial & large intermittent streams clear of obstructing debris." On state forests, all streams that are to meet this standard will have a clearly defined bed with a width that equals or exceeds four feet.

The bed is that portion of the stream that is the lowest level where water commonly flows at typical (not storm) levels. This will generally be at the base of the banks and will usually consist of aggregate or exposed alluvium. The bed will generally be free of any significant vegetation because of the regular scouring and water flows. An area with a strong, well-rooted vegetative component with a relatively stable soil surface will not be considered streambed. In streams where the channel is strewn with large rocks, the bed will be the area of smaller gravel at the base of the large rocks.

The stream will be considered four feet or wider until the bed, moving upstream, reaches the first point where the stream bed width drops below four feet for a lineal distance of 10 feet or more. Any portion of the drainage system up stream of this point will not be subject to the debris removal guidelines for large intermittent streams, and debris left in these portions of the drainage will not be considered a departure during monitoring.

Downstream of the identified four foot wide point all logging debris, except as noted below, that will come in contact with the water when the stream is "bank full", and impede or divert stream flow, must be removed from the stream channel. Unattached, individual pieces of debris, less than two inches in diameter or less than four feet in length will not ordinarily impede flow and do not need to be removed. Debris that bridges the stream channel from top of bank to top of bank, does not impede flow, and is unlikely to fall into the stream channel within one year is not required to be removed. Debris less than 2 inches in diameter obstructing less than 20% of the stream channel does not need to be removed.

Debris removal is to be accomplished in a manner that will minimize disturbance to the stream banks. The recommended method of removal is to pull the material free of the channel using a cable skidder or other equipment that is kept back from the stream edges. Another option is cut debris into smaller pieces that can be removed from the channel or that would no longer impede flow. Equipment should not be used in the stream channel to push the material out of the channel. Careful marking of the trees to be harvested, use of directional felling, and clearly explaining the BMP requirements during the pre-harvest conference will minimize the amount of debris that must be removed from stream channels.

The point where the stream channel reaches the four-foot width threshold should be clearly delineated in harvest areas. While upstream of this point will not be considered subject to debris removal from streams, care should be taken to avoid excessive, intentional deposition of debris in all naturally occurring drainage features regardless of size. Excessive piling (beyond felling) of debris in any drainage that severely impedes flow may be considered a departure.

Appendix B
FORESTRY BMP MONITORING WORKSHEET
(2000)

DATE INSPECTED:_____
TEAM:_____
OWNER:_____ PHONE:_____
_____
_____

COUNTY:_____Site #:_____ ACRES HARVEST-
ED:_____
CIVIL TWP:_____ USGS QUAD:_____
_____
SEC:_____TWP:_____ RANGE:_____
MAJOR WATERSHED:_____
DATE OF ACTIVITY:_____
HARVEST EQUIPMENT USED: Dozer:__ Skidder:__ Horses:__ Other:__
TYPE OF HARVEST: Diameter limit:__ Single Tree:__ Group Selection:__ Clear Cut:__ Other:__

SITE CONDITIONS

TERRAIN: BOTTOMLAND_____% RIDGES_____% SIDE SLOPES_____%
SLOPE STEEPNESS: (2-6%)_____ (6-12%)_____ (12-20%)_____ (20+%)_____
LAKES PRESENT: name:_____shore length:_____
PERENNIAL STREAMS PRESENT: name:_____width:_____length:_____
SINKHOLES PRESENT: Yes_____ No_____ FLOWING SPRINGS PRESENT: Yes_____
No_____
OPEN WATER WETLANDS PRESENT: Yes_____ No_____ .

FOR OFFICE USE – DO NOT COMPLETE

OPERATOR/FORESTER: (leave blank)_____

TYPE OF OWNERSHIP: nipf:__ clf:__ industry:__ state:__ fed:__ county:__ other:__

APPLICATION
0--The Practice Not Needed or Applied on Site
1--Operation Meets Requirement of BMP
2--Minor Departure from BMP
3--Major Departure from BMP
4--Gross Neglect of BMP

EFFECTIVENESS
1--Adequate Protection of Water Resources
2--Indirect and Temporary Impacts on Water Resources
3--Indirect and Prolonged Impacts on Water Resources
4--Direct and Temporary Impacts on Water Resources
5--Direct and Prolonged Impacts on Water Resources

APPLICATION DEFINITIONS (BY EXAMPLE)
MINOR DEPARTURE: Practice not clearly needed; attempted practice but poorly applied; small potential for soil to reach streams.
MAJOR DEPARTURE: Practice clearly needed; common departures from practice; large potential for soil to reach streams.
GROSS NEGLECT: No attempt at application; total disregard for water quality; large and direct impacts.

