Wisconsin's Forestry Best Management Practices (BMPs) for Water Quality

2014 BMP Monitoring Report




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Executive Summary

In 2014, federal landowners and large landowners (previously known as industrial) were monitored for the application and effectiveness of Wisconsin's Forestry Best Management Practices (BMPs) for Water Quality. Each of these landowners had 29 sites, totaling 58 sites monitored. All 58 of these sites have water resources in or adjacent to the sale in order to be eligible to be monitored for the BMP program. Some sites had more than one water resource with wetlands being the most common water resource observed.

Timber sale information includes: age, size, season, and the species composition of the harvest.

Federal

Twenty-four of the sites were harvested between 1-2 years before the monitoring took place, with the average size of 36.6 acres. The total acres monitored were 1062 with a range from 7 acres to 70 acres. The most common season of harvest was winter (12 sites); with spring having the fewest number (1 site). Selection harvests were also the most abundant (17 sites) with aspen being the most harvested dominant tree stand classification type (17 sites). The least harvested timber type was tied between oak/hickory and swamp conifers (1 site each).

Large

Twenty-one of the sites were harvested between 1-2 years before the monitoring took place, with an average size of 104.4 acres. The total acres monitored were 3027.25 with a range from 7.25 acres all the way up to 500 acres. Large landowners completed the harvests over more than one season (9 sites), and spring was the least common season of harvest (1 site). Selection harvests were the most abundant (12 sites) with maple/basswood being the most harvested dominant tree stand classification type (20 sites). The least harvested timber type was tied between swamp conifers and spruce/fir (1 site each).

A large number of the BMPs (74.7% for federal and 71.5% for large landowners) were not applicable to the monitoring sites. Since there are 119 questions on a BMP monitoring form, this equates to only an average of 32 BMP questions that were applicable for an individual sale. Of the BMPs that are applicable to the sale, there are three ways the monitoring teams could rate the BMP. They are:

- Applied Correctly (example: properly installed and aligned culvert on forest road system)
- Applied Incorrectly (example: culvert was installed but undersized)
- Not Applied (example: culvert was not installed on forest road system where it was needed)

In 2014, the BMP monitoring program saw good application rates; 96.3% (federal) and 94.7% (large) of the time BMPs were being 'applied correctly where needed'. The effectiveness of the BMPs that were 'applied correctly' was very good and 99.8% (federal) and 99.9% (large) of the time no adverse impacts were observed on these BMPs. Only a total of 3.7% (federal) and 5.3% (large) of the BMPs that were

applicable, were either ‘applied incorrectly’ or ‘not applied’. The effectiveness of BMPs that were ‘not applied’ were lower at protecting water quality (32.0% federal, 48.6% large), and the effectiveness of BMPs that were ‘applied incorrectly’ were lower still (14.3% federal, 11.8% large).There are five monitoring categories that the BMP questions are broken down into and each had different correct application rates:

Table 1. Correct Application Rates		
BMP Monitoring Category	**Federal**	**Large**
Fuels, Wastes, Lubricants, and Spills	98.20%	94.80%
Riparian Management Zones	100%	95.40%
Forest Roads	92.90%	90.60%
Timber Harvesting	98.70%	97.40%
Wetlands	96.10%	98.00%

Table 1. The correct application rates, listed by monitoring category, between federal and large landowners.

Overall, Wisconsin’s BMPs for water quality are effective at protecting water quality because the majority of the BMPs are ‘applied correctly’ at 96.3% (federal) and 94.7% (large), which result in low amounts of negative impact to water quality 0.2% (federal) and 0.1% (large). Failure to apply BMPs correctly negatively impacts water quality much more frequently, but this only happened 3.7% (federal) and 5.3% (large) of the time. Forest roads were the lowest monitored category of correctly applied BMPs for both landowners, whereas RMZs and wetlands had the highest for federal and large landowners respectively.

2014 BMP Monitoring Sites Map

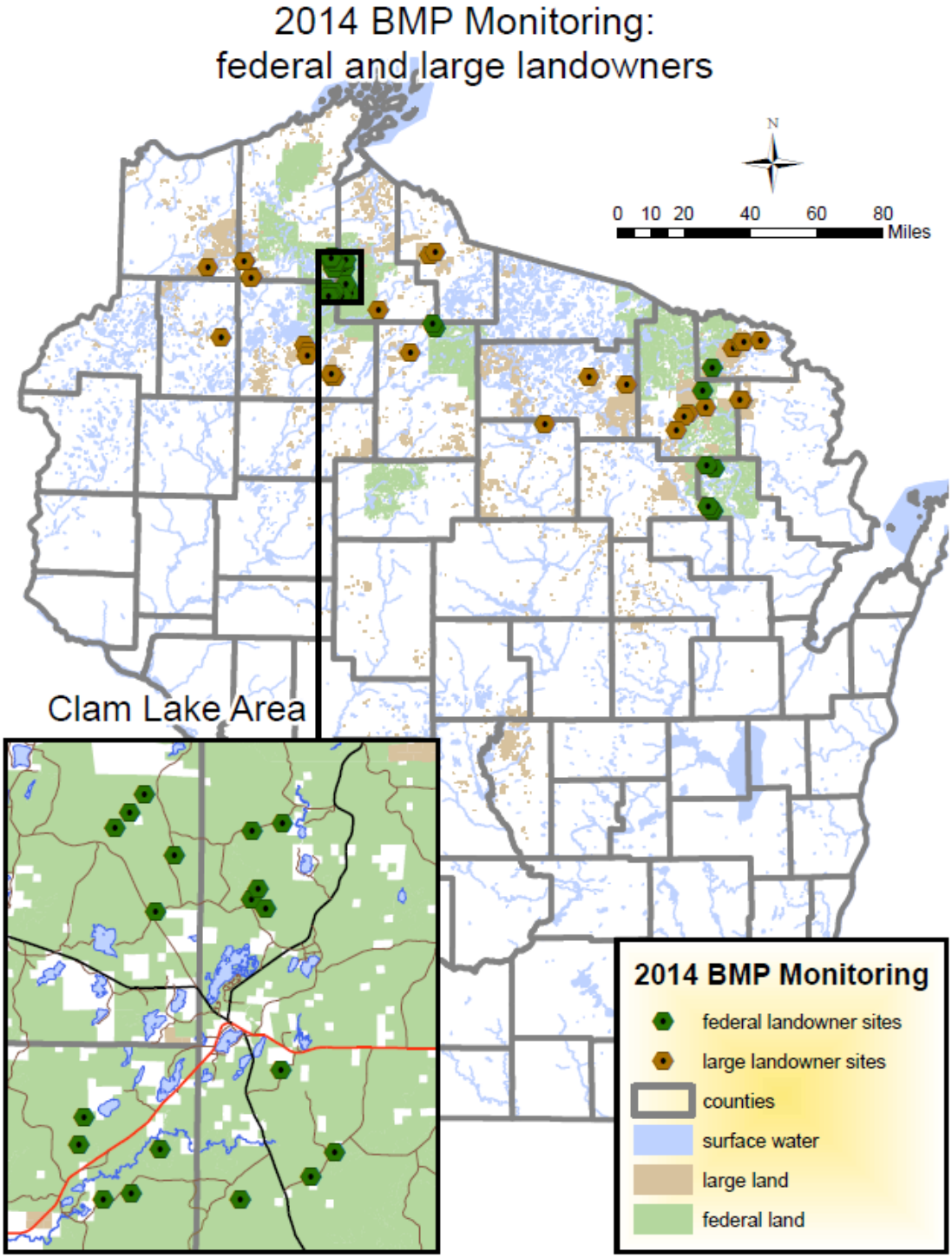


Figure 1. The sites monitored by the 2014 BMP teams. Brown dots represent large landowner sites and green dots represent federal landowner sites. Included is an inset of the Clam Lake area on Hwy 77 which contained 19 of the 29 federal sites. ***Note: Some dots are close together making the total number of sites difficult to determine on this map.*** ***Disclaimer:*The Department has made reasonable efforts to provide you with accurate information, but cannot exclude the possibility of errors or omissions in sources or of changes in actual conditions. The Department makes no warranties of any kind, either the express or implied. Changes may be periodically made to the information herein.****

Introduction

The 2014 Best Management Practices (BMPs) for water quality were monitored on harvested lands held by large landowner (previously listed in past reports as Industrial), and by the federal government. BMPs for water quality are in place to ensure that the water resources in Wisconsin remain safe and clean after silvicultural activities take place in Wisconsin's forests.

There were 750 sites held by the federal government and 969 sites were owned by large landowners. These sites range across the entire state, but are largely focused to the northern half of the state. They also range greatly in size and could be 7 acres in size to over 500 acres. In order to provide a statistically valid sample size, 58 sites (29 from each land owner category) were chosen to be monitored to ensure that BMPs for water quality were being practiced and used correctly.

The list of possible monitoring sites comes from the DNR Forest Tax Field Manager and the Timber Program Manager for Chequamegon-Nicolet and Ottawa National Forests. These people are supplied cutting notices from large landowners and federal lands (respectively), for all sites that are listed to be cut within the year 2013. From there it is up to the DNR Forest Hydrologist and a DNR BMP Forester to determine whether they are eligible to be monitored.

There were a couple reasons that sites may not have been monitored for the 2014 BMP monitoring cycle even though they were on the cutting notices from the year 2013. The first reason is that a site must be eligible for BMP monitoring. In order to be eligible a site must have at least one of the following characteristics:

- Harvesting completed within 200 feet of a lake, river or steam
- At least one acre of wetland harvested
- A significant length of wetland crossed (≥50 ft.)
- A stream crossed

In addition to these eligibility criteria, some additional constraints were put on choosing sites after DNR staff visited some of the site locations. One very simple reason why some of these sites did not make it was due to the fact that they were not yet harvested. Some of these sites even had paint designating them to be cut, but due to unknown circumstances, they did not get harvested as presumed on the cutting notice date of 2013. Another reason why some sites were not able to be monitored even though they had met the eligibility criteria was because the sites were not physically able to be visited. This may have been due to private property crossings, gates which restricted access, or other physical barriers like windfall timber or washed out roads.

Timber Harvest Information

Harvest Age

The vast majority (24 federal and 21 large) of the sites were cut between 1-2 years prior to the monitoring in 2014 (Table 2). The other age categories of less than one year and greater than two years is less common and only makes up 5 sites for federal and 8 sites for large landowners. If not provided the harvest age by the landowner/forester, teams assessed harvest age by the regeneration growth of vegetation that took place after the harvest occurred. In one case, a monitoring team was unable to determine the age of the harvest on large landowners property.

Table 2. Harvest Age

Age	Federal	Large
Less than 1 year	4	0
1 year - 2 years	24	21
more than 2 years	1	7
unknown	0	1

Table 2. The amount of time between when the site was cut and when the site was monitored is called harvest age. The results for harvest age between federal and large landowners.

Harvest Size

When breaking the harvest size into the two categories of landowners—federal and large landowners (named industrial in prior BMP reports)—one trend becomes very apparent. Federal cuts are much smaller on average (36.6 acres compared to 104.3 acres), range was smaller (63 acres compared to 492.75 acres), and the grand total of acreage harvested is also much smaller (1062 acres compared to 3027.25 acres). This is almost a 3:1 ratio, meaning that for every acre monitored on federal land, three acres were monitored on large landowners. The federal monitoring sites were probably smaller due to the fact that they were broken down into smaller sections—called payment units—and each payment unit was a considered a separate site, eligible to be monitored individually.

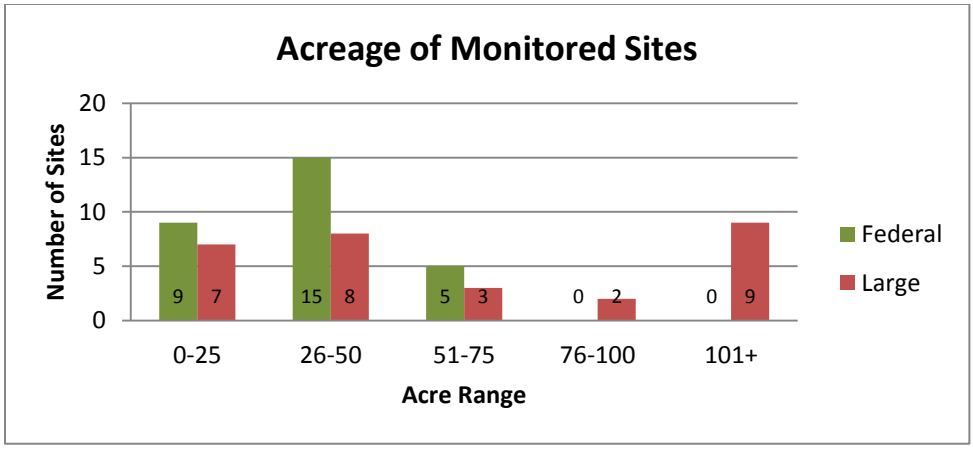


Figure 2. The acreage of monitoring sites, divided between the two landowners.

Season of Harvest

The easiest and most effective way for a BMP monitoring team to determine the season of cut is to ask an accompanying forester who oversaw the sale. There are two other ways for teams to determine a season of cut if a sale forester is not present. One way was to look at ground disturbance especially within wet areas of the sale. If little or no ground disturbance was noticed the sale was placed in the winter category. The other method to determine season was to look at stump height. If the site was cut in winter, the stumps should be left higher, due to snow cover, than if they were cut in other seasons.

Federal

The most common season of harvest was winter (12 out of 29 sites) and the least common was spring (1 site). The proportion of winter harvests that occurred on federal land may not be a true proportion of winter harvest that occurred out of the initial 750 cut sites. This is due to the fact that selected sites are more likely to have a water resource(s) present and therefore, the site is much more likely to be cut during frozen or dry condition than a site that had no water resource present.

Large

More than one season was the most common category of harvest for large landowners (9 sites). The least common season of harvest was spring (1 site) and a fairly uniform harvest across winter, summer and fall, with 5, 4, 4 sites respectively. The reason some sites used multiple seasons to complete a harvest and cut non-water sensitive areas in a non-winter season and came back later in the winter to comply with the BMP guidance of operating in these specified sensitive areas when ground is needed to be frozen or dry. Water sensitive sites along with having a large site were the main reasons that sites are harvested in more than one season.

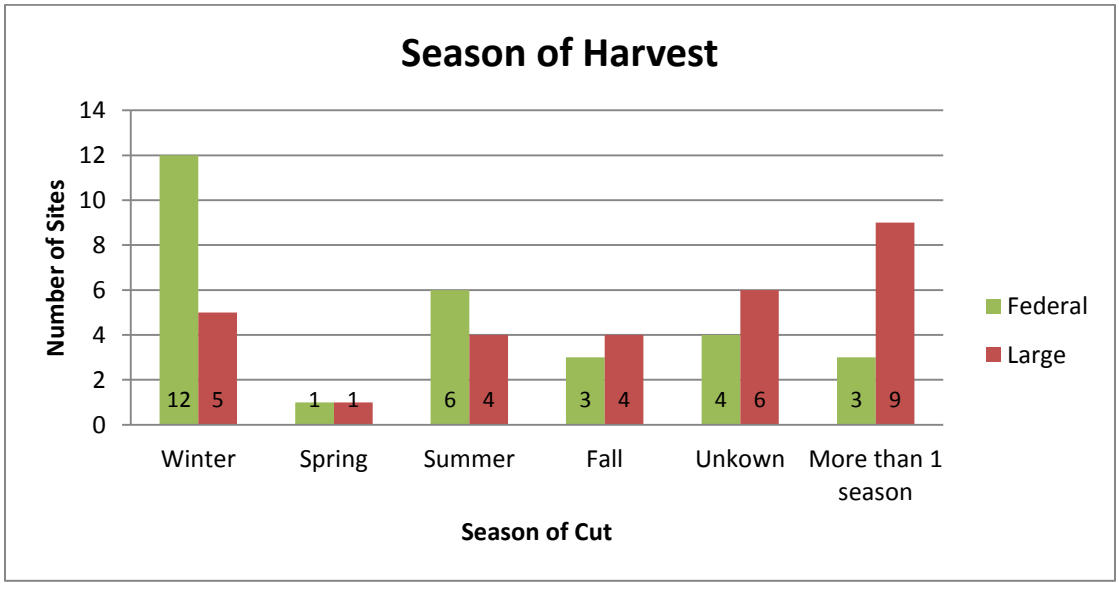


Figure 3. The season(s) that the monitoring sites were harvested.

Water Resources

There were four types of water resources (Lakes, Streams, Wetlands, and Springs/Seeps) found in the 2014 BMP monitoring sites. Streams are broken down even farther by their width and designated trout stream classification (Figure 4). Width and the presence of trout are important because these two factors help determine the distance of the Riparian Management Zone (RMZ). Some of the larger streams that was encountered by the BMP monitoring teams were the South Branch of the Oconto River (Oconto County), the North Fork of the Totogatic River (Bayfield County), and Bean Brook (Washburn County) just to name a few. Some of the smaller streams include Patterson Creek (Price County) and Blaser Creek (Bayfield County).

Federal

The most common water resource is wetlands (24 sites) with lakes being the least common (1 site). Streams were the second most common, with 6 sites containing streams greater than three feet wide, 3 sites containing streams one to three feet wide, and 1 site containing a stream less than one foot wide. Springs and/or seeps were only present on 2 sites.

Large

The most common water resource is wetlands (24 sites) with lakes being the least common (2 sites). Streams were the second most common, with 10 sites containing streams greater than three feet wide, 3 sites containing streams one to three feet wide, and no sites contained a stream less than one foot wide. Springs and/or seeps were only present on 5 sites.

