April 24, 2012

MEMORANDUM

TO: Forest Practices Board

FROM: Walt Obermeyer, Compliance Monitoring Program Administrator

SUBJECT: 2010-2011 Biennial Compliance Monitoring Report

Attached is a copy of the 2010-2011 Biennial Compliance Monitoring Report. The report covers FPAs approved August 2008 through July 2010. A summary presentation is scheduled for the May 8th board meeting to provide an overview of the results and answer questions.

NATURAL RESOURCES

Forest Practices Compliance Monitoring Report 2010/2011

April 2012

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

Acknowledgements

The contributions of the following were critical to the completion of this report:

The tribal, Washington State Departments of Ecology and Fish & Wildlife, and DNR region staff that perform the field reviews in good weather and bad. A special thanks to those that reviewed and entered data, including Jean Parodi, John Heimburg, Ritch Wood, and Craig Graber, and Mark Peterschmidt.

The Compliance Monitoring Stakeholders Committee, for their thoughtful consideration of the issues. Special thanks to those who provided extensive comments on the draft documents: Terry Jackson, Pete Heide, Mark Hicks, Steve Barnowe-Meyer, Nancy Sturhan, Dick Miller, and Marc Gauthier.

The Forest Practices Division leadership and staff for their patient editing of the various drafts with a special note of thanks to Gretchen Robinson for her time and talents in improving this report.

NATURAL RESOURCES

Forest Practices Compliance Monitoring Report 2010/2011

April 2012

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WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

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FOREST PRACTICES COMPLIANCE MONITORING BIENNIAL REPORT 2010/2011

Summary

Washington State Department of Natural Resources (DNR) Forest Practices Program is charged with protecting public resources such as water, fish, and wildlife on more than 12 million acres of private and state-owned forests. The Forest Practices Compliance Monitoring Program was established to assess whether forest practices are being conducted in compliance with the state Forest Practices Rules (WAC 222-08-160(4)).

The Compliance Monitoring Team is led by DNR's Forest Practices staff. The team also includes representatives of the state Departments of Ecology and Fish and Wildlife and disciplines including fish and wildlife biologists, geologists, hydrologists and forest practices foresters.

During the 2010-2011 Biennium, the program evaluated two Forest Practices Application (FPA) samples focusing on riparian and road-related forest practices prescriptions:

- The "standard sample" included two separate compliance evaluations at the activity site—checking for consistency with the conditions of the approved FPA and for compliance with the Forest Practices Rule requirements.
- The "emphasis sample" evaluated water and wetland classification to determine if recently submitted FPAs were accurate in how they had been 'typed' on the ground according to the recently implemented water type classification worksheet.

Under Forest Practices Rules, water is assigned a specific category or "type" based on the presence of fish, perennial flows, and whether the water body is a stream or a wetland. Each water type has specific riparian prescriptions. The Compliance Monitoring Program used a "Supplemental Water Information Form" to record observed differences between how a typed water feature appeared during the compliance monitoring evaluation, and what was recorded on the approved application. The team ordinarily evaluates only the stream or wetland reach (length) within the proposed boundary shown on the FPA, whereas, a water type survey evaluates the entire reach to points at which the water type changes.

Although the team may observe what appear to be differences in a stream type, the observations cannot be used as a basis for reclassifying water types for two reasons: they have a limited length of the stream or water body to observe, and they may not be aware of prior accepted protocol surveys.

Results

During the standard sampling for 2010-2011, there were 197 forest practices reviewed. The water and wetland classification sample was 37 FPAs that were approved between May 1, 2011 and September 30, 2011.

Table A provides riparian prescription compliance rates for the standard sample prescriptions reviewed for compliance with the forest practices rules.

Table A. Forest Practices Rule Riparian Prescription Average Compliance Rates

Western Washington						
	No Entry Inner Zone	No Entry RMZ	DFC Option 1	DFC Option 2	Type Ns	Type Np
% compliant	64%	64%	43%	60%	90%	82%
Sample size	44	14	7	25	61	49

Eastern Washington				
	No Entry Inner Zone	No Entry RMZ	Type Ns	Type Np
% compliant	78%	67%	100%	100%
Sample size	9	3	10	19

Statewide	
	Wetland
% compliant	95%
Sample size	38

In the sample, there were 112 road construction activities reviewed. Road construction where there was no sediment delivery potential accounted for 49 instances (44 percent of all road construction). Fifty-four roads (48 percent of all road construction) were located where there was a sediment delivery potential to typed water; these were found to have an 87 percent compliance rate with the Forest Practices rules. A separate sample of haul routes indicated a 96 percent compliance rate.

An emphasis sample evaluated water type classification for non-Type F water on FPAs approved beginning May 2011. Of the 55 typed waters or wetlands reviewed, 12 (22percent) met Type F physicals in some portion of the reach and did not have documentation indicating an approved water type classification.

What we learned through 2010-2011 compliance monitoring

Compliance with the Desired Future Condition options for Western Washington Type F Waters continues to be a challenge. Though most of the non-compliance was rated minor in severity, it occurred across the spectrum of detailed requirements in the riparian rules.

Correctly classifying small, low gradient streams needs improvement. Where the Water Type Modification process has not been used, it is necessary to correctly identify physical characteristics prior to submission of a Forest Practices Application and also in the application approval process.

INTRODUCTION

This report provides a measurement of how well timber harvest and other forest management activities in proximity of typed water complied with forest practices rules for Forest Practices Applications (FPAs) approved August 1, 2008 through July 31, 2010.

The 1999 Legislature revised the Forest Practices Act to adopt the *Forest and Fish Report*, and established a Compliance Monitoring Program (Program). The rule included the requirement that the Washington State Department of Natural Resources (DNR) Forest Practices Program produce a biennial report (WAC 222-08-160 (4)) regarding results of monitoring forest operations. The legislature has funded the Compliance Monitoring Program since the 2006-2007 biennium, including participation by Washington State Departments of Ecology (Ecology) and Fish & Wildlife (WDFW).

Compliance monitoring reports for previous biennia can be found online.

The standard sample in this report is similar to the standard sample of previous reports, providing a common basis for comparison of monitoring results between the biennia. Additionally, the current report includes the results from an emphasis sample of water type classification on recently approved Forest Practices Applications and a haul route review that evaluates Forest Practices Rules regarding road usage and maintenance.

Context

Washington's Forest Practices rules are complex and comprehensive in scope, containing detailed prescriptions for how timber harvest or other forest management activities are to be carried out to protect public resources: water, fish, wildlife, and capital improvements. The development of such rules was pursued for several reasons. The citizens of Washington have long valued the protection of public resources for quality of life and economic well-being. Washington landscapes hold some of the most productive coniferous forests in the world, and these forests have a long history of providing high quality forest products. Protecting both public resources and economic viability are the primary goals of forest practices laws and rules.

The Compliance Monitoring Program's specific purpose is to assess the level of compliance of specific types of forest management activities statewide, with particular focus on riparian and wetland areas, and road building and maintenance. Although the sample size is sufficient for that purpose, it is not large enough to be meaningful for other uses such as assessing the compliance of individual landowners or compliance differences between DNR regions.

DNR maintains a separate database to track forest practices violations and enforcement actions, but this is not part of the Program. When the Program's field reviewers encounter violations, the regional DNR Forest Practices staff responsible for approving FPAs is notified and is responsible for initiating enforcement, consistent with DNR policy.

The Forest Practices rules prescribe regulatory conditions or limits that need to be met in the course of timber harvest or other forest practices activities. These rules define and categorize public resources requiring protection. Some examples are 'typed' waters (including fish bearing and non-fish bearing), wetlands, habitats of wildlife species and capital improvements. The Program reviews the specific forest practices prescriptions to assess whether the prescribed protection has been applied correctly. When the post-operations site conditions meet or exceed the prescription requirement, the prescription is considered compliant. When implementation is insufficient to meet rule requirements, the prescription is considered non-compliant.

