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

2015 BMP Monitoring Report




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Acknowledgements

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Executive Summary

In late fall of 2015, Non-Industrial Private Forestland (NIPF) was monitored for the application and effectiveness of Wisconsin's Forestry Best Management Practices (BMPs) for Water Quality. There were a total of 36 sites monitored, with 26 of the landowners enrolled in the MFL program. These sites were chosen because of the water resources in or adjacent to the sale. Information on how the BMPs were implemented and how effective they were, were recorded along with site information such as; sale size, season of harvest, harvest type, water resources, forest roads, and tree species of the harvest area.

The average harvest size for all NIPF sites monitored in 2015 was only 30 acres, which is a slight decrease from prior years monitoring, with a total of 1083 acres monitored. Almost two-thirds (23:36) of sites were monitored one to two years after they received their harvest. By far, the most common season of harvest was winter (21 sites), compared to the next highest was cut during 'more than one' season (8 sites). Over 90% (33:36) sites had wetlands listed as a water resource along with 23 sites containing streams, while only 3 sites had lakes within proximity of the sale. Overall there was an increase in the number of water resources during the 2015 monitoring compared to past years, despite the decrease in harvest size. Most of the sites (25:30), where water resources were present; where RMZs were recommended by the BMP manual, either increased or met the recommended RMZ distance. The two most abundant dominant cover types were maple/basswood (16 sites) and aspen (15 sites). Selection harvest (13 sites) was listed as the most commonly used harvest method along with 'multiple' also being common (10 sites). Culverts were the most common type of stream crossing (8) on forest roads systems, while frozen crossings (2) were the most common on skid trails that crossed streams. Most sites (27:36) had forest roads in place for the harvest and over half (16:27) were either constructed or improved for the harvest activity. Of the 27 sites that contained forest roads, 23 were being used as active roads, and eight had drainage structures associated with the forest roads.

The number of applicable BMPs per site averaged 30%, which is higher than 2008, where only 20% of all BMPs were applicable per site. The correct application rate of BMPs was relatively high, at 90% of the time – the same as 2008 (tied for the highest since the start of the BMP program). The difference in correct application of BMPs between MFL and Non-MFL Landowners is the smallest since the programs start at only 0.4%. BMPs that are *applied incorrectly* and BMPs that are *not applied* make up small percentage of all BMPs (2.4% and 7.6% respectively). Of the five monitoring categories, 'RMZs' received the highest correct application (94.6%) whereas 'forest roads' received the lowest rating (85%). However, this rating on 'forest roads' is up 15% from 2008.

The effectiveness of BMPs that were *applied correctly* was extremely high (99.6%) at protecting water quality, but when BMPs were *applied incorrectly* or *not applied* BMP effectiveness rates woefully dropped (6.3% and 9.4% respectively). Effectiveness for protecting water quality was not determined to be affected by monitoring categories when application categories were held constant. Even with the low water quality protection of BMPs that were *applied incorrectly* and *not applied,* no major impacts were reported on any NIPF sites. Even though these two categories make up only 10% of applicable BMPs, reducing this 10% is still the greatest way to achieve higher water quality protection.

Map of 2015 BMP NIPF Monitoring Sites

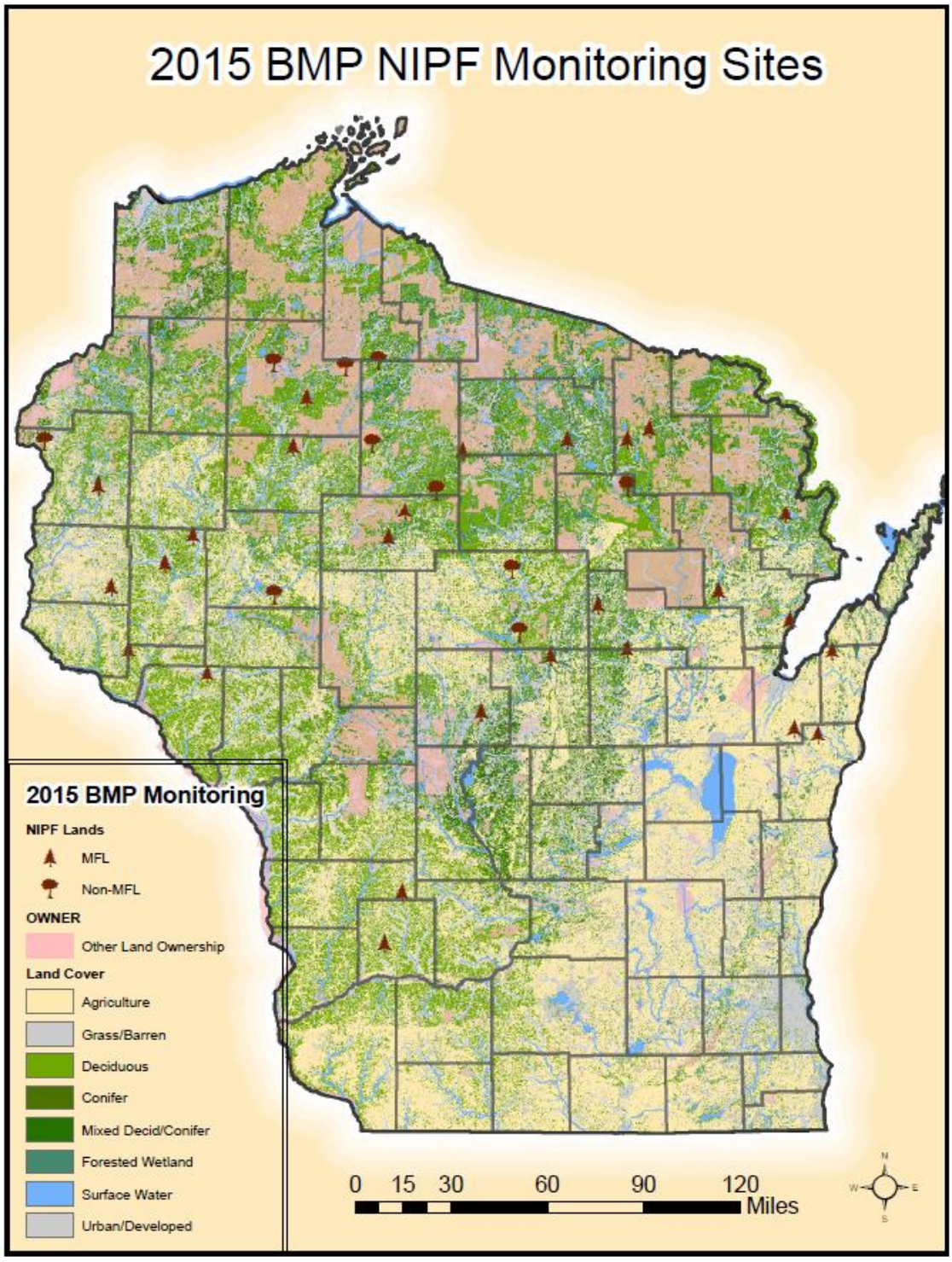


Figure 1. The sites monitored by the 2015 BMP teams. Coniferous trees represent sites that were in the MFL program and deciduous trees represent sites not in the MFL program. ***Note: Some dots are close together making the total number of sites difficult to determine on this map.*** ***Disclaimer:*The 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

Since the Federal Clean Water Act was originally passed in 1972, several revisions have been made and now include the specific activities of silviculture and its' contributing factors to nonpoint source pollution (NPS). Each state is required to develop either guidelines or regulations to reduce the NPS from silviculture to the "maximum extent practical". In Wisconsin, this has led to the development of the Best Management Practices (BMPs), which are designed to protect water quality – from silvicultural activity – according to the Clean Water Act of 1972 and its revisions.

Wisconsin adopted the BMP program in 1995, and through monitoring, statistical analysis, and written reports, Wisconsin is able to document success in protecting water quality through the BMP program. Initially, all silvicultural activities done within the state of Wisconsin were subject to being monitored every year. There are many different landowners that reside over the forests of Wisconsin including: Federal, Industrial (Large), County, State, Non-Industrial Private (NIP), and Tribal landowners. With this many landowners, monitoring a statistically valid sample size from each proved to be too demanding of a task and the BMP Advisory Committee (comprised of individuals who represent many different interests in Wisconsin's forests) decided to only monitor one or two landowners on any given year.

The landowner group that received monitoring during 2015 was Non-Industrial Private Forestland (NIPF). There were a total of 8322 sites that received harvest during the year 2014 and therefore, eligible to be monitored during 2015. In order to run statistical analyses of the results, 36 were chosen to be monitored in order to obtain a 95% confidence interval. The sites are randomly selected and pre-screened using a variety of aerial photos obtained from GIS sites, DNR Surface Water Data Viewer, and Google Earth. Sites that are chosen to be monitored have at least one of the eligibility criteria including:

- 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

This ensures that the BMP program, through the monitoring teams, will be focusing their time at timber sales that can potentially have the most impact on water quality. Sites that lack all of these characteristics are unlikely to impact water quality in a direct (observable) manner.

The BMP monitoring teams are comprised of three to four individuals and have a wide background of expertise ranging from hydrology, soil science, ecology, conservation, silviculture and logging. In order to achieve consistent evaluations across all the different sites, there were trainings held for all team members, put on by the DNR Forest Hydrologist. These trainings included both lecture/discussion in a classroom type setting and field portions where participants went to sites to go through the monitoring worksheets together. Information about the site was collected as well as being evaluated for the application and effectiveness of BMPs.

Timber Harvest Information

Harvest Age

The harvest age of a timber stand is the amount of time since the harvesting was completed to the time the BMP monitoring teams are on site. In order to be eligible for the 2015 BMP NIPF monitoring, one of the criteria was that a county cutting notice had to be filed for a stand expecting harvest in 2014. This means the vast majority of stands had cutting notices submitted during 2014 and most of the harvest took place during this time as well. In some cases, a cutting notice would be filed for multiple years, usually during the winter of 2013/2014 or 2014/2015 to allow for some flexibility with harvest times (Table 1). It was these types of sales that made up the < 1 year old (10 sites) and > 2 years old (3 sites). The reason this time frame is used for BMP monitoring is because it allows the site to experience one runoff season (spring). Monitoring after one runoff season allows for several practical implications to occur: water quality issues become more apparent, they can be (if found) be brought to the landowners attention in a timely manner, and lastly, if the site is found in good condition, it is assumed to handle future runoff seasons without affecting water quality. This is conditional if site conditions remain constant (examples, no new harvesting occurs or a closed forest road remains closed in the future).

Table 1 Harvest Age

Years	# of Sites
< 1	10
1 to 2	23
> 2	3

Table 1. The amount of time that has passed since the site was harvested/cut and when it was monitored.

Harvest Size

The harvest size of the 2015 monitoring sites was relatively small with an average of 30.1 acres and is reduced even farther when using the median at only 20.5 acres. However, the range is relatively large going from 3 acres all the way up to one site of 120 acres (Figure 3). The total number of acres was 1083 acres, which were distributed over 36 sites, giving an average of 30 acres per site. Even though the average seems small, it is not much different from the averages found in past monitoring, which range from 31 acres (2002, previously the smallest) to 35 acres (1996, largest) (Figure 4). The harvest size includes both areas of harvest and non-harvest within a boundary that experienced silvicultural activities (See Figure 2 for example). With harvest areas being as small as they were, teams became very comfortable and familiar with the harvest area.

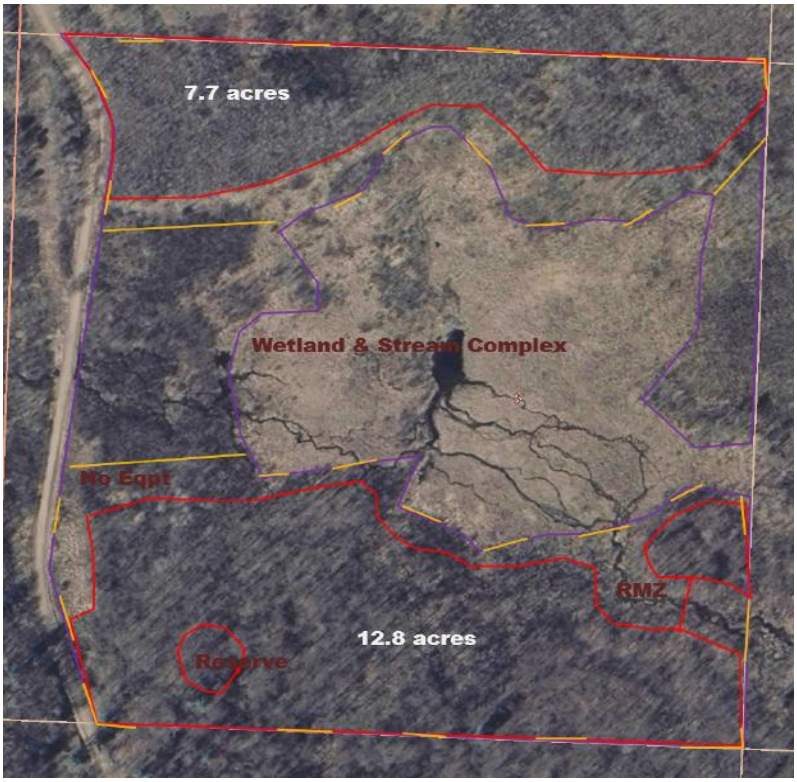


Figure 2. Purple boundary includes all harvestable area. Red area includes areas where trees were harvested. Dashed yellow indicates the area that the monitoring teams would consider for harvest size. Note these areas include areas like small reserves, no equipment zones, and RMZ boundaries into the total area. This brings up a total of 20.5 acres of harvest area.

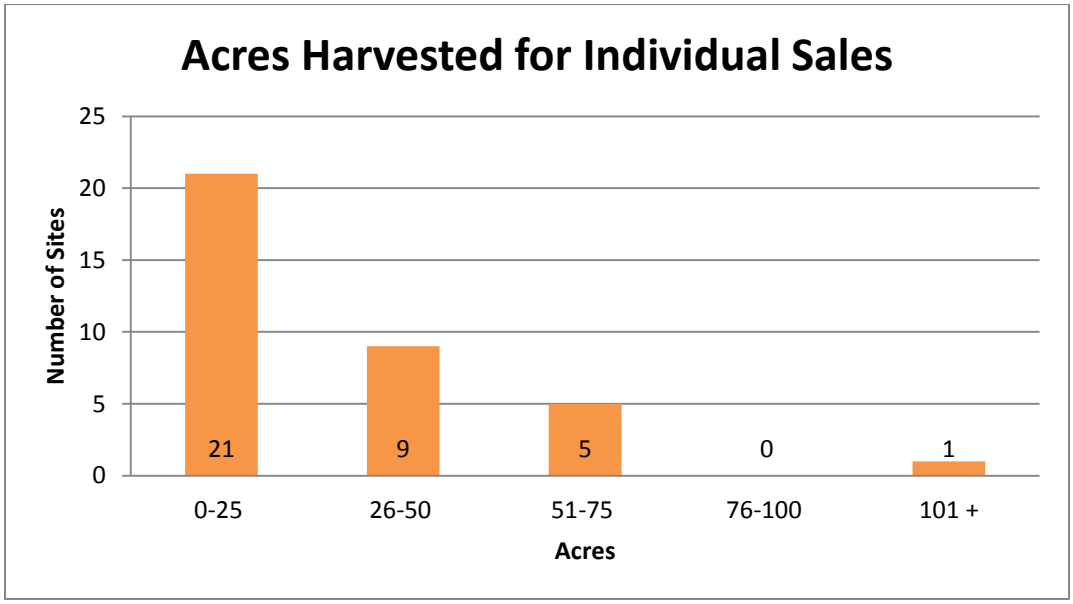


Figure 3. The number of acres that were harvested for each of the sales conducted on NIPF.

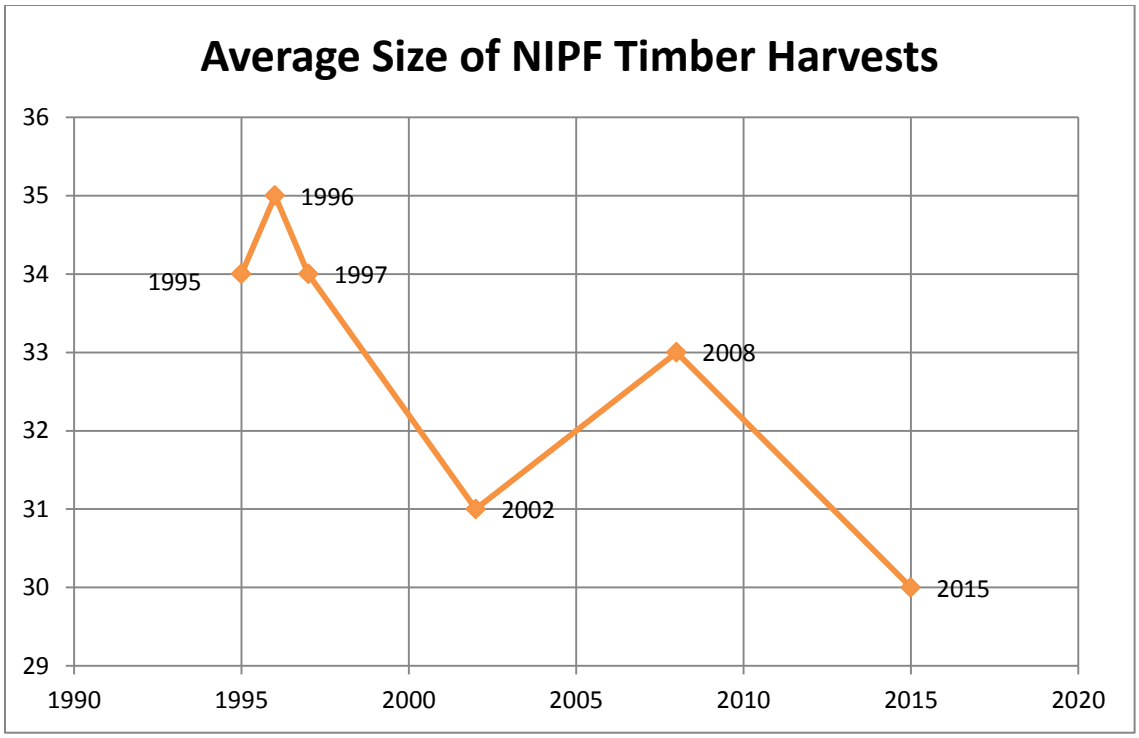


Figure 4. The average size of NIPF timber harvests since the start of Wisconsin's BMP program in 1995 to the most recent monitoring in 2015.