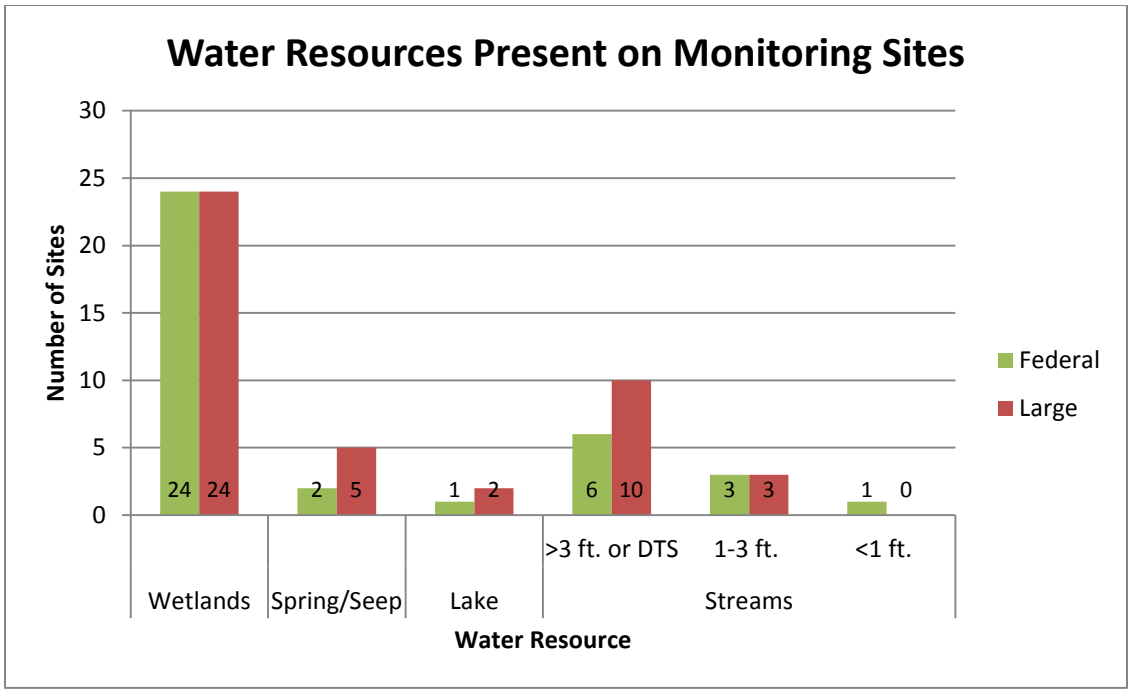


Figure 4. Type of water resource found in each of the monitoring sites. Additionally, streams are broken down according to width and Designating Trout Streams (DTS). *Note some sites have more than one stream classification running in or adjacent through the sale causing the total number of sites with streams to be less than the sum of all the different stream classes.*

RMZs

Riparian Management Zones (RMZs) are areas of specific management criteria next to a stream or lake in order to provide shade and soil stabilization. Excess heat or soil erosion caused by an exposed RMZ can possibly lead to impacts to water quality. The two different RMZ distances are 100 feet and 35 feet. A 100 foot RMZ is recommended for lakes and streams of a width three feet or greater and all designated trout streams. A 35 foot RMZ is recommended for the two categories of streams less than three feet wide. All four water resources, that recommend an RMZ, have different harvesting BMPs unique to each resource. RMZs can be modified in the BMP manual by foresters according to several reasons including: timber species composition, presence of beavers, slope, soil, season of harvest, and storm or insect damage. The BMP Manual's recommended RMZ distance from Ordinary High Water Mark (OHWM) to the timber harvesting edge can fall into one of four categories:

- The site RMZ can be increased in distance
- The site RMZ can meet the recommended distance
- The site RMZ can be decreased in distance
- The site may not have used an RMZ

Federal

Of the 11 sites that had water resources which recommended a RMZ: 4 RMZs were increased, 4 RMZs were the recommended distance, and 3 RMZs were decreased. All sites that contained a water resource that recommended a RMZ were observed to have a RMZ in place, even if it was modified. The only water resource that received a decrease RMZ distance was streams greater than three feet wide or designated trout streams.

Large

Of the 11 sites that had water resources which recommended a RMZ: 5 RMZs were increased, 6 RMZs were the recommended distance, and only 1 RMZ were decreased. Three sites, which contained water resources that recommended an RMZ, were found not to have any observable RMZ in place. Both lakes present next to the harvest areas did not have an RMZ used.

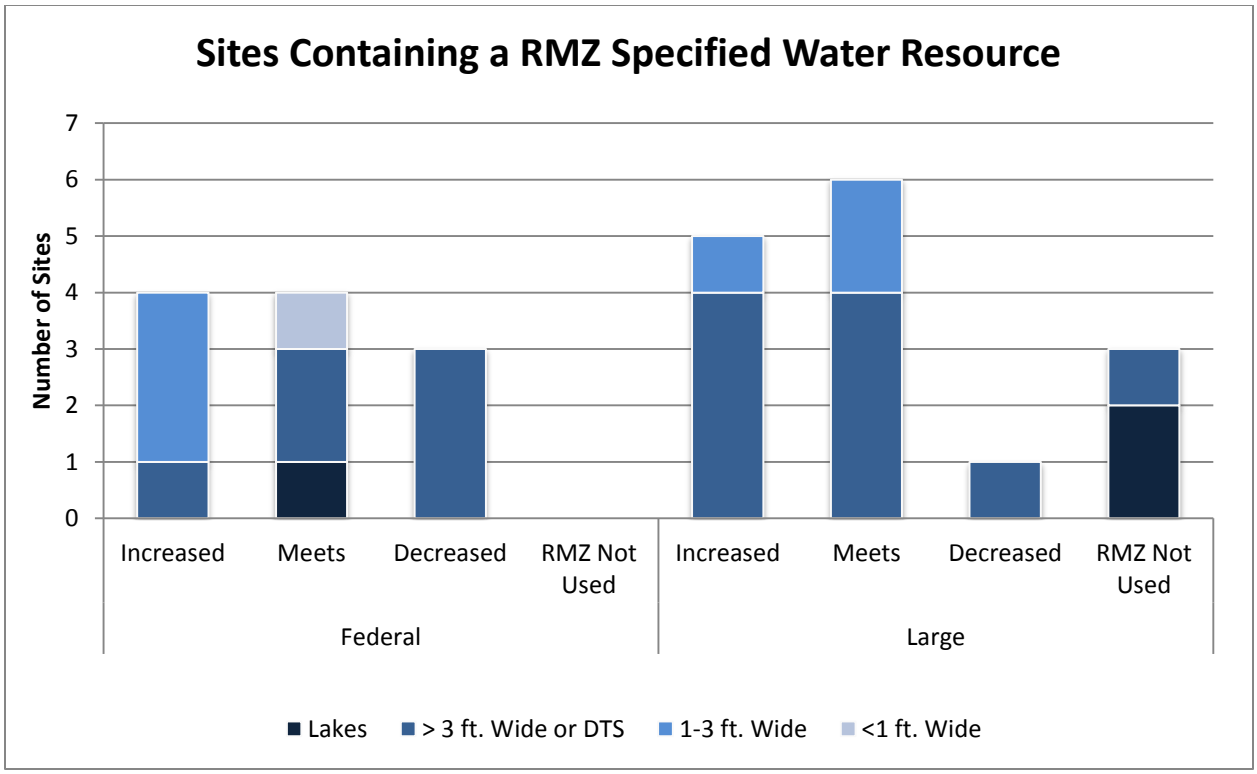


Figure 5. Sites containing surface water qualifying for RMZs (Increased, Meets, Decreased, or Not Used). The water resource type is shown at the bottom of the figure.

Species Composition of Harvest Sites

There were several tree stand classifications recognized by the BMP teams. It is important to note that these are not mutually exclusive categories and many stands had more than one type of tree harvested. Some tree species in the harvest tree category of "other" include eastern hemlock and birch.

Federal

The most common harvest tree category was aspen (17 sites) and there were two tree categories tied for the least common, oak/hickory and swamp conifers (each has 1 site). Spruce/Fir and Pine were also very common harvest tree categories, at 16 sites and 13 sites respectively.

Large

The most common harvest tree category was maple/basswood (20 sites) followed by aspen (14 sites). Spruce/fir and swamp conifers were tied at the least common harvest tree category (each has 1 site). Oak/hickory was the third most common (9 sites) and all the other categories contained less than 4 sites each.

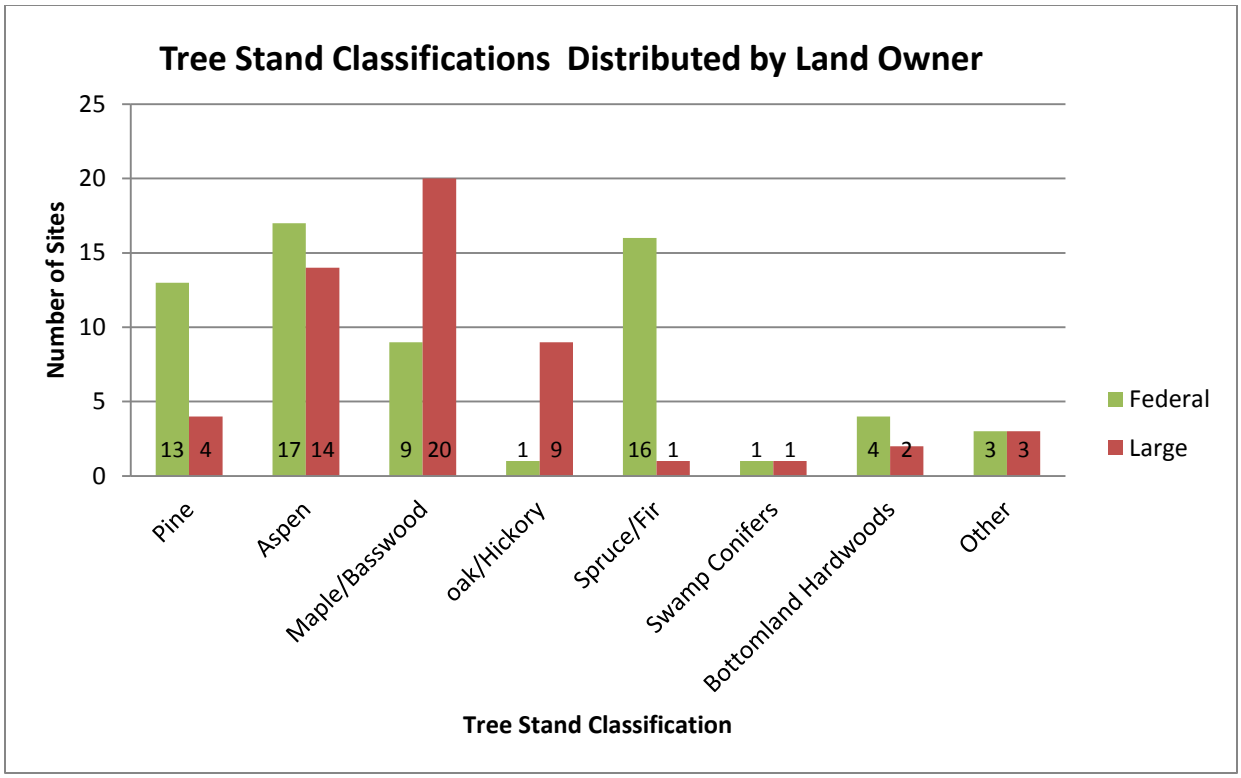


Figure 6. Tree stand classifications between federal and large landowners. ***Note: the sites containing more than one dominate cover type were recorded as having both tree stand classifications.***

Silviculture Prescriptions

Silviculture prescriptions determine several aspects of a timber harvest: it can determine which trees get harvested, how many trees get harvested, what the remaining tree density should be, and may determine which tree species are established post-harvest.

Federal

The most common harvest method is 'selection harvest' (17 sites) with the second most common being 'clearcut with reserves' (10 sites). The only other two harvest methods used were 'more than one method' and 'shelterwood' (1 site each).

Large

The most common harvest method is 'selection harvest' (12 sites) with the least common being 'clearcut with reserves' (2 sites). The harvest method 'other' was utilized at 8 sites and 'more than one method' (3 sites) and 'clearcut' (4 sites) were also utilized.

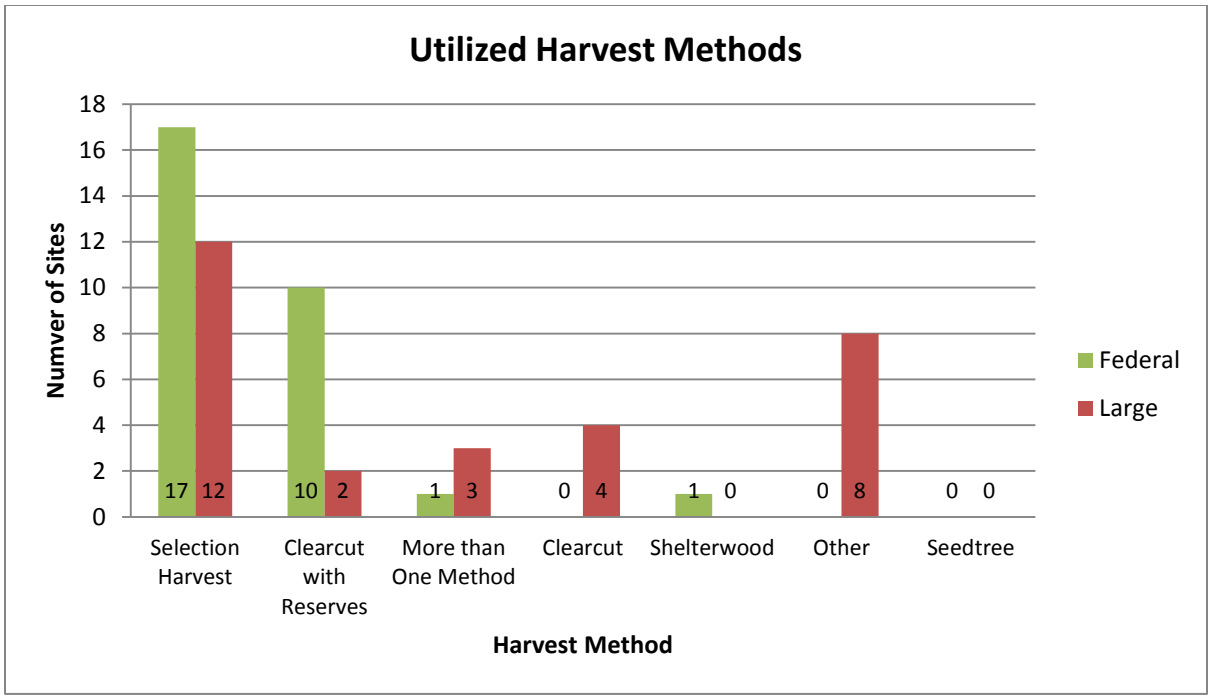


Figure 7. The harvest methods utilized by the 2014 BMP monitoring sites.

Timber Stand Improvements

Timber stand improvements (TSI) are defined as improving the quality of a forest or tree stand by removing undesirable trees or tree species to obtain the desired forest composition or forest timber productivity. This may include methods that yield no current merchantable timber including girdling, spraying herbicide, and burning.

Federal

The most common TSI was 'other' (13 sites) and both 'crop tree release' and 'none' were tied at 8 sites each. Some of the 'other' category includes 'regeneration' and 'canopy gap opening 'cuts. No pre-commercial thinning TSI's were conducted.

Large

The most common TSI was 'none' (21 sites) and 'crop tree release' is the second most common (5 sites). The least common TSI was other (3 sites). No pre-commercial thinning TSI's were conducted.

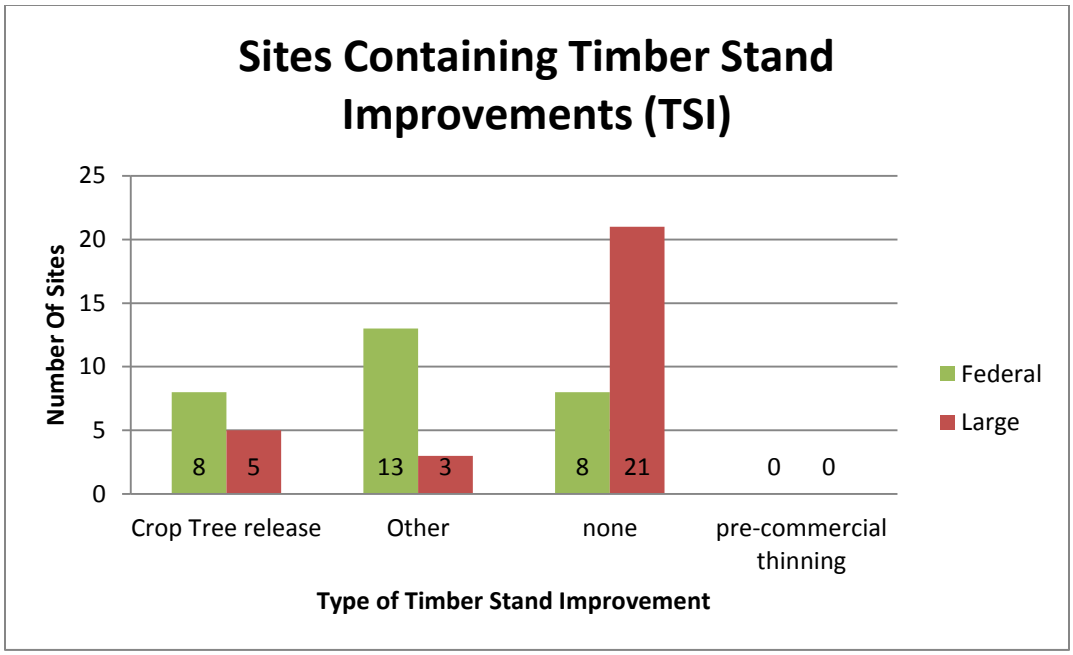


Figure 8. The number of sites that incorporate TSI's into their harvesting methods.

Harvest System

The vast majority of sites (26 federal and 28 large) used shortwood as their primary type of harvest system. Only 3 of sites (all federal sites) used tree-length (pole skidding) as their primary type of harvest system. One site (large landowner site) used both shortwood and tree-length.

Table 3. Harvest Systems Used

Harvest System	Federal	Large
Shortwood(Cut-to-length)	26	28
Tree-length(pole skidding)	3	0
Whole Tree (chipping)	0	0
Both	0	1

Table 3. Harvest Systems Used on federal and large landowners.

Equipment

The BMP monitoring teams determined the equipment used for the harvest operation using several methods. If a site specific forester was present, they simply inquired him/her for that information. Otherwise looking for signs of either wheel or track marks on the ground as a result of the harvest operation. If the ground was dry, frozen, or had lots of snow, the equipment marks would be difficult to see if even present.

Wheeled was the most commonly used equipment (20 federal sites and 21 large landowner sites), whereas nine sites used both tracked and wheeled for federal sites and two for large landowner sites. On, six of the large landowner sites, BMP monitoring teams were unable to determine the type of equipment used. No sites for either landowner used solely tracked equipment.

Table 4. Equipment Used		
Equipment Type	Federal	Large
Wheeled	20	21
Tracked	0	0
Both	9	2
Unknown	0	6

Table 4. Equipment used on federal and large landowners.

Road Systems

Forest road systems were found on 27 federal sites and 29 large landowner sites that were monitored during the 2014 BMP monitoring cycle. Forest roads serve several purposes: access to the sale by trucks and other equipment, moving wood from the sale to the landing, and in some cases provide area for decking. How roads are designed, constructed, and maintained plays a large role in how successful a harvesting operation will be at protecting water quality.

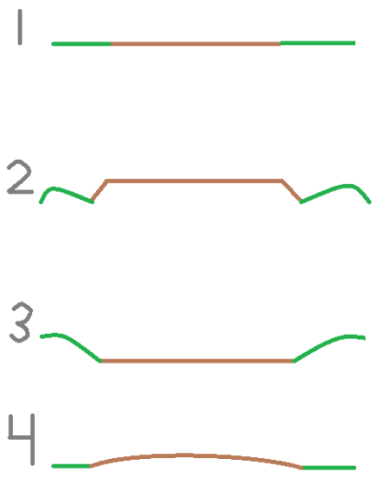


Figure 9. Road type one is 'at grade'. Road type two has ditching. Road type three is 'below grade'. Road type four is 'crowned'.

There are four ways a forest road can be designed in the BMP manual, with respect to its adjoining land (Figure 9). The first type is 'at grade' with the adjoining land (Figure 9-1). This type of road is very inexpensive and is designed for temporary use on stable soils in dry conditions. The second type of road has ditches constructed between its surface and the adjoining land (Figure 9-2). This type of road can be expensive to build but doesn't require as much maintenance as other road types and offers great water quality protection. In turn, it can also sustain heavy use and does not degrade quickly in wet conditions. The third type of road is 'below grade' of the adjoining land (Figure 9-3). Forest roads that are built this way are usually due to the rough ground surface (because of stumps, rocks, or bumps) and it is more cost effective than bringing material in to make an even surface. This type of road will quickly degrade with moisture: either due to the interception and entrapment of water on the road surface after a precipitation event or from saturated soils. The fourth type of road is 'crowned', where the road surface is higher than its adjacent land surface (Figure 9-4). This is done using fill, such as gravel, so that the surface of the road sheds water quickly. This allows the road to remain in good condition even with

precipitation events. This type of road is suitable for sustained use but can be expensive to build and maintain.