Applying discrete rules to a site that is influenced by continuous and dynamic natural processes occasionally result in situations in which the difference between compliance and non-compliance is extremely difficult to determine with confidence. The specificity of some forest practices prescriptions assumes a level of measurement precision that can at times be difficult to achieve. For example**,** in Western Washington the Riparian Management Zone (RMZ) widths on Type F streams (fish-bearing) depend on whether the "bankfull width" of the stream is less than or greater than 10 feet. As described in the Forest Practices Board Manual, protocols to determine the stream bankfull width recommend at least ten transects (across the stream) taken at equal distances apart (up the stream). Streams vary in width, so the transect-measured widths are then averaged. If the measured average is very close to the 10-foot threshold, the margin of sampling error can make it difficult to determine whether the stream is under or over the threshold. Therefore, in such cases, the review team cannot assess whether the operation is in compliance with the rules. Bankfull width measurements along some stream reaches can vary significantly, even between skilled and knowledgeable observers.

These uncertainties, though infrequent, are not exceptional. Where they occur, the outcome is given a value of indeterminate or no consensus and noted in the compliance monitoring report results. Non-compliance is rated as to its severity in three classes; Minor, Moderate, or Major which provides the perspective of how non-compliant the applied prescription was per deviation from the approved FPA or rule.

The Program initially used the conditions of the approved FPA as the standard against which to measure compliance. During the 2006-2007 biennium, observers found that there could be differences between what was approved and what was observed on site one-to-two- years later. During that time frame, site conditions may have changed or the FPA may have included an error that was not discovered prior to completion of the prescription. In order to capture these conditions, in 2008, the Program instituted a 'determination of compliance' for each forest practices prescription, both with the application and the rules.

Individuals participating on the Compliance Monitoring team realized that in certain monitoring situations it would not be beneficial to follow the "either in compliance or not" standard that had been followed in the past.

The 2011 haul route sample introduced this year represents a departure from the "compliant" or "non-compliant" approach. It assesses each 0.1 mile segment of forest road for correct design, construction or maintenance of roads—such as ditches, culverts, and road surfaces to protect 'typed waters' from sediment delivery. This strategy allows for determining the rate of compliance for the entire haul route of the FPA. The method reports the proportion of non-compliance, the severity of each non-compliant segment, and the cause of the non-compliance. This allows greater understanding of onsite conditions and provides a better explanation than a statement of whether or not an entire haul route was non-compliant. It also provides valuable information for training and for areas of focus for Forest Practices foresters.

Compliance Monitoring Program Design Elements

The Forest Practices Application submitted by the landowner, timber owner, or operator—describes the proposed forestry activities and is used to track the activities on the ground, through time. Within each FPA, all of the activities subject to the Forest Practices rules are listed. During the review process, FPAs are reviewed by DNR and assigned a classification of II, III, or IV, based on the nature of the activities and known geographical information. A field review process is then performed to confirm the location and condition of the features and proposed prescriptions. Based on that review, the FPA is approved, approved with conditions, or disapproved and returned to the applicant to correct the information and/or prescriptions.

Forest Practice Activities

Forest practices activities are operations subject to Washington State's Forest Practice Rules. The rules protect specified features by prescribing what and how activities may be implemented in the areas influencing the protected public resources and features—such as water, slope stability, and cultural resources, etc. Individual FPAs generally contain multiple protected features to which the forest practices rules apply. The Compliance Monitoring Program review process evaluates one of each type of prescription on the approved FPA. If more than one of the same prescription type exists within the unit, one prescription of that type is selected randomly for compliance review. For 2010-2011, the program limited its review to harvest prescriptions along riparian features and those involved with road construction. Each type of riparian prescription was selectable: Desired Future Condition (DFC) Option 1, DFC Option 2, No Inner Zone Harvest, No Riparian Management Zone Entry, Np, Ns, Wetland Management Zones, etc. Road work needed for harvesting—such as construction, abandonment, landings and Type N stream crossings— also were evaluated.

Team measures site with equipment used inside the riparian buffer.

Standard Sample

The standard sample is used to assess Forest Practices rule compliance broadly for prescription and feature types over time. It is essential in the standard sample that all forestry activities be completed prior to the compliance monitoring review, and since each FPA has a term of two years, a time window is picked to ensure completion of operations. For the sample period in this report, the population was all FPAs meeting the screening criteria approved from August 1, 2008 through July 31, 2010.

For this two-year period there were 8,973 FPAs approved from across Washington State. The desired margin of error (+/- 5 percent at the 95 percent confidence level) requires slightly fewer than 200 FPAs. The sample population was selected using a randomly assigned number for each FPA. The list was then ranked, providing the order for selection of applications. Every FPA that met the Compliance Monitoring Program's screening

criteria had an opportunity to be selected, relative to the proportion that a DNR region's FPAs represented against the statewide total.

This sample size was intended to meet confidence targets of combined averages for compliance on road and riparian prescriptions. The confidence interval of each prescription type was not anticipated to meet the +/- 5 percent at the 95 percent confidence level. These individual prescription types frequently have sample sizes less than twenty and occasionally less than ten. The underlying mathematics of statistical analysis cannot attain the higher levels of confidence without larger sample sizes.

Since each DNR region is sampled in proportion to the number of applications approved annually, there are many fewer Forest Practices Applications reviewed for Eastern Washington than Western Washington. Prescriptions specific to Eastern Washington generally have much smaller sample sizes because of this proportional selection. The total applications reviewed for Eastern Washington was 38, compared to 158 for Western Washington.

Activities not included in compliance monitoring report

The entire set of forest practices prescriptions that are allowed were not evaluated for compliance. Rather, the Compliance Monitoring Program initially focused on those activities or prescriptions which had the most potential risk to the resource and which had attributes which could be measured. Other prescriptions were not evaluated or reported —those that were deemed to have less risk to the resource and which had insurmountable sampling and measurement challenges. They include areas such as forest conversions to other uses (WAC 222-16-060), aerial spray applications (WAC 222-38), and cultural resources (WAC 222-16). Other prescriptions that may be evaluated in subsequent years include prescriptions designed to protect wildlife species, Class II Applications (WAC 222-16-050 (3)), and unstable slopes (WAC 222-16-050 (d) (i)).

Emphasis samples

In 2011 the Compliance Monitoring Program instituted two new samples—a haul route survey regarding forest roads, and a water/wetland classification emphasis sample. The haul route evaluation previously had not been assessed. DNR and Ecology worked to develop a sampling strategy to assess haul routes in 2010. This strategy was implemented in 2011 using a subset of the standard sample to assess both recently completed and active haul routes.

A water/wetland classification emphasis sample was included in 2011 to help answer two questions. DNR needed to know whether new requirements in the FPA application approval process improved the rate of correct water typing. The team measured the stream physical characteristics to determine if they were consistent with those reported on the approved FPA, and whether or not Type N streams were verified adequately, as defined in rule. The sample was randomly selected from FPAs approved from May through September 2011, in proportion to each region's percentage of total FPAs.