Season of Harvest

The most common season of harvest was winter with over half (21:36) of sites being exclusively harvested during the months of December through February (Figure 6). Interestingly, the next most common time was listed as 'more than one' season. With the sale sites being relatively small, it is unexpected that more than one season would be needed to complete such a harvest. One possible reason, (and verified by several landowners) to having the harvest occur during multiple seasons, is that it allows for more flexibility to successfully harvest around weather dependent factors. This flexibility can help protect water quality and is often recommended for sites that could be partially harvested in non-frozen/wet conditions along with more sensitive areas that call for frozen/dry conditions. Also, no sites were harvested during the spring, often the wettest period of the year. With the combination of no spring harvests and high numbers of 'more than one' season and winter harvests, the BMPs have a high possibility of being applied correctly.

Figure 5. Picture of stream crossing that would have been frozen during winter harvest conditions.

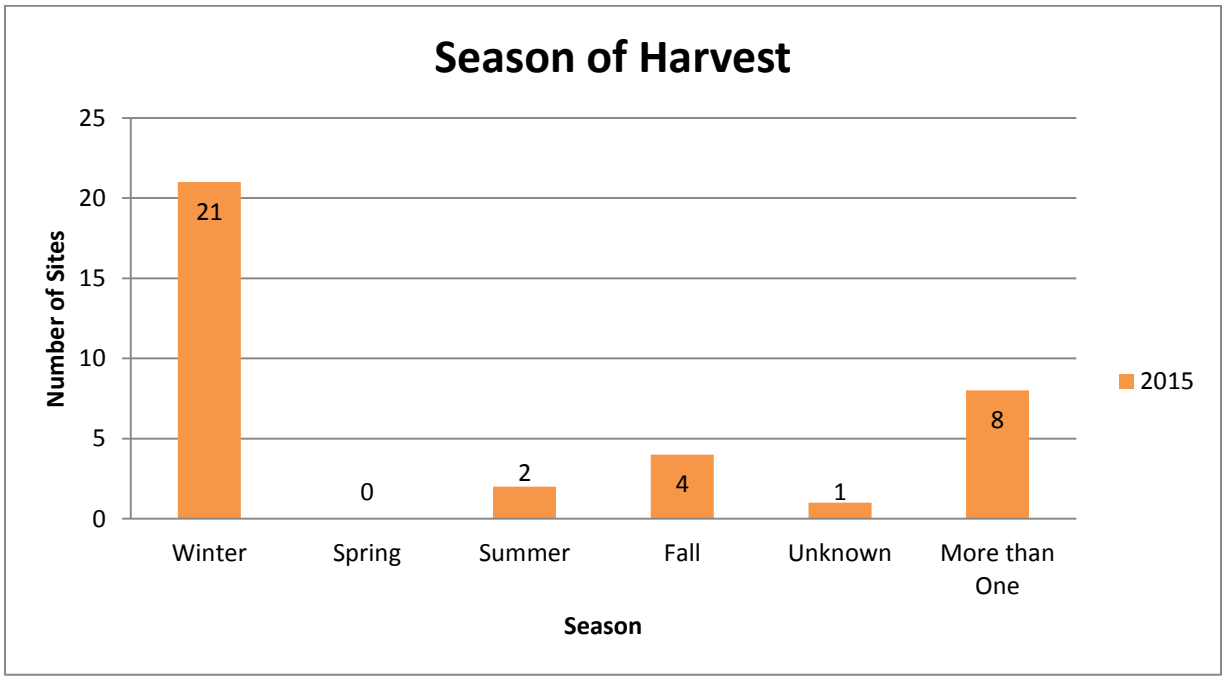


Figure 6. Number of sales that received harvest during specified seasons.

Water Resources

As to be expected in a water quality study, there were many water resources present on the sites chosen for the 2015 NIPF BMP monitoring. The most abundant water resource was wetlands (33 sites) with only 3 of the 36 sites not having wetlands (Figure 7). It is important to note that in order for a water resource to be counted in the BMP study, they must either be in, immediately adjacent to, or be crossed on a forest road system that connects to the harvest area. The next most common water resource was streams with 23 sites containing steams. There are three different classifications of streams based on

stream width and the designation of streams based on a presence of trout. If a stream is 'greater than three feet wide' or is a 'designated trout stream' (DTS) it goes into the first classification. The second two classifications are streams between 'one to three feet wide' and steams 'less than one foot wide'. Springs/seeps are also fairly common (9 sites) and lakes were the least commonly present (3 sites). Also, these water resources are not exclusive, meaning that one site may have multiple water resources present (example: one site may have a wetland, one stream 'greater than three feet wide', and another stream 'less than one foot wide' and would be counted in each of its respective categories).

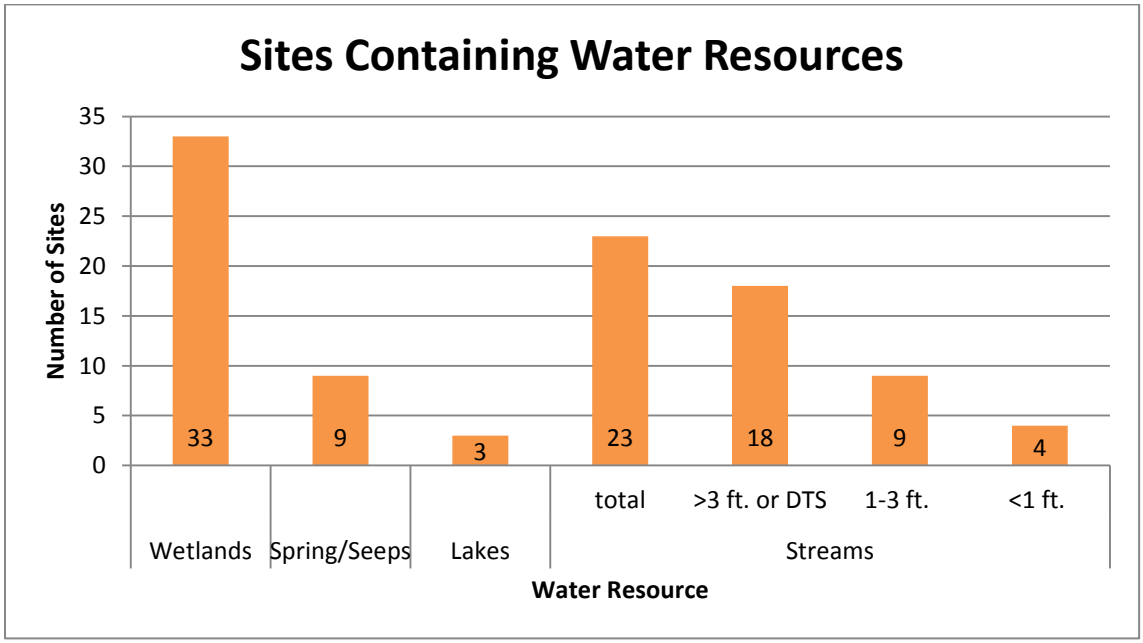


Figure 7. The number of sites that contain different types of water resources. Streams are broken down into three categories depending on width and/or if they are designated trout streams (DTS). ***Note: Sites may have more than one type of water resource and more than one type of stream.***

In order for a site to be eligible for BMP monitoring, it must have one of these criteria:

- 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

Wetlands were present at 92% of the monitored sites which is the highest in its category since the BMP program started in 1995(Figure 8). Along the same lines, streams also had a high presence rate of 64%. Lakes, however, are at the opposite end of the spectrum and only had a presence rate of 8%. However, when we look at total amount of qualifying resources present between all the years, the 2015 monitoring has the greatest presence of water resources (Figure 9). This is calculated by adding the three percentages to give a total. Since a healthy portion of the BMPs are about the qualifying water resources, a site with more water resources often has more BMPs associated with it, leading it to become a better site to look at for the monitoring teams. This is even more impressive when the harvest

sites are, on average, smaller than past years. One possible explanation of this occurrence could be that the necessary number of sites to reach statistical validity was less than prior years, so a more selective process could be used when looking at sites.

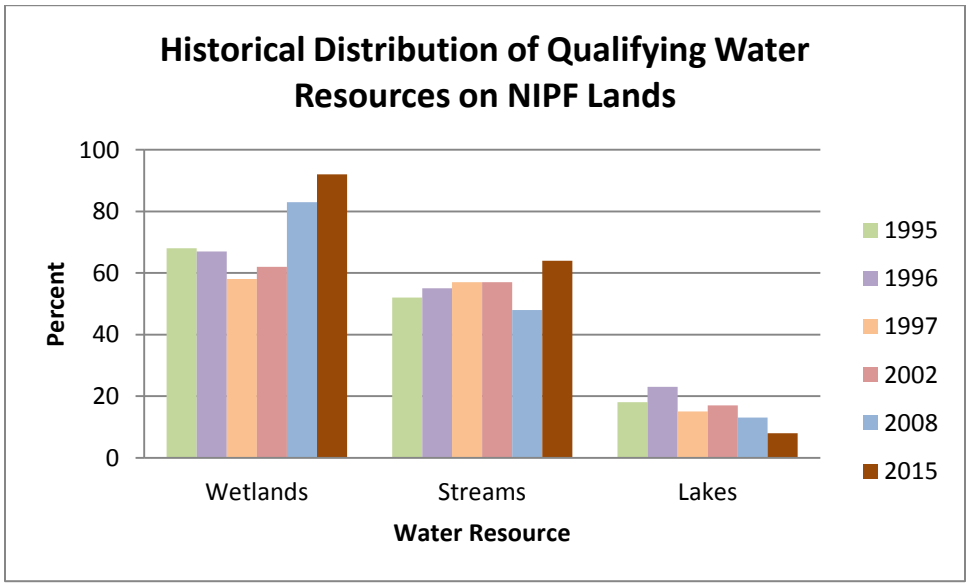


Figure 8. The percentage of different types of qualifying water resources found on monitoring sites from 1995 to 2015.

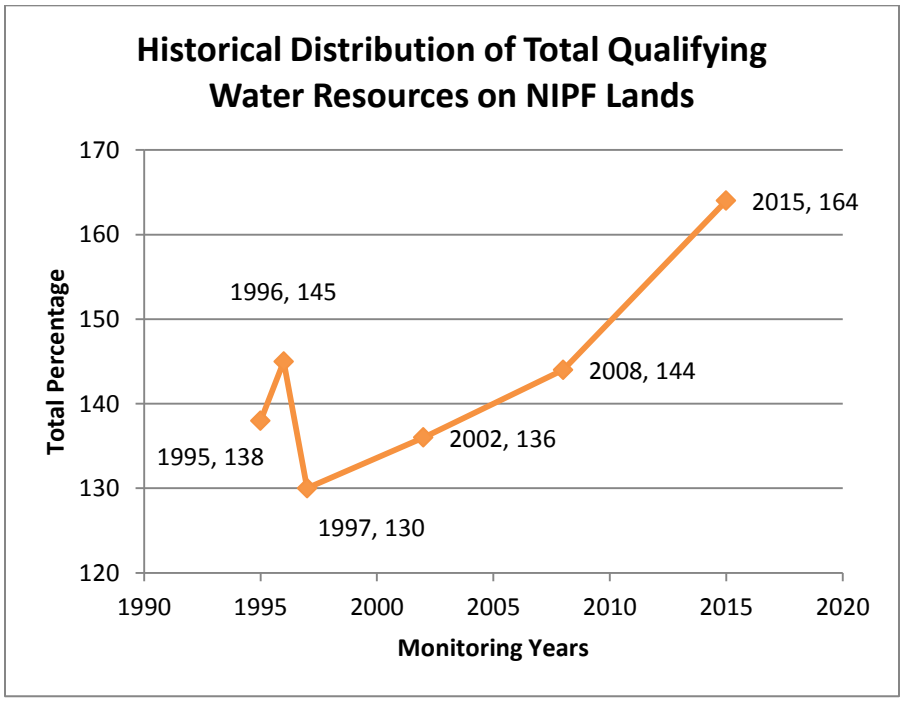


Figure 9. The total percentage qualiifying water resources found on monitoring sites from 1995 to 2015. The range of possible percentages would theroritically be between 100% (1 water resource per site) and 300% (3 water resources per site).

RMZs

Riparian Management Zones are areas adjacent to streams or lakes where special harvesting guidelines are in place to protect the water resource. The harvesting guidelines specifically address how harvesting can impact the water resource by mitigating the potential problems of:

- Increase in sediment and nutrient inputs through erosion along the banks
- Decrease shade that can cause thermal impacts
- Decrease of future woody debris that would naturally fall in the stream and provide cover for fish and wildlife.
- Increase in peak flows

There are three different classes of RMZs that are driven by the type of water resource they are designed to protect. The first class of RMZ is for all lakes, designated trout streams, and streams with a width greater than three feet. These water resources have been recognized as needed the greatest amount of protect and therefore have the most guidelines concerning silvicultural operations. This RMZ calls for a 100 ft. area from the bank of the water resource (called Ordinary High Water Mark or OHWM) compared to the 35 ft. area that are in place for the remaining two classifications – streams one to three feet wide and streams less than one foot wide. These two RMZ classes are very similar, with both being 35 ft. wide, but more liberty is given to equipment usage and trees harvested in the RMZ of streams that are less than one foot wide.

Even with these three different RMZ classifications, there is flexibly in the BMP manual to what should be done within each given RMZ. Foresters may increase or decrease an RMZ depending on many factors such as; timber species composition, presence of beavers, slope, soil, season of harvest, and storm or insect damage. With all the possible modifications that can occur within the RMZ, the BMP monitoring teams record how, or if, the distance was modified from the BMP manual (Figure 11). The monitoring teams recorded into one of these 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
- The site may have used a variable RMZ that ranged from increasing to decreasing

This year, the new category ‘variable’ was written in for a couple sites. While this was not a pre-defined category on the monitoring worksheet (see appendix E), it was perfectly acceptable for foresters to modify the RMZ according to the aforementioned reasons (listed above) and end up with a RMZ that varies in distance.

Figure 10. This site received harvesting within recommended 100 ft RMZ. However, trees were handcut so equipment was not operated within the 'no equipment zone' specified in the BMP manual of 15 feet for streams greater than 3 feet wide or wider.

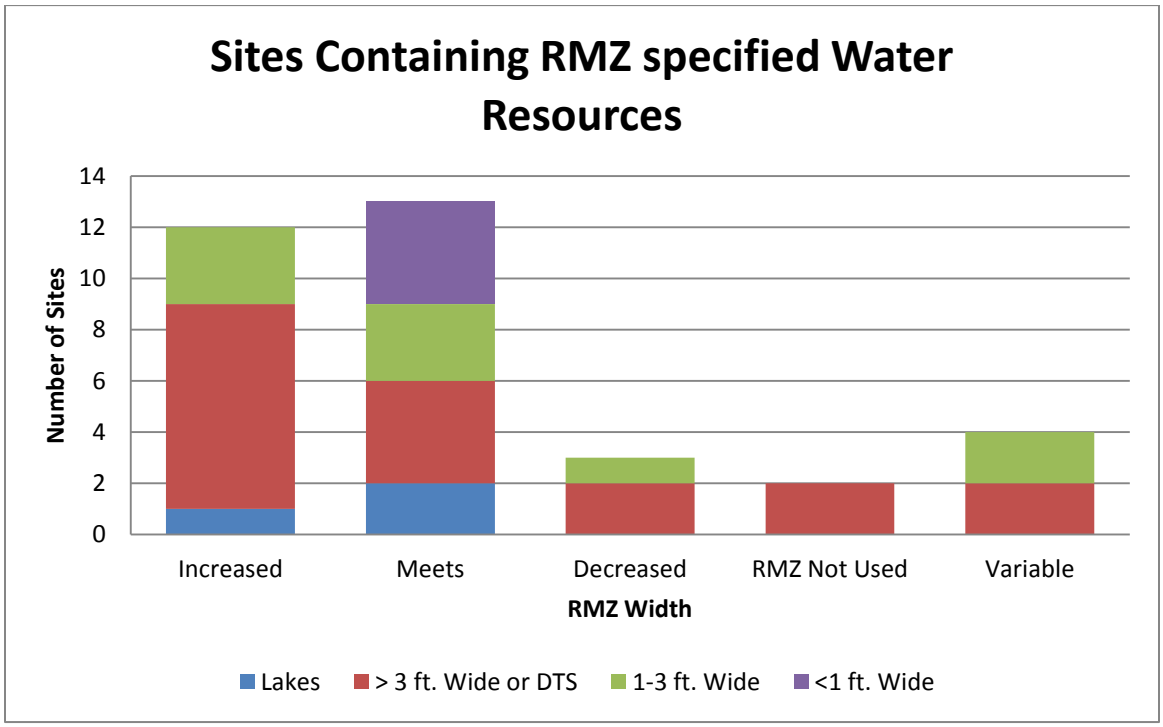


Figure 11. The number of sites that have RMZ specified water resource within or on the boundary of the sale. The RMZ can be increased in width, variable in width, decreased in width, follow the recommended distance, or not be used at all.