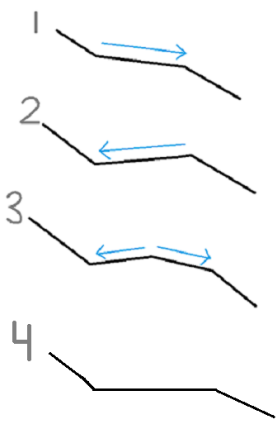


Figure 10. Road type one is 'out-sloped. Road type two is 'in-sloped. Road type three is 'crowned'. Road type four is 'flat'. Arrows show movement of water flow.

There are also four different types of road surface designs in the BMP manual. The first is an 'out-sloped' road that is designed to shed water toward the downhill gradient of the adjoining land (Figure 10-1). This design comes with the benefits of not needing cross drainage structures but does not slow down the water as it moves across its surface (which may be damaged by heavy precipitation events). The second is an 'in-sloped' road that is made to shed water towards the uphill gradient of the adjoining land (Figure 10-2). This design comes with the benefit of slowing water down and minimizing road surface flow but needs cross drainage structures (culverts) that allows water to move underneath the road to lower elevation. If this type of road does not have cross drainage structures, it will cause a large buildup of water to accumulate between the gradients of the slope and the road. The third type of road surface is designed to shed water off the road surface very quickly in order to minimize erosion and is called a 'crowned' road (Figure 10-3). This road may require cross drainage structures or ditching along the road edge. The fourth type of road contains a flat surface (Figure 10-4). This type of road is often the cheapest to make but is not engineered to shed water off of its surface. This causes it to need frequent maintenance, especially during spring runoffs or precipitation events.

Multiple different road designs and construction types were found in the 2014 BMP monitoring sites. (Table 4). Each road has a corresponding water removal efficiency associated with it depending on the road design and construction. In turn, the traffic volume capacity is dictated by how effective the road design is at removing water off its surface and away from its base. Many of the sites had road design and construction categories that were ineffective at moving water off the road surface and away from the road base. These types of roads are very well suited for silvicultural activities because they are inexpensive to build and still protect water quality during frozen/dry conditions and low traffic use. However, high volume traffic—like post-harvest or unauthorized use—along with little maintenance from the landowners/loggers can cause roads with low water removal efficiency to fail and become a negative impact to water quality. According to the road types found during the 2014 BMP monitoring, only a few sites had roads that were built to withstand high volumes of traffic, but most were designed with only temporary/seasonal traffic in mind.

Table 5. Road Types and Water Protection					
Water Removal Efficiency	**Traffic Volume Capacity**	**Road Category**	**Road Type**	**#of Sites: Federal**	**#of Sites: Large**
Low	Temporary/ Seasonal	Design	Flat	19	19
		Construction	Below Grade	8	6
		Construction	At Grade with No Ditch	20	18
Moderate	Seasonal	Design	In-Slope	0	0
		Design	Out-Slope	0	0
		Design	Crowned/Flat	6	4
		Design	Many Typed	1	0
		Construction	Cut and Fill on Side Slopes	1	1
High	Permanent	Design	Crowned	1	6
		Construction	Ditch < 1 ft. Deep	5	7
		Construction	Ditch > 1 ft. Deep	1	6
		Construction	Fill Material with No Excavation	6	0

Note: This table shows the results of two separate BMP questions on the monitoring form (design and construction). For both questions, monitoring teams selected all road characteristics that apply.

Results

Overview

During the 2014 Wisconsin Forestry Best Management Practices for Water Quality, 58 sites were visited by the monitoring teams and included 29 sites for both large landowners and federal landowners. For each of these sites, 119 BMP questions were assessed for application and effectiveness. These questions were divided into five categories:

- Fuels, Lubricants, Waste and Spills
- Riparian Management Zones (RMZs)
- Forest Roads
- Timber Harvesting
- Wetlands

The results provided an examination of the BMPs in several ways:

- As groups divided between the two different landowners-federal and large landowners
- As sub groups divided between the five different monitoring categories
- As sub groups divided between the application rates –Not Applicable, Applied Correctly, Applied but Incorrectly, Not Applied Where Needed, Insufficient Information

Along with these results, the report will attempt to explain the results using professional judgment and experience from visiting these sites. These explanations hope to offer the reader additional understanding to how the BMPs are protecting water quality in many varied conditions and circumstances.

All BMP Applications

When starting the review process for BMP monitoring sites, team members must first decide whether or not the BMP question is applicable to the site. The five applications categories are: not applicable, applied correctly, applied but incorrectly, not applied where needed, and insufficient information to determine application. In the monitoring worksheet, there were a total of 119 questions where BMP applications needed to be determined by the monitoring teams.

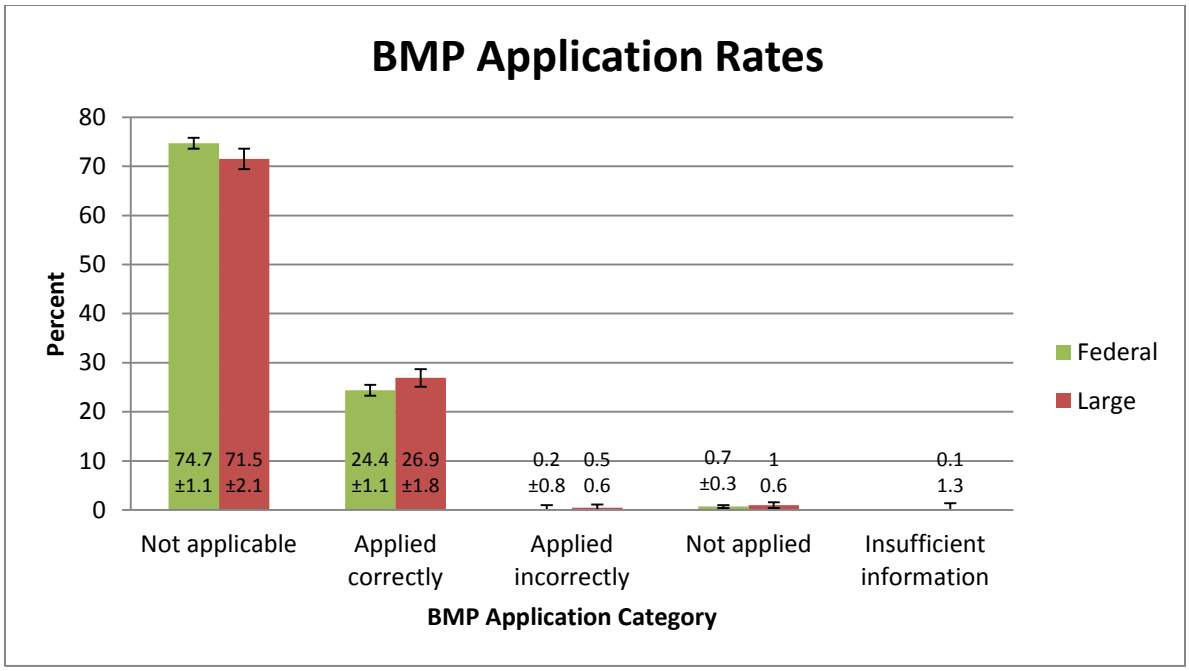


Figure 11. The five application categories that an individual BMP question could be answered for during the 2014 monitoring.

Of these 119 questions, the vast majority of the questions were not applicable (74.7% federal and 71.5% large) to the monitoring site. An example of this is marking not applicable to the questions 3-20 (see supplementary section) which asks about RMZs associated with lakes and streams if a site does not contain either of these features.

The amount of correctly applied BMPs was only slightly different between landowners with federal landowner being slightly below (24.4%) the large landowner (26.9%).

The last three BMP application categories make up a minor fraction of the answers on the 2014 BMP monitoring worksheets (0 .9% federal and 1.6% large). BMPs that were 'not applied' made up the majority of the remaining percentage (0.7% federal and 1.0% large). BMPs that were 'applied but incorrectly' made up 0.2% for federal and 0.5% for large landowners. Lastly, insufficient information received the fewest questions answered of all the BMP application categories (0% federal and 0.1% large).

The results revealed that federal landowners had more 'not applicable' BMP questions at 74.7% compared to the large landowners with 71.5% (Figure 11). This might be due to the reason that the large landowners had more water resources in or around their sites to be evaluated for BMPs. In turn, more water resources could possibly contribute to the fact that 3 times the amount of acres were monitored on large landowners compared to federal landowners, even though the same number of sites were monitored for each landowner category.

Federal landowners applied BMPs correctly more often (96.3%) than large landowners (94.7%). Federal landowners also had fewer BMPs 'not applied where needed' (2.9%) and fewer BMPs 'applied but incorrectly' (0.8%) compared to large landowners that had 3.6% and 1.7% respectively. This may be due to the fact that large landowners had more BMPs to implement because of the number of acres they had cut, as stated earlier, compared to the federal landowners.

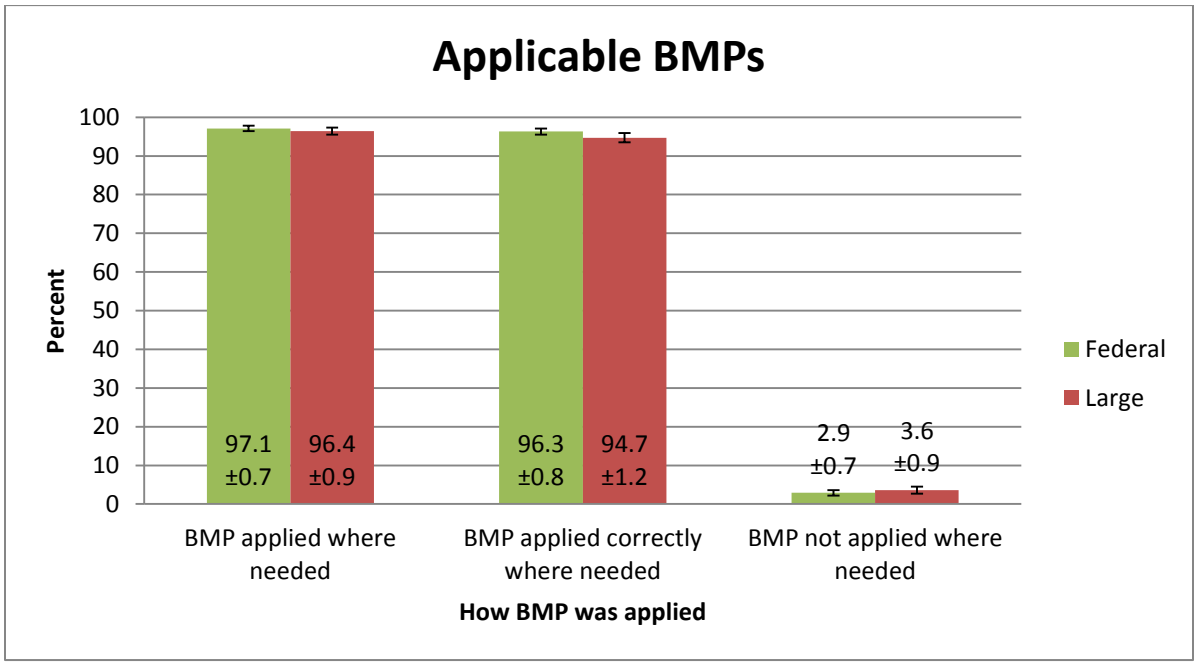


Figure 12. How BMPs were applied between federal and large landowners.

All BMP Effectiveness

After a BMP monitoring team decides whether or not a BMP is applicable to the site, they must decide how effective the respective BMP application is in protecting water quality. As to be expected, BMPs are the highest in protecting water quality when they are 'applied correctly' compared to when they are 'not applied where needed' and when they are 'applied, but incorrectly'. The 2014 BMP monitoring effectiveness rates are similar for those found in the 2006 BMP report. The rates listed below compares the 2006 rates to the 2014 rates and are as follows:

Federal

- BMP applied correctly: [99.9% for 2006] vs. [99.8% for 2014]
- BMP applied but incorrectly: [9.1% for 2006] vs. [14.3% for 2014]
- BMP not applied where needed: [60.0% for 2006] vs. [32.0% for 2014]

Large

- BMP applied correctly: [99.3% for 2006] vs. [99.9% for 2014]
- BMP applied but incorrectly: [26.7% for 2006] vs. [11.8% for 2014]
- BMP not applied where needed: [44.0% for 2006] vs. [48.6% for 2014]

Intuition would seem to be: applying a BMP but not quite correctly should be more effective on protecting water quality than not applying one at all. While this line of thinking is almost certainly not wrong; there could be some reasons as to why BMPs that were 'applied but incorrectly' were less effective than BMPs that were 'not applied' as the results show in the 2014 BMP monitoring data (Figure 13). The first simple reason is both of these categories, as stated from the beginning of the report, make up only 0.9% (federal) and 1.5% (large) of all BMP questions, meaning it has a very small sample size. That can also be seen when looking at the error bars for this graph on those two categories. They overlap, meaning that they are not one standard error apart from each other and therefore not statistically different from each other.

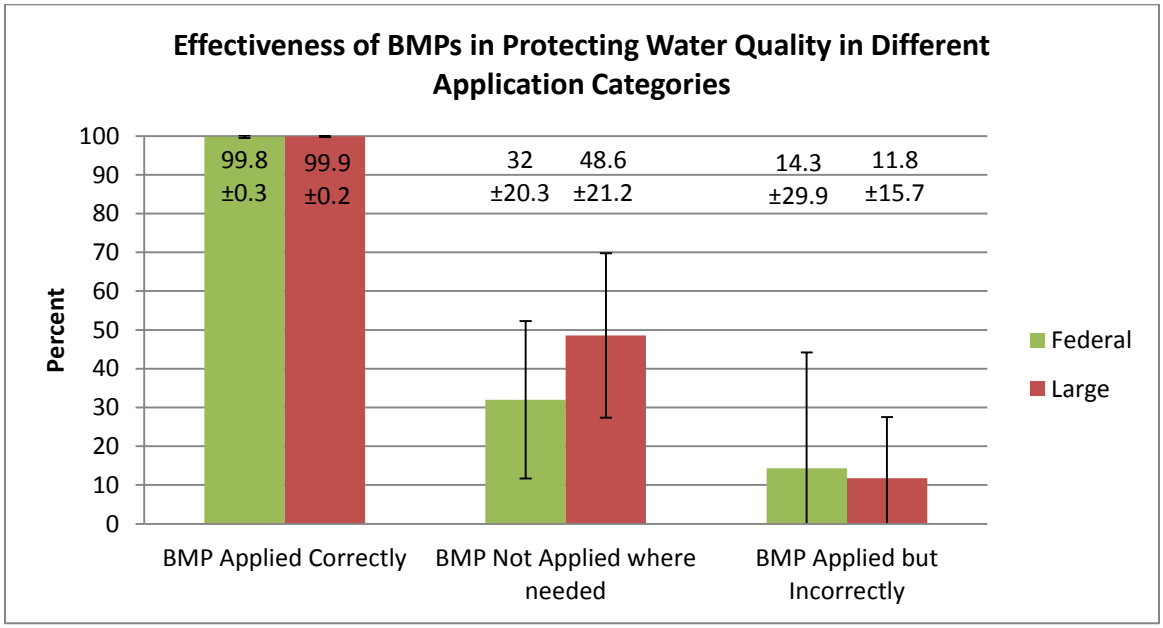


Figure 13. The effectiveness of BMPs, in there different application categories, at protecting water quality. The three application categories 'applied correctly', 'not applied where needed' and 'applied but incorrectly' are shown to have different results in protecting water quality. The percent refers to the amount of time, no negative impacts to water quality are observed.

Another reason the BMPs that were 'applied but incorrectly' may have been less effective in protecting water quality is because of the possible types of situations they were used in. BMPs that are applied incorrectly are often correlated with the more difficult situations to begin with. Whereas BMPs that are 'not applied' may not even be apparent in order to protect water quality. The result of BMPs on difficult situations being applied incorrectly would most likely have a greater effect on water quality than a situation where a BMP was not used and it was not apparent to apply a BMP.

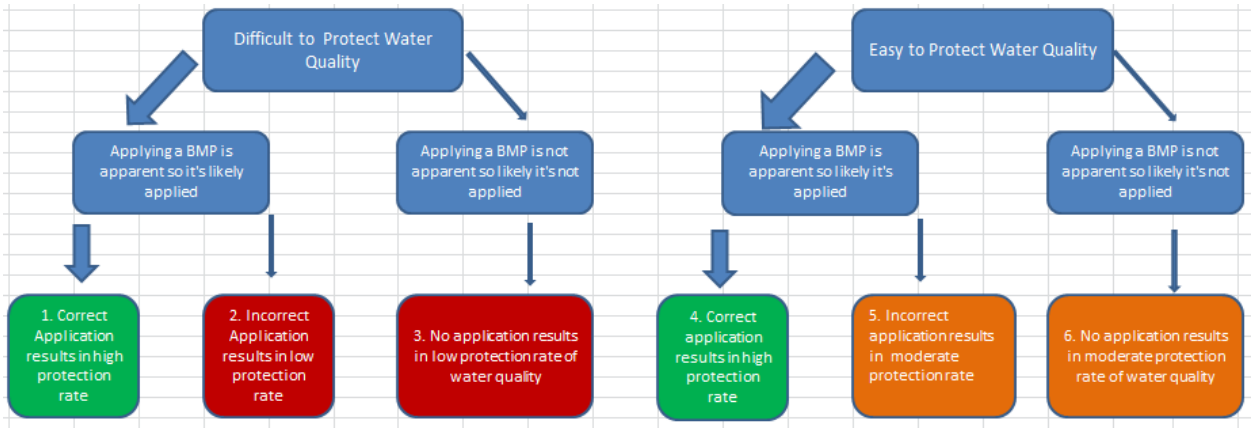


Figure 14. The different situations BMP are "applied correctly", "applied but incorrectly", or "not applied" in. Green represents high protection of water quality, orange represents moderate protection of water quality, and Red represents low protection rate of water quality.

Figure 15. This site road ran approximately 500 yards with a slight-to-moderate slope at about 8-10%. This site had ditches dug with a well-developed road and even had several diversion ditches along it. This large gully developed because the inlet of the diversion ditches were not dug quite to the ditch level and were not armored. This caused the water to bypass the diversion ditches and continue to pick up velocity and magnitude which eventually led to the development of this gully at the bottom of the hill and end of the road. Landowners were aware of BMPs and tried to apply them but failed to apply them correctly because of the small missed detail on the depth and armoring of their diversion ditch inlets.

The effectiveness in protecting water quality, when BMPs are 'not applied where needed', is broken down even further by describing how much impact (as a percentage) did the BMP not being applied have (Figure 16). The most common type of impact, when including both landowners is 'no adverse impact' (32.0% federal and 48.6% large) along with a minor long term impact (44.0% federal and 37.1% large). 'Minor short term' had water quality impacts 20.0% (federal) and 10.7% (large) and 'major long term' had water quality impacts 4.0% (federal) and 2.9% (large) of the time. No major short term impacts occurred when BMPs were not applied where needed.

The type of impacts that were assigned to describe the effectiveness of the BMPs is conducted as qualitative measures that reflect only the point in time that the monitoring team is present. The monitoring teams are asked to use their best professional judgment as to what the type of impact the effectiveness of the BMP will have on water quality.

- Short term may refer to an impact that lasts less than one year or recurring for a short period of time for multiple years.
- Long term may refer to an impact that lasts more than one year or persist for a significant length of time for multiple years.
- Minor refers to an slight adverse impact on water quality
- Major refers to a significant adverse impact on water quality

By describing these impacts as a point in time effectiveness, it means that the best professional expertise is used to rate how an impact is occurring on a specific site at that current time. This could lead to impacts being more or less serious depending on what happens to the site in the future. For example, a huge rain event could wash out a culvert that appeared to be working well which would cause greater adverse impact, or foresters could be planning to fix a road problem after spring break-up, causing less adverse impact.