Sampling and Field Protocols

Specific details about the observation methods and program protocols are described in the documents *Washington State Department of Natural Resources Forest Practices Compliance Monitoring Program Design* and *Compliance Monitoring Protocols—Western and Eastern Washington*, found on DNR's website

These protocols are used in the field to determine whether or not the prescription is compliant. If not compliant, a severity rating of one of three levels is applied. The non-compliance rating categories are:

- **Minor:** Minor impacts of short duration over a small area, such as a few trees harvested in the core, inner or outer zones of a Riparian Management Zone (RMZ) or evidence of small amounts of sediment having entered typed perennial waters.
- **Moderate:** Apparent and potentially longer-term impacts to public resources such as the complete removal of outer zone RMZ trees or significant under-stocking of leave trees in the inner zone. Also, undersized culverts cut and fill slopes and small but visible sediment plumes in typed waters.
- **Major:** Evident or high potential impact such as harvest in the RMZ core zone, or cut or fill slopes directly contributing visible volumes of sediment to typed waters.

In the case of some compliant riparian prescriptions where the operation maintained additional protection that went significantly beyond rule minimums, an "**Exceeds**" rating is given. Data describing on-site conditions and consistency of the FPA information with observed features also is recorded to provide context for analysis.

Landowner population groups

Results are given separately for Small Forest Landowners and Industrial Landowners in response to stakeholders' requests, but it is important to note that estimates of statewide compliance for these individual categories have lower confidence, given the limited sample size. When FPAs are selected for compliance monitoring, they are landowner blind.

Stream typing for riparian prescriptions

Stream and wetland type classification is a fundamental aspect of determining which Forest Practices rules apply to any riparian feature type in a given FPA. DNR maintains water typing maps that need to be verified in the field for each FPA. Required Riparian Management Zone strategies cannot be determined without a measurement of a stream's physical characteristics as defined in WAC 222-16-031, or a protocol (fish) survey as specified in Forest Practices Board Manual 13. Applicants are required to either complete water type classification worksheets or complete protocol surveys. If applicants want to change the recorded stream type on DNR's water type maps, they are required to submit a Water Type Modification Form.

While Water Type Modification Forms and the water types on each Forest Practices Application are made available to all stakeholders for review, DNR may not receive reviews and comments from all stakeholders. Documentation on file with DNR is needed to confirm a regulatory water type change.

The Compliance Monitoring Program does not change water types because that action has a defined process beyond the scope of the compliance review. The stream types as recorded in the FPA documentation and on the

DNR hydro layer provide the basis for the compliance determination. Where the compliance monitoring review observes differences between water type information in the FPA and the on-the-ground features, a Supplemental Water Information Form (SWIF) is completed by the compliance monitoring team. This form records features found in the geographic limits on the FPA, and as such is not sufficiently comprehensive to unequivocally determine stream type. The SWIF provides a basis to report the frequency of differences between what was submitted by the landowner and what was observed by the review team at the site.

Team completes paperwork on monitoring a site near Willapa Bay.

COMPLIANCE MONITORING RESULTS

Results provided in this section address compliance rates from observations at prescription sites, checking for consistency with the conditions of the approved Forest Practices Applications (FPAs), and also with the Forest Practices rule requirements for site features. This approach will inform DNR as to whether notable differences exist between the conditions on the ground, those described or documented on the approved FPA and those required by the rules. To examine this, we evaluated approved FPAs for which proposed prescriptions had been completed prior to the onsite review. The outcomes of field reviews are provided for each prescription type. Due to minor differences in how compliance data were collected and results presented, a comparison with previous compliance results is not presented in this report.

The compliance monitoring report content is organized as follows: first to present riparian information (standard sample and the supplemental water forms and the water classification emphasis), followed by road information from the standard sample and the haul route survey.

Results for Riparian-Related Activities

These results were analyzed from the standard sample (197 FPAs) conducted in calendar years 2010 and 2011. The sampling strategy was to observe one prescription of each type that occurred on the FPA. The riparian prescriptions are presented in Table 1.

Table 1. Types of Riparian Prescriptions reviewed and observed during 2010/2011 Compliance Monitoring

Western Washington	Eastern Washington	Statewide
No Outer Zone Harvest	No RMZ Harvest	Wetlands
No Inner Zone Harvest	No Inner Zone Harvest	Riparian Salvage Harvest
Option 1-Thinning from Below	Inner Zone Harvest (combined habitat types)	
Option 2- Leaving Trees Closest to Water	Type Np RMZ	
Type Np RMZ	Type Ns Equipment	
Type Ns Equipment Limitation Zone	Limitation Zone	

Table 2 shows the status of compliance within the terms of the FPAs for Riparian Management Zone-related prescriptions for Type F (fish-bearing streams) and Type N (non-fish bearing streams, both perennial and seasonal), and wetlands. Each prescription has a unique set of timber harvest requirements, and includes the use of a corresponding set of protocols and questions to determine compliance status. Forest Practices rule prescriptions for Type F and N streams can be different for Eastern and Western Washington (chapter 222-30 WAC).Wetland rules are consistent across the state. Note that the sample size for some prescriptions is small and inferences regarding those are subject to wide confidence intervals. Table 3 shows the corresponding rule compliance. Methods for estimating confidence intervals are described in Appendix A.

Table 2. Compliance with Approved FP Applications for 2010/2011 Riparian Harvest Prescriptions with 95% confidence intervals

Eastern and Western Washington Riparian Activities 2010/2011 Biennium															
		Western Washington						Eastern Washington					Statewide		
	Status of Compliance	No Inner Zone	No Entry RMZ	DFC Option 1	DFC Option 2	Type Ns	Type Np	No Inner Zone	No Entry RMZ	Inner Zone	Type Ns	Type Np	Type Ns	Type Np	Wetland [a]
Small Forest Landowners	Compliant	2	1	0	0	5	2	1	0	0	2	3	7	5	8
	Out of Compliance	2	5	0	1	0	1	1	0	0	0	0	0	1	1
	Percent Compliant	50%	17%	na	0%	100%	67%	50%	na	na	100%	100%	100%	83%	89%
	Confidence Interval	(8, 92)	(1, 62)	na	na	na	(11, 99)	na	na	na	na	na	na	(38, 99)	(69, 100)
	Total	4	6	0	1	5	3	2	0	0	2	3	7	6	9
Industrial Landowners	Compliant	31	6	5	17	55	51	6	2	1	8	20	63	71	27
	Out of Compliance	13	2	4	7	4	6	1	0	1	0	1	4	7	3
	Percent Compliant	70%	75%	56%	71%	93%	89%	86%	100%	50%	100%	95%	94%	91%	90%
	Confidence Interval	(56, 83)	(37, 96)	(23, 85)	(50, 87)	(84, 98)	(79, 96)	(44, 100)	na	na	na	(77, 100)	(86, 98)	(83, 96)	(79, 100)
	Total	44	8	9	24	59	57	7	2	2	8	21	67	78	30
All Landowners	Compliant	33	7	5	17	60	53	7	2	1	10	23	70	76	35
	Out of Compliance	15	7	4	8	4	7	2	0	1	0	1	4	8	4
	Percent Compliant	69%	50%	56%	68%	94%	88%	78%	100%	50%	100%	96%	95%	90%	90%
	Confidence Interval	(54, 81)	(24, 76)	(23, 85)	(47, 84)	(85, 98)	(78, 95)	(42, 97)	na	na	na	(80, 100)	(87, 98)	(82, 96)	(88, 100)
	Total	48	14	9	25	64	60	9	2	2	10	24	74	84	39

[a] These are combined ratio proportions (i.e., multiple prescriptions possible on a single FPA) na = not applicable