Steam Crossings

Almost one-third (11:36) of the sites had one or more stream crossings either on their forest road system or on the skid trails that were used for the harvest. Since one site may have more than one crossing, the number of crossings (figure 12) does not add up to the number of sites that used stream crossings. With that being said, eight crossings were found to have culverts and all of them were on forest road systems. The next most common stream crossing was fords at five, with all but one being on the forest road system. One fact to note is that bridges were not used for any type of crossing. While this might seem unusual, one must keep in mind the landowner objectives, size of project, and cost of building a bridge to hold forestry equipment. Size of the project and cost are interrelated because the larger the sale, the more money will come in from the harvest that can be used to offset the cost for an expensive stream crossing like a bridge. So a smaller sale will generally drive more cost efficient permanent crossings, like culverts and fords; or the possible use of temporary crossings, which can be extremely cost effective, like timber slash or frozen crossings. This is exactly what was observed during the 2015 BMP monitoring. Another foreseeable pattern that occurred was that the more temporary crossings tended to be found on skid trails (ice and slash crossings) and the more permanent crossings (culverts) tended to be found on the forest road system. Some landowners even avoided crossing steams altogether when an alternative way could be found to complete their harvest, like asking and receiving permission from neighbors to cross their land in order to save the landowner from crossing a stream. This type of activity (or lack thereof) is not specifically documented in the BMPs but is precisely the decision that the BMP manual calls for before getting into the specifics of stream crossings. So when landowners decide not to cross streams, their site does not get evaluated for stream crossings, the landowner is doing a superb job of protecting water quality by finding alternative routes for harvesting.

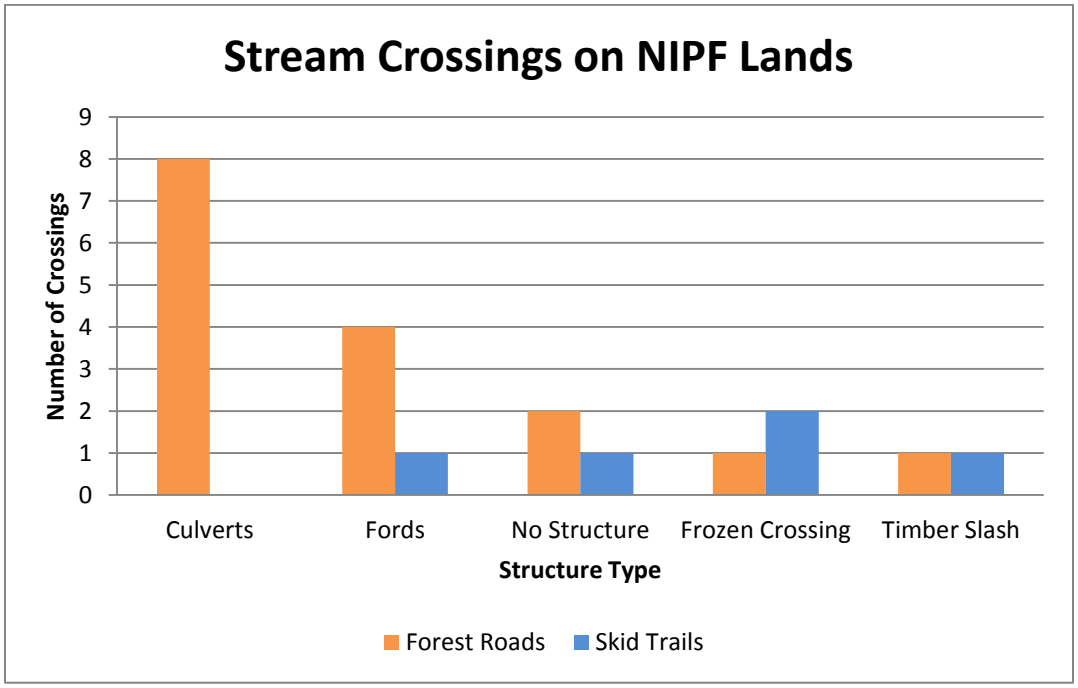


Figure 12. The different types of crossings used for timber harvests on monitoring sites.

Figure 13. Team members are determining if this watercourse is a stream (with a bed and bank) or not. A forest road crossed this watercourse, which was determined to be a stream. This determination was made away from the influence of the culvert.

Species Composition of Harvest Sites

There was a diverse mix of dominant cover types observed during the 2015 BMP monitoring with 'maple/basswood' forests being the most common listed at 16 sites and 'aspen' following closely behind with 15 sites. The two least common cover types were 'spruce' (5 sites) and 'swamp conifers' (4 sites). There are no specific guidelines on what percentage a cover type must be in order to be considered a dominant one. Instead, it is up to the BMP monitoring team to decide which cover types are dominant. More than one dominant cover type is normally reported for a single site.

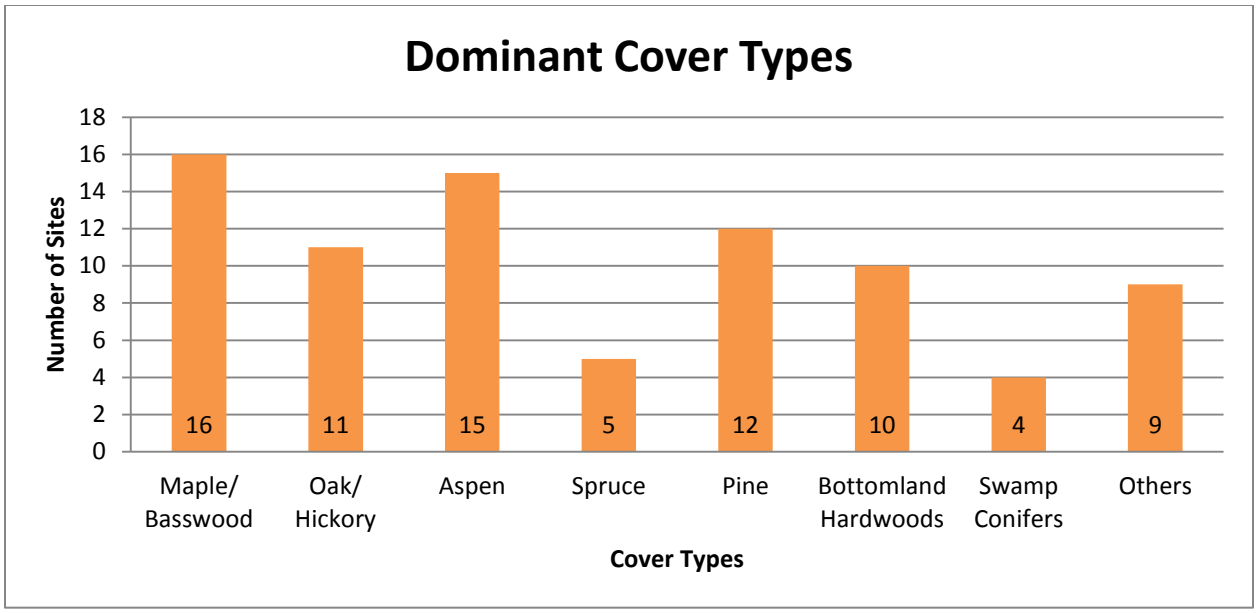


Figure 14. Dominant cover types present on monitored sites. ***Note: a site may have multiple dominant cover types listed as present.***

Silvicultural Prescriptions

Harvest methods were less evenly distributed than what was found in cover types with 'selection harvests' and 'multiple' harvest methods, clearly being the leading two types (13 sites and 10 sites respectively). 'Other' (5 sites), 'clearcut with reserves' (5 sites), and 'seed tree' (3 sites) were all in the middle, whereas no sites received solely 'clearcut' or 'shelterwood' harvest prescriptions (Figure 15). Only one type of harvest method may be listed, otherwise 'multiple' is listed. So it is still possible that 'clearcut' and 'shelterwood' was observed, but as a compliment to another harvest method and not as a stand-alone method.

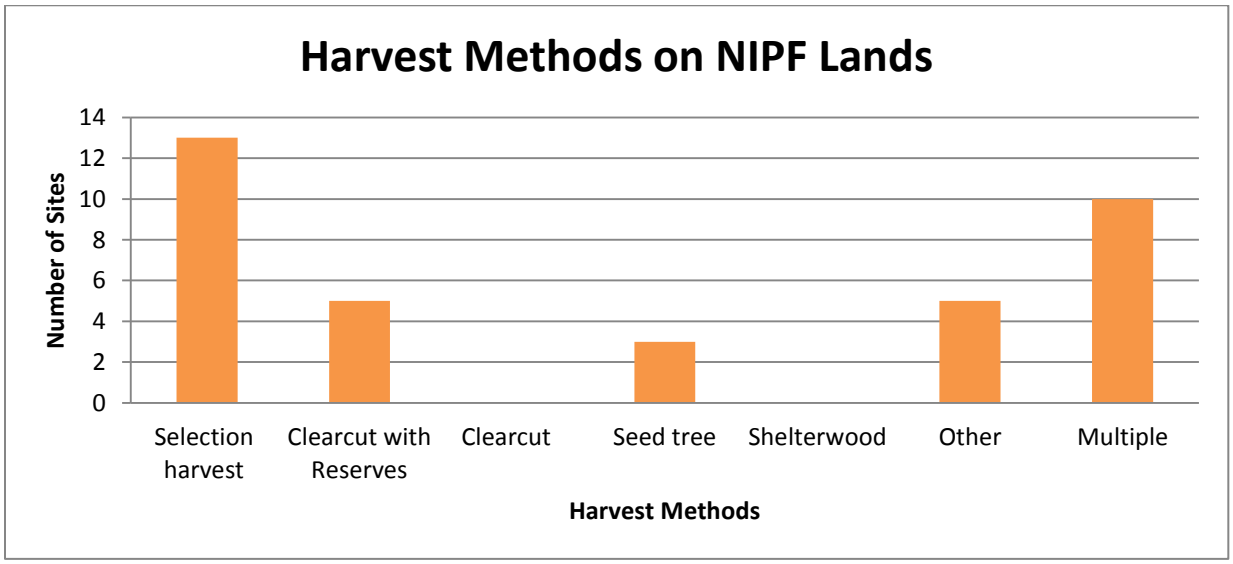


Figure 15. Types of harvest methods used on NIPF.

Equipment

The majority of the harvest equipment observed was 'wheeled' with 23 sites having wheeled harvesting equipment (Table 2). None of the sites used soley 'tracked' equipment but seven sites did utilize both 'wheeled' and 'tracked' equipment. On three sites, the BMP monitoring teams were unable to determine what type of equipment was used, along with another three sites that experienced 'other' equipment being used. The BMP monitoring teams gather this information by asking the landowner, if present, or by looking at ground markings on skid trails and forest roads.

Table 2. Equipment	
Types of Equipment	# of Sites
Wheeled	23
Tracked	0
Both Wheeled and Tracked	7
Unknown	3
Other	3

Table 2. The different types of equipment that were recorded.

Additional Harvest Information

There are several checkboxes in the BMP worksheet (see Appendix E) that do not always go directly into BMP analysis but are rather additional harvest/site information which can help the BMP monitoring teams understand certain components of a harvest. All three of the categores: 'timber stand improvements', 'salvage harvests', and 'dry washes' can influece the setup of the timber sale by determining a range of elements from the tree species that are harvested to which parts of the sales are accessed vs left alone (Table 3). There were four sites that had 'timber stand improvements' done to improve the quality of the forest by, for example, decreasing the density of invasive species such as buckthorn (*Rhamnus cathartica*). Two sites had 'salvage harvest' along with another two sites had 'dry washes' present in the harvest area. Both dry washes and practicing silviculture in a salvage harvest can add additional difficulties for following BMPs. For example, water resources – especially small ones, may be hard to locate in a salvage harvest and dry washes can play a large role in determining where a forest road can be built, or if only skid trails should be used.

Table 3. Additional Harvest Information	
Additional Harvest Information	# of Sites
Timber Stand Improvements	4
Salvage Harvests	2
Dry Washes	2

Table 3. Other information gathered during BMP monitoring.

Road Systems

Forest Road systems have arguably, some of the most important and difficult BMPs, which can set the tone for water quality protection for the rest of the timber harvest. There are so many factors that can determine whether a forest road will provide adequate water quality protection. These include factors that are directly controllable, like design and location, but also factors that are predetermined by the site, such as slope and soils. With that being said, NIPF landowners can actually have an advantage over other landowners who manage land for public use, because of the controlled access that the NIPF landowners have on their own property. As stated in prior BMP reports for public land, much of the damage to forest roads comes from unauthorized or unintended use. It is this damage that the NIPF landowners do not have to contend with. However, they do have their own special problems when it comes to forest roads. Their forest roads may not have been primarily developed for the activity of silviculture, like the vast majority of forest roads on public land. Many landowners build their own forest road systems that are only designed to handle their own intended traffic. So while NIPF landowners do not have problems with the unauthorized use of their land, they often need to improve their forest roads so they can handle silviculture activities. This is indeed what was observed with over half the sites (16/28) being either 'constructed' or 'improved' for the timber harvest (Table 4). Almost all of the sites (23/28) had 'active' forest roads and were used during various times of the year by the landowner and not just for the timber harvest.

Table 4. Forest Road Information	
Forest Road Information	**# of Sites**
Forest Roads	28
Existing Forest Roads	24
Constructed or Improved Forest Roads	16
Active Forest Roads	23
Inactive Forest Roads	5
Drainage Structures	8

Table 4. Information on forest roads

In addition to having high amounts of active forest roads, 'drainage structures' were also utilized by eight sites. It was observed that most of the construction and design of forest roads were expecting temporary or season traffic (Table 5).

Table 5. Road Types and Water Protection				
Water Removal Efficiency	Traffic Volume Capacity	Road Category	Road Type	#of Sites:
Low	Temporary/ Seasonal	Design	Flat	22
		Construction	Below Grade	4
		Construction	At Grade with No Ditch	23
Moderate	Seasonal	Design	In-Slope	1
		Design	Out-Slope	0
		Construction	Combination	2
		Design	Many Typed	4
		Construction	Cut and Fill on Side Slopes	6
High	Permanent	Design	Crowned	1
		Construction	Ditch < 1 ft. Deep	2
		Construction	Ditch > 1 ft. Deep	0
		Construction	Fill Material with No Excavation	1

Table 5. The construction and design of roads shown on NIPF, with their respective water removal capabilities along with their associated recommended traffic volume capacity.

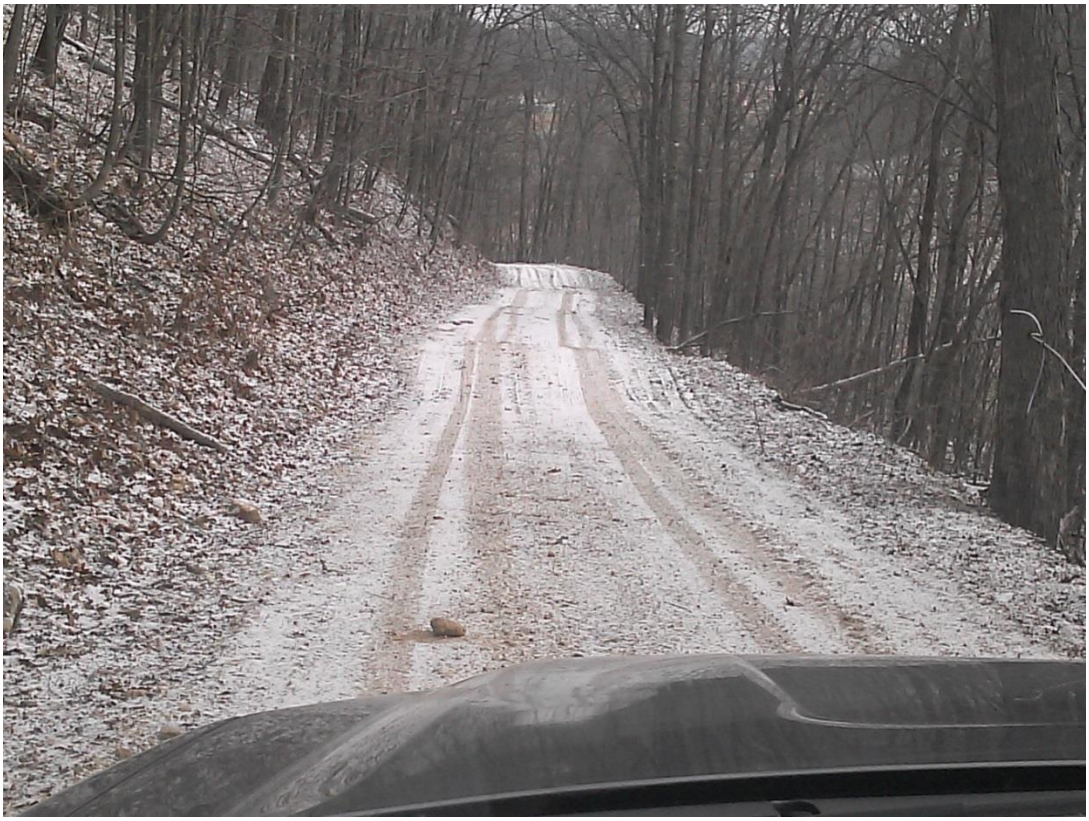


Figure 16. Excellent road in the driftless area of WI. Road was graveled and had multiple broadbased dip structures as well as wrapping around the hill. This provided a much more gentle grade over nearly a 250 vertical foot elevation change.

Qualitative Observations

At the end of each site review, the monitoring team provides an overall evaluation. This is where team members discuss what they saw on the site and how the combined site application for BMPs and its subsequent impact on water quality provides two overall ratings. This is not calculated by going back through the worksheet and tallying individual BMPs – but rather allows for the teams to use their expertise, take other site variables into consideration, and give the site one final rating. There are five categories for BMP application, from 'total negligence' to 'excellent' and five categories for impacts on water quality that range from 'severe' to 'no visible' impacts. The most common ranking for sites was excellent; the highest category possible for application (15 sites) and another 15 sites receiving 'no visible' for impacts on water quality (Figure 17). Likewise, none of the sites received the lowest category possible for application and impacts. While this overall evaluation is not based on quantitative data, the BMP monitoring teams generally observed good application and very few impacts on water quality for the 2015 BMP monitoring. Quantitative data will be presented in the next section of this report.