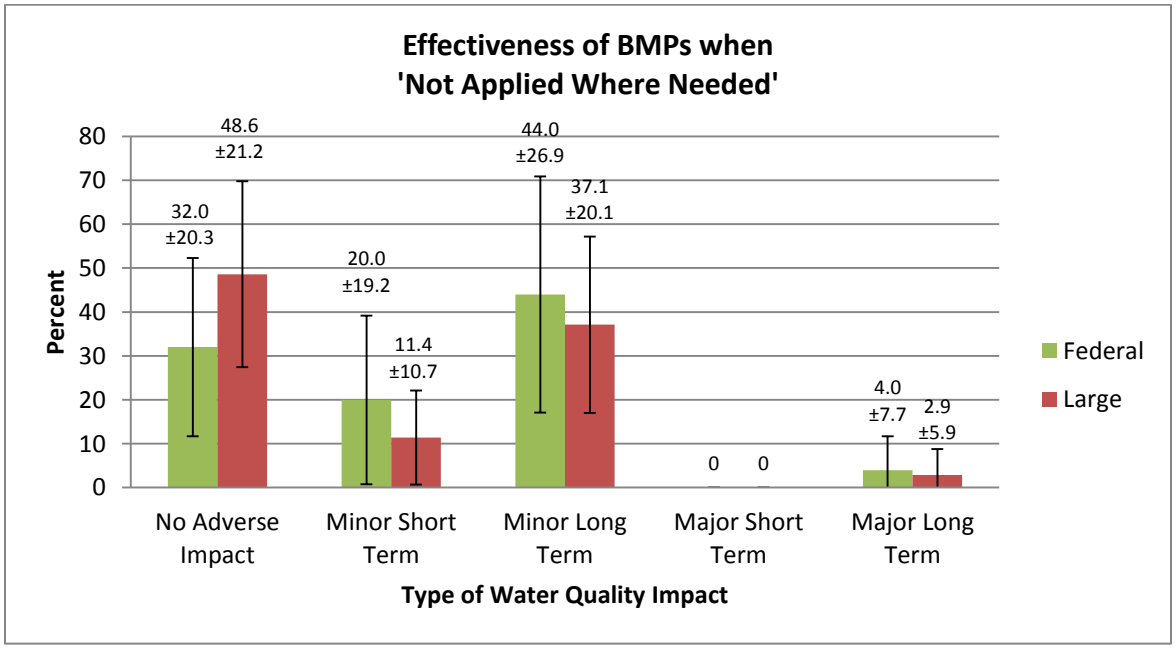


Figure 16. Types of impacts, between the landowners, when BMPs were 'not applied where needed'.

BMP Application by Monitoring Category

Federal landowners had a higher percentage rate of correctly applying BMPs across every monitoring category except wetlands when compared to large landowners (Figure 17). The highest percentage rates of 'correctly applied' BMPs were RMZs for federal landowners at 100% and wetlands for large landowners at 98.0%. The lowest percentage rate of 'correctly applied' BMPs was forest roads for both landowners at 92.9% (federal) and 90.6% (large).

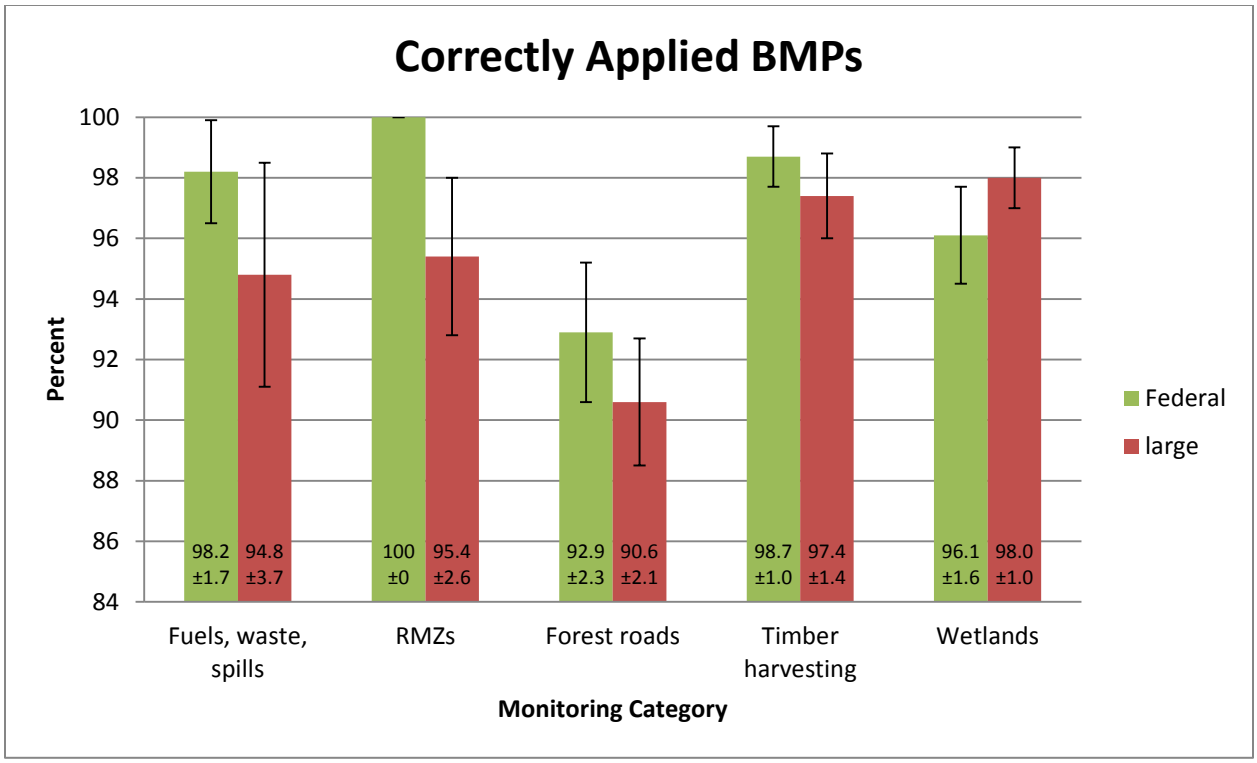


Figure 17. The percentage of correctly applied BMPs broken down into the monitoring categories.

The low percent of correctly applied BMPs in the Forest road category can possibly be attributed to a couple different factors. The first reason is that every sale that contains forest roads (all but two sites) is rated for BMPs. This is very different from other monitoring categories like RMZs, which most sites did not have. The second reason is the monitoring teams enter and exit their visit on these forest roads, so the monitoring team effectively gather lots of BMP data about the forest road throughout every stage of examining the sale: before, during and after.

The last, and most likely the primary reason, forest roads have the lowest percentage of correctly applied BMPs is two-fold: cost and usage. The usage forest roads endure adds additional constraints for owners to ensure that BMPs are correctly applied and maintained. For every other monitoring category, it is solely up to the landowner, the forester, and the logger within the time frame of the actual operation to ensure that BMPs are implemented correctly; this is far from the case for forest roads. For example, roads not designed to sustain heavy use or non-frozen use can degrade and become an issue to water quality any time after the sale has been completed. Additionally, it costs money to repair roads damaged by non-intended or unauthorized users or may cost money (installing gates, berms or signs) to keep non-intended users from entering forest roads susceptible to water quality issues. Cost for repairing forest road elements, like replacing broken or undersized culverts or re-grading the road to retain proper shape is another way that makes the BMPs a continued process and therefore a unique monitoring category that faces special challenges. While the exact reasons that forest roads had lower BMPs correctly applied were not directly recorded, it was observed by many of our teams that the roads were damaged after the harvesting operation was complete by unintended or unauthorized users.

Figure 18. An Ashland County road that was not restricted by physical barriers or signs received significant rutting by un-authorized vehicle use, after the harvest was completed. *Note that the road has a flat surface with no drainage structures and is built at-grade of the adjoining land.* These road designs indicate that the road was not built for neither sustained nor permanent use, especially during wet times or heavy precipitation. By not restricting access, this road was exposed to elements beyond its designated use, thus causing it to become a negative impact to water quality.

Figure 19. A small stream and associated wetland being crossed. Crossing was done well on frozen ground conditions and blocked off from non-silvicultural use. BMPs were correctly applied with no adverse impact to water quality. This situation had multiple BMPs to apply in order to protect the water resource and the landowner/logger did an excellent job ensuring that this stream crossing and wetland road was a success.

BMP Effectiveness by Monitoring Category

BMPs are effective at protecting water quality within the different monitoring category regardless of the different landowners when the BMPs are correctly applied. 99.8% (federal) and 99.9% (large) of the time, when BMPs are applied correctly, BMPs successfully protected water quality (figure 20). This translates to BMPs not working to protect water quality only 1 out of 500 times on federal landowners and only 1 out of 1000 times on large landowners when they were correctly applied during the 2014 BMP monitoring.

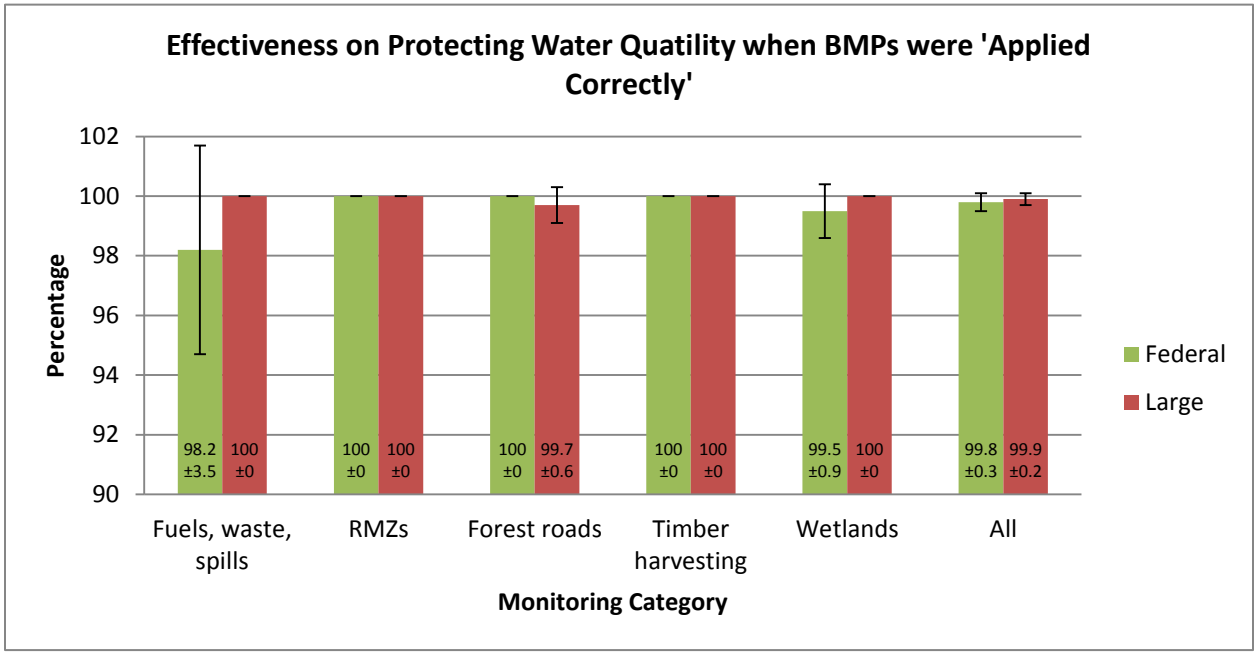


Figure 20 shows the effectiveness of BMPs throughout the monitoring categories when BMPs are 'applied correctly'.

Examining the original small subset of BMPs that were 'not applied where needed', the effectiveness in protecting water quality goes down dramatically from BMPs that were 'applied correctly'. However, the different monitoring categories do not experience similar amounts of decreased effectiveness when they were 'applied correctly' (Figure 21). For example, it shows that RMZs for large landowner (and therefore both because federal did not have any in this category) did not apply BMPs where needed were still 100% (both federal and large landowners) effective at protecting water quality. However, when BMPs are 'not applied where needed' in the monitoring category of fuels , waste and spills, water quality is not protected. This could possibly be explained by two reasons. The first reason is because of the small sample size. Remember that only 0.7% (federal) and 1.0% (large) of all BMPs application questions were in this category. The second reason is because not following BMPs in different monitoring categories can affect water quality in different ways. For example, cutting within the RMZ is allowed but must be noted with both a reason for the cutting, any modifications to the RMZ area, and how it still protects water quality. Without this note, it is difficult for the monitoring teams to tell if an RMZ was used and mark down that the site did not have an RMZ, but in actuality, the site used a

modified RMZ but failed to provide the proper documentation. In contrast, when a spill is on a site and is failed to be addressed, water quality is clearly affected and noted by the monitoring teams.

Overall, when BMPs are 'not applied where needed', the 2014 monitoring teams found water quality protected only 32.0% (federal) and 48.6% (large) of the time. This is dramatically lower than the water quality protection offered by BMPs that were 'applied correctly where needed' at 99.8% (federal) and 99.9% (large) of the time.

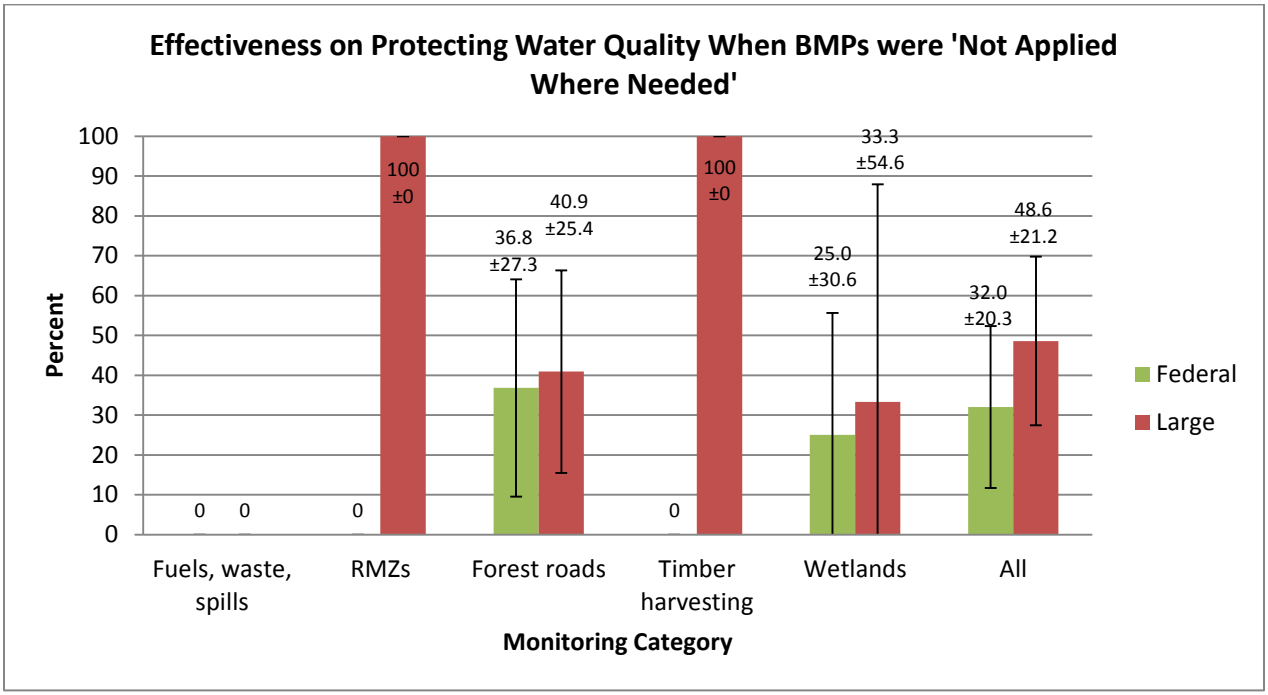


Figure 21. The effectiveness of BMPs throughout the monitoring categories when BMPs were 'not applied where needed'.

The effectiveness of BMPs in water quality protection varied greatly when BMPs were 'correctly applied' vs. when they were 'not applied where needed' compared to all the different monitoring categories (Figure 22). Of the five monitoring categories, the 'fuels wastes and spills' category had the lowest effectiveness at protecting water quality when BMPs were 'not applied correctly'. Fuels, wastes and spills also had the biggest difference, in protecting water quality, when they are 'applied correctly', to when they are 'not applied where needed'. Overall, there is large variation (possible due to small sample size) between the effectiveness in protecting water quality when BMPs are 'not applied' (Figure 22). This can also be due to the reason that certain monitoring categories are much more likely to negatively impact water quality when BMPs are' not applied'; like in the case of 'fuels, wastes, and spills' vs. 'RMZs'.

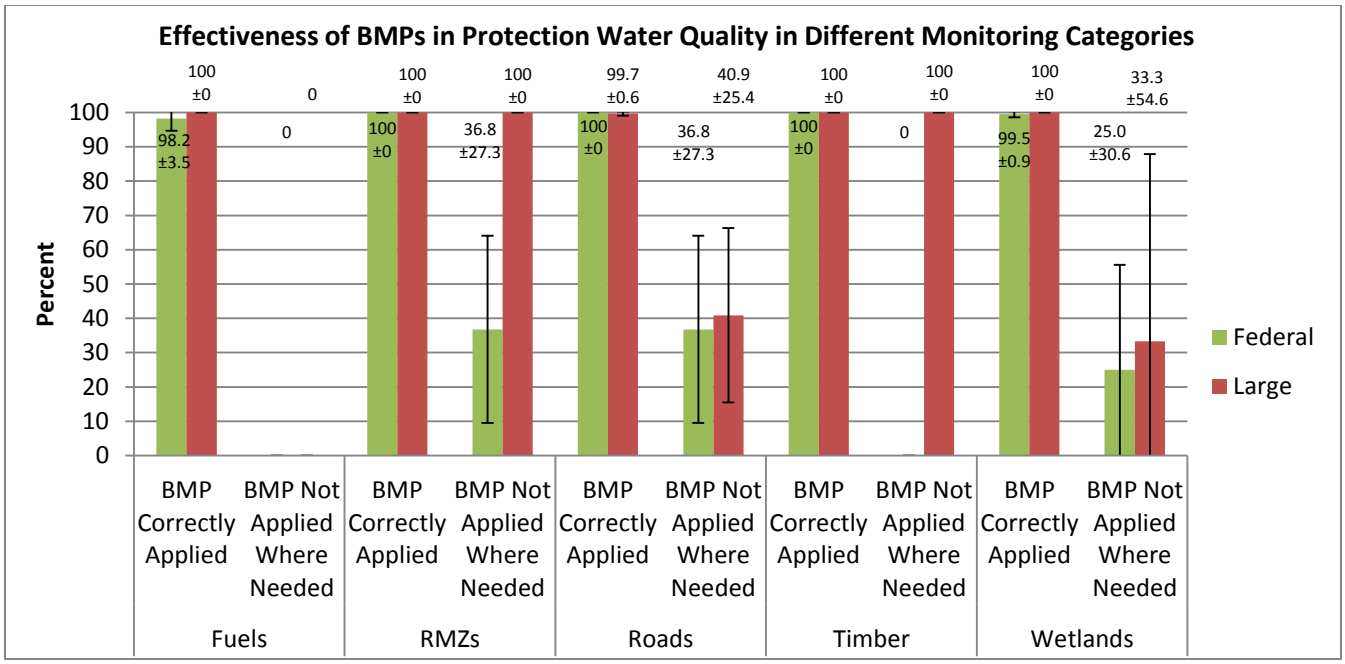


Figure 22. The effectiveness of BMPs in different monitoring categories in both groups of landowner and compares the effectiveness between BMPs that were correctly applied vs BMPs that were not applied where needed.