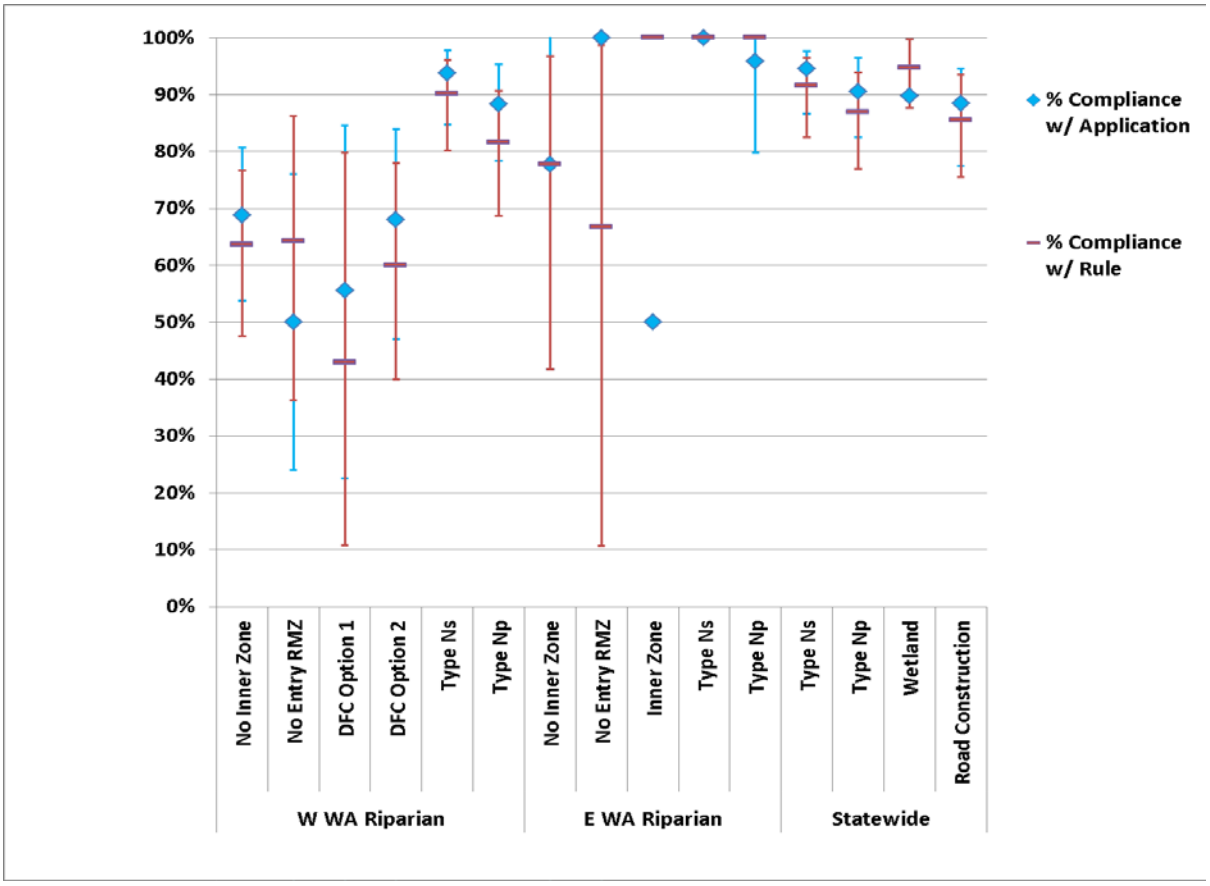
Table 3. Compliance with Forest Practices Rules for 2010/2011 Riparian Harvest Prescriptions with 95% confidence intervals

Eastern and Western Washington Riparian Activities 2010/2011 Biennium															
		Western Washington						Eastern Washington					Statewide		
	Status of Compliance	No Inner Zone	No Entry RMZ	DFC Option 1	DFC Option 2	Type Ns	Type Np	No Inner Zone	No Entry RMZ	Inner Zone	Type Ns	Type Np	Type Ns	Type Np	Wetland[a]
Small Forest Landowners	Compliant	2	3	0	0	5	0	1	0	0	2	3	7	3	9
	Out of Compliance	2	3	0	1	0	2	1	0	0	0	0	0	2	0
	Percent Compliant	50%	50%	na	0%	100%	0%	50%	na	na	100%	100%	100%	60%	100%
	Confidence Interval	(8, 92)	(13, 87)	na	na	na	na	na	na	na	na	na	na	(16, 94)	(97, 100)
	Total	4	6	0	1	5	2	2	0	0	2	3	7	5	9
Industrial Landowners	Compliant	26	6	3	15	50	40	6	2	1	8	17	58	57	27
	Out of Compliance	14	2	4	9	6	7	1	1	0	0	0	6	7	2
	Percent Compliant	65%	75%	43%	63%	89%	85%	86%	67%	100%	100%	100%	91%	89%	93%
	Confidence Interval	(49, 79)	(37, 96)	(11, 80)	(42, 80)	(79, 96)	(72, 93)	(44, 100)	(11, 99)	na	na	na	(81, 96)	(79, 95)	(85, 100)
	Total	40	8	7	24	56	47	7	3	1	8	17	64	64	29
All Landowners	Compliant	28	9	3	15	55	40	7	2	1	10	20	65	60	36
	Out of Compliance	16	5	4	10	6	9	2	1	0	0	0	6	9	2
	Percent Compliant	64%	64%	43%	60%	90%	82%	78%	67%	100%	100%	100%	92%	87%	95%
	Confidence Interval	(48, 77)	(36, 86)	(11, 80)	(40, 78)	(80, 96)	(69, 91)	(42, 97)	(11, 99)	na	na	na	(83, 97)	(77, 94)	(88, 100)
	Total	44	14	7	25	61	49	9	3	1	10	20	71	69	38

[a] These are combined ratio proportions (i.e., multiple prescriptions possible on a single FPA) na= not applicable

Figure 1 displays compliance percentages for all riparian prescriptions sampled. The error bars show the lower and upper limits of a 95 percent confidence interval. Confidence intervals are wider for prescriptions where the sample size is smaller.

Figure 1. Percent of Compliance for All Riparian Harvest Prescriptions in 2010/2011



Riparian Non-compliance Analysis for Western Washington

Upon the publication of the 2006-2007 Biennial Forest Practices Compliance Monitoring report in 2009, it was noted that riparian-related prescriptions in forests along Type F Westside streams had a noticeably lower rate of compliance than other prescriptions. The question was raised as to why there was a lower than expected compliance rate. The compliance monitoring team cannot clearly determine "why" in terms of either the specific actions that were taken or the intent of the applicant when the prescription was performed. The team can, however, observe and document conditions surrounding the non-compliant prescription in the comments. The following graphs, tables and discussion for each riparian prescription type are taken from the data and comments recorded during each site visit.

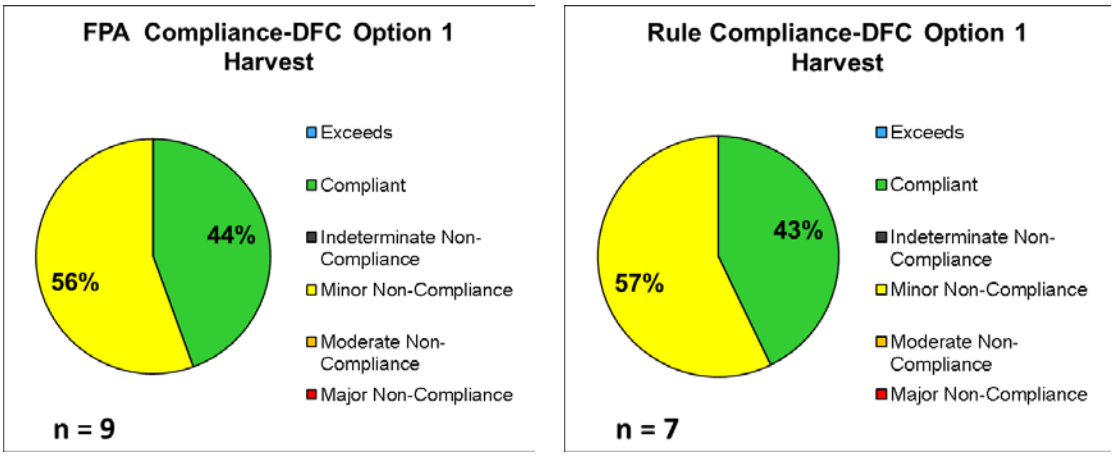
Desired Future Condition Option 1

Desired Future Condition (DFC) Option 1 was found to be the least-used Western Washington Type S and F prescription in the sample. Landowners must undertake a complex process to determine which trees

are allowed to be harvested in the inner zone, and to plan and execute the harvest. To determine if thinning is allowed, landowners must inventory and enter existing stand data into a web-based computer program (also known as the Desired Future Condition (DFC) model), and the program calculates and reports the number and size of conifer trees that must be retained after harvest.