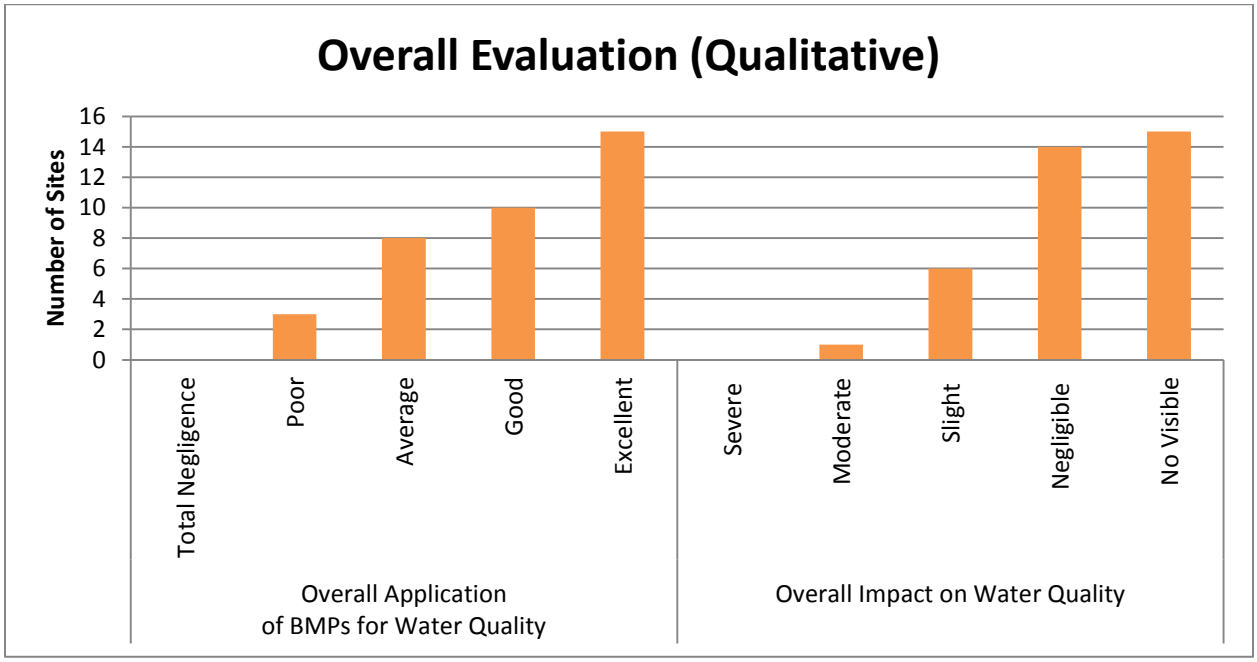


Figure 17. The overall evaluation filled out by the monitoring teams at the end of the worksheet. Both application and effectiveness are qualitatively rated.

Results of BMP Monitoring

Overview

During the 2015 Wisconsin Forestry Best Management Practices (BMPs) for Water Quality, 36 sites were visited by the monitoring teams. Of these 36 sites, 26 were owned by landowners enrolled in the DNR's Managed Forest Law program (called MFL sites) and 10 were owned by landowners not involved with the MFL program (called Non-MFL sites). As a whole, these sites will be known as Non-Industrial Private Forestland (called NIPF sites) throughout this report. It is important to note that statistical validity is only assured for the combined NIPF sites and MFL only sites as a subset. The subset of Non-MFL only sites is not statistically valid. For each of these sites, 119 BMPs were assessed for application and effectiveness (See Appendix E). These BMPs were divided into five categories:

- *Fuels, Lubricants, Waste and Spills*: There are two BMPs on the monitoring form and relate to location of fueling, and cleaning up waste and spills.
- *Riparian Management Zones (RMZs)*: There are 18 BMPs on the monitoring form and are divided into sections according to different RMZ practices that occur on subsequent water bodies.
- *Forest Roads*: There are 47 BMPs on the monitoring form and they are divided into several sections which cover a variety of aspects including location, drainage structures, and stream crossing on forest roads.
- *Timber Harvesting*: There are 36 BMPs on the monitoring form and they are divided into a multitude of sections which include: skid trails and all aspects regarding them, log landings, and dry washes.
- *Wetlands*: There are 15 BMPs on the monitoring form and they cover wetland harvesting, wetland crossings, filter strips, springs and seeps, and rutting in wetlands.

BMP Application

When the monitoring teams are walking the timber harvest, the first element is to decide which BMPs are applicable to a site and which ones are not. For the BMPs that are applicable, one of the five subsequent application ratings is given:

- BMP is *not applicable* to the site
- BMP is applicable to the site and it was *applied correctly*
- BMP is applicable to the site and it was *applied* but *incorrectly*
- BMP is applicable to the site and was *not applied*
- Monitoring team can't determine if the BMP was applicable and is determined to have *insufficient information* to rate

BMP Application Rates

Most of the BMPs (69.6%) are *not applicable* to the site (Figure 18). This means, on average, only about 30% of the BMPs are applicable to any one site – and while this may seem small, it is actually an increase that can be attributed to the greater number of water resources in the 2015 BMP monitoring. There are 119 BMPs that range across the spectrum of soil stabilization, culverts, wetlands, stream crossings, to RMZs. With all these BMPs addressing a multitude of potential water quality issues on timber harvests, it is easy to see why the number of applicable BMPs, for any one given site, is as low as it is. For the remainder of the report, the results will focus on the BMPs that were applicable to a site.

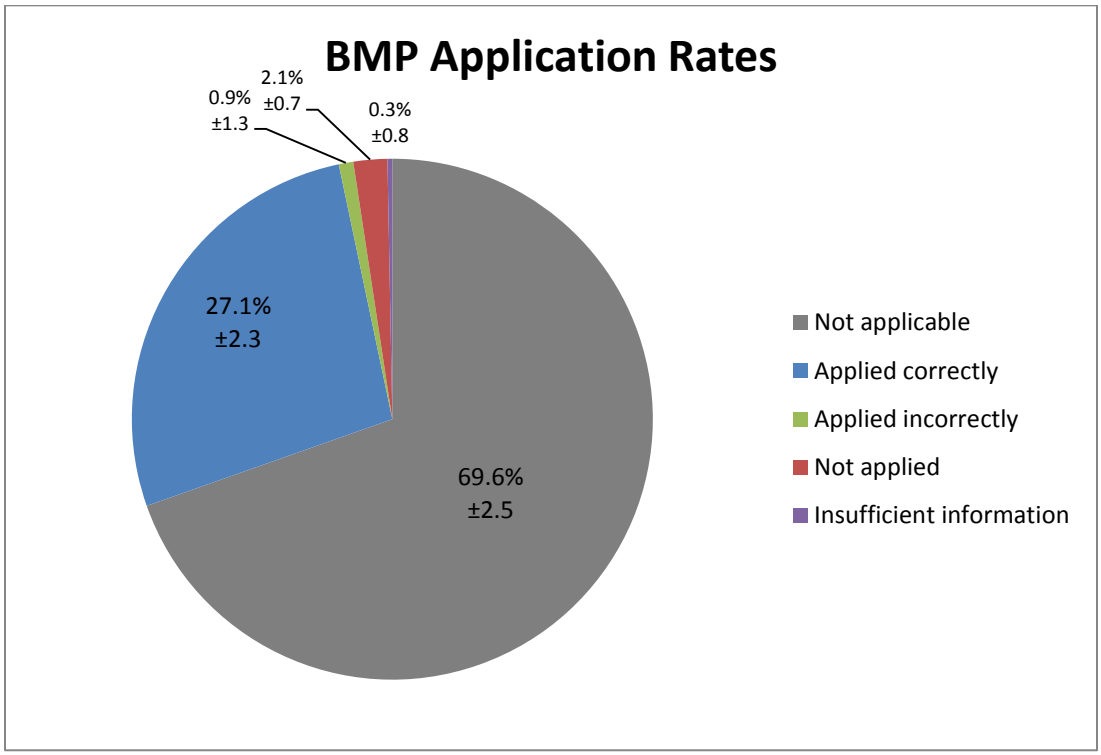


Figure 18. The amount of BMP application categories, on NIPF sites, for the 2015 BMP monitoring.

NIPF saw fairly good application rates (Figure 19) with both Non-MFL and MFL landowners being fairly equivalent. Overall, BMPs were applied 92.4% on NIPF lands, with MFL landowners applying BMPs 93% compared to Non-MFL landowners at 91% of the time. Interestingly, BMPs that were *applied correctly* – had almost identical rates between Non-MFL and MFL landowners for a combined total of 90%. BMPs that were *applied incorrectly* can be calculated by subtracting the application rate on NIPF (92.4%) from the BMPs that were *applied correctly* (90%) to yield only 2.4% of BMPs were *applied incorrectly*. Only 7.6% of the time, BMPs where *not applied* to a situation when they were applicable.

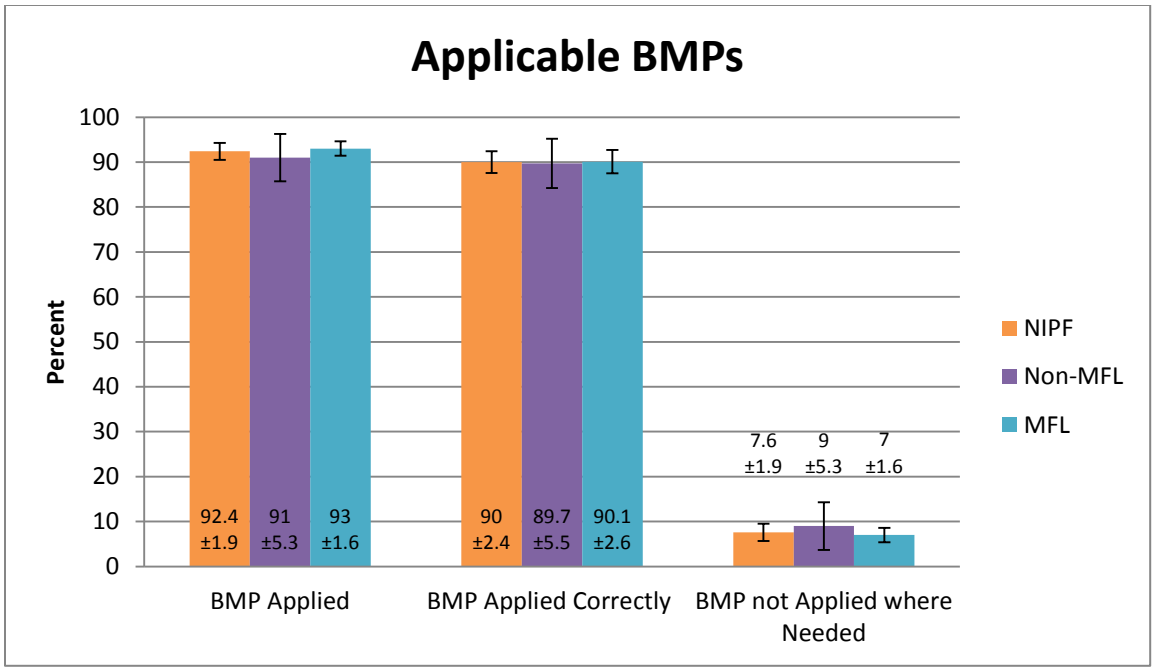


Figure 19. The percentage rate of BMPs that were applied, applied correctly, and not applied where they were needed.

BMP Application by Monitoring Category

BMP application rates were broken down into respective monitoring categories to provide greater detail of where BMPs were undergoing high or low compliance rates. Variances in application rates, between the monitoring categories, are both common and expected. This is due to the intrinsic properties between the monitoring categories and how easy or difficult it is for landowners to correctly apply BMPs. For example, 'forest road' is a BMP monitoring category where it is usually more difficult to achieve a higher BMP correct application rating than the monitoring category of 'fuel, waste, and spills'. Here are just a few reasons the BMPs for 'forest roads' are more difficult to achieve compliance:

- 'Forest road' BMPs are subject to location and design criteria
- 'Forest roads' have both short and long term maintenance, which may include road closure
- 'Forest roads' may receive unintended or post closure use

This is compared with BMPs for the monitoring category 'fuels, waste, and spills' where, to achieve a high application rate, the only requirement is to clean up any trash or spills that may (or may not) have occurred during the harvest operation. Historically, 'forest roads' are usually the monitoring category that receives the lowest *correct application*, regardless of landowner – and the 2015 NIPF monitoring results show this to be a continued trend (Figure 20). However, this range of *correct application* between the monitoring categories was less than 10%, which is a relatively small. 'RMZs' and 'fuels, waste and spills' were the two monitoring categories that received the highest amounts of *correct application* at 94.6% and 94.1% respectively. 'Timber harvesting' (91.3%) and 'wetlands' (89.4%) were close to the average of 90% and 'forest roads' were the lowest at 85%.

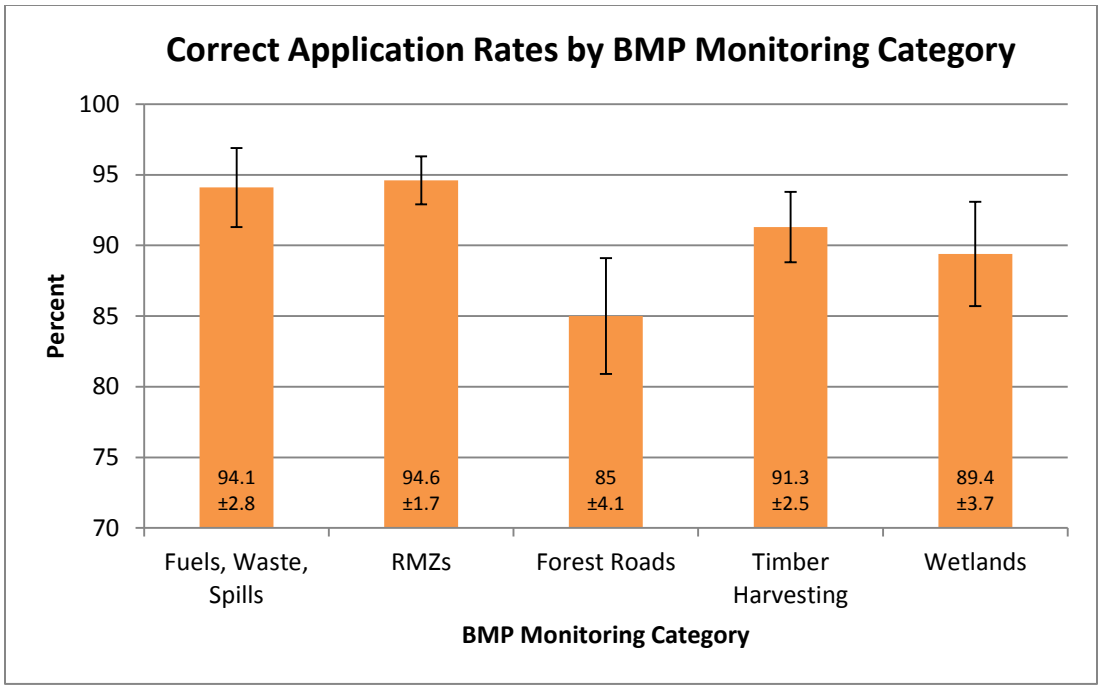


Figure 20. The 2015 NIPF correct application of BMPs broken down by monitoring categories.

Figure 21. Forest road showing early signs of erosion due to snow melt in December. This soil exposure, which happened during the fall, was not from silvicultural activities but from the landowner widening the road. The soils, slope, and time of year this activity took place, created a situation where erosion is and will be a problem.

History of BMP Application on NIPF Sites

The comparison of current results to past findings is an extremely important function of the BMP monitoring program. It allows an important question to become answerable: "Is Wisconsin's BMP program protecting water quality?" By comparing the application rates from different years – silvicultural activities can be shown to ensure continued – and hopefully, improving protection of water quality in Wisconsin. This self-evaluation, allows for changes to the BMP program to be made, so it can adopt new ways to measure and protect water quality. Changes to both the BMP manual and the monitoring worksheets have occurred, since its' start in 1995, to incorporate better ways to monitor and implement protection of water quality.

Even though both the 2008 and 2015 monitoring received the same overall correct application rates, when breaking them into monitoring categories, they do not appear to be very similar (Figure 22). 'Fuels, waste, spills', 'timber harvesting' and 'wetlands' all decreased in *correct application* from 2008 to 2015 but 'RMZs' and 'forest roads' increased in *correct application*. The most noticeable difference was not between the monitoring categories themselves, but between the ranges. In 2008, the range between the highest and lowest monitoring category was 30%, whereas in 2015, the range was less than 10%. This reveals that for the overall BMP *correct application* rate to improve – there is not one single BMP monitoring category that needs to be targeted for improvement, but rather the general awareness of correctly applying BMPs. This is very different from 2008 monitoring effort, where the key result was to focus improvements on the low *correct application* of individual monitoring categories (i.e. 'forest roads').

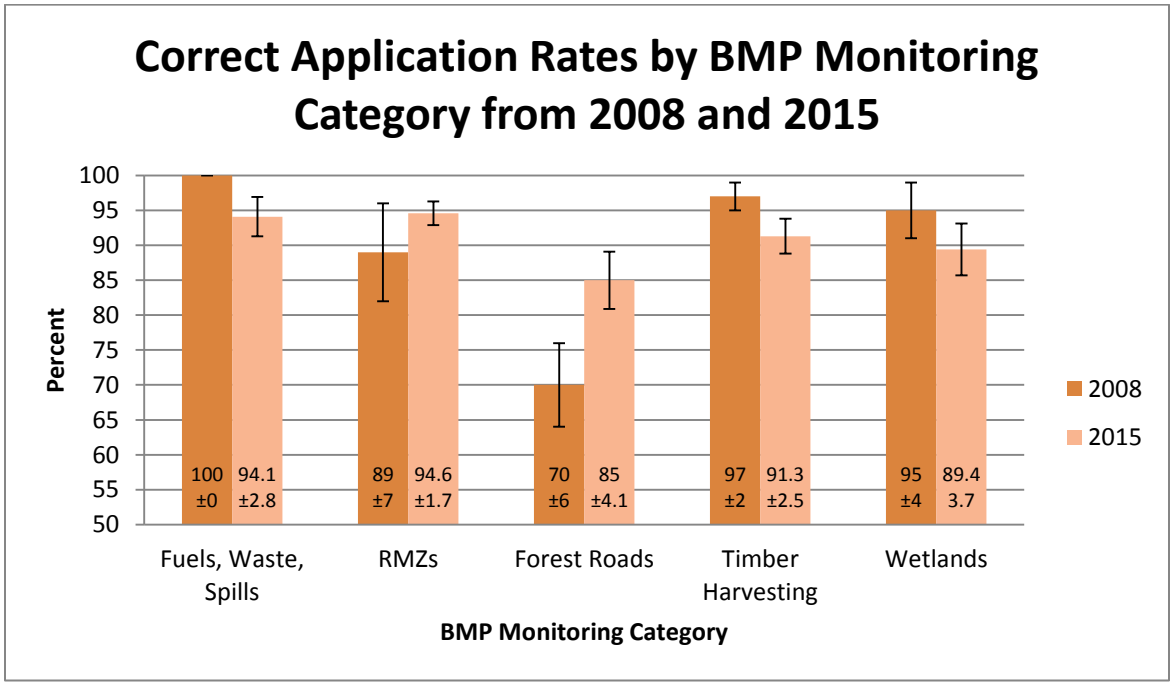


Figure 22. The 2008 and 2015 BMP correct application rates, both on NIPF, are broken down into different monitoring categories.