Conclusion and Recommendations

Comparing the 2014 BMP monitoring results with the 2006 and the 1995-1997 BMP monitoring results, which were also done on federal and large landowners, we find similar rates of application across the monitoring categories (Table 6, Figure 23 and Figure 24).

Table 6. Comparing 2014 BMP Application Rates to 2006 BMP Application Rates

Landowner	Federal landowners			Large landowners		
Year	1995-1997	2006	2014	1995-1997	2006	2014
Fuels and spills	100(±0)	100(±0)	98.2(±1.7)	98(± 2)	98(±2)	94.8(±3.7)
RMZs	79(±7)	94(±3)	100(±0)	81(± 5)	95(±3)	95.4(±2.6)
Forest roads	89(±5)	93(±3)	92.9(±2.3)	92(± 4)	90(±3)	90.6(±2.1
Timber Harvest	98(±7)	99(±1)	98.7(±1.0)	98(± 1)	99(±1)	97.4(±1.4)
Wetlands	100(0)	93(±2)	96.1(±1.6)	91(± 3)	98(±1)	98(±1.0)
Overall	91(± 5)	95(±2)	96.3(±0.8)	91(± 4)	94(±3)	94.7(±1.2)

Table 6. The 2006 and 1995-1997 BMP monitoring results compared with the 2014 Monitoring results.

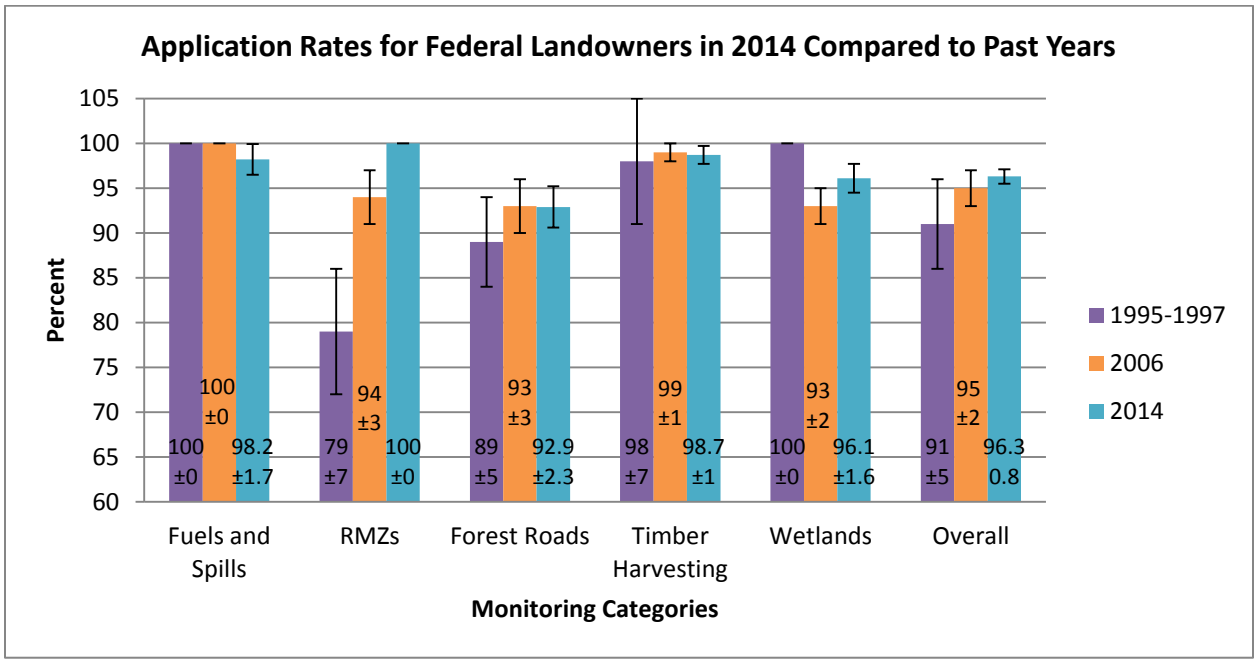


Figure 23. The application rates for federal landowners from 2014 compared to 2006 and 1995-1997. Even though the change not statistically significant, overall BMP application on federal lands has been improving since the start of BMP monitoring in 1995. *Note: The larger error bars associated with the 1995-1997 data are due to a low number of monitored sites.*

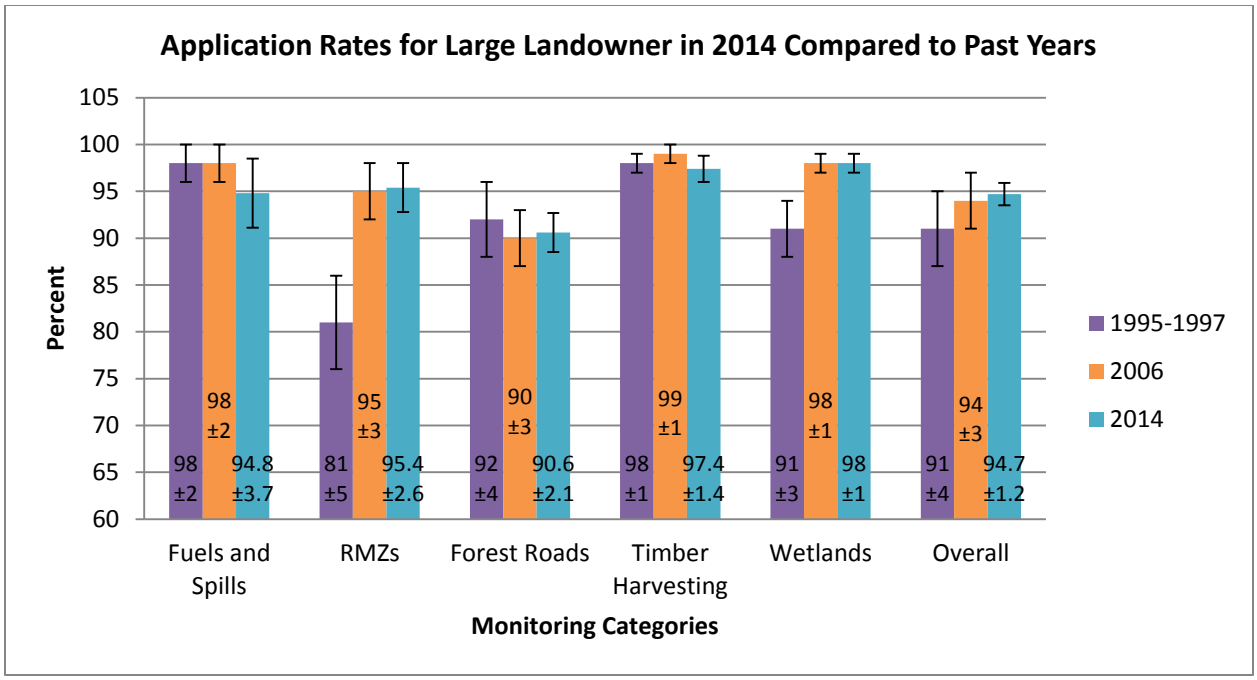


Figure 24. The application rates for large landowners from 2014 compared to 2006 and 1995-1997. Even though the change not statistically significant, overall BMP application on large lands has been improving since the start of BMP monitoring in 1995. ***Note: The larger error bars associated with the 1995-1997 data are due to a low number of monitored sites.***

The results of the 2014 BMP monitoring cycle provides continued evidence that water quality is protected at great length by the Wisconsin's Forestry BMP program. BMPs are seeing high correct application rates and this leads to an extremely high water quality protection rate. In contrast, when BMPs are either not 'applied incorrectly' or 'not applied at all' (which happens only 3.7% of the time for federal and 5.3% of the time for large landowners), water quality is often not protected. ***The greatest potential for improving water quality protection is to address the small percentage of BMPs that are either 'applied incorrectly' or 'not applied at all'***. This reinforces the continued use of BMP program and all its derivatives, which includes:

- the education of BMPs to loggers, foresters, and landowners
- training monitoring teams to review harvest sites for BMP application and effectiveness
- producing reports to assess effectiveness and compliance with the BMP program
- Continue improving the BMP Field Manual and Monitoring Worksheet in order to incorporate new scientific findings on water quality and to ensure clear understanding of all BMP rules, guidelines, and goals.

With the sustained use of the BMP program we hope to see even greater correct application rates, and therefore water quality protection, in the future for Wisconsin's waters.

Appendix A: Methods

Selection of Timber Harvests

There were a total of 1719 sites between both landowners that were available to be monitored during the 2014 BMP cycle. Of those 1719 sites, 750 were federal and 969 were large landowners. It was determined that 29 sites of each landowner were needed to assure a sample size that held statistical validity. Due to the number of attributes collected by the monitoring teams for each sale, a single stage cluster sampling method (which used each sale as a cluster) was used for analysis. By assuring that 29 sites for each land owner were monitored, this report could confidently (95% confidence interval) assess the accuracy in that the monitoring results were a true representation of the total 1719 sites that were available for monitoring.

Bias and Limitations

Bias, with regard to BMP monitoring, is where one site is more likely to be selected than another regardless of eligibility criteria. This type of bias can result in a skewed depiction of the total sales, and was limited to the best possible extent.

All sales that were thought to be cut in 2013 were given to DNR Forest Tax Field Manager (large) and the Timber Program Manager (federal) and then passed to the DNR Forest Hydrologist and DNR BMP Forester to review. Any sales cut on large or federal landowners that were not given to their respective manager would not be eligible to be monitored even if the site was cut in 2013 and met the eligibility criteria. A bias introduced intentionally by our eligibility criteria include sites that have water resources and are close enough to a road system for a monitoring team to walk to them in a timely manner. These intentional biases are brought in so that monitoring teams can focus on sites that have the most possible BMPs applicable and that they can monitor those sites in a time effective manner.

To prevent unwanted bias, all sites that were sent from the Managers were entered into a spreadsheet were they were selected using a random number generator. All sites that were randomly selected were determined to be eligible based on a combination of a physical trip to the site and air recon through DNR Surface Water Data Viewer.

Another form of bias that was observed was due to how the listings of the large landowner sales were listed in the data base. Every quarter-quarter that received harvest was listed within the data base. This usually equated to one harvest having multiple listings under quarter-quarters, with the bigger sales having more than smaller ones. This effectively caused the random number generator to pick larger sales or smaller sales that were at the corners of quarter-quarters due to the fact that they contained more listings for one individual sale.

Appendix B: Eligibility Criteria- Field Form

State of Wisconsin
DEPARTMENT OF NATURAL RESOURCES
101 S. Webster Street
Box 7921
Madison WI 53707-7921

Scott Walker, Governor
Cathy Stepp, Secretary
Telephone 608-266-2621
Toll Free 1-888-936-7463
TTY Access via relay - 711

Eligibility Criteria - Field Form

2014 Forestry BMP Monitoring

ID:_____ Date: _____

Landowner:_____ Landowner Phone:_____

County:_____ Township:_____

Legal Description: T _____ N, R _____ E / W, Section _____, _____ 1/4, _____1/4

GPS Lat/Long: _____

Eligibility Criteria:

1.	Was harvesting completed within 200 feet of lake, river or stream?	❑ Yes	❑ No
2.	Was at least one acre of wetland harvested?	❑ Yes	❑ No
3.	Was a significant length of wetland crossed?	❑ Yes	❑ No
4.	Was a stream crossed?	❑ Yes	❑ No
5.	Is it less than a ½ mile walk to the timber sale? (required "yes")	❑ Yes	❑ No

Background Information:
If the timber sale has at least one "yes" in the eligibility criteria, please provide the following information, if known.

Site Conditions
Dominant Cover type:

❑ Spruce-Fir ❑ Aspen ❑ Pine Plantation ❑ Pine (not plantation)
❑ Maple-Basswood ❑ Oak-Hickory ❑ Bottomland Hardwoods

Dominant Topography:

❑ Flat (0-3%) ❑ Gently Rolling (4-9%) ❑ Rolling Hills (10-19%)
❑ Steep (20-45%) ❑ Very Steep (>45%)

Water Resources

Lake: ❑ Yes ❑ No

Name:_____ Size:_____

Stream: ❑ Yes ❑ No

Name:_____ ❑ Perennial ❑ Intermittent

Navigable: ❑ Yes ❑ No Trout Stream: ❑ Yes ❑ No

Wetlands: ❑ Yes ❑ No

Area Harvested:_____ Length Crossed:_____

Springs: ❑ Yes ❑ No Seeps: ❑ Yes ❑ No

Approximate Number: _____ Approximate Number:_____

Notes about water resources:_____

_____

_____

_____

Access to Site

Gated entrance: ❑ Yes ❑ No

Contact Information for Access:_____

Recommended Driving Directions to site/parking location:_____

_____

Is 4-wheel drive or a high clearance vehicle needed to access site? ❑ Yes ❑ No

Sale Information

Forester/Timber Sale Administrator:_____

Contact Information:_____

Logger:_____ Master Logger: ❑ Yes ❑ No

Contact Information:_____

Date Harvested:_____

Logging Equipment Used:_____

Was any equipment tracked? ❑ Yes ❑ No

Harvest System Used: ❑ Clear-cut ❑ Shelterwood ❑ Salvage ❑ Thinning/Selection

❑ Other:_____

Approximate Acres Harvested:_____

Appendix C: BMP Monitoring Worksheet

2014 BMP Monitoring Worksheet

for Wisconsin's Forestry Best Management Practices for Water Quality

Objectives of BMP Monitoring

1) Determine the extent to which BMPs were applied on the selected sites.
2) Determine the effectiveness of properly applied BMPs in protecting water quality on the selected sites.
3) Determine the effects of not applying BMPs where needed on the selected sites.
4) Obtain descriptive information about RMZs and buffer strips (where present) with respect to size, vegetative composition, and past use.

The results of these objectives from BMP Monitoring will be used to:

* Identify trends
* Identify where modifications may be needed in the BMP field manual
* Identify research and information needs
* Educate landowner, loggers and foresters involved in the sites that are monitored
* Compare and contrast with other landowner categories

Timber Sale ID: _____

Landowner Name: _____

Date: _____

Team:

Gibbs	Penske	Childress
Roush-Fenway	Hendrick	Petty
Stewart-Haas	Waltrip	

Non-Team Members: _____

Age of Harvest: ❑ Less than 1 y.o. ❑ 1 to 2 y.o. ❑ More than 2 y.o. ❑ Unknown

Acres Harvested: _____

Weather Conditions: ❑ Sunny ❑ Partly Sunny ❑ Cloudy/Overcast ❑ Rain ❑ Snow ❑ Drought

Any Extreme or Rare Weather Events? ❑ Yes ❑ No
Please explain:

APPLICATION Was the BMP applied at the sale? 1 -- BMP applied correctly 2 -- BMP applied but incorrectly 3 -- BMP not applied 4 -- Insufficient information to rate X -- BMP not applicable to the site (site or harvest conditions not found on site)	**EFFECTIVENESS** What effect did applying (or not applying) the BMP have? 1 -- No adverse impact 2 -- Minor short-term impact 3 -- Minor long-term impact 4 -- Major short-term impact 5 -- Major long-term impact X -- Effectiveness rating not applicable

BEST MANAGEMENT PRACTICES	**APPLICATION**	**EFFECTIVENESS**	**COMMENTS/IMPACT**
A. Fuels, Lubricants, Waste and Spills			
Fuels, Lubricants, and Waste (p. 115)			
1. Designate specific areas for equipment maintenance and fueling. Locate these areas on level terrain, a minimum of 100 feet from all streams and lakes.			
2. Collect all waste lubricants, containers, and trash (i.e. grease cartridges).			
B. Riparian Management Zones			
BMPs Common to All Three RMZ Categories (p. 90)			
B-a. Is there a lake or stream present in the area monitored for the timber sale? (Check all that apply.)	❑ Yes – lake(s). ❑ Yes – stream(s). Go to next question.	❑ No. Go to Section C – Forest Roads.	
3. Locate roads outside the RMZ, unless necessary for stream crossings.			
4. Locate landings outside the RMZ.			
5. Do not dispose of or pile slash within the RMZ.			
6. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.			
B-b. Did harvesting occur within the RMZ?	❑ Yes.	❑ No.	
B-c. If harvesting occurred within the RMZ, what type of equipment was used?			
BMPs for Lakes, Designated Trout Streams, & Streams 3' Wide & Wider (100' RMZ) (p. 91)			
B-d. Is there a lake, designated trout stream, or stream 3' wide or wider in or adjacent to the harvest area of the timber sale?	❑ Yes. Go to next question.	❑ No. Go to Question B-i.	
7. Do not operate wheeled or tracked equipment within 15 feet of the ordinary high water mark (OHWM) except on roads or at stream crossings.			
8. Operate wheeled or tracked equipment within 15 to 50 feet of the OHWM when the ground is frozen or dry.			
9. Do not harvest fine woody material within 50 feet of the OHWM.			
10. Use selection harvests and promote long-lived tree species appropriate to the site.			
11. Harvesting intervals should be a minimum of every 10 years.			