Out of the 197 Forest Practices Applications sampled, nine included the DFC Option 1 prescription. FPA compliance was determined for all nine occurrences while rule compliance was determined for only seven. Rule compliance status could not be determined for one occurrence based on RMZ length inconsistency between the field-measured length and what was reported on the FPA. For the other compliance could not be determined because trees were harvested within 75 feet (as allowed in the DFC model) but no shade documentation was on file. Figure 2 displays the sampled outcomes for the DFC Option 1 prescription.

Figure 2. Desired Future Conditions Option 1 Sampled Outcomes



One prescription was FPA-compliant but not rule-compliant. In this case, there was harvest within 75 feet of the stream without shade documentation; it received a 'Minor' severity rating for rule compliance.

Of the eight FPAs assessed for compliance with the rules, three were determined to be compliant and five were determined to be non-compliant with a 'Minor' severity rating. The causes for non-compliance were:

- Harvest of three or fewer trees in the core zone (two FPAs);
- Too few outer zone trees (one FPA);
- One tree cut larger than allowed in the DFC Option 1 prescription (one FPA); and
- Error in the primary species used in the stocking model, causing it to be short 18 trees in the 14-inch diameter class in the inner zone (one FPA).

There is no obvious reason or pattern to the rule non-compliance. Some possibilities for the reasons are presented in the discussion section. Though overall there was a lower rule compliance rate for the Desired

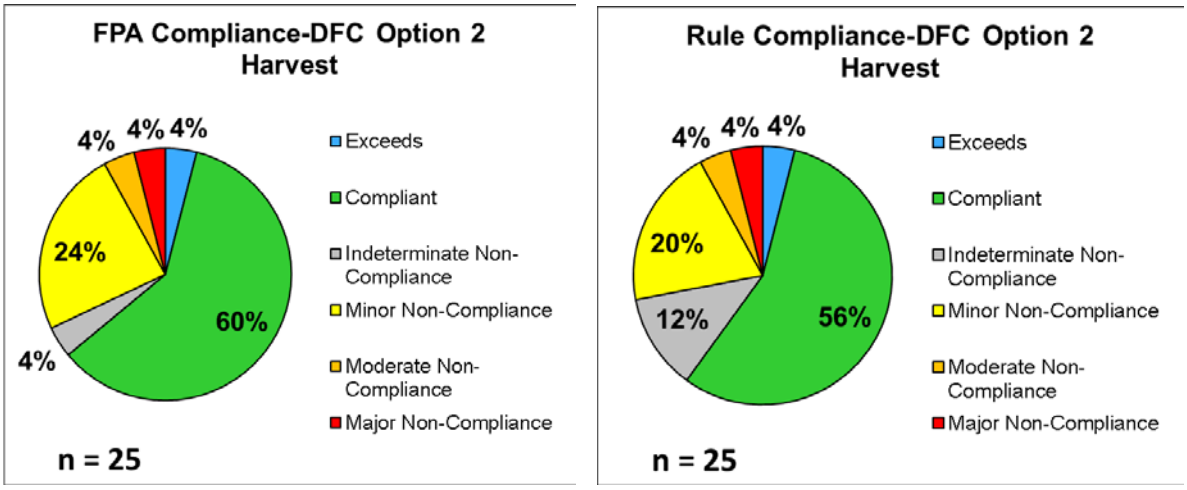
Future Condition Option 1 prescription than we saw in the previous biennium,[1] the sample size was small in both sampling periods (n=9 for 2010-2011 vs. n =10 for 2008-2009), and therefore the difference is not statistically significant. This biennium, all non-compliance severity ratings were 'Minor', whereas in 2008-2009, 20 percent of the sample was non-compliant at either 'Moderate' or 'High' severity. Again, the sample is too small for this to be considered a statistical trend.

Desired Future Condition Option 2

Desired Future Condition Option 2 (DFC Option 2) also requires stand inventory and use of the DFC model, and allows the applicant to concentrate the inner zone leave trees closest to the water. When that stocking requirement is met, the remaining inner zone may be harvested to 20 conifer trees per acre that are 12 inches in diameter or larger. This prescription is less complex to implement, and it occurred more frequently in the sample than the DFC Option 1 prescription.

Out of the 197 FPAs sampled, 25 included the DFC Option 2 prescription. Figure 3 shows the compliance breakout for both rule and FPA compliance.

Figure 3. Westside Riparian Forest Desired Future Conditions Option 2 Sampled Outcomes, Comparing FPA and Rule Compliance



Of the 25, one prescription was found to be 'rule indeterminate' but 'FPA compliant' because the outer zone trees were reported on the FPA as using both 'clumped' and 'dispersed' strategies; however, only one strategy may be declared on the FPA. The conifer tree count was short of the number needed. Hardwood was present, but hardwood is not allowed in the dispersed outer zone leave tree strategy. This resulted in the decision of 'rule-indeterminate' because the review team initiated the survey assessing the riparian zone as dispersed strategy and did not tally the hardwood at the beginning of the survey, realizing the problem after the fact.

[1] See Table 1, Appendix B

Ten prescriptions in the sample were non-compliant with the Forest Practices rules:

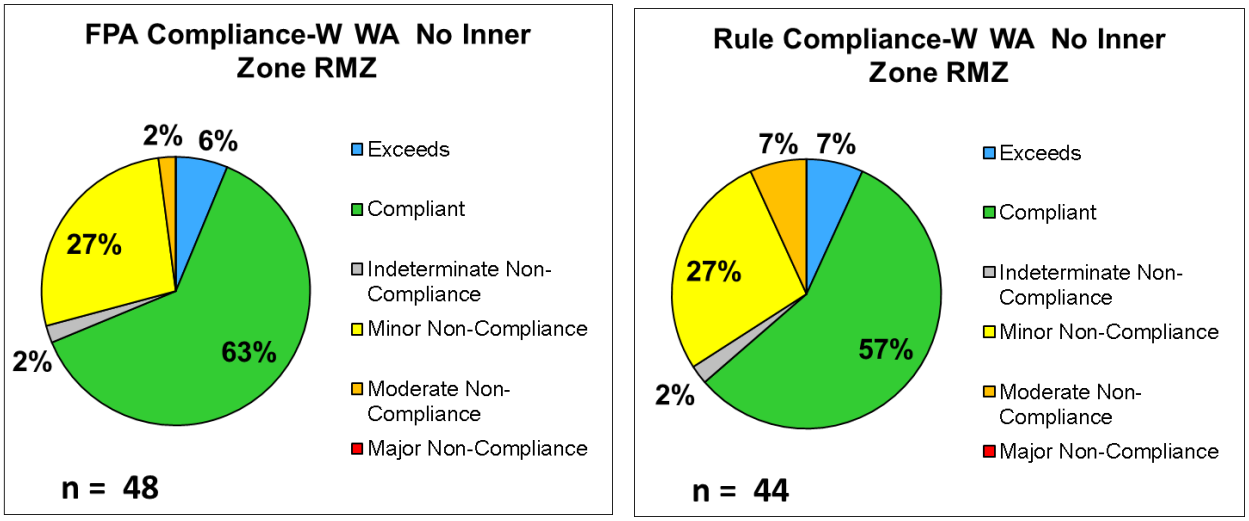
- One severity rating was rated 'Major' because 750 feet of a 1,300 foot Riparian Management Zone had 102 trees cut within the core zone. The stream had a branched channel within part of this reach, and it was not clear whether this branch had been considered by the applicant in the RMZ layout.
- There was one prescription with a 'Moderate' non-compliance rating. It had eight of the 17 required outer zone trees, although the core and inner zones met the rule-required width.
- Six non-compliant prescriptions were rated 'Minor', ranging from too few trees in the outer zone, leaving excess trees in the harvested portion of the inner zone, and cutting two too many trees in the inner zone.