Examining the *correct application* of BMPs on NIPF sites throughout history reveals three major points of interest (Figure 23).

- There has been a substantial jump in *correct application* from beginning years' (1995-1997 and 2002) to later years' (2008 and 2015).
- MFL BMP *correct application* rates have stayed the same since separating landowner categories in 2002.
- BMP *correct application* on Non-MFL landowners has made vast improvements since 2002. It has shown an increase in every monitoring cycle, and is now on par with MFL landowners.

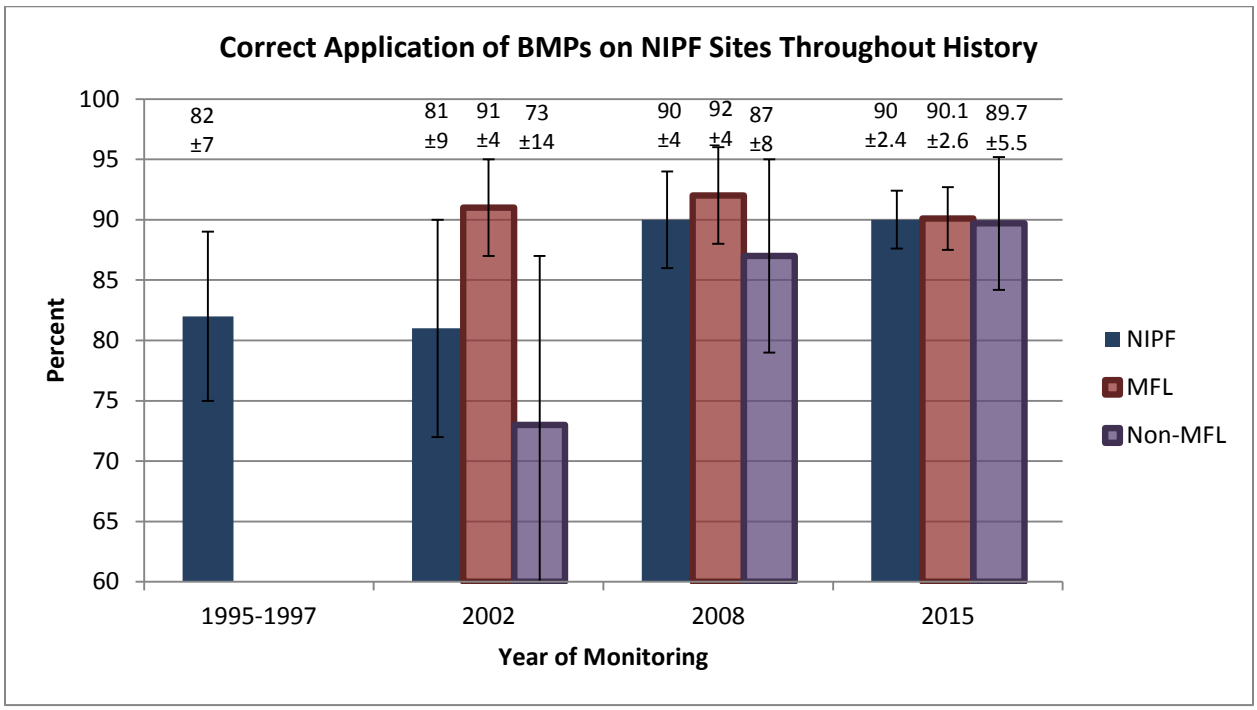


Figure 23. Correct application, on NIPF sites, since the start of Wisconsin's BMP program. There is no separate data on MFL and Non-MFL land during 1995-1997.

2013-2015 BMP Monitoring Cycle

Comparing the most recent cycle of BMP monitoring (2013-2015) across all landowners and monitoring categories, it shows a relatively high rate of BMP *correct application* overall. However, there is variation to both monitoring categories and landowners (Figure 24). The overall range of *correct application* across landowners and monitoring categories was 16.6% (84.4% on county 'forest roads' and 100% on 'fuels, waste, and spills', along with 'RMZs' on State and Federal lands respectively). The two highest monitoring categories, when combining landowners, of BMP *correct application* were also 'fuels, waste, and spills' along with 'RMZs' with 97.1%. 'Timber harvesting' (96.4%) and 'wetlands' (94.7%) were in the middle of application ratings and 'forest roads' had the lowest (89.6%). When combining all landowners and all monitoring categories, **Wisconsin's BMP *correct application* rating, for the 2013-2015 monitoring cycle, is 94.2%.**

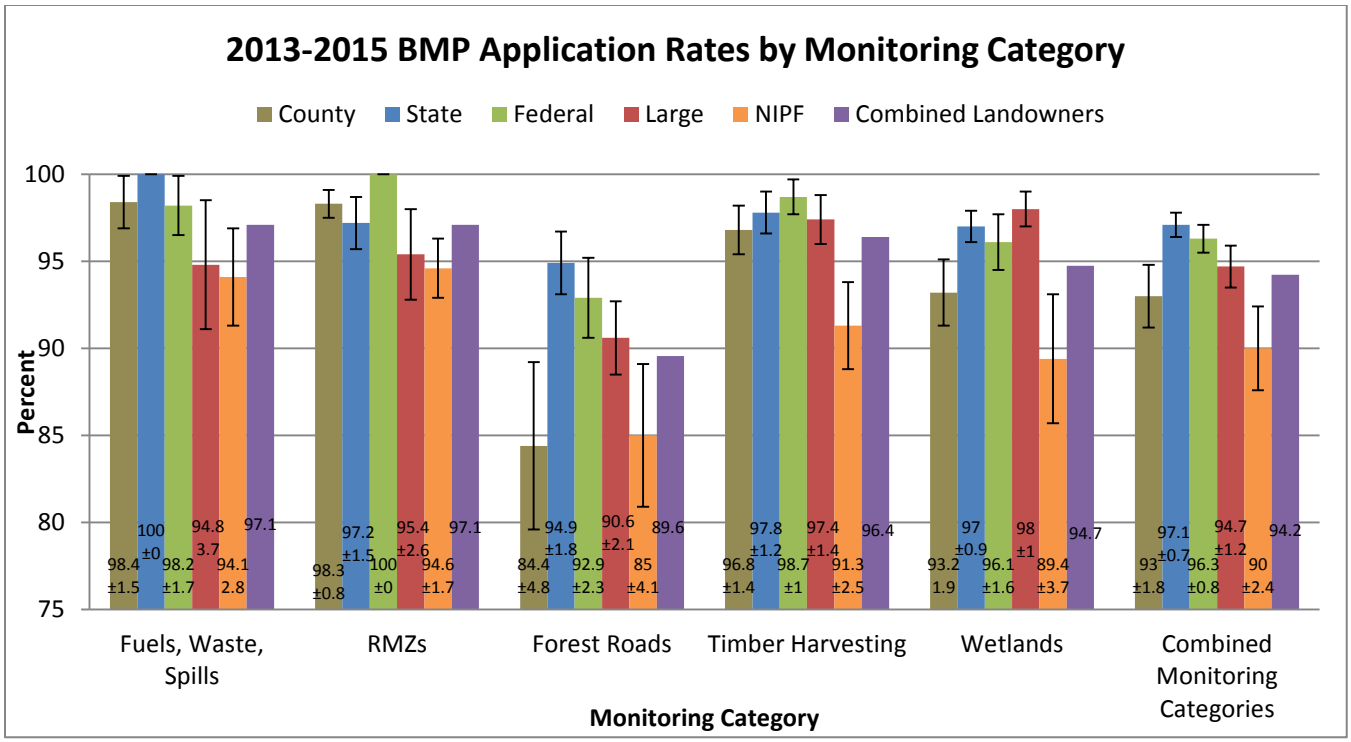


Figure 24. BMP correct application for the 2013-2015 monitoring cycle, broken down into monitoring categories. The last set of vertical bars shows the overall correct BMP application rates for each landowner. In addition, the purple vertical bars show the average of all landowners for each category.

History of Application Ratings

As stated previously, one of the most important elements of any BMP program is to compare long-term trends to see if BMP compliance, in general, is either going up, down, or staying the same. **Comparing all the data collected from Wisconsin's BMP program since its inception in 1995, reveals that overall BMP *correct application* is going up for <u>every</u> landowner monitored.** There is yearly fluctuation between landowners, but analyzing the data using a linear regression reveals all slopes are positive – indicating improvement over time (Figure 25). The fact that every landowner's linear regression shows an increase in BMP *correct application* speaks volumes to the widespread knowledge, acceptance, and use of Wisconsin's BMPs for water quality. The combined effort, of not just the different types of landowners, but all of Wisconsin's foresters and loggers are responsible for this positive data trend. While, it is unrealistic that this trend will occur indefinitely (due to the maximum limit of 100% application), it shows that Wisconsin's BMP program has made progress since its start, continues to address areas of low application, and has developed into a mature BMP program.

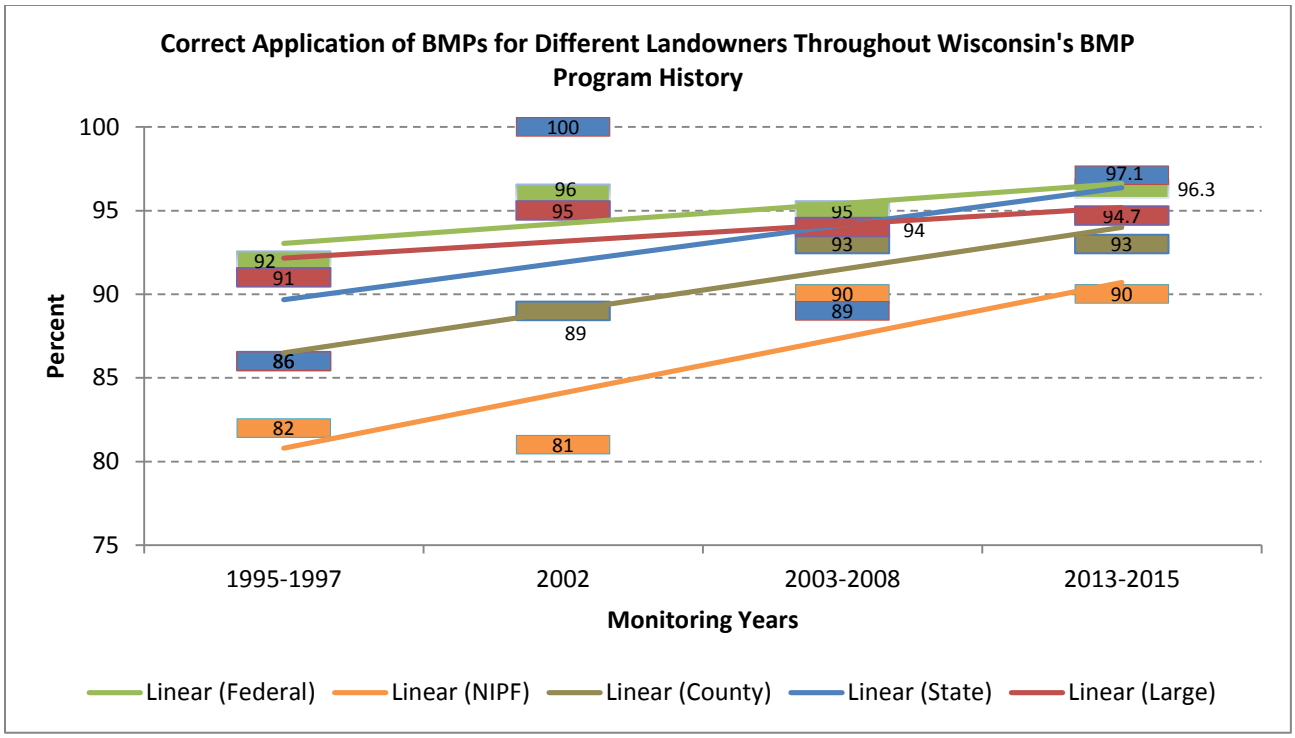


Figure 25. The correct application of BMPs on different landowners are represented by an absolute rate – which is measured for a specific set of years and by a linear regression – it shows how the trend of BMP correct application has been going up since the start of the program. The solid colored boxes represent the absolute rate while the lines represent the linear regression. Note: some of the boxes may be completely or partially hidden due to the fact that some landowners have the same correct application during the same set of years.

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. There are five different categorical effectiveness ratings that can be given to any BMP question that is found to be applicable:

- *No adverse* impact to water quality
- *Minor short-term* impact to water quality
- *Minor long-term* impact to water quality
- *Major short-term* impact to water quality
- *Major long-term* impact to water quality

The types of impacts, which describe the effectiveness of the BMPs, are conducted as qualitative measures. These evaluations reflect only the point in time for which the monitoring team is present. The monitoring teams are asked to use their best professional judgment as to the type of impact the effectiveness will have on water quality.

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

Figure 26. This forest road shows that the BMP addressing road surface stabilization was *applied correctly*, and consequently, showed that the BMP was effective (no erosion was present).

BMP Effectiveness and Application Categories

As to be expected, BMP effectiveness is very different in the three BMP application ratings: *applied correctly*, *not applied*, and *applied incorrectly* (Figure 27). For BMPs that were *applied correctly*, the effectiveness was extremely high, regardless of landowner category at almost 100%. This means, when the BMP monitoring teams saw a BMP being used appropriately where it was needed, water quality was almost always protected. This is in contrast to the remainder two BMP application categories; *not applied* and *applied incorrectly*. Both of these application ratings received very low effectiveness ratings and *applied incorrectly* was found to be lower (6.3%) than *not applied* (9.4%). However, both of these application categories have a small amount of BMPs (data) associated with them so they are not statistically different from each other – essentially landowners that used a BMP incorrectly was no more effective at protecting water quality than landowners that did not use a BMP at all. This finding is equivalent to BMP report in 2014 on federal and industrial land. One suspected reason that these two application ratings seem equivalent in effectiveness is due, in part; to the situations they tend to be used in. BMPs that *are applied incorrectly* will likely be used in a situation where it is apparent that something is needed in order to protect water quality, but it might be difficult to do correctly or maintain (example: steep slope where water bars failed because they were too far apart). Whereas, BMPs that are *not applied* are used in situations where BMP use would not be apparent, but easy to protecting water quality (example: not providing road drainage to shed water is easy to construct, but may not be apparent in the dry season, except it will likely become a water quality issue during spring runoff).

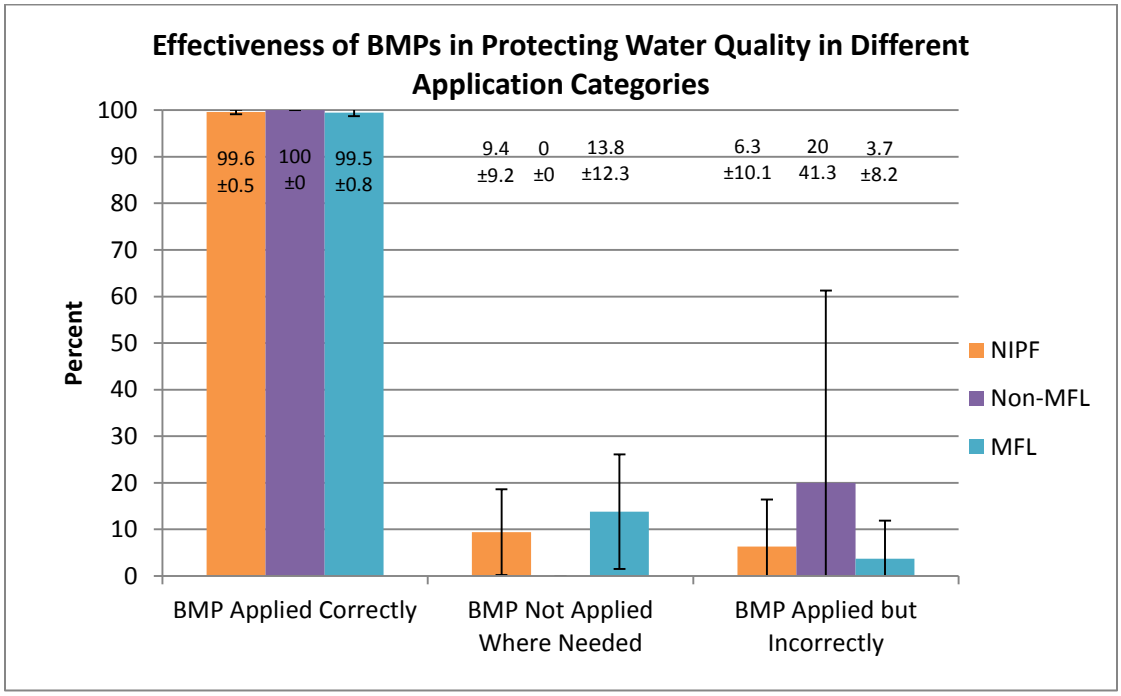


Figure 27. The effectiveness for BMPs in the different application categories – 'applied correctly', 'not applied', and 'applied but incorrectly'.