EFFECTIVENESS DEFINITIONS (BY EXAMPLE)
ADEQUATE: Small amount of material eroded; material does not reach drainages, streams, lakes or sinkhole openings.
INDIRECT IMPACT: Erosion and delivery of material to drainages (including ephemerals) but not to intermittent or perennial streams, lakes or sinkhole openings.
DIRECT IMPACT: Erosion and subsequent delivery of sediment to intermittent or perennial streams, lakes or sinkhole openings.
TEMPORARY IMPACT: Impacts lasting one year or less; no more than one runoff season; small amount of material involved.
PROLONGED IMPACT: Impacts lasting more than one year; large amount of material involved.

*It is possible to have a departure from BMPs and still have adequate protection.

ACCESS ROADS							APPLICATION (0-4)		
								EFFECTIVENESS (1-5)	
									COMMENTS
There is no access road present _____ (If true, do not answer questions below)									
A1. Uses existing routes where appropriate									
A2. Adequate buffer strip next to water courses and sensitive areas									
A3. Avoids unstable gullies, seeps, very poorly drained areas									
A4. Road grades are within standards									
A5. Amount of roads minimized									
A6. Stream crossings minimized									
A7. Road excavation minimized									
A8. Excavated and fill materials placed appropriately									
A9. Roads constructed to drain well									
A10. Appropriate road stabilization, drainage & diversions installed									
X=applied	**water bars_____ dips/rolls_____ outslopes_____ berms cut_____ culverts____ geotextile____ rock____ seed____ mulch____**								
A11. Water diversions are in working order (_____% working) **Failure due to: installation, damage, location, timing, weather, other**									
A12. Runoff diverted onto stable forest floor areas									
A13. Mud kept off public roadways									
A14. Public road drainage system maintained									
A15. Appropriate traffic barriers installed									

APPLICATION
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LOG LANDINGS									
							APPLICATION (0-4)		
								EFFECTIVENESS (1-5)	
									COMMENTS
Y1. Suitable number and size of landings									
Y2. Landings located outside RMZ									
Y3. Landings located on stable areas									
Y4. Excavation of site minimized									
Y5. Landings avoid concentrating or collecting runoff									
Y6. Landing's runoff enters stable area									
Y7. Proper water diversions in working order									
Y8. Landing smoothed and soil stabilized									
Y9. Landings free of fuel and lubricant spills and litter									
Y10. Landing location suitable for equipment fueling and maintenance									
Number of log landings _____ Size: (acres) _____									

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SKID TRAILS								
						APPLICATION (0-4)		
							EFFECTIVENESS (1-5)	
								COMMENTS
S1. Uses existing routes where appropriate								
S2. Adequate buffer strip next to water courses & sensitive areas								
S3. Avoids steep and long straight grades (>20% for >200')								
S4. Avoids unstable gullies, seeps, poorly drained areas								
S5. Amount of skid trails minimized								
S6. Trail excavation minimized								
S7. Appropriate drainage and diversions installed								
X= applied	water bars____ outslopes____ dips/rolls____ berms cut____ culverts____ seed____ mulch____ rock____ other____							
S8. Water diversions in working order (_____% working) Failure due to: installation, damage, location, timing, weather, other								
S9. Runoff diverted onto stable forest floor areas								
S10. Streams not used as skid trails (except crossings)								
Types of streams involved and length of disturbance: perennial_____ , mapped intermittent_____. Unmapped intermittent_____ , ephemeral_____.								

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STREAM CROSSINGS					
			APPLICATION (0-4)		
				EFFECTIVENESS (1-5)	
					COMMENTS
X1. Number of crossings minimized					
X2. Crossings minimize disturbance to the natural bed & banks					
X3. Stream bank approaches properly designed and stabilized					
X4. Water runoff diverted from road prior to crossing					
X5. Crossing as close to 90 degree angle as practicable					
X6. Crossing does not unduly restrict water flow					
X7. Soil has not been used as fill in the stream (except culverts)					
X8. Ford constructed of non erosive materials that will not degrade water quality					
X9. Fords have stable banks and streambed					
X10. Culverts are properly sized and installed					
X11. Culverts clear of significant flow obstructions					
X12. Temporary structures properly anchored					
X13. Temporary structures and resulting obstructions removed					
Number of perennial crossings_____ widths_____. **Number of intermittent crossings_____ widths_____ Number of unmapped intermittents_____ widths_____.**					