Three of the non-compliant prescriptions were rated 'Indeterminate'. One was due to the Desired Future Condition model identifying a stream size as narrow when it actually was wide (> 10 feet) (chapter 222-30 WAC). On another, the review team could not determine a severity rating based on the RMZ floor zone width differences. And on the third, there was a two-sided buffer in which one side's outer zone leave trees were insufficient; however the combined average tree count for both sides met the rule requirement.

No Inner Zone Harvest

The No Inner Zone Harvest prescription allows harvest only in the outer zone of Type S and F waters, leaving the inner and core zones entirely intact. Out of the 197 Forest Practices Applications sampled 49 included the No Inner Zone harvest prescription. The compliance on one was considered 'Indeterminate' for the application and the rule, based on inconclusive presence of channel migration zone indicators, such as channel structure and flow evidence. Four more of the samples were rule 'Indeterminate' because of undeterminable shade status and undetermined channel migration zone presence. Those remaining are presented in Figure 4.

Figure 4. Westside No Inner Zone Riparian Management Zone Harvest Sampled Outcomes



Three prescriptions were rated ‘Moderate’ for not complying with the rule:

- One required a wider RMZ than implemented; field personnel measured the stream width and determined it was greater than 10 feet, but the FPA had recorded less than a 10 foot width.
- One was due to the buffer length being too short where field personnel observed fish upstream from the buffer.
- The third received the rating due to inner zone harvest of ten trees and five less trees than required having been retained in the outer zone.

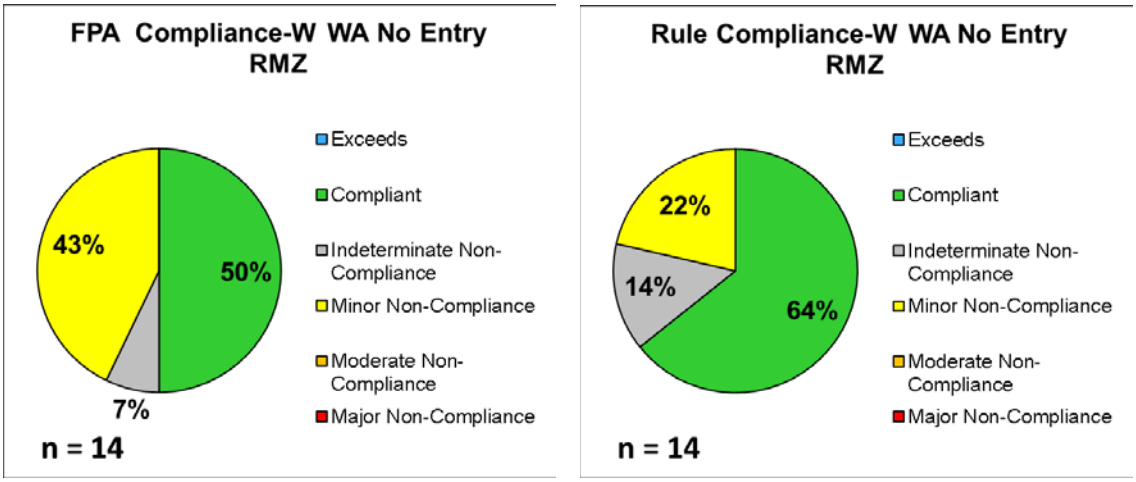
Twelve prescriptions were rated ‘Minor’ regarding rule non-compliance. Eleven had a few trees cut in the inner zone, four of which also had insufficient outer zone trees retained.

Three of the prescriptions that complied with the rule exceeded the tree count requirements by 20 percent or more and received an ‘Exceeds’ rating.

No Entry Riparian Management Zone

The No Entry Riparian Management Zone prescription occurs when the Forest Practices Application states that no harvest is to occur within any portion of the RMZ. 14 of these prescriptions occurred in the FPA sample.

Figure 5. Western Washington No Entry Riparian Management Zone Sampled Outcomes



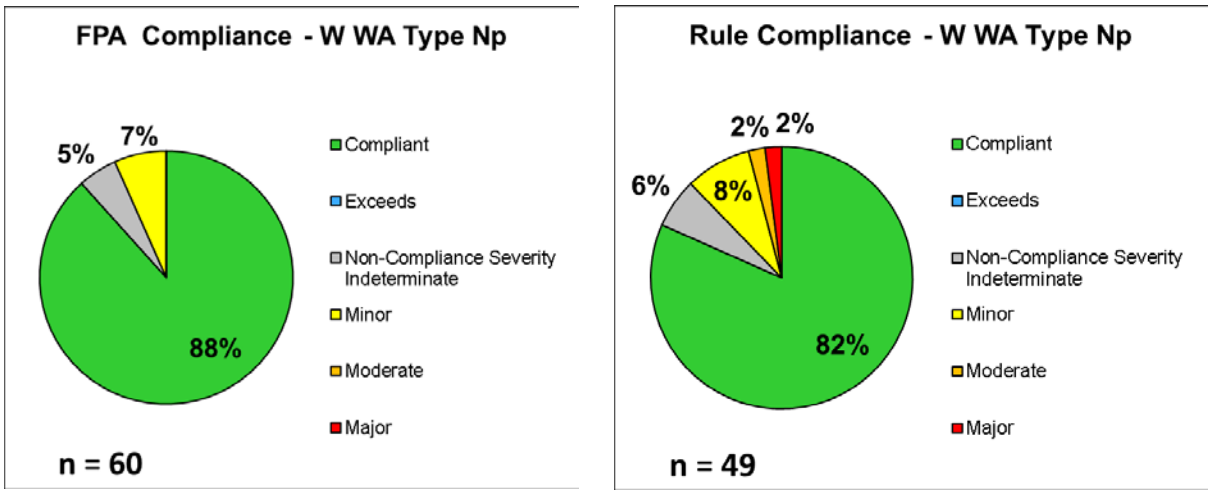
Of the five instances of No Entry RMZ prescriptions that did not comply with the rule, three were rated ‘Minor’. These three had trees cut in the outer zone. In two of these instances, harvest also was observed in the inner zone. Two of the No Entry RMZ prescriptions that did not comply with the rule were rated ‘Indeterminate’ in severity. One had 23 trees removed from a 600-foot-long outer zone (with no record kept on the amount of trees harvested in excess of the rules).

Western Washington Type Np Riparian Management Zones

Type Np prescriptions occurred 62 times in the sample. Forest Practices Application compliance could not be determined for two of the 62, and rule compliance could not be determined for 13. The high number of rule-indeterminate decisions is due in large part to sampling protocols specifying an 'Indeterminate' conclusion if Type F physical criteria are present for the observed reach. When this occurs, these features are recorded in the Supplemental Water Information Form (SWIF) and presented in that part of the analysis.