BMP Effectiveness in Different Monitoring Categories

Breaking down BMPs *applied correctly* and BMP *not applied* into the five monitoring categories revealed that there was little variation between the monitoring categories. For BMPs *applied correctly*, BMP effectiveness was rated above 99%, with three of the five monitoring categories getting 100% water protection rating (Figure 28). The variation between the monitoring categories for BMPs *not applied* was larger ranging from 0% to 22.7%; however, all except one category was within the error ranges of the average of 9.4%, meaning they were not statistically different. Only the monitoring category 'fuels, waste, and spills' was statistically different and offered 0% water quality protection when BMPs were *not applied*. This could be due to the intrinsically simple property of this monitoring category – it only consists of two BMPs. This forces a limited number of outcomes when evaluating these BMPs:

- There are no water quality impacts because no issues (i.e. spills or waste) occurred (BMP *applied correctly* and no water quality impacts occur).
- Issues occurred but were cleaned up (BMP *applied correctly* and no water quality impacts occur).
- Issues occurred and were not cleaned up (BMP *not applied* and water quality impacts have or likely occurred).

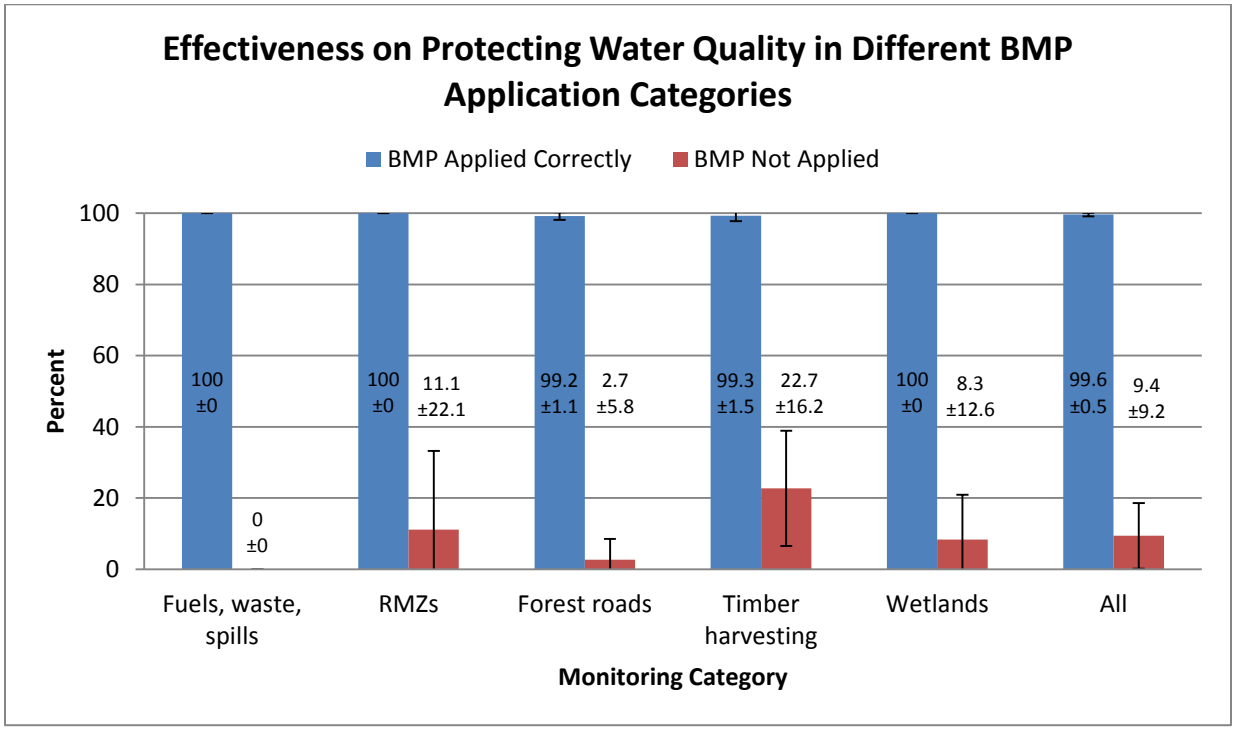


Figure 28. The effectiveness of water quality protection in different monitoring categories for different application ratings.

Types of Water Quality Impacts for Different Application Categories

As explained earlier, the effectiveness category is broken down into five different impacts; ranging from *no adverse impact* on water quality to *major long-term* adverse impacts on water quality. Different BMP application categories have been shown in prior sections to be a strong driver of water quality protection (no adverse impact rates). However, within the different types of impacts – excluding no adverse impact – different categories of BMP application rates do not appear to be the primary driver of impact types. For example, no major impacts were recorded regardless of the application category (Figure 29). BMPs that were *not applied* and BMPs that were *applied incorrectly* are not statistically different from each other in any impact category. However, the one trend between these two application categories was; BMPs that are *not applied* tended to be labeled as *long-term* impacts and BMPs that *were applied incorrectly* are split evenly between *short* and *long-term* impacts.

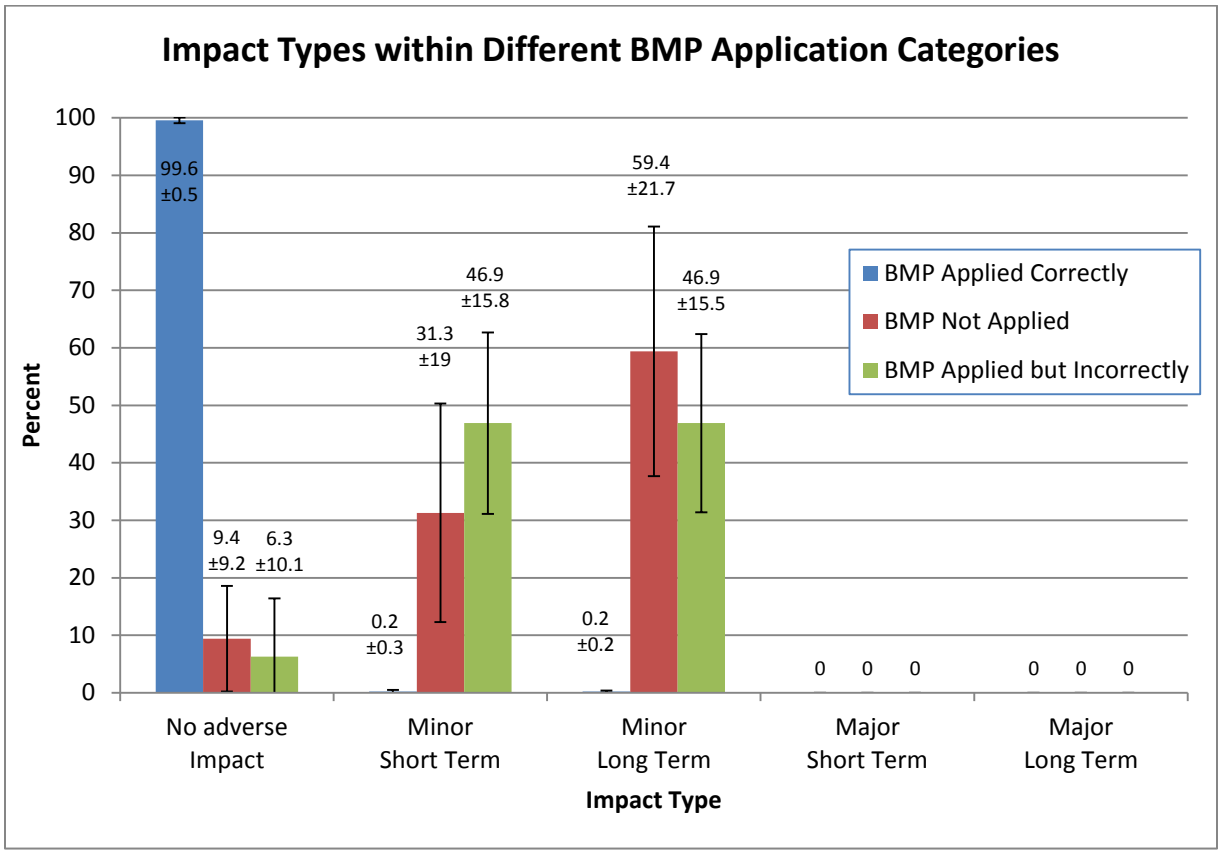


Figure 29. Types of impacts for different BMP application categories.

Conclusion and Recommendations

The results of the 2015 monitoring on NIPFs concludes that the BMP program has some similar findings to past monitoring cycles, with some differences. Overall, the sites were slightly smaller in size than past years along with having fewer sites to monitor. With that being said, there was a relatively large increase in the number of applicable BMPs compared to all past monitoring on NIPF due to the increase in density of streams and wetlands on the 2015 monitoring sites. Similarities include *correct application* rates, with 2015 and 2008 having the exact same application rate of 90%. High rates of correctly applying BMPs (90%) led to an even higher rate of protecting water quality (99.6%). Even though the overall percent of correct application did not go up from 2008, the monitoring categories saw much less fluctuation in 2015 with *correct application* rates. 'Forest roads', which have historically low application rates, saw a large improvement from 2008 from 70% to 85% in 2015 correct application – however it still remains the lowest monitoring category for correct application. Water quality is impacted much more often when BMPs are either *applied incorrectly* (2.4%) or *not applied* (7.6%) where water quality is only protected 6.3% and 9.4% respectively. Even though these combined categories make up only 10% of all the BMPs and there were no major impacts recorded, addressing these two categories is the best way in increasing water quality protection on NIPF lands. This reinforces the continued use of the BMP program and all its derivatives, which includes:

- The education of water quality 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.
- Having more quantitative studies that address certain areas of BMPs – these will hopefully provide reassurance to the findings by our monitoring teams. These in turn, will give the qualitative rating given by the monitoring teams, using their professional experience, even more weight.

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 water resources.

Appendix A: Methods

Selection of Timber Harvests

There was over 8000 NIPF timber harvests reported for the year 2014, which makes up the list of sites eligible to be monitored in 2015. In order to calculate the number of sales needed to be monitored in order to reach statistical validity, a few different variables are required to be used in an equation that estimates proportions based on cluster sampling. Two variables that are very important in determining sample size come from the prior years of BMP monitoring: the variance in correct application rates and the number of BMPs found to be applicable, on average, per site. It is because of the variance calculation that the total number of combined NIPF harvests is actually lower than the Non-MFL harvests as a standalone category (Table 6). Due to practical limitations; the monitoring for 2015 did not try to reach statistical validity for Non-MFL harvests.

Table 6. Determining Sample Size

Year	2008			2015		
	Total # Sales	Sample Size Needed	Number monitored	Total # Sales	Sample Size Needed	Number monitored
NIPF Harvests	6886	50	52	8322	34	36
MFL Harvests	2260	5	32	2831	21	26
Non-MFL Harvests	4626	60	20	5491	51	10

Table 6. The number of sites needed for statistical validity in 2008 and 2015 for combined NIPF harvests, along with MFL and Non-MFL harvests.

All the calculations for sample size determination and application and effectiveness analyses are run in a statistical computer program called SAS.

While it is helpful to have monitoring sites spread across the state – so they encompass the full variability of Wisconsin's diverse forest landscape – it is not a requirement and as stated in *'Water Resources'* section. Rather, any site that meets the criteria for monitoring is able to be monitored and spatial relation to other monitoring sites is not taken into account. While the sites might not be distributed evenly throughout the whole state, they are fairly distributed between forest covered landscapes that are privately owned (excludes county forests, state lands, tribal lands, federal land, and large land owners).

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.

To prevent some areas of bias, all sites were entered into a spreadsheet where they were selected using a random number generator. All sites that were randomly selected were determined to be eligible for monitoring based on the set eligibility criteria found through the combination of: a trip to the site, and satellite review through DNR Surface Water Data Viewer and Google Earth.

The first method where bias could have played a role is the timber sale selection method due to county cutting notices and MFL invoices. Wisconsin State Statute 26.03 states that all landowners must file a cutting notice with their respective county when they wish to harvest forest products off their land. Likewise, any lands in MFL undergoing a harvest, the landowner must have a MFL invoice along with a county cutting notice. However, some counties not having a county cutting notice system (a few counties around the Milwaukee area) and some landowners may not file either an invoice or cutting notice. Any sales where the landowners failed to file their harvest in the correct manner would be excluded from this study.

Another method of bias comes from county cutting notices and invoices which were filed in a different year from the time when timber sale actually received harvest. Timber sales eligible for monitoring were supposed to be cut (at least in part) during 2014 – so this is the year where all the cutting notices and invoices were accepted for this project. However, due to many possible reasons, not all harvests that were harvested in 2014 had a cutting notice filed the same year. This could range from a landowner filing a cutting notice in Dec 2013 (so the harvest can begin right away in Jan 2014) or be an extension of a previously filed cutting notice during past years; this possibly would make the total number of sales larger than what was calculated. Conversely, every cutting notice or invoice received on the intent to harvest may not have gone through with the harvest for many different reasons; possibly making the total number of sales smaller than what was initially calculated. Either way, there is no exact way of knowing how many timber sales were harvested in 2014, but the best estimate was calculated based on the data available.

There were two types of duplication that could possibly overinflate the total number of sales cut during 2014. The first level of duplication is MFL landowners that (correctly) filed both a county cutting notice and MFL invoice intent to harvest. The second level of duplication was where a single landowner, filed multiple cutting notices or MFL invoices for a single harvest – the number of duplications were usually a result of multiple legal descriptions (like quarter-quarters) receiving harvest. Both of these methods of duplication were cut down by creating a master workbook in Microsoft excel, sorting by landowner name, and if two or more sites matched multiple criteria, the duplicates were removed and all areas cut were listed under one row in Microsoft excel.

Some sales, that would have meet the eligibility criteria for this study, were never able to be monitored because of the voluntary nature of the BMP program. Landowners reserve the right whether they want to let people on their property to look at their timber harvest. They can – and many did – say no or not respond to phone calls or letters asking to look at their timber harvest. Landowner responses varied

from praised acceptance to straight refusal. However, landowners sometimes allowed the monitoring and recon to take place with special guidelines or circumstances; examples include selecting a time where the landowners could join in or avoiding times (deer hunting) when the landowner did not want others on the property.

The last area of bias is one common to almost all BMP programs – how sites are rated for effectiveness at protecting water quality. The two elements that lead to bias through effectiveness ratings come from:

- how effective (or not effective) a BMP was is only judged as it is presented at a specific point in time to the monitoring teams
- being qualitative(observational) rather than quantitative(measurable)

When effectiveness is rated from a specific point in time, it only allows the monitoring team a narrow view of what could be happening on site. Variables as simple as snow cover, can make BMPs appear to be more or less effective than they actually were. More complicated variables, like scheduled maintenance on forest roads, can greatly increase the effectiveness of BMPs compared to when the monitoring teams evaluate the site. To combat this issue, the DNR has another study planned for 2016, in which sites that received low effectiveness ratings will be revisited to see if monitoring teams rated these sites appropriately and to see if landowners corrected some of these issues after the monitoring.

When effectiveness is rated from a qualitative standpoint, it allows monitoring teams to be more flexible on how they rate a site. This allows for professional judgment of the team as a whole, and as individuals, be expressed as they rate the site for effectiveness. Bias is introduced because not every team or team member has the same professional judgment and they may rate sites different from other teams or individuals. The reason the ratings are done as a qualitative measure is because of time, practicality, and cost is greatly reduced compared to monitoring done using quantitative measures. One way to reduce this professional judgment bias is by the monitoring training held every year for individuals that participate in BMP monitoring. This allows for a greater consistency across individuals and monitoring teams for the recorded effectiveness.