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RIPARIAN MANAGEMENT ZONES			
	APPLICATION (0-4)		
		EFFECTIVENESS (1-5)	
			COMMENTS
Z1. RMZ present on this site include: _____ lakes, _____ rivers, _____ perennial streams, _____ intermittent streams, _____ sinkhole openings (specify), _____ open water wetlands, _____ unmapped intermittent streams			
Z2. Perennial & large intermittent streams clear of obstructing logging debris			
Z3. Logging debris placed back from water course to prevent movement into streams during floods			
Z4. RMZ free of piled slash, debris and fill			
Z5. Less than 10% bare mineral soil scattered within RMZ - not including crossing			
Z6. Adequate tree stocking in primary RMZ next to perennial streams			
Z7. RMZ free of roads and landings (except crossings) Were roads pre-existing? _____			
Z8. Water diverted from roads before entering RMZ			
Z9. Water diverted onto stable areas of the forest floor			
Z10. Road and trail surfaces stabilized as needed within RMZ			
Z11. Ephemeral channels free of excavated material			

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SUPPLEMENTAL QUESTIONS AND SUMMARY

1) What went right on this site? (Summarize highlights.)

2) What went wrong on this site? (Summarize problems.)

3) Have other activities occurred on this site that potentially impact water quality? (e.g,. ATV use, other vehicle traffic, grazing, etc.) If so, please explain.

4) Were traffic barriers in place to prevent trespass damage? _____.
What kind of trespass damage was observed?

5) Are there mitigating activities that should take place on this site or is corrective action already being taken?

6) -Has the sale administrator received BMP training? Yes_____ No_____Unknown_____
- Has the operator (logger) received BMP training? Yes_____ No_____Unknown_____
- Was the sale administered by a forester? Yes_____ No_____Unknown_____
- Is the landowner aware of BMPs? Yes_____ No_____Unknown_____

7) Give this site an overall rating of 1-8 combining application of BMPs with impact to water quality.

Rate this site from 1-4 for the overall application of BMPs _____
1=above average 2=average 3=poor 4=total negligence

Rate this site from 1-4 for its overall impact to water quality _____
1= no visible impact 2=slight 3=moderate 4=severe

SITE RATING _____/2=_____

Note: These numbers do no necessarily need to directly reflect the worksheet ratings for application or effectiveness.

Field Guide Cross Reference

On this page is each question in the monitoring sheet and the corresponding pages on the subject in the BMP Field Guide.

ACCESS Roads == Section II, pages 8-16

A1 == pages 4, 8, 10
A2 == pages 8, 9, 12, Section V page 32, 33, Table 4 page 34, 35
A3 == page 8
A4 == page 8
A5 == page 10
A6 == page 8 and Section IV page 24 – 30
A7 == pages 8, 10
A8 == pages 10, 12, 24, 29
A9 == pages 8, 10, Table 1 page 11, 12
A10 = pages 8, 10 Table 1 page 11, 12, 14, 15, Table 2 page 21, 22
X=Applied == (waterbars, pages 21-22), (dips/rolls, pages 21-22), (outslopes, Glossary), (berms cut, Glossary),(culverts, pages 27-28), (geotextile, Glossary), (rock, page 10), (seed, Appendix A), (mulch, Appendix A).
A11 = pages 14, 15, Table 1 page 11, 18, Table 2 page 21
A12 = page 10
A13 = pages 13, 14
A14 = page 14

LOG LANDINGS == Section IV, pages 36-40

Y1 == pages 36, 39
Y2 == Table 4 page 34, 36
Y3 == page 36
Y4 == page 38
Y5 == pages 36, 38-40
Y6 == pages 38-40
Y7 == pages 38-40
Y8 == pages 38-40
Y9 == pages 39, 40
Y10 = page 39

SKID TRAILS == Section III, pages 18-22

S1 == pages 4, 18
S2 == pages 18, 20, Section V pages 32-35
S3 == page 18
S4 == page 18
S5 == page 18
S6 == page 18
S7 == Table 1 page 11, pages 18-20, Table 2 page 21, 22, 27, 28

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S8 == Table 1 page 11, pages 14, 15, 20 Table 2 page 21
S9 == page 20
S10 = pages 18-20, Section IV pages 24-30
Types of Streams == page 24, Glossary, and Section V pages 32-35

STREAM CROSSINGS == Section IV, pages 24-30

X1 == page 24
X2 == page 24
X3 == pages 24, 25
X4 == pages 24, 25
X5 == page 24
X6 == pages 24-26, 28
X7 == pages 24, 29
X8 == pages 24, 29
X9 == pages 24, 25, 29
X10 = pages 25, 27, Table 3 page 28
X11 = pages 24, 27, 28
X12 = pages 25, 26
X13 = pages 25-29

RIPARIAN MANAGEMENT ZONES == Section V, pages 32-35

Z1 == pages 32, 34, Glossary
Z2 == page 33
Z3 == pages 32-34
Z4 == pages 32-34
Z5 == pages 32-34
Z6 == pages 32-34
Z7 == pages 32, 34
Z8 == pages 33, 34
Z9 == pages 32-34
Z10 = pages 33, 34
Z11 = page 35