Figure 6 displays the results for the Type Np prescriptions.

Figure 6. Western Washington Type Np Management Zone Sampled Outcomes



One instance of non-compliance with the rule was rated 'Major' where the applicant treated the Type Np as a Type Ns and the buffer was completely harvested.

The one 'Moderate' rating for rule compliance occurred where fish were observed in the stream reach, affirming a Type F classification; however a mitigating factor was a larger than standard Type Np buffer left due to slope stability issues.

Four prescriptions were rated 'Minor' for non-compliance with the rule- for reasons ranging from one tree cut in the no-harvest Riparian Management Zone, to RMZs not meeting the required length.

Two were rated 'Indeterminate' regarding rule compliance where the review team concurred that the stream met Type F physical criteria for some portion of the reach without Water Type Modification Forms or ID Team documentation.

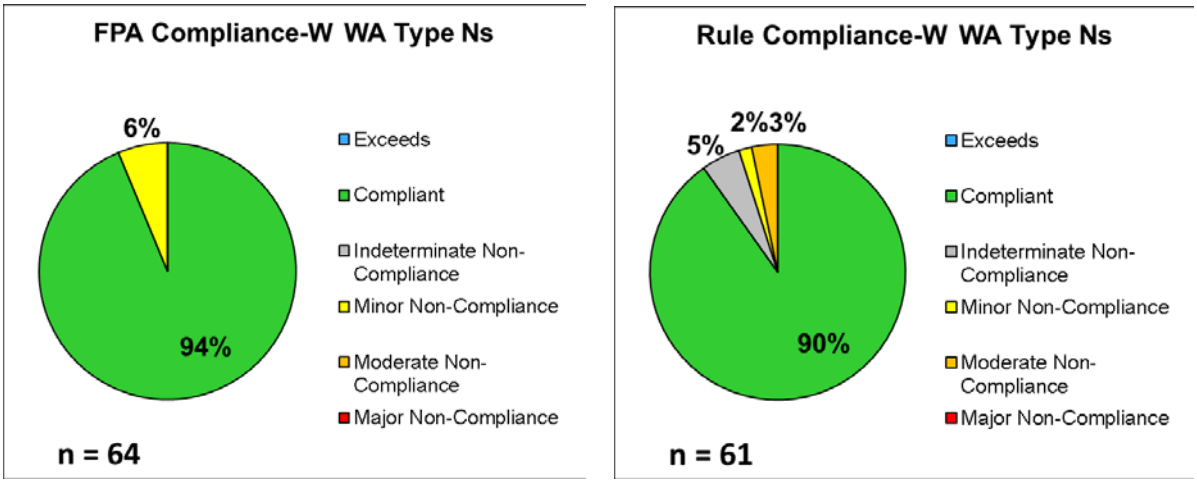
Western Washington Type Ns Riparian Management Zones

Type Ns prescriptions occurred 65 times in the sample. Forest Practices Application compliance could not be determined for one of the 65 while rule compliance could not be determined for four—three of which

exhibited Type F physical criteria and the other was located entirely within a Type F Riparian Management Zone.

Figure 7 provides the breakout for Ns prescriptions where compliance was determined.

Figure 7. Western Washington Type Ns Management Zone Sampled Outcomes



Two instances were rated 'Moderate' for non-compliance with the Forest Practices Rules. A fish was observed in a stream reach in one (The effect of this misclassification was to some extent mitigated by the buffer of trees in an area of slope instability), and in the other, more than 10 percent of the equipment limitation zone (ELZ) was disturbed by equipment without appropriate mitigation. The one 'Minor' rating was also due to disturbance within the equipment limitation zone.

Riparian Non-compliance for Eastern Washington

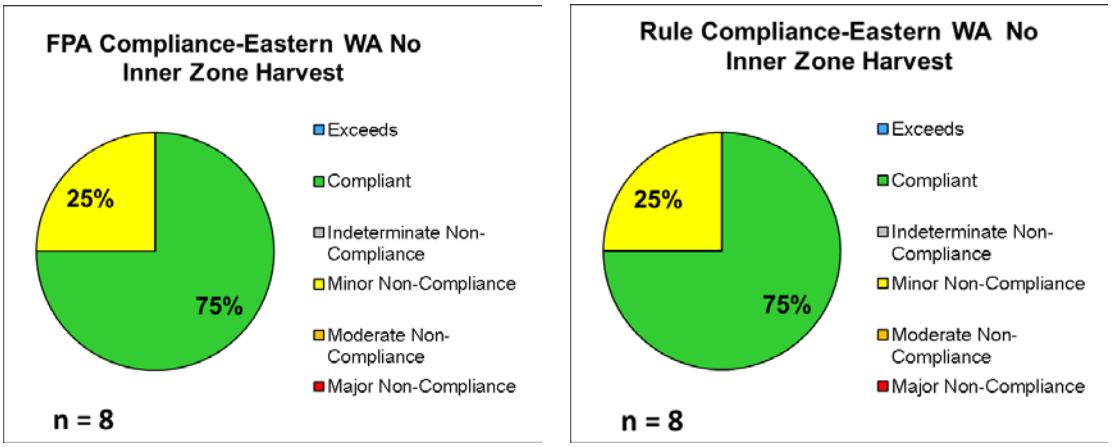
Riparian Analysis for Eastside Type F or S water

There are fewer Type F and S prescriptions in Eastern Washington than in Western Washington. Accordingly, there are fewer Eastern Washington Type F or S prescriptions in the compliance monitoring sample.

Eastern Washington No Inner Zone Harvest

Eight Eastern Washington No Inner Zone Harvest prescriptions occurred in the sample and are presented in Figure 8.

Figure 8. Eastern Washington No Inner Zone Harvest Sampled Outcomes



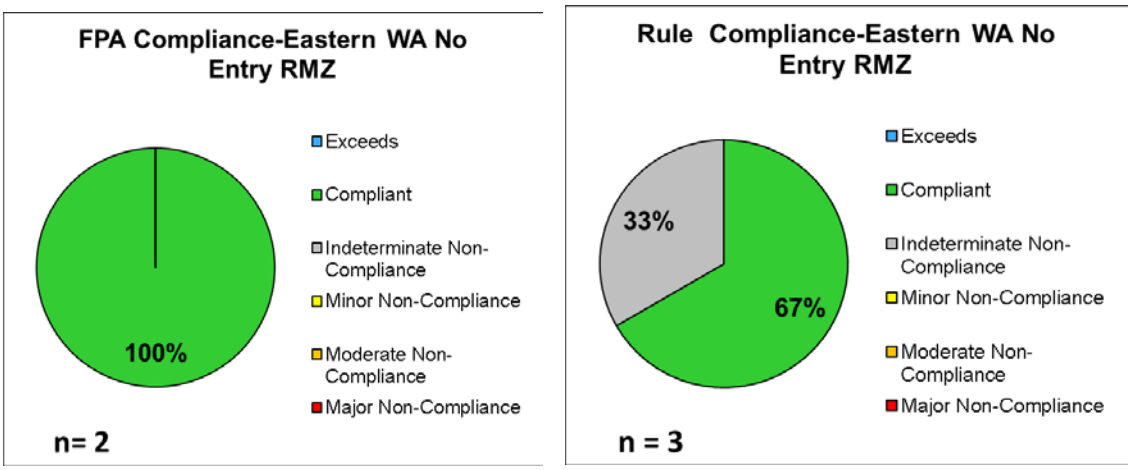
There were two instances of non-compliance with the rule. They both were rated 'Minor' for trees cut within the inner zone.