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

2015 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 Teams

Team Leaders are shown in Bold

Team Spartans

Sue Reinecke, Melissa Yarrington, Lowell Peterson

Team Golden Gophers

Nolan Kriegel, Ben Garrett, Ruth King, Steve Runstrom, Rachel Peacher

Team Hawkeyes

Rachel McDonald, Joel Green, Justin Kania, Brad Hutnick

Team Wolverines

Dave Kafura, Rebecca Mouw, Jake Walcisk, Teri Asleson

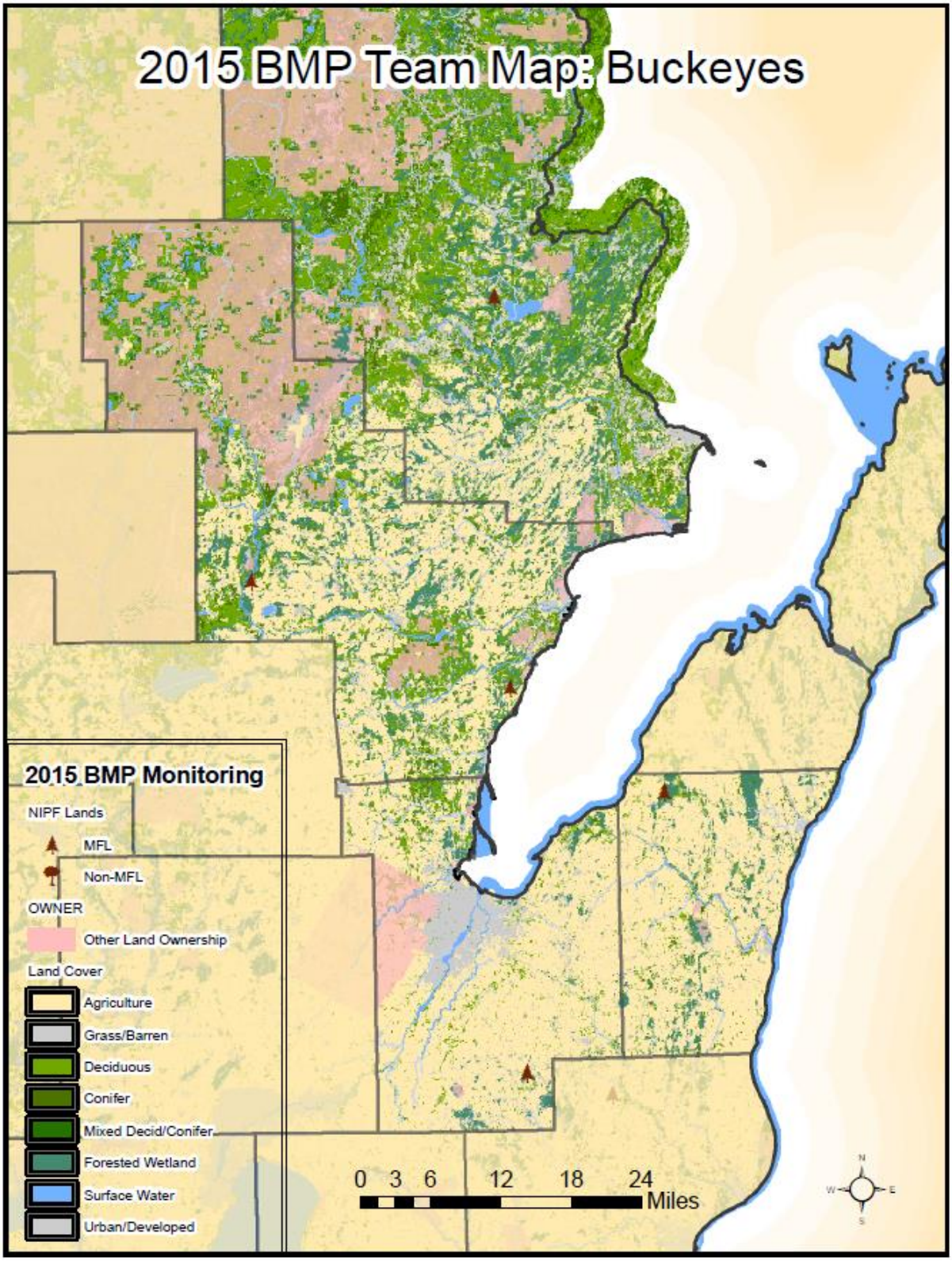
Team Fighting Illini

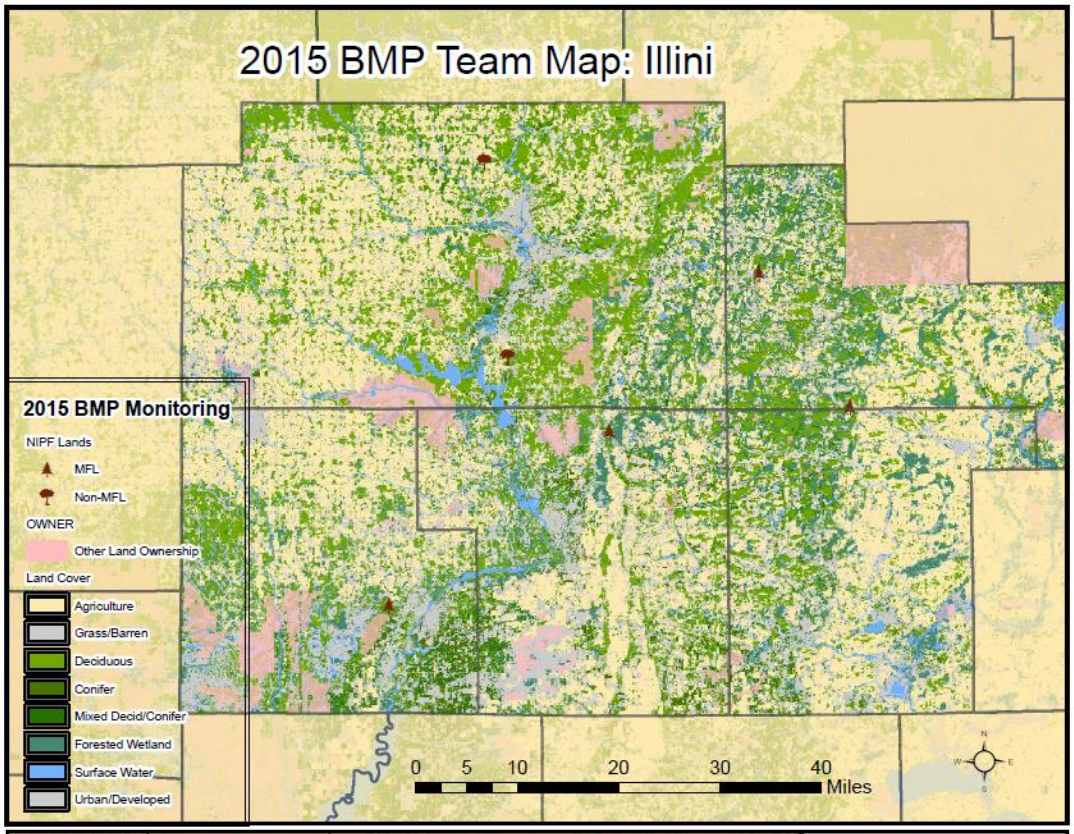
Jason Henes, Zach Hylinski, Michael Ard

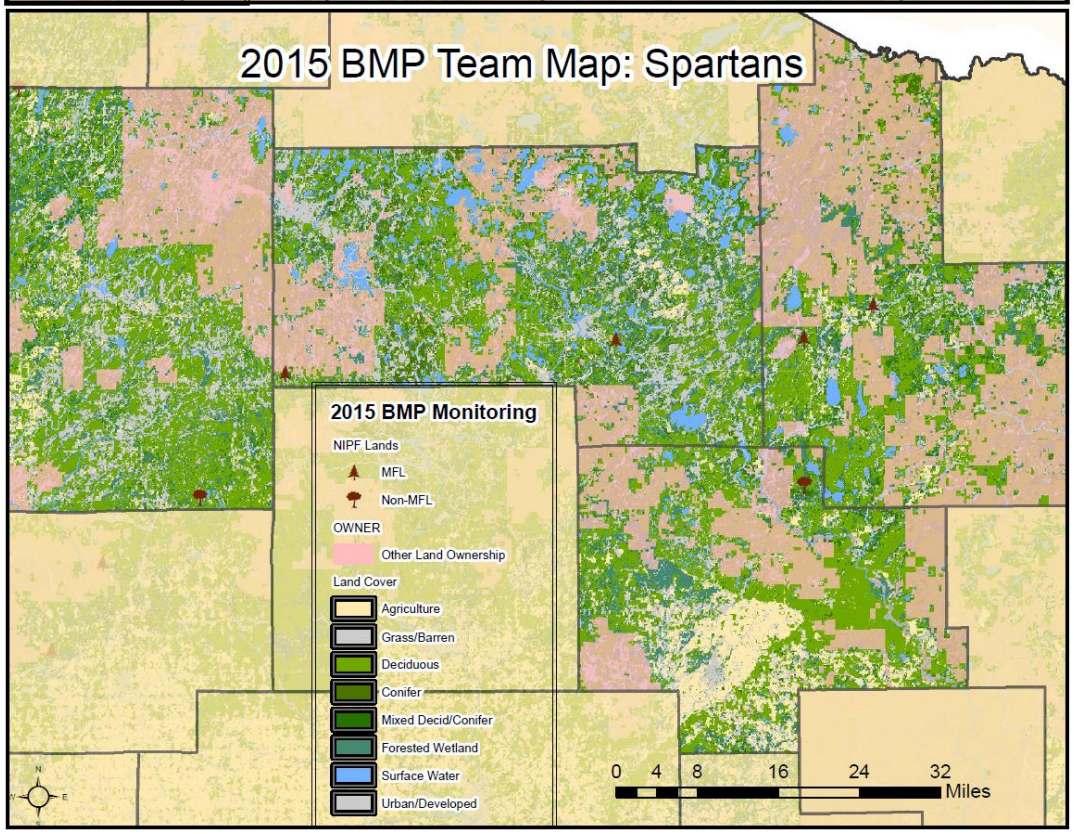
Team Buckeyes

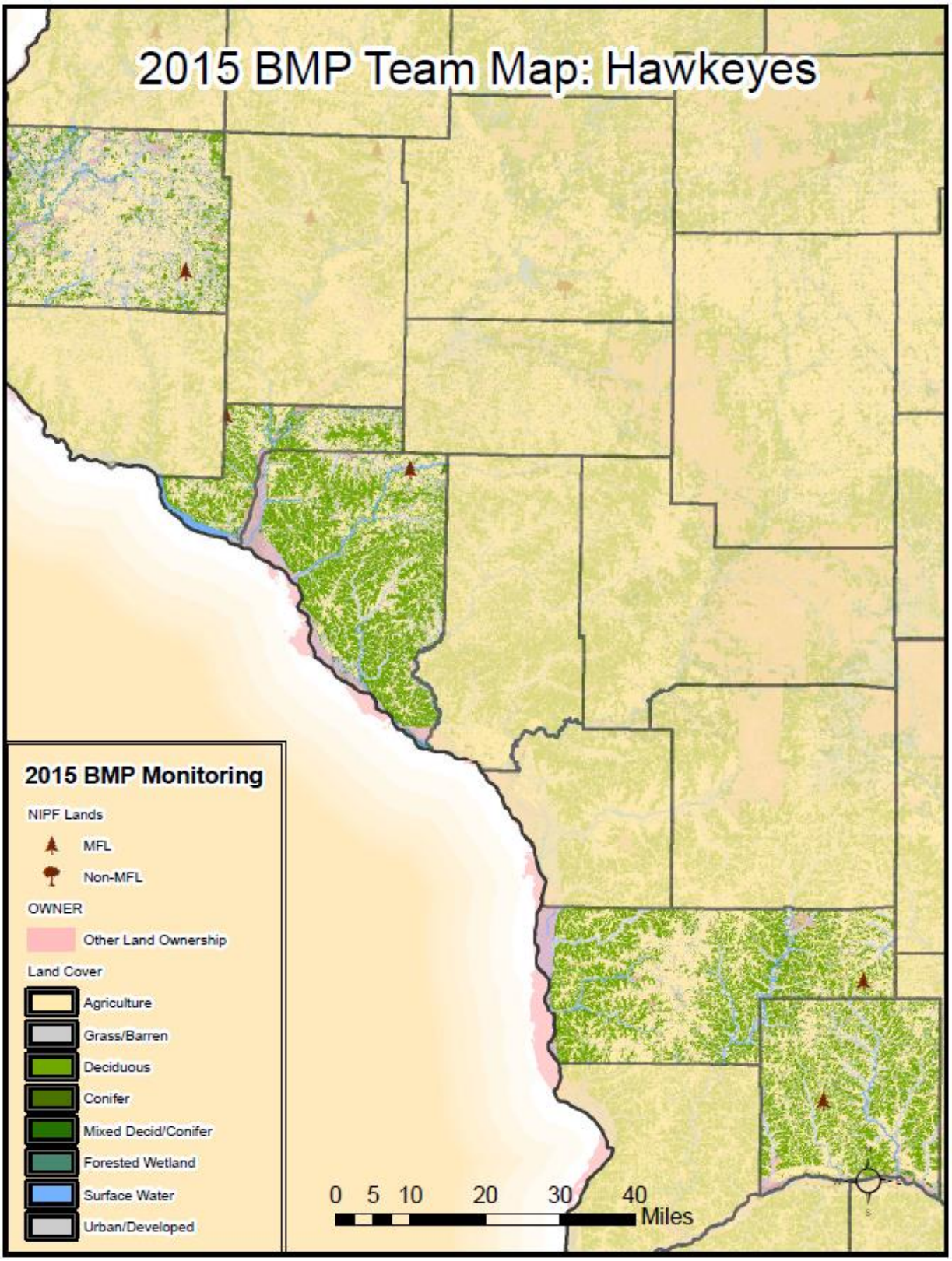
Mark Heyde, Steve Kaufman, Chris Duncan

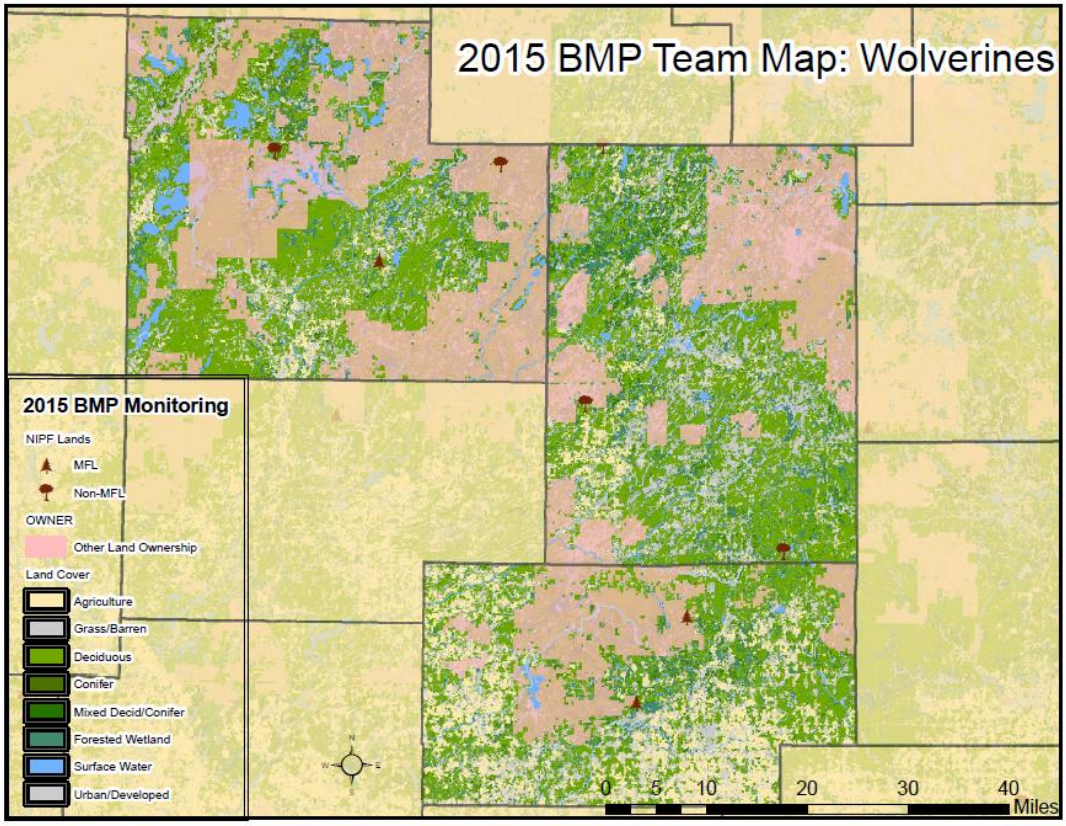
Appendix D: BMP Monitoring Team Maps

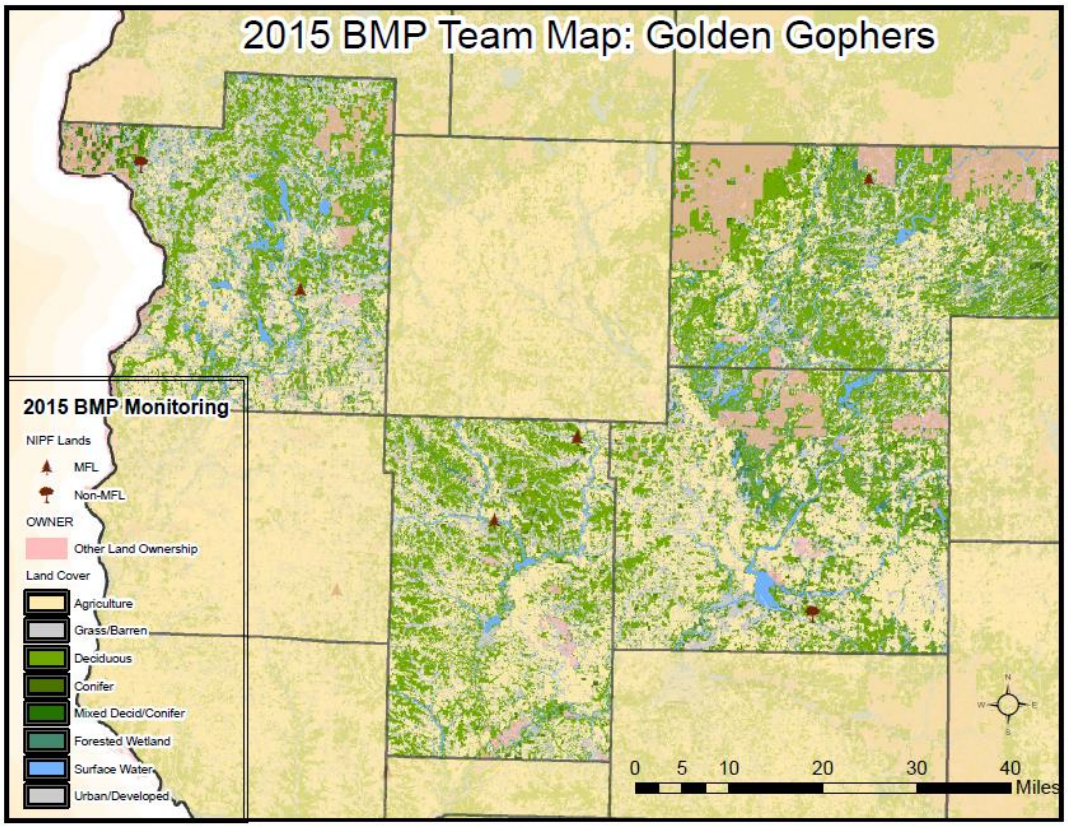



2015 BMP Team Map: Illini
2015 BMP Monitoring
NIPF Lands
MFL
Non-MFL
OWNER
Other Land Ownership
Land Cover
Agriculture
Grass/Barren
Deciduous
Conifer
Mixed Decid/Conifer
Forested Wetland
Surface Water
Urban/Developed
0 5 10 20 30 40
Miles


2015 BMP Team Map: Spartans
2015 BMP Monitoring
NIPF Lands
MFL
Non-MFL
OWNER
Other Land Ownership
Land Cover
Agriculture
Grass/Barren
Deciduous
Conifer
Mixed Decid/Conifer
Forested Wetland
Surface Water
Urban/Developed
0 4 8 16 24 32
Miles


2015 BMP Team Map: Hawkeyes
2015 BMP Monitoring
NIPF Lands
MFL
Non-MFL
OWNER
Other Land Ownership
Land Cover
Agriculture
Grass/Barren
Deciduous
Conifer
Mixed Decid/Conifer
Forested Wetland
Surface Water
Urban/Developed
0 5 10 20 30 40
Miles


2015 BMP Team Map: Wolverines
2015 BMP Monitoring
NIPF Lands
MFL
Non-MFL
OWNER
Other Land Ownership
Land Cover
Agriculture
Grass/Barren
Deciduous
Conifer
Mixed Decid/Conifer
Forested Wetland
Surface Water
Urban/Developed
0 5 10 20 30 40
Miles


2015 BMP Team Map: Golden Gophers
2015 BMP Monitoring
NIPF Lands
MFL
Non-MFL
OWNER
Other Land Ownership
Land Cover
Agriculture
Grass/Barren
Deciduous
Conifer
Mixed Decid/Conifer
Forested Wetland
Surface Water
Urban/Developed
0 5 10 20 30 40
Miles

Appendix E: BMP Monitoring Worksheet

2015 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: Golden Gophers | Wolverines | Spartans
Hawkeyes | Fighting Illini | Buckeyes

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 plans should leave at least 60 ft^2 of basal area per acre in trees 5 inches DBH and larger, evenly distributed.			
12. 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.
13. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high water mark (OHWM), only when the ground is frozen or dry.			
14. Do not harvest fine woody material within 15 feet of the OHWM.			
15. Use selection harvests and promote long-lived tree species appropriate to the site.			
16. Harvesting intervals should be a minimum of every 10 years.			
17. 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.
18. Operate wheeled or tracked harvesting equipment within 15 feet of the ordinary high-water mark (OHWM) only when the ground is frozen or dry.		
19. 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.
20. 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 C-f.
21. Select road locations that allow for drainage away from the road.		