12. Harvesting plans should leave at least 60 ft^2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.			
13. Develop trees 12 inches DBH and larger.			
B-e. The RMZ width….	❑ Meets the minimum standard of 100 feet. ❑ Exceeds the minimum standard of 100 feet. ❑ Is less than the minimum standard of 100 feet. ❑ An RMZ was not used.		
B-f. If the RMZ width was modified, it was…	❑ Increased _____ feet. ❑ Decreased _____ feet.		
B-g. The basal area retained within the RMZ was…	❑ 0 – 20 sq. ft./acre ❑ 20 – 40 sq. ft./acre ❑ 40 – 60 sq. ft./acre ❑ 60 – 80 sq. ft./acre ❑ More than 80 sq. ft./acre		
B-h. The **pre-harvest** condition of the RMZ was…	❑ Forested the entire width ❑ Forested greater than 50% of the width ❑ Forested less than 50% of the width ❑ Not forested (tag alders or sedge meadow)		
BMPs for Stream Less Than 3' Wide (35' RMZ) (p. 92)			
B-i. Is there a stream less than 3 feet wide in or adjacent to the harvest area of the timber sale?	❑ Yes. Go to next question.		❑ No. Go to Question B-n.
14. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high water mark (OHWM), only when the ground is frozen or dry.			
15. Do not harvest fine woody material within 15 feet of the OHWM.			
16. Use selection harvests and promote long-lived tree species appropriate to the site.			
17. Harvesting intervals should be a minimum of every 10 years.			
18. Harvesting plans should leave at least 60 ft^2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.			
B-j. The RMZ width….	❑ Meets the minimum standard of 35 feet. ❑ Exceeds the minimum standard of 35 feet. ❑ Is less than the minimum standard of 35 feet. ❑ An RMZ was not used.		
B-k. If the RMZ width was modified, it was…	❑ Increased _____ feet. ❑ Decreased _____ feet.		
B-l. The basal area retained within the RMZ was…	❑ 0 – 20 sq. ft./acre ❑ 20 – 40 sq. ft./acre ❑ 40 – 60 sq. ft./acre ❑ 60 – 80 sq. ft./acre ❑ More than 80 sq. ft./acre		
B-m. The **pre-harvest** condition of the RMZ was…	❑ Forested the entire width ❑ Forested greater than 50% of the width ❑ Forested less than 50% of the width ❑ Not forested (tag alders or sedge meadow)		

BMPs for Streams Less Than 1' Wide (35' RMZ) (p. 93)			
B-n. Is there a stream less than 1 foot wide in or adjacent to the harvest area of the timber sale?	❑ Yes. Go to next question.		❑ No. Go to Section C – Forest Roads.
19. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark (OHWM) only when the ground is frozen or dry.			
20. Do not harvest fine woody material within 15 feet of the OHWM.			
B-o. The RMZ width….	❑ Meets the minimum standard of 35 feet. ❑ Exceeds the minimum standard of 35 feet. ❑ Is less than the minimum standard of 35 feet. ❑ An RMZ was not used.		
B-p. If the RMZ width was modified, it was…	❑ Increased _____ feet. ❑ Decreased _____ feet.		
B-q. The basal area retained within the RMZ was…	❑ 0 – 20 sq. ft./acre ❑ 20 – 40 sq. ft./acre ❑ 40 – 60 sq. ft./acre ❑ 60 – 80 sq. ft./acre ❑ More than 80 sq. ft./acre		
B-r. The **pre-harvest** condition of the RMZ was…	❑ Forested the entire width ❑ Forested greater than 50% of the width ❑ Forested less than 50% of the width ❑ Not forested (tag alders or sedge meadow)		

C. Forest Roads

Location and Design of Forest Roads (p. 37 & 44)			
C-a. Was there a forest road system for this timber sale?	❑ Yes. Go to next question.		❑ No. Go to Section D – Timber Harvesting.
C-b. What best describes the forest road design? (Check all that apply.)	❑ Crowned ❑ Out-sloped		❑ In-sloped ❑ Flat
C-c. What best describes the predominant construction of forest roads?	❑ Roads are below the grade of adjoining land. ❑ Roads are at grade with no ditch constructed. ❑ Roads have an excavated ditch less than 1 foot deep. ❑ Roads have an excavated ditch greater than 1 foot deep. ❑ Roads were created by cut and fill on side slopes. ❑ Roads were constructed of fill material with no excavation. ❑ Roads are a combination of these types.		
C-d. Was there an existing forest road system for this timber sale?	❑ Yes. Go to next question.		❑ No. Go to Question C-e.
21. Use existing roads when they provide the best long-term access.			
C-e. Were forest roads constructed or improved for this timber sale?	❑ Yes. Go to next question.		❑ No. Go to Question 35
22. Select road locations that allow for drainage away from the road.			

23. Where possible, locate roads on well-drained soils.			
24. Minimize the number of stream, dry wash, and wetland crossings.			
25. Locate roads outside of riparian management zones and wetland filter strips, except at crossings			
26. Road grades should not exceed 10%. If road grades greater than 10% are necessary, limit grade length or break the grade using drainage structures.			
27. Construct roads to follow natural contours and minimize cut and fills.			
28. Construct roads to remove water from road surfaces.			
29. Construct stable cut and fill slopes that will re-vegetate easily, either naturally or artificially.			
30. Do not bury debris in the road base.			
Drainage Structures on Forest Roads (p. 53)			
C-f. Were forest roads constructed or improved for this timber sale?	❑ Yes. Go to next question.		❑ No. Go to Question 35.
31. Install drainage structures to remove water from road surface and ditches.			
32. Install a berm at the inlets of drainage structures, if needed, to direct water into the structures.			
33. Provide erosion protection at the outlets of drainage structures to minimize erosion and disperse the water.			
34. Install drainage structures at grades of at least 2% more than the ditch grade and at a 30 to 45 degree angle to the road.			
35. Check drainage structures to ensure that they are not filling with sediment or other debris. Clean if needed.			
C-g. What types of drainage structure were used on the road system? (check all that apply)	❑ New cross drain culvert(s). Go to Question 36. ❑ Existing cross drain culvert(s) ❑ New open-top culvert(s) ❑ Existing open-top culvert(s) ❑ New broad-based dip(s). Go to Question 37. ❑ Existing broad-based dip(s) ❑ New water bar(s) ❑ Existing water bar(s) ❑ New diversion ditch(es) ❑ Existing diversion ditch(es) ❑ No drainage structures were used		
Cross Drain Culverts for Drainage on Forest Roads (pp. 54)			
36. Install cross drain culverts long enough to extend beyond the road fill.			
Broad-based Dips for Drainage on Forest Roads (p. 54)			
37. Construct broad-based dips deep enough to provide adequate drainage and wide enough to allow trucks and equipment to pass safely.			
Soil Stabilization on Forest Roads (p. 56)			
38. Use seed, mulch and/or erosion control netting where necessary to minimize soil erosion into lakes, streams and wetlands. See Tables 4-3 and 4-4.			

39. Install sediment control structures where necessary to slow the flow of runoff and trap sediment until vegetation is established at the sediment source. See Tables 4-3 and 4-4.			
40. Maintain, clean and/or replace sediment control structures until areas of exposed soil are stabilized.			

Forest Road Maintenance – Active Forest Roads (p. 61)		
C-h. Does the forest road system include active roads? Roads are considered active if they continue to be used by the landowner and/or public for multiple uses, such as forest management, hunting and recreation.	❑ Yes. Go to next question.	❑ No. Go to Question C-i.

41. Inspect the road system at regular intervals. Clear debris from drainage structures to prevent clogging that can lead to washouts.			
42. Keep traffic to a minimum during wet periods and spring break-up to reduce maintenance needs.			
43. Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible to reduce erosion potential.			
44. Remove berms along the edge of the road if they will trap water on the road.			
45. When dust control agents are used, apply them in a manner that will keep these compounds from entering lakes, stream and groundwater.			

Forest Roads Maintenance – Inactive Forest Roads (p. 62)		
C-i. Does the forest road system include inactive roads? Inactive roads are not used for extended periods of time and may be closed by gates, berms, boulders, pits or other measures that make vehicle passage unlikely in order to protect the road surface and water protection measures. In some instances, the length of time and/or reason for closure may be posted and acceptable uses may be invited to assure compliance with the road closure.	❑ Yes. Go to next question.	❑ No. Go to Question C-j.

46. Remove all temporary drainage and crossing structures.			
47. Shape all road system surfaces to maintain proper surface drainage, if necessary.			
48. Inspect and maintain road surfaces, drainage structures, and crossings to minimize erosion.			

General BMPs for Stream Crossings on Forest Roads (p. 67-68)		
C-j. Was a stream crossed in forest road system?	❑ Yes. Go to next question.	❑ No. Go to Section D – Timber Harvesting.
C-k. Which of the following best describe the stream crossing?	❑ New crossing used. Go to next question. ❑ Existing stream crossing used. Go to Question 55. ❑ Both new and existing stream crossings used. Go to next question.	

49. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.			
50. Install stream crossing structures at right angles to the stream channel.			
51. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.			
52. Minimize channel changes and the amount of excavation or fill needed at the crossing.			
53. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.			
54. Use soil stabilization practices on exposed soil at stream crossings.			
55. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.			
56. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.			
57. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.			
C-l. What type of stream crossings were used in the forest road system?	❑ Bridges ❑ Culverts ❑ Fords ❑ Pole fords (PVC or logs) ❑ Timber mats ❑ Frozen snow/ice crossing ❑ Other: _____ ❑ Stream crossed without any structure		
Stream Crossing BMPs for Culverts on Forest Roads (p.69)			
C-m. Were culverts used as stream crossing structures on the forest roads?	❑ Yes. Go to next question.	❑ No. Go to Question C-o.	
C-n. Which of the following best describe the stream crossing structure(s)?	❑ New culvert(s) were installed. Go to next question. ❑ Existing culvert(s) were used. Go to Question 63. ❑ Both new and existing culvert(s) were used. Go to next question.		
58. Install culverts that extend at least 1 foot beyond the road fill.			
59. Install culverts that are large enough to pass flood flows.			
60. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.			
61. Firmly compact material around culverts, particularly the bottom half. To prevent crushing, cover the top of culverts with fill to a depth of 1/3 the culvert diameter or at least 12 inches, whichever is greater.			
62. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.			

63. Keep culverts clear and free of debris so that water can pass unimpeded at all times.			
Stream Crossing BMPs for Fords on Forest Roads (p. 70)			
C-o. Were fords installed as stream crossing structures on the forest roads?	❑ Yes. Go to next question.		❑ No. Go to Question C-p.
64. Locate fords where stream banks are low.			
65. Locate where the stream bed has a firm rock or gravel streambed.			
Temporary Stream Crossing BMPs on Forest Roads (p. 71)			
C-p. Were temporary stream crossing structures installed on the forest roads?	❑ Yes. Go to next question.		❑ No. Go to Section D – Timber Harvesting.
66. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.			
67. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.			
D. Timber Harvesting			
Landings BMPs (p. 74)			
D-a. Were there any existing landings available for this timber sale?	❑ Yes. Go to next question.		❑ No. Go to Question 69.
68. Use existing landings if possible.			
69. Locate landings on frozen ground or on firm well-drained soils with a slight slope or that have been shaped to promote efficient drainage.			
70. Locate residue piles (sawdust, chipping residue, and other material) away from areas where runoff may wash residue into streams, lakes or wetlands.			
Skid Trail BMPs (p. 39)			
71. Where possible, keep skid trail grades less than 15%. Where steep grades are unavoidable, break the grade and install drainage structures at recommended intervals. Grades greater than 15% should not exceed 300 feet in length.			
72. Use existing skid trails if they provide the best long-term access.			
General Timber Harvesting BMPs (p. 76)			
73. Limit the length and number of skid trails, landing, and stream crossing to the minimum necessary for conducting the harvest operation and to meet the landowner's objectives.			
74. Whenever possible, winch logs up steep slopes if conventional skidding could cause erosion that affects water quality.			
75. Avoid operating equipment where excessive soil compaction, rutting, or channelized runoff may cause erosion that affects water quality.			

76. Fill in ruts, apply seed and mulch, and install sediment control structures and drainage structures on skid trails and landings where needed to prevent erosion and sedimentation into surface waters.			
77. Inspect soil stabilization practices periodically during and after harvest operations to insure that they are successful and remain functional.			
78. Do not dispose of or pile slash in areas where runoff may wash slash into lakes, streams, or wetlands.			
79. For winter harvesting, mark stream channels, dry washes, and existing culvert locations before snowfall.			
Dry Wash BMPs (p.78)			
D-b. Are there any dry washes associated with the timber harvest?	❑ Yes. Go to next question.		❑ No. Go to Question D-c.
80. Use selection harvests or patch clear-cuts within 35 feet of the dry wash to promote tree species appropriate to the site.			
81. Avoid locating roads and landings within 35 feet of the dry wash unless necessary for crossings.			
82. Operate wheeled or tracked equipment within 15 feet of the dry wash only when the ground is frozen or dry.			
83. Do not harvest fine woody material within 15 feet of the dry wash.			
84. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.			
85. Avoid cabling logs across the dry wash, where feasible, to prevent damage to the banks of the dry wash.			
General BMPs for Stream Crossings on Skid Trails (p. 67-68)			
D-c. Are there any stream crossings associated with the skid trails?	❑ Yes. Go to next question.		❑ No. Go to Section E – Wetlands.
D-d. Which of the following best describe the stream crossing?	❑ New crossing used. Go to next question. ❑ Existing stream crossing used. Go to Question 92. ❑ Both new and existing stream crossings used. Go to next question.		
86. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.			
87. Install stream crossing structures at right angles to the stream channel.			
88. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.			
89. Minimize channel changes and the amount of excavation or fill needed at the crossing.			
90. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.			
91. Use soil stabilization practices on exposed soil at stream crossings.			
92. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and			

other aquatic life.			
93. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.			
94. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.			
D-e. What type of stream crossings were used on the skid trails?	❑ Bridges ❑ Culverts ❑ Fords ❑ Pole fords (PVC or logs) ❑ Timber mats ❑ Frozen snow/ice crossing ❑ Other: _____ ❑ Stream crossed without any structure		
Stream Crossing BMPs for Culverts on Skid Trails (p. 69)			
D-f. Were pipe culverts used for crossing streams on skid trails?	❑ Yes. Go to next question.	❑ No. Go to Question D-h.	
D-g. Which of the following best describe the stream crossing structure(s)?	❑ New culvert(s) were installed. Go to next question. ❑ Existing culvert(s) were used. Go to Question 100. ❑ Both new and existing culvert(s) were used. Go to next question.		
95. Install culverts that extend at least 1 foot beyond the road fill.			
96. Install culverts that are large enough to pass flood flows.			
97. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.			
98. Firmly compact material around culverts, particularly the bottom half. To prevent crushing, cover the top of culverts with fill to a depth of 1/3 the culvert diameter or at least 12 inches, whichever is greater.			
99. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.			
100. Keep culverts clear and free of debris so that water can pass unimpeded at all times.			
Fords for Stream Crossings on Skid Trails (p. 27 & 40)			
D-h. Were fords used for crossing streams on skid trails?	❑ Yes. Go to next question.	❑ No. Go to Question D-j.	
D-i. Which of the following best describe the stream crossing structure(s)?	❑ New ford(s) were installed. Go to next question. ❑ Existing ford(s) were used. Go to Question D-h. ❑ Both new and existing ford(s) were used. Go to next question.		
101. Locate fords where stream banks are low.			
102. Locate where the stream bed has a firm rock or gravel streambed.			

Temporary Stream Crossing BMPs on Skid Trails (p. 71)			
D-j. Were temporary stream crossing structures installed on skid trails?	❑ Yes. Go to next question.		❑ No. Go to Section E – Wetlands.
103. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.			
104. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.			

E. Wetlands

General Wetland BMPs (p.100)			
E-a. Is there a wetland present?	❑ Yes. Go to next question.		❑ No. Go to Section F – Supplemental Questions.
105. Whenever practical, avoid locating roads and landings in wetlands; otherwise use extreme caution.			
106. Whenever possible, forest management activities in wetlands should occur on frozen ground to minimize rutting.			
107. Do not dispose of or move upland slash into a wetland. Slash from trees harvested within the wetland may remain in the wetland.			
E-b. What best describes the source of slash deposition in the wetland?	❑ Slash was moved into the wetland from the uplands. ❑ Slash was from trees harvested in the wetlands. ❑ No slash was left in the wetland.		
108. Keep slash out of open water.			
109. Whenever practical, avoid equipment maintenance and fueling in wetlands.			

Wetland Filter Strip BMPs (p.101)			
110. Whenever practical, avoid locating roads and landings in the wetland filter strip; otherwise use extreme caution.			
111. Minimize soil exposure and compaction to protect the ground vegetation and the duff layer in the wetland filter strip.			
112. Operate equipment in the wetland filter strip only when the ground is firm or frozen.			

Wetland Roads, Skid Trails, and Landings (pp. 105-108)			
E-c. Were any wetlands crossed to access or to harvest the timber sale or were any wetlands used as landings?	❑ Yes. Go to next question.		❑ No. Go to Section F – Supplemental Questions.
113. Construct upland approaches to the wetland so the surface runoff is diverted away from the road approach prior to reaching the wetland.			
114. If landings are necessary in a wetland, build them to the minimum size required for the operation and to achieve the landowner's objective.			

115. Avoid operating equipment in areas of open water, springs, or seeps.			
116. Provide for adequate cross-road drainage in roads to minimize changes to natural surface and subsurface flow in the wetland.			
117. Use low ground pressure equipment, such as wide tire or tracked equipment, if necessary to minimize rutting.			
118. Minimize rutting in wetlands by conducting forestry activities on firm or frozen ground that can support the equipment.			
119. Cease equipment operations when rutting becomes excessive.			

F. Supplemental Questions

Water Resources

F-a. Are there any springs or seeps present?	❑ Yes. Go to next question.	❑ No. Go to Question F-d.
F-b. Was there a skid trail or forest road in a spring or seep?	❑ Yes. Go to next question.	❑ No. Go to Question F-d.
F-c. What was the impact on the spring or seep?	❑ No adverse impact to water quality. ❑ Minor short-term impacts to water quality ❑ Minor long-term impacts to water quality. ❑ Major short-term impacts to water quality. ❑ Major long-term impacts to water quality.	

Timber Harvesting

F-d. What is the dominant cover type(s) of the harvested area? (check all that apply)	❑ Aspen ❑ Spruce/Fir ❑ Pine ❑ Maple/Basswood ❑ Oak/Hickory ❑ Bottomland Hardwoods ❑ Swamp Conifers ❑ Other:
F-e. If the dominant tree species that were harvested are different than the dominant cover type, what types of tree species were harvested?	❑ Aspen ❑ Spruce/Fir ❑ Pine ❑ Maple/Basswood ❑ Oak/Hickory ❑ Bottomland Hardwoods ❑ Swamp Conifers ❑ Other:
F-f. What best describes the silvicultural prescription(s) used?	❑ Clearcut ❑ Clearcut with reserves ❑ Shelterwood ❑ Seedtree ❑ Selection harvest ❑ Other:
F-g. What best describes the timber stand improvements that were used, if any.	❑ Pre-commercial thinning ❑ Crop tree release ❑ Other: ❑ None
	❑ Shortwood (cut-to-length)

F-h. What best describes the type of harvesting system(s) used? (check all that apply)	❑ Tree-length (pole skidding) ❑ Whole tree (chipping operation) ❑ Other:	
F-i. What best describes the logging equipment used?	❑ Wheeled ❑ Tracked ❑ Both ❑ Other:	
F-j. Was this a salvage operation?	❑ Yes	❑ No.
F-k. What season(s) did harvesting occur?	❑ Spring (March – May)	
	❑ Summer (June – August)	
	❑ Fall (September – November)	
	❑ Winter (December – February)	
	❑ Unknown	
Overall Evaluation		
F-l. What were some of the positive aspects of this timber sale?		
F-m. With respect to water quality, what could have been done better?		
F-n. How would you rate this site for the overall application of BMPs for water quality?	❑ 1 = Total negligence ❑ 2 = Poor ❑ 3 = Average ❑ 4 = Good ❑ 5 = Excellent	
F-o. How would you rate this site for its overall impact on water quality?	❑ 1 = Severe impacts to water quality ❑ 2 = Moderate impacts to water quality ❑ 3 = Slight impacts to water quality ❑ 4 = Negligible impacts to water quality ❑ 5 = No visible impacts to water quality	

GPS and Photo Waypoint Log

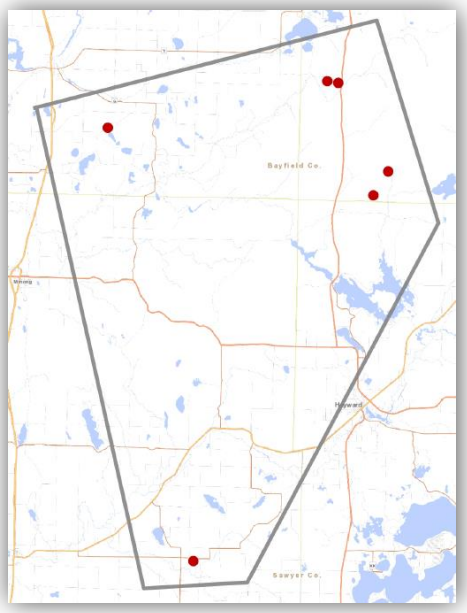
(Important for documenting waypoint data)