Eastern Washington No Outer Zone Harvest

Type F or S Riparian Management Zone

Three Eastern Washington No Entry prescriptions occurred in the sample and are presented in Figure 9. One prescription was not assessed for FPA compliance because the landowner had identified a stream reach as a Type Np water rather than Type F as indicated on the Forest Practices HYDRO base map. Notes on the FPA indicate there was an interdisciplinary (ID) team review of the reach, but there was no documentation available for the compliance monitoring review. Therefore there was uncertainty as to whether or not the water type had been agreed to as part of the FPA approval process or not.

Figure 9. Eastern Washington No Entry RMZ Sampled Outcomes



The prescription was non-compliant with the rule, and rated as 'Indeterminate' in severity.

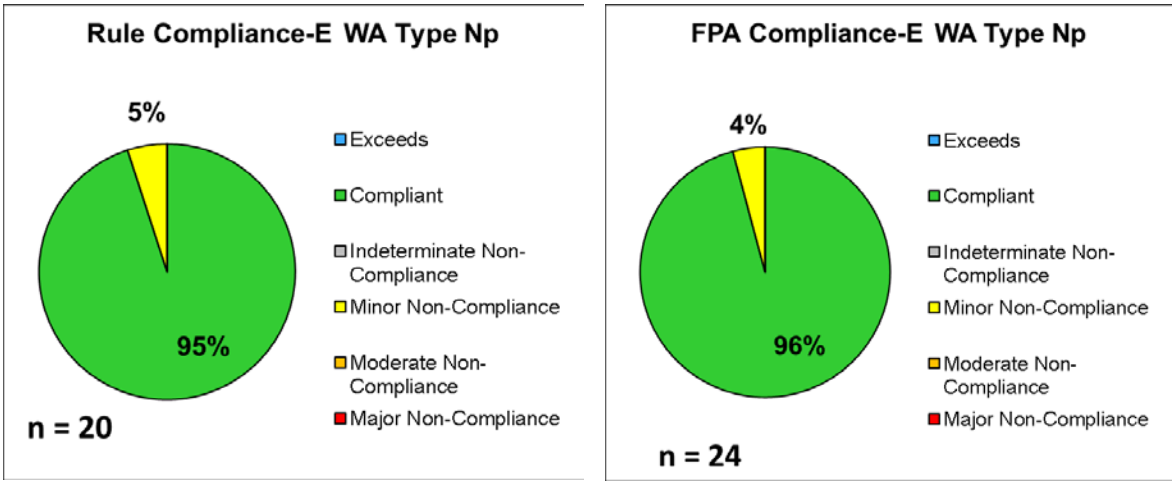
Eastern Washington Type S and F Inner Zone Harvest

Two Eastern Washington Inner Zone Harvest prescriptions occurred in the sample. Both were located in Ponderosa pine habitat. One was compliant and the other was rule non-compliant with a 'Minor' severity rating because two trees were cut within 75 feet of the stream without shade documentation in the FPA.

Eastern Washington Type Np Riparian Management Zones

Twenty-four Eastern Washington Type Np harvest prescriptions occurred in the sample and are presented in Figure 10.

Figure 10. Eastern Washington Type Np Riparian Management Zone Outcomes

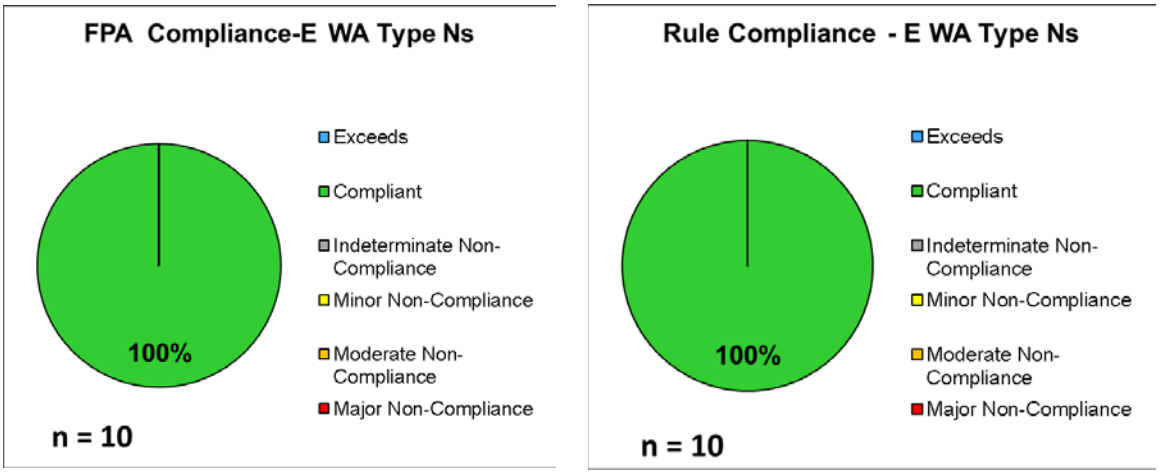


All but one of twenty Type Np Riparian Management Zone prescriptions was compliant with the rule, which was rated 'Minor' in severity due to one tree cut in the no-harvest portion of the RMZ?

Eastern Washington Type Ns Equipment Limitation Zones

Eleven Eastern Washington Type Ns Equipment Limitation Zone prescriptions occurred in the sample and all were assessed as both FPA and rule compliant as shown in Figure 11.

Figure 11. Eastern Washington Type Ns Equipment Limitation Zone Outcomes



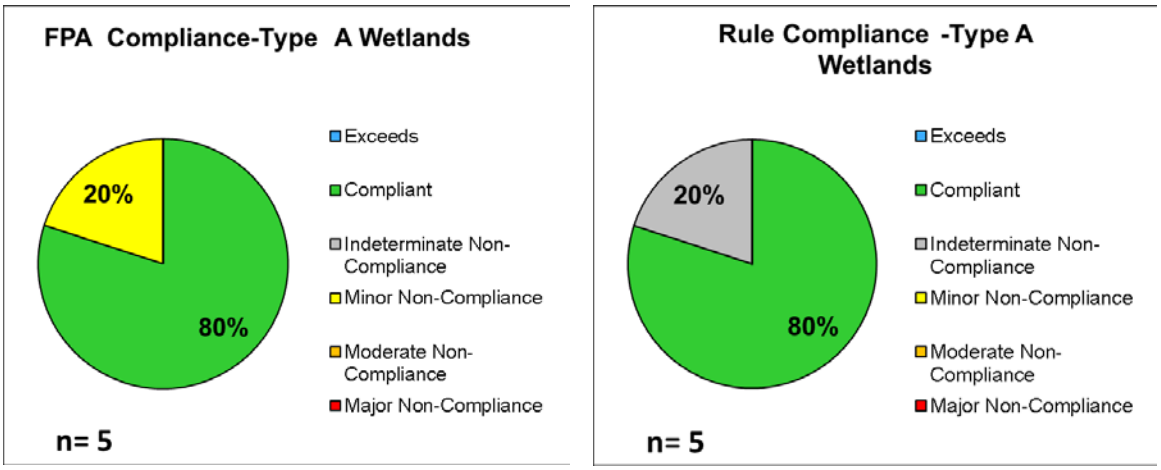
Statewide Wetland Management Zones

Forest practices wetland rules are the same for Western and Eastern Washington. When a wetland feature occurs in the compliance monitoring sample, it is assessed for compliance with its particular (Type A, Type B, or Forested) wetland prescription.

Statewide Type A Wetland Management Zones

Five Type A wetland management zone prescriptions occurred in the sample and are presented in Figure 12.

Figure 12. Statewide Type A Wetland Management Zone Prescription Outcomes