22. Where possible, locate roads on well-drained soils.			
23. Minimize the number of stream, dry wash, and wetland crossings.			
24. Locate roads outside of riparian management zones and wetland filter strips, except at crossings			
25. Road grades should not exceed 10%. If road grades greater than 10% are necessary, limit grade length or break the grade using drainage structures.			
26. Construct roads to follow natural contours and minimize cut and fills.			
27. Construct roads to remove water from road surfaces.			
28. Construct stable cut and fill slopes that will re-vegetate easily, either naturally or artificially.			
29. Do not bury debris in the road base.			
Drainage Structures on Forest Roads (p. 53)			
C-f. Were new or existing drainage structures located on forest roads?	❑ Yes. Go to next question.		❑ No. Go to Question 38.
30. Install drainage structures to remove water from road surface and ditches.			
31. Install a berm at the inlets of drainage structures, if needed, to direct water into the structures.			
32. Provide erosion protection at the outlets of drainage structures to minimize erosion and disperse the water.			
33. 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.			
34. 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)			
35. Install cross drain culverts long enough to extend beyond the road fill.			
Broad-based Dips for Drainage on Forest Roads (p. 54)			
36. 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)			
37. 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.			

38. 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.			
39. 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.
40. Inspect the road system at regular intervals. Clear debris from drainage structures to prevent clogging that can lead to washouts.			
41. Keep traffic to a minimum during wet periods and spring break-up to reduce maintenance needs.			
42. 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.			
43. Remove berms along the edge of the road if they will trap water on the road.			
44. 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.
45. Remove all temporary drainage and crossing structures.			
46. Shape all road system surfaces to maintain proper surface drainage, if necessary.			
47. 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.		

48. Identify optimum stream crossing locations: straight and narrow stream channels; low banks; firm rocky soil; keep approaches at the least gradient possible.			
49. Install stream crossing structures at right angles to the stream channel.			
50. Install stream crossings using materials that are clean, non-erodible and non-toxic to aquatic life.			
51. Minimize channel changes and the amount of excavation or fill needed at the crossing.			
52. Limit construction activity in the streambed to periods of low or normal flow. Keep use of equipment in the stream to a minimum.			
53. Use soil stabilization practices on exposed soil at stream crossings.			
54. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.			
55. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.			
56. 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.		
57. Install culverts that extend at least 1 foot beyond the road fill.			
58. Install culverts that are large enough to pass flood flows.			
59. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.			
60. 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.			
61. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.			

62. 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.
63. Locate fords where stream banks are low.			
64. 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.
65. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.			
66. 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.
67. Use existing landings if possible.			
68. Locate landings on frozen ground or on firm well-drained soils with a slight slope or that have been shaped to promote efficient drainage.			
69. 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)			
70. 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.			
71. Use existing skid trails if they provide the best long-term access.			
General Timber Harvesting BMPs (p. 76)			
72. 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.			
73. Whenever possible, winch logs up steep slopes if conventional skidding could cause erosion that affects water quality.			
74. Avoid operating equipment where excessive soil compaction, rutting, or channelized runoff may cause erosion that affects water quality.			

other aquatic life.			
92. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.			
93. 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.		
94. Install culverts that extend at least 1 foot beyond the road fill.			
95. Install culverts that are large enough to pass flood flows.			
96. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.			
97. 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.			
98. Use riprap around the inlet and outlet of culverts to prevent water from eroding and undercutting the culvert.			
99. 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.		
100. Locate fords where stream banks are low.			
101. 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.
102. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.				
103. 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.
104. Whenever practical, avoid locating roads and landings in wetlands; otherwise use extreme caution.				
105. Whenever possible, forest management activities in wetlands should occur on frozen ground to minimize rutting.				
106. 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.			
107. Keep slash out of open water.				
108. Whenever practical, avoid equipment maintenance and fueling in wetlands.				
Wetland Filter Strip BMPs (p.101)				
109. Whenever practical, avoid locating roads and landings in the wetland filter strip; otherwise use extreme caution.				
110. Minimize soil exposure and compaction to protect the ground vegetation and the duff layer in the wetland filter strip.				
111. 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.
112. Construct upland approaches to the wetland so the surface runoff is diverted away from the road approach prior to reaching the wetland.				
113. If landings are necessary in a wetland, build them to the minimum size required for the operation and to achieve the landowner's objective.				

114. Avoid operating equipment in areas of open water, springs, or seeps.			
115. Provide for adequate cross-road drainage in roads to minimize changes to natural surface and subsurface flow in the wetland.			
116. Use low ground pressure equipment, such as wide tire or tracked equipment, if necessary to minimize rutting.			
117. Minimize rutting in wetlands by conducting forestry activities on firm or frozen ground that can support the equipment.			
118. 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) ❑ Tree-length (pole skidding) ❑ Whole tree (chipping operation) ❑ Other:
F-h. What best describes the type of harvesting system(s) used? (check all that apply)	
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 F: Monitoring Results

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	2954					
	Insufficient Information	10					
	Applied Correctly	1188	1184	2	2	0	0
	Applied Incorrectly	32	2	15	15	0	0
	Not Applied	100	9	30	61	0	0
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	2					
	Insufficient Information	2					
	Applied Correctly	31	31	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
2. Collect all waste lubricants, containers and trash (i.e. grease cartridges).	Not Applicable	0					
	Insufficient Information	0					
	Applied Correctly	33	33	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	0	1	2	0	0
Riparian Management Zones							
3. Locate roads outside the RMZ, unless necessary for stream crossings.	Not Applicable	12					
	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
4. Locate landings outside the RMZ.	Not Applicable	13					
	Insufficient Information	0					
	Applied Correctly	22	22	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0

5. Do not dispose of or pile slash within the RMZ.	Not Applicable	11					
	Insufficient Information	0					
	Applied Correctly	22	22	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	0	1	2	0	0
6. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.	Not Applicable	12					
	Insufficient Information	0					
	Applied Correctly	23	23	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	0	0
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.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	19	19	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	17					
	Insufficient Information	0					
	Applied Correctly	18	18	0	0	0	0
	Applied Incorrectly	1	0	1	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	17					
	Insufficient Information	0					
	Applied Correctly	19	19	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	20					
	Insufficient Information	0					
	Applied Correctly	14	14	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	1	0	0	1	0	0
11. Harvesting intervals should be a minimum of every 10 years.	Not Applicable	21					
	Insufficient Information	0					
	Applied Correctly	15	15	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	20					
	Insufficient Information	0					
	Applied Correctly	15	15	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
13. Develop trees 12 inches DBH and larger.	Not Applicable	22					
	Insufficient Information	0					

	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	1	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	27					
	Insufficient Information	0					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	1	0	1	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	9	9	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 promote long-lived tree species appropriate to the site.	Not Applicable	29					
	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
17. Harvesting intervals should be a minimum of every 10 years.	Not Applicable	29					
	Insufficient Information	1					
	Applied Correctly	6	6	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	28					
	Insufficient Information	0					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	1	0	1	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	32					
	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
20. Do not harvest fine woody material within 15 feet of the OHWM.	Not Applicable	32					
	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
Forest Roads							
21. Use existing roads when they provide the best long-term access.	Not Applicable	12					
	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
22. Select road locations that allow for drainage away from the road.	Not Applicable	22					
	Insufficient Information	0					
	Applied Correctly	10	9	0	1	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	3	0	0	3	0	0
23. Where possible, locate roads on well-drained soils.	Not Applicable	24					
	Insufficient Information	0					
	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	2	0	0	2	0	0
	Not Applied	0	0	0	0	0	0
24. Minimize the number of stream, dry wash, and wetland crossings.	Not Applicable	21					
	Insufficient Information	0					
	Applied Correctly	13	12	0	1	0	0
	Applied Incorrectly	2	0	0	2	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	20					
	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
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	29					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
27. Construct roads to follow natural contours and minimize cut and fills.	Not Applicable	21					
	Insufficient Information	0					
	Applied Correctly	14	14	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
28. Construct roads to remove water from road surfaces.	Not Applicable	21					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	2	0	0	2	0	0
29. Construct stable cut and fill slopes that will re-vegetate easily, either naturally or artificially.	Not Applicable	28					
	Insufficient Information	0					
	Applied Correctly	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	2	0	0

30. Do not bury debris in the road base.	Not Applicable	22					
	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
31. Install drainage structures to remove water from road surface and ditches.	Not Applicable	31					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	0	0	0	0	0	0
32. Install a berm at the inlets of drainage structures, if needed, to direct water into the structures.	Not Applicable	35					
	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
33. Provide erosion protection at the outlets of drainage structures to minimize erosion and disperse the water.	Not Applicable	33					
	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
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	33					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	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	30					
	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
36. Install cross drain culverts long enough to extend beyond the road fill.	Not Applicable	32					
	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	34					
	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
38. Use seed, mulch and/or erosion control netting where	Not Applicable	22					
	Insufficient Information	0					

necessary to minimize soil erosion into lakes, streams and wetlands.	Applied Correctly	10	10	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	3	0	2	1	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	28					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	5	0	3	2	0	0
40. Maintain, clean and/or replace sediment control structures until areas of exposed soil are stabilized.	Not Applicable	34					
	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
41. Inspect the road system at regular intervals. Clear debris from drainage structures to prevent clogging that can lead to washouts.	Not Applicable	16					
	Insufficient Information	0					
	Applied Correctly	18	18	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	2	0	0
42. Keep traffic to a minimum during wet periods and spring break-up to reduce maintenance needs.	Not Applicable	15					
	Insufficient Information	0					
	Applied Correctly	20	20	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	0	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	17					
	Insufficient Information	0					
	Applied Correctly	14	14	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	5	1	2	2	0	0
44. Remove berms along the edge of the road if they will trap water on the road.	Not Applicable	25					
	Insufficient Information	0					
	Applied Correctly	8	8	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	2	0	1	1	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	35					
	Insufficient Information	1					
	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	35					
	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
47. Shape all road system surfaces to maintain proper surface drainage, if necessary.	Not Applicable	32					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
48. Inspect and maintain road surfaces, drainage structures, and crossings to minimize erosion.	Not Applicable	31					
	Insufficient Information	0					
	Applied Correctly	4	4	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	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	32					
	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
50. Install stream crossing structures at right angles to the stream channel.	Not Applicable	33					
	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	33					
	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	32					
	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
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	32					
	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
54. Use soil stabilization practices on exposed soil at stream crossings.	Not Applicable	33					
	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	Not Applicable	29					

maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.	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
56. Use diversion ditches, broad-based dips, or other practices on the road approaches to prevent road runoff from entering the stream.	Not Applicable	31					
	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
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	6	6	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
58. Install culverts that extend at least 1 foot beyond the road fill.	Not Applicable	33					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	1	0	1	0	0	0
59. Install culverts that are large enough to pass flood flows.	Not Applicable	33					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	1	0	0	1	0	0
	Not Applied	1	0	0	1	0	0
60. Install culverts so there in no change in the stream bottom elevation. Culverts should not dam or pool water.	Not Applicable	33					
	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
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	33					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	1	0	0	1	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	34					
	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
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	5	5	0	0	0	0

	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	0	0	3	0	0
64. Locate fords where stream banks are low.	Not Applicable	32					
	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
65. Locate where the stream bed has a firm rock or gravel streambed.	Not Applicable	32					
	Insufficient Information	0					
	Applied Correctly	3	3	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
66. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.	Not Applicable	35					
	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	35					
	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
Timber Harvesting							
68. Use existing landings if possible.	Not Applicable	12					
	Insufficient Information	1					
	Applied Correctly	23	23	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 efficient drainage.	Not Applicable	4					
	Insufficient Information	1					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	2	1	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	10					
	Insufficient Information	0					
	Applied Correctly	22	22	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	0	3	1	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	10					
	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
72. Use existing skid trails if they provide the best long-term access.	Not Applicable	17					
	Insufficient Information	0					
	Applied Correctly	19	19	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	0					
	Applied Correctly	35	35	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	27					
	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
75. Avoid operating equipment where excessive soil compaction, rutting, or channelized runoff may cause erosion that affects water quality.	Not Applicable	3					
	Insufficient Information	0					
	Applied Correctly	30	30	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	2	0	0	2	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	15	15	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	2	0	1	1	0	0
77. Inspect soil stabilization practices periodically during and after harvest operations to insure that they are successful and remain functional.	Not Applicable	18					
	Insufficient Information	0					
	Applied Correctly	16	16	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	1	0	0	1	0	0
78. Do not dispose of or pile slash in areas where runoff may wash slash into lakes, streams, 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	7	1	2	4	0	0
79. For winter harvesting, mark stream channels, dry washes, and existing culvert locations before snowfall.	Not Applicable	19					
	Insufficient Information	1					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	1	1	0	0	0	0
	Not Applied	3	2	0	1	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	34					
	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
81. Avoid locating roads and landings within 35 feet of the dry wash unless necessary for crossings.	Not Applicable	34					
	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
82. Operate wheeled or tracked equipment within 15 feet of the dry wash only when the ground is frozen or dry.	Not Applicable	34					
	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
83. Do not harvest fine woody material within 15 feet of the dry wash.	Not Applicable	34					
	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
84. Minimize soil exposure and compaction to protect ground vegetation and the duff layer.	Not Applicable	34					
	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
85. Avoid cabling logs across the dry wash, where feasible, to prevent damage to the banks of the dry wash.	Not Applicable	34					
	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
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	34					
	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
87. Install stream crossing structures at right angles to the stream channel.	Not Applicable	34					
	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
88. Install stream crossings using materials that are clean,	Not Applicable	34					
	Insufficient Information	0					

non-erodible and non-toxic to aquatic life.	Applied Correctly	2	2	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	34					
	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
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	34					
	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
91. Use soil stabilization practices on exposed soil at stream crossings.	Not Applicable	34					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
92. Design, construct and maintain stream crossings to avoid disrupting the migration/movement of fish and other aquatic life.	Not Applicable	33					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	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	34					
	Insufficient Information	0					
	Applied Correctly	1	1	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
94. Stabilize approaches to crossings with aggregate or other suitable material to reduce sediment entering the stream.	Not Applicable	34					
	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
95. Install culverts that extend at least 1 foot beyond the road fill.	Not Applicable	36					
	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	36					
	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	36					
	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	36					
	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	36					
	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	36					
	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	35					
	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
102. Locate where the stream bed has a firm rock or gravel streambed.	Not Applicable	35					
	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
103. Use temporary stream crossings such as timber mats, pole fords, or frozen fords when appropriate.	Not Applicable	36					
	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	36					
	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 caution.	Not Applicable	3					
	Insufficient Information	0					
	Applied Correctly	30	30	0	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	1	0	1	0	0	0
106. Whenever possible, forest management activities in wetlands should occur on frozen ground to minimize rutting.	Not Applicable	5					
	Insufficient Information	0					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	2	0	1	1	0	0
	Not Applied	1	0	0	1	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	4					
	Insufficient Information	0					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	4	0	2	2	0	0
108. Keep slash out of open water.	Not Applicable	8					
	Insufficient Information	0					
	Applied Correctly	25	25	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	3	1	0	2	0	0
109. Whenever practical, avoid equipment maintenance and fueling in wetlands.	Not Applicable	6					
	Insufficient Information	1					
	Applied Correctly	28	28	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	1	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	28	28	0	0	0	0
	Applied Incorrectly	2	0	2	0	0	0
	Not Applied	1	0	1	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	6					
	Insufficient Information	0					
	Applied Correctly	29	29	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
112. Operate equipment in the wetland filter strip only when the ground is firm or frozen.	Not Applicable	6					
	Insufficient Information	0					
	Applied Correctly	29	29	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	1	0	0	1	0	0
113. Construct upland approaches to the wetland so	Not Applicable	25					
	Insufficient Information	0					

the surface runoff is diverted away from the road approach prior to reaching the wetland.	Applied Correctly	9	9	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	1	0	0	1	0	0
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.	Not Applicable	32					
	Insufficient Information	0					
	Applied Correctly	2	2	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	1	0	1	0	0
115. Avoid operating equipment in areas of open water, springs, or seeps.	Not Applicable	21					
	Insufficient Information	0					
	Applied Correctly	12	12	0	0	0	0
	Applied Incorrectly	1	0	1	0	0	0
	Not Applied	2	0	1	1	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	28					
	Insufficient Information	0					
	Applied Correctly	6	6	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	1					
	Applied Correctly	17	17	0	0	0	0
	Applied Incorrectly	1	0	0	1	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	15					
	Insufficient Information	0					
	Applied Correctly	17	17	0	0	0	0
	Applied Incorrectly	2	0	0	2	0	0
	Not Applied	2	0	1	1	0	0
119. Cease equipment operations when rutting becomes excessive.	Not Applicable	26					
	Insufficient Information	1					
	Applied Correctly	7	7	0	0	0	0
	Applied Incorrectly	0	0	0	0	0	0
	Not Applied	2	0	0	2	0	0