Lat/Long/Waypoint Name	Description of Waypoint and Photo	Date and Time

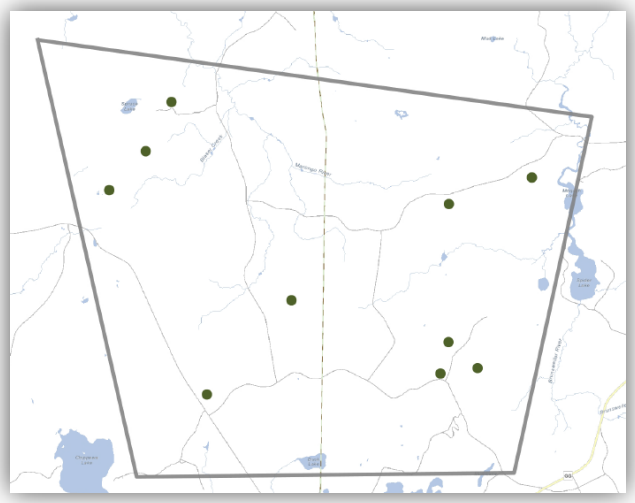
Appendix D: BMP Monitoring Teams

- **Team Gibbs:**
  - Nicolas Crane (Team Leader)
  - Dale Higgins
  - Rachel McDonald
  - Zach Hylinski
- **Team Roush-Fenway:**
  - Andrew Nevelin (Team Leader)
  - Sue Reineke
  - Terry Aselson
  - Matt Slater
- **Team Stewart-Haas:**
  - Manny Oradei (Team Leader)
  - Alyssa Core
  - Todd Pond
  - Melissa Yarington
- **Team Penske:**
  - Scott Mueller (Team Leader)
  - Charlie Zinsmaster
  - Terry Aselson
  - David Bohla
- **Team Hendrick:**
  - Nolan Kriegel (Team Leader)
  - Ron Gropp
  - Joe Kies
  - Joel Green
- **Team Waltrip:**
  - Jim Mineau (Team Leader)
  - Jamie Holly
  - Mark Heyde
  - Jason Hennes
- **Team Childress:**
  - Sara Summer (Team Leader)
  - Dennis Fincher
  - Mark Braasch
  - Chris Martin
- **Team Petty:**
  - Dave Kafura (Team Leader)
  - Dan Vuchetich
  - Lowell Petersen
  - Ruth King

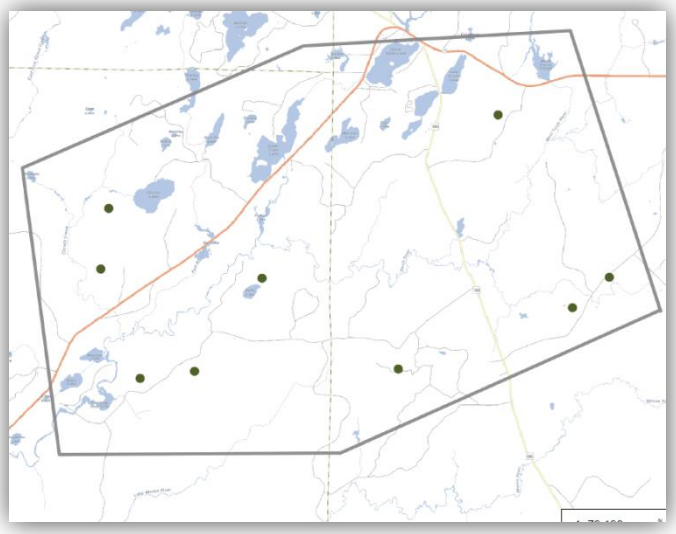
Appendix E: Team Maps



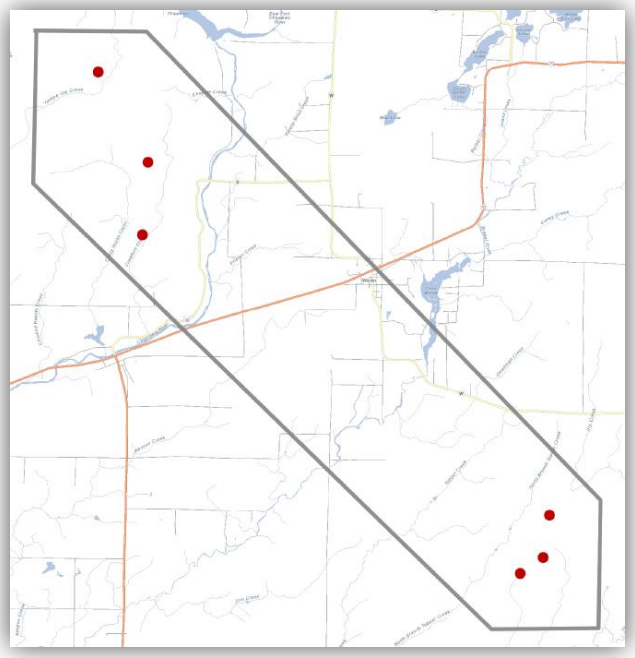
Team Penske



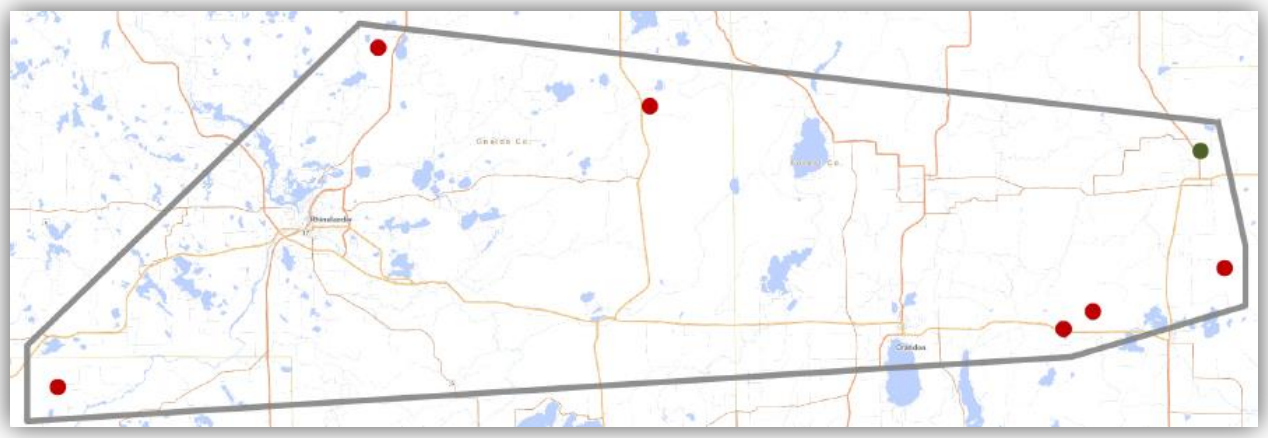
Team Petty



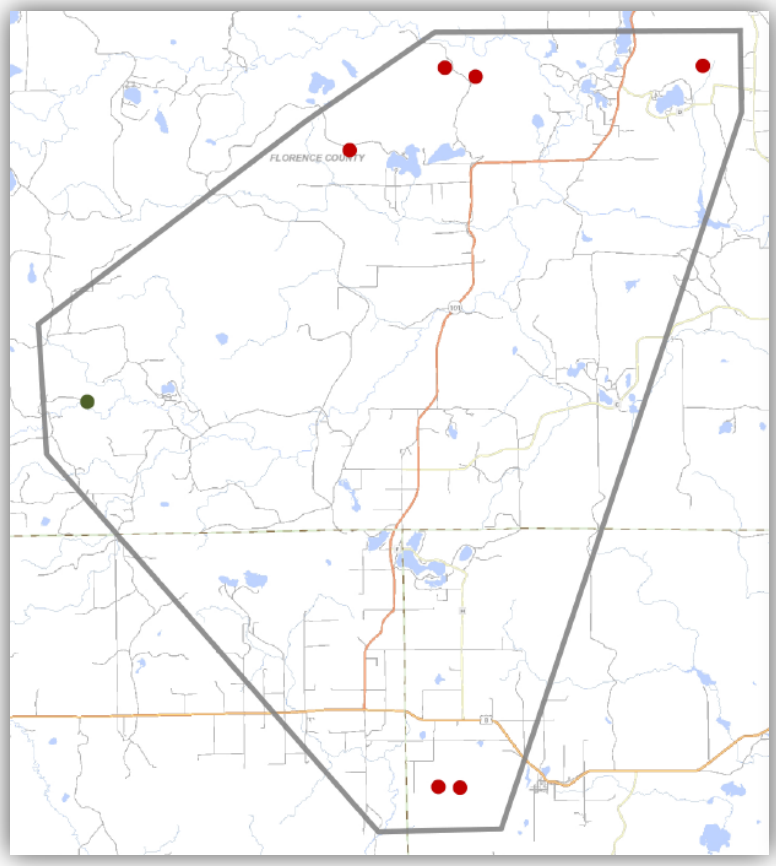
Team Roush-Fenway



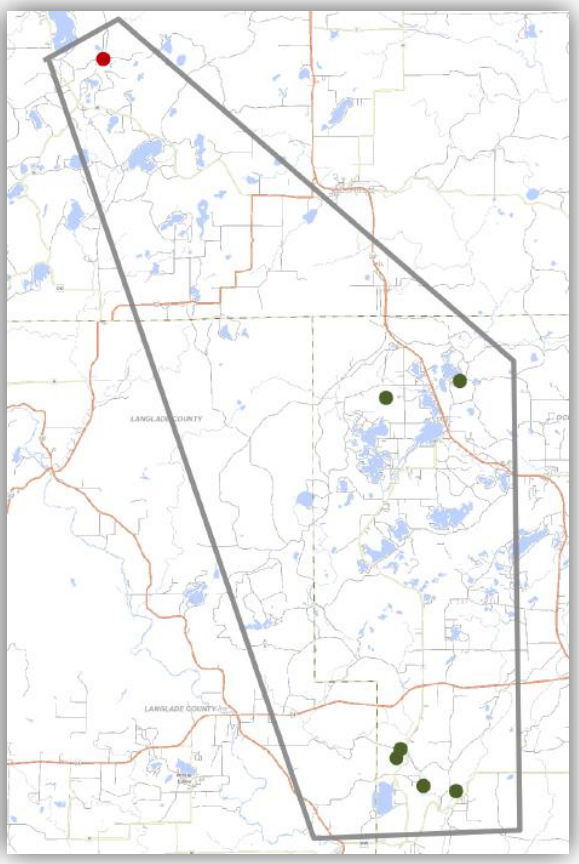
Team Hendrick



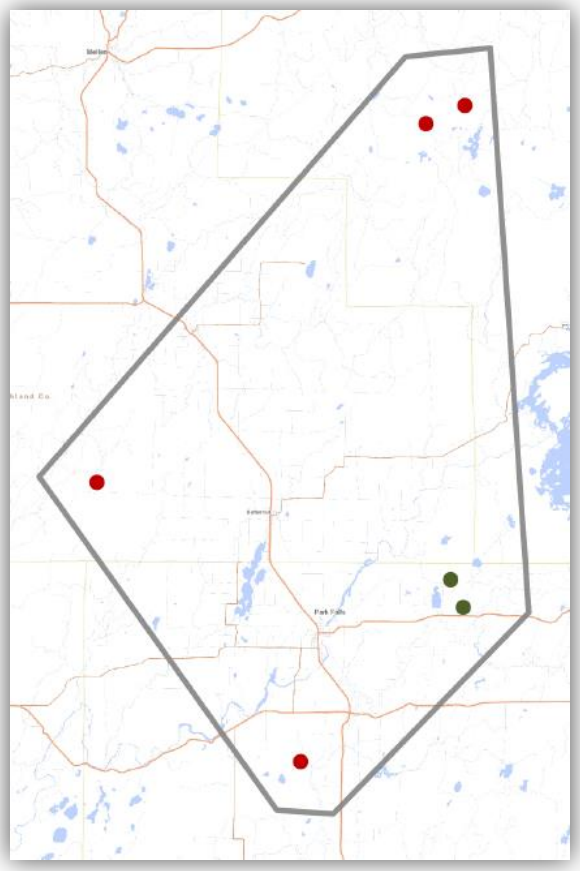
Team Stewart-Haas



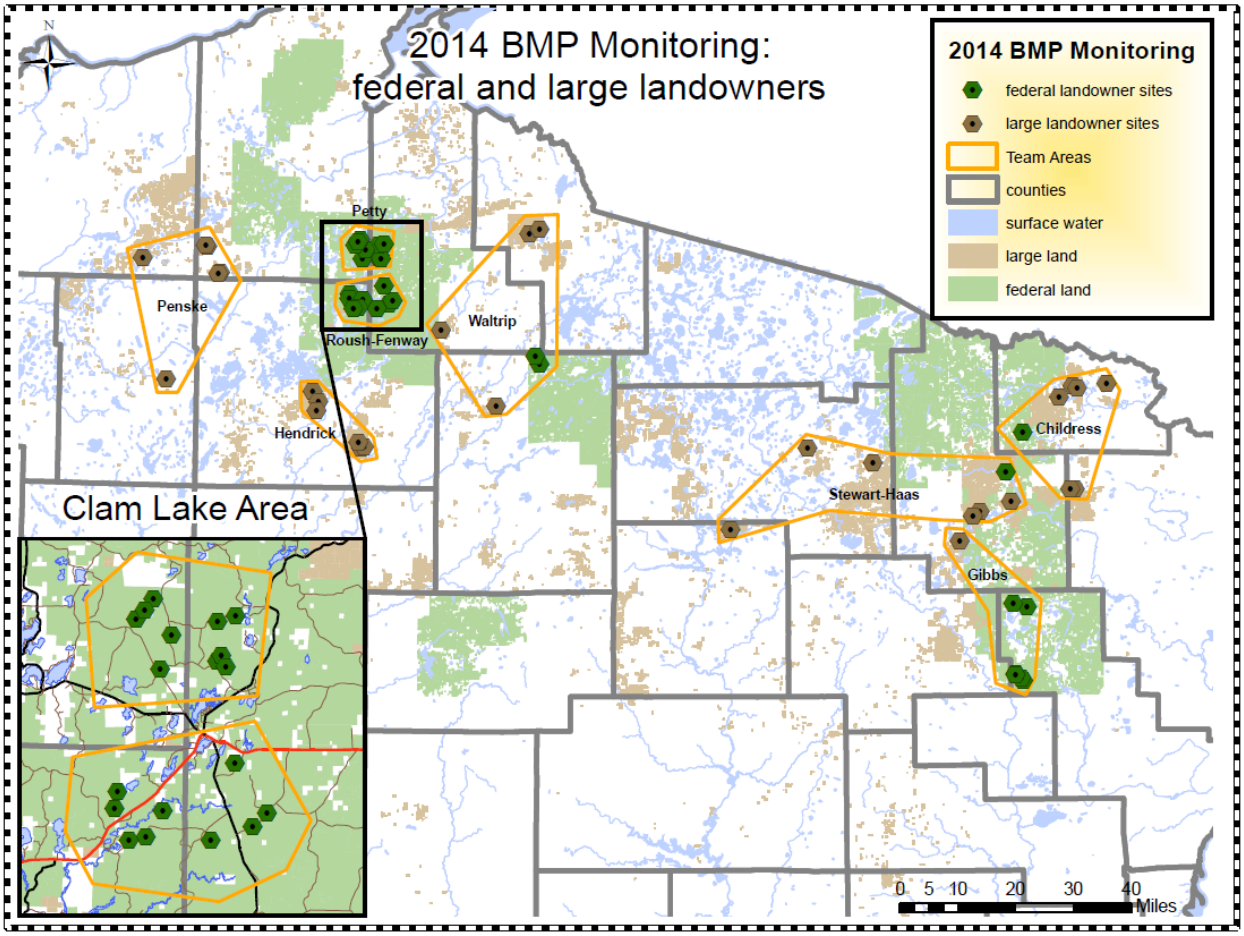
Team Childress



Team Gibbs



Team Waltrip


2014 BMP Monitoring:
federal and large landowners
2014 BMP Monitoring
federal landowner sites
large landowner sites
Team Areas
counties
surface water
large land
federal land
Petty
Penske
Roush-Fenway
Waltrip
Hendrick
Childress
Stewart-Haas
Gibbs
Clam Lake Area
0 5 10 20 30 40
Miles

Appendix F.1: Monitoring Results – Federal landowners

Timber Sales	Application Rating	Effectiveness Rating					
BMP	BMP Application	Total	No Adverse Impact	Minor Short-Term Impact	Minor Long-Term Impact	Major Short-Term Impact	Major Long-Term Impact
Summary of ALL BMP's	Not Applicable	2586					
	Insufficient Information	0					
	Applied Correctly	834	832	1	1	0	0
	Applied Incorrectly	7	1	4	2	0	0
	Not Applied	24	7	5	11	0	1
Fuels, Lubricants, Waste, and Spills							
1. Designate specific areas for equipment maintenance and fueling. Locate these areas on level terrain, a minimum of 100 feet from all lakes and streams.	Not Applicable	1					
	Insufficient Information	0					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
2. Collect all waste lubricants, containers and trash (i.e. grease cartridges).	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	28	27	0	1	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
Riparian Management Zones							
3. Locate roads outside the RMZ, unless necessary for stream crossings.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
4. Locate landings outside the RMZ.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
5. Do not dispose of or pile slash within the RMZ.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
6. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
7. Do not operate wheeled or	Not Applicable	22					

tracked equipment within 15 feet of the ordinary high water mark (OHWM) except on roads or at stream crossings.	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
8. Operate wheeled or tracked equipment within 15 to 50 feet of the OHWM when the ground is frozen or dry.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
9. Do not harvest fine woody material within 50 feet of the OHWM.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
10. Use selection harvests and promote long-lived tree species appropriate to the site.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
11. Harvesting intervals should be a minimum of every 10 years.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
12. Harvesting plans should leave at least 60 ft2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
13. Develop trees 12 inches DBH and larger.	Not Applicable	23					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
14. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high water mark (OHWM), only when the ground is frozen or dry.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
15. Do not harvest fine woody material within 15 feet of the OHWM.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
16. Use selection harvests and	Not Applicable	28					

promote long-lived tree species appropriate to the site.	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
17. Harvesting intervals should be a minimum of every 10 years.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
18. Harvesting plans should leave at least 60 ft2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
19. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark (OHWM) only when the ground is frozen or dry.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
20. Do not harvest fine woody material within 15 feet of the OHWM.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
Forest Roads							
21. Use existing roads when they provide the best long- term access.	Not Applicable	4					
	Insufficient Information	0					
	Applied Correctly	25	25	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
22. Select road locations that allow for drainage away from the road.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
23. Where possible, locate roads on well-drained soils.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
24. Minimize the number of stream, dry wash, and wetland crossings.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

25. Locate roads outside of riparian management zones and wetland filter strips, except at crossings	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
26. Road grades should not exceed 10%. If road grades greater than 10% are necessary, limit grade length or break the grade using drainage structures.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
27. Construct roads to follow natural contours and minimize cut and fills.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
28. Construct roads to remove water from road surfaces.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
29. Construct stable cut and fill slopes that will re-vegetate easily, either naturally or artificially.	Not Applicable	25					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
30. Do not bury debris in the road base.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
31. Install drainage structures to remove water from road surface and ditches.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	2	0	0
32. Install a berm at the inlets of drainage structures, if needed, to direct water into the structures.	Not Applicable	25					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
33. Provide erosion protection at the outlets of drainage structures to minimize erosion and disperse the water.	Not Applicable	24					
	Insufficient Information	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

34. Install drainage structures at grades of at least 2% more than the ditch grade and at a 30 to 45 degree angle to the road.	Not Applicable	23					
	Insufficient Information	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
35. Check drainage structures to ensure that they are not filling with sediment or other debris. Clean if needed.	Not Applicable	24					
	Insufficient Information	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
36. Install cross drain culverts long enough to extend beyond the road fill.	Not Applicable	25					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
37. Construct broad-based dips deep enough to provide adequate drainage and wide enough to allow trucks and equipment to pass safely.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
38. Use seed, mulch and/or erosion control netting where necessary to minimize soil erosion into lakes, streams and wetlands.	Not Applicable	25					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
39. Install sediment control structures where necessary to slow the flow of runoff and trap sediment until vegetation is established at the sediment source.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
40. Maintain, clean and/or replace sediment control structures until areas of exposed soil are stabilized.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
41. Inspect the road system at regular intervals. Clear debris from drainage structures to prevent clogging that can lead to washouts.	Not Applicable	11					
	Insufficient Information	0					
	Applied Correctly	18	18	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
42. Keep traffic to a minimum during wet periods and spring break-up to reduce maintenance needs.	Not Applicable	6					
	Insufficient Information	0					
	Applied Correctly	19	19	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	2	1	0	0	1

43. Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible to reduce erosion potential.	Not Applicable	6					
	Insufficient Information	0					
	Applied Correctly	19	19	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	2	1	1	0	0
44. Remove berms along the edge of the road if they will trap water on the road.	Not Applicable	16					
	Insufficient Information	0					
	Applied Correctly	13	13	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
45. When dust control agents are used, apply them in a manner that will keep these compounds from entering lakes, stream and groundwater.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
46. Remove all temporary drainage and crossing structures.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
47. Shape all road system surfaces to maintain proper surface drainage, if necessary.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
48. Inspect and maintain road surfaces, drainage structures, and crossings to minimize erosion.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
49. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
50. Install stream crossing structures at right angles to the stream channel.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
51. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

52. Minimize channel changes and the amount of excavation or fill needed at the crossing.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
53. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
54. Use soil stabilization practices on exposed soil at stream crossings.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
55. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
56. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
57. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
58. Install culverts that extend at least 1 foot beyond the road fill.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
59. Install culverts that are large enough to pass flood flows.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
60. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

61. Firmly compact material around culverts, particularly the bottom half. To prevent crushing, cover the top of culverts with fill to a depth of 1/3 the culvert diameter or at least 12 inches, whichever is greater.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
62. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
63. Keep culverts clear and free of debris so that water can pass unimpeded at all times.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
64. Locate fords where stream banks are low.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
65. Locate where the stream bed has a firm rock or gravel streambed.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
66. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
67. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
Timber Harvesting							
68. Use existing landings if possible.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
69. Locate landings on frozen ground or on firm well-drained soils with a slight slope or that	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	29	29	0	0	0	0

have been shaped to promote efficient drainage.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
70. Locate residue piles (sawdust, chipping residue, and other material) away from areas where runoff may wash residue into streams, lakes or wetlands.	Not Applicable	3					
	Insufficient Information	0					
	Applied Correctly	26	26	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
71. Where possible, keep skid trail grades less than 15%. Where steep grades are unavoidable, break the grade and install drainage structures at recommended intervals. Grades greater than 15% should not exceed 300 feet in length.	Not Applicable	2					
	Insufficient Information	0					
	Applied Correctly	27	27	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
72. Use existing skid trails if they provide the best long-term access.	Not Applicable	12					
	Insufficient Information	0					
	Applied Correctly	17	17	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
73. Limit the length and number of skid trails, landing, and stream crossing to the minimum necessary for conducting the harvest operation and to meet the landowner's objectives.	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	29	29	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
74. Whenever possible, winch logs up steep slopes if conventional skidding could cause erosion that affects water quality.	Not Applicable	23					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
75. Avoid operating equipment where excessive soil compaction, rutting, or channelized runoff may cause erosion that affects water quality.	Not Applicable	1					
	Insufficient Information	0					
	Applied Correctly	26	26	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	1	0	1	0	0	0
76. Fill in ruts, apply seed and mulch, and install sediment control structures and drainage structures on skid trails and landings where needed to prevent erosion and sedimentation into surface waters.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	0	0	0	0	0	0
77. Inspect soil stabilization practices periodically during and after harvest operations to insure that they are successful and remain functional.	Not Applicable	15					
	Insufficient Information	0					
	Applied Correctly	14	14	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
78. Do not dispose of or pile slash in areas where runoff may wash slash into lakes, streams, or	Not Applicable	1					
	Insufficient Information	0					
	Applied Correctly	28	28	0	0	0	0

wetlands.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
79. For winter harvesting, mark stream channels, dry washes, and existing culvert locations before snowfall.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
80. Use selection harvests or patch clear-cuts within 35 feet of the dry wash to promote tree species appropriate to the site.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
81. Avoid locating roads and landings within 35 feet of the dry wash unless necessary for crossings.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
82. Operate wheeled or tracked equipment within 15 feet of the dry wash only when the ground is frozen or dry.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
83. Do not harvest fine woody material within 15 feet of the dry wash.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
84. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
85. Avoid cabling logs across the dry wash, where feasible, to prevent damage to the banks of the dry wash.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
86. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
87. Install stream crossing structures at right angles to the stream channel.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0

	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
88. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
89. Minimize channel changes and the amount of excavation or fill needed at the crossing.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
90. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
91. Use soil stabilization practices on exposed soil at stream crossings.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
92. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
93. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
94. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
95. Install culverts that extend at least 1 foot beyond the road fill.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
96. Install culverts that are large enough to pass flood flows.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0

	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
97. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
98. Firmly compact material around culverts, particularly the bottom half. To prevent crushing, cover the top of culverts with fill to a depth of 1/3 the culvert diameter or at least 12 inches, whichever is greater.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
99. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
100. Keep culverts clear and free of debris so that water can pass unimpeded at all times.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
101. Locate fords where stream banks are low.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
102. Locate where the stream bed has a firm rock or gravel streambed.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
103. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
104. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
Wetlands							
105. Whenever practical, avoid locating roads and landings in	Not Applicable	5					
	Insufficient Information	0					

wetlands; otherwise use extreme caution.	Applied Correctly	23	23	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	0	0	0	0	0	0
106. Whenever possible, forest management activities in wetlands should occur on frozen ground to minimize rutting.	Not Applicable	9					
	Insufficient Information	0					
	Applied Correctly	20	19	1	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
107. Do not dispose of or move upland slash into a wetland. Slash from trees harvested within the wetland may remain in the wetland.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	22	22	0	0	0	0
	Applied Incorrectly	2	1	1	0	0	0
	Not Applied	0	0	0	0	0	0
108. Keep slash out of open water.	Not Applicable	8					
	Insufficient Information	0					
	Applied Correctly	21	21	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
109. Whenever practical, avoid equipment maintenance and fueling in wetlands.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	24	24	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
110. Whenever practical, avoid locating roads and landings in the wetland filter strip; otherwise use extreme caution.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	24	24	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
111. Minimize soil exposure and compaction to protect the ground vegetation and the duff layer in the wetland filter strip.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	23	23	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
112. Operate equipment in the wetland filter strip only when the ground is firm or frozen.	Not Applicable	8					
	Insufficient Information	0					
	Applied Correctly	20	20	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
113. Construct upland approaches to the wetland so the surface runoff is diverted away from the road approach prior to reaching the wetland.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
114. If landings are necessary in a wetland, build them to the	Not Applicable	29					
	Insufficient Information	0					

minimum size required for the operation and to achieve the landowner's objective.	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
115. Avoid operating equipment in areas of open water, springs, or seeps.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
116. Provide for adequate cross-road drainage in roads to minimize changes to natural surface and subsurface flow in the wetland.	Not Applicable	23					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	0	0	3	0	0
117. Use low ground pressure equipment, such as wide tire or tracked equipment, if necessary to minimize rutting.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
118. Minimize rutting in wetlands by conducting forestry activities on firm or frozen ground that can support the equipment.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
119. Cease equipment operations when rutting becomes excessive.	Not Applicable	21					
	Insufficient Information	0					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

Appendix F-1: Monitoring Results – Large landowners

Timber Sales	Application Rating	Effectiveness Rating					
BMP	BMP Application	Total	No Adverse Impact	Minor Short-Term Impact	Minor Long-Term Impact	Major Short-Term Impact	Major Long-Term Impact
Summary of ALL BMP's	Not Applicable	2468					
	Insufficient Information	4					
	Applied Correctly	926	926	0	0	0	0
	Applied Incorrectly	18	2	10	3	0	3
	Not Applied	35	17	6	11	0	1
Fuels, Lubricants, Waste, and Spills							
1. Designate soecific areas for equipment maintenance and fueling. Locate these areas on level terrain, a minimum of 100 feet from all lakes and streams.	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
2. Collect all waste lubricants, containers and trash (i.e. grease cartridges).	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	27	27	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	1	1	0	0
Riparian Management Zones							
3. Locate roads outside the RMZ, unless necessary for stream crossings.	Not Applicable	16					
	Insufficient Information	0					
	Applied Correctly	13	13	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
4. Locate landings outside the RMZ.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
5. Do not dispose of or pile slash within the RMZ.	Not Applicable	16					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	0	0	0	0	0	0
6. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.	Not Applicable	16					
	Insufficient Information	0					
	Applied Correctly	13	13	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
7. Do not operate wheeled or	Not Applicable	18					

tracked equipment within 15 feet of the ordinary high water mark (OHWM) except on roads or at stream crossings.	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	2	0	0	0	0
8. Operate wheeled or tracked equipment within 15 to 50 feet of the OHWM when the ground is frozen or dry.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
9. Do not harvest fine woody material within 50 feet of the OHWM.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
10. Use selection harvests and promote long-lived tree species appropriate to the site.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
11. Harvesting intervals should be a minimum of every 10 years.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
12. Harvesting plans should leave at least 60 ft2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
13. Develop trees 12 inches DBH and larger.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
14. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high water mark (OHWM), only when the ground is frozen or dry.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
15. Do not harvest fine woody material within 15 feet of the OHWM.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
16. Use selection harvests and	Not Applicable	27					

promote long-lived tree species appropriate to the site.	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
17. Harvesting intervals should be a minimum of every 10 years.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
18. Harvesting plans should leave at least 60 ft2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
19. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark (OHWM) only when the ground is frozen or dry.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
20. Do not harvest fine woody material within 15 feet of the OHWM.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
Forest Roads							
21. Use existing roads when they provide the best long- term access.	Not Applicable	2					
	Insufficient Information	0					
	Applied Correctly	27	27	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
22. Select road locations that allow for drainage away from the road.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
23. Where possible, locate roads on well-drained soils.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
24. Minimize the number of stream, dry wash, and wetland crossings.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

25. Locate roads outside of riparian management zones and wetland filter strips, except at crossings	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
26. Road grades should not exceed 10%. If road grades greater than 10% are necessary, limit grade length or break the grade using drainage structures.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
27. Construct roads to follow natural contours and minimize cut and fills.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
28. Construct roads to remove water from road surfaces.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	2	0	0	0	0
29. Construct stable cut and fill slopes that will re-vegetate easily, either naturally or artificially.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
30. Do not bury debris in the road base.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
31. Install drainage structures to remove water from road surface and ditches.	Not Applicable	23					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	1	0	0	1	0	0
32. Install a berm at the inlets of drainage structures, if needed, to direct water into the structures.	Not Applicable	25					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	0	0	0	0	0	0
33. Provide erosion protection at the outlets of drainage structures to minimize erosion and disperse the water.	Not Applicable	24					
	Insufficient Information	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

34. Install drainage structures at grades of at least 2% more than the ditch grade and at a 30 to 45 degree angle to the road.	Not Applicable	24					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	1	0	0	0	0	1
	Not Applied	0	0	0	0	0	0
35. Check drainage structures to ensure that they are not filling with sediment or other debris. Clean if needed.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
36. Install cross drain culverts long enough to extend beyond the road fill.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
37. Construct broad-based dips deep enough to provide adequate drainage and wide enough to allow trucks and equipment to pass safely.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
38. Use seed, mulch and/or erosion control netting where necessary to minimize soil erosion into lakes, streams and wetlands.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	5	5	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	1	0	0	0
39. Install sediment control structures where necessary to slow the flow of runoff and trap sediment until vegetation is established at the sediment source.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
40. Maintain, clean and/or replace sediment control structures until areas of exposed soil are stabilized.	Not Applicable	24					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	1	1	0	0	0	0
41. Inspect the road system at regular intervals. Clear debris from drainage structures to prevent clogging that can lead to washouts.	Not Applicable	8					
	Insufficient Information	0					
	Applied Correctly	20	20	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
42. Keep traffic to a minimum during wet periods and spring break-up to reduce maintenance needs.	Not Applicable	7					
	Insufficient Information	0					
	Applied Correctly	16	16	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	6	2	1	3	0	0

43. Shape road surfaces periodically to maintain proper surface drainage. Fill in ruts and holes with gravel or compacted fill as soon as possible to reduce erosion potential.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	18	18	0	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	4	1	0	3	0	0
44. Remove berms along the edge of the road if they will trap water on the road.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
45. When dust control agents are used, apply them in a manner that will keep these compounds from entering lakes, stream and groundwater.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
46. Remove all temporary drainage and crossing structures.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
47. Shape all road system surfaces to maintain proper surface drainage, if necessary.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
48. Inspect and maintain road surfaces, drainage structures, and crossings to minimize erosion.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	0	0	1
49. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
50. Install stream crossing structures at right angles to the stream channel.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
51. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

52. Minimize channel changes and the amount of excavation or fill needed at the crossing.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
53. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
54. Use soil stabilization practices on exposed soil at stream crossings.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
55. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	2	1	0	1	0	0
	Not Applied	1	0	1	0	0	0
56. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.	Not Applicable	23					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
57. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
58. Install culverts that extend at least 1 foot beyond the road fill.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
59. Install culverts that are large enough to pass flood flows.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
60. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0

61. Firmly compact material around culverts, particularly the bottom half. To prevent crushing, cover the top of culverts with fill to a depth of 1/3 the culvert diameter or at least 12 inches, whichever is greater.	Not Applicable	27					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
62. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
63. Keep culverts clear and free of debris so that water can pass unimpeded at all times.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
64. Locate fords where stream banks are low.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
65. Locate where the stream bed has a firm rock or gravel streambed.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
66. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
67. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
Timber Harvesting							
68. Use existing landings if possible.	Not Applicable	12					
	Insufficient Information	0					
	Applied Correctly	17	17	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
69. Locate landings on frozen ground or on firm well-drained soils with a slight slope or that have been shaped to promote	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	24	24	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0

efficient drainage.	Not Applied	0	0	0	0	0	0
70. Locate residue piles (sawdust, chipping residue, and other material) away from areas where runoff may wash residue into streams, lakes or wetlands.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	11	11	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
71. Where possible, keep skid trail grades less than 15%. Where steep grades are unavoidable, break the grade and install drainage structures at recommended intervals. Grades greater than 15% should not exceed 300 feet in length.	Not Applicable	13					
	Insufficient Information	0					
	Applied Correctly	16	16	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
72. Use existing skid trails if they provide the best long-term access.	Not Applicable	13					
	Insufficient Information	0					
	Applied Correctly	16	16	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
73. Limit the length and number of skid trails, landing, and stream crossing to the minimum necessary for conducting the harvest operation and to meet the landowner's objectives.	Not Applicable	1					
	Insufficient Information	1					
	Applied Correctly	26	26	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
74. Whenever possible, winch logs up steep slopes if conventional skidding could cause erosion that affects water quality.	Not Applicable	26					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
75. Avoid operating equipment where excessive soil compaction, rutting, or channelized runoff may cause erosion that affects water quality.	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
76. Fill in ruts, apply seed and mulch, and install sediment control structures and drainage structures on skid trails and landings where needed to prevent erosion and sedimentation into surface waters.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	1	1	0	0	0	0
77. Inspect soil stabilization practices periodically during and after harvest operations to insure that they are successful and remain functional.	Not Applicable	21					
	Insufficient Information	1					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
78. Do not dispose of or pile slash in areas where runoff may wash slash into lakes, streams, or wetlands.	Not Applicable	6					
	Insufficient Information	0					
	Applied Correctly	23	23	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0

	Not Applied	0	0	0	0	0	0
79. For winter harvesting, mark stream channels, dry washes, and existing culvert locations before snowfall.	Not Applicable	21					
	Insufficient Information	2					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
80. Use selection harvests or patch clear-cuts within 35 feet of the dry wash to promote tree species appropriate to the site.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
81. Avoid locating roads and landings within 35 feet of the dry wash unless necessary for crossings.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
82. Operate wheeled or tracked equipment within 15 feet of the dry wash only when the ground is frozen or dry.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
83. Do not harvest fine woody material within 15 feet of the dry wash.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
84. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
85. Avoid cabling logs across the dry wash, where feasible, to prevent damage to the banks of the dry wash.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
86. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
87. Install stream crossing structures at right angles to the stream channel.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0

	Not Applied	0	0	0	0	0	0
88. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
89. Minimize channel changes and the amount of excavation or fill needed at the crossing.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
90. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
91. Use soil stabilization practices on exposed soil at stream crossings.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
92. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
93. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
94. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
95. Install culverts that extend at least 1 foot beyond the road fill.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
96. Install culverts that are large enough to pass flood flows.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0

	Not Applied	0	0	0	0	0	0
97. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
98. Firmly compact material around culverts, particularly the bottom half. To prevent crushing, cover the top of culverts with fill to a depth of 1/3 the culvert diameter or at least 12 inches, whichever is greater.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
99. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
100. Keep culverts clear and free of debris so that water can pass unimpeded at all times.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
101. Locate fords where stream banks are low.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
102. Locate where the stream bed has a firm rock or gravel streambed.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
103. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
104. Anchor temporary structures on one end with a cable or other device so they do not float away during high water.	Not Applicable	29					
	Insufficient Information	0					
	Applied Correctly	0	0	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
Wetlands							
105. Whenever practical, avoid locating roads and landings in wetlands; otherwise use extreme	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	23	23	0	0	0	0

caution.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	1	0	0	0	0
106. Whenever possible, forest management activities in wetlands should occur on frozen ground to minimize rutting.	Not Applicable	8					
	Insufficient Information	0					
	Applied Correctly	20	20	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	0	0	0	0	0	0
107. Do not dispose of or move upland slash into a wetland. Slash from trees harvested within the wetland may remain in the wetland.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	24	24	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
108. Keep slash out of open water.	Not Applicable	12					
	Insufficient Information	0					
	Applied Correctly	17	17	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
109. Whenever practical, avoid equipment maintenance and fueling in wetlands.	Not Applicable	6					
	Insufficient Information	0					
	Applied Correctly	23	23	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
110. Whenever practical, avoid locating roads and landings in the wetland filter strip; otherwise use extreme caution.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	24	24	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
111. Minimize soil exposure and compaction to protect the ground vegetation and the duff layer in the wetland filter strip.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	24	24	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
112. Operate equipment in the wetland filter strip only when the ground is firm or frozen.	Not Applicable	8					
	Insufficient Information	0					
	Applied Correctly	21	21	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
113. Construct upland approaches to the wetland so the surface runoff is diverted away from the road approach prior to reaching the wetland.	Not Applicable	20					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
114. If landings are necessary in a wetland, build them to the minimum size required for the	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0

operation and to achieve the landowner's objective.	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
115. Avoid operating equipment in areas of open water, springs, or seeps.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
116. Provide for adequate cross-road drainage in roads to minimize changes to natural surface and subsurface flow in the wetland.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	2	0	0
117. Use low ground pressure equipment, such as wide tire or tracked equipment, if necessary to minimize rutting.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
118. Minimize rutting in wetlands by conducting forestry activities on firm or frozen ground that can support the equipment.	Not Applicable	16					
	Insufficient Information	0					
	Applied Correctly	13	13	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0
119. Cease equipment operations when rutting becomes excessive.	Not Applicable	19					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	0	0	0	0	0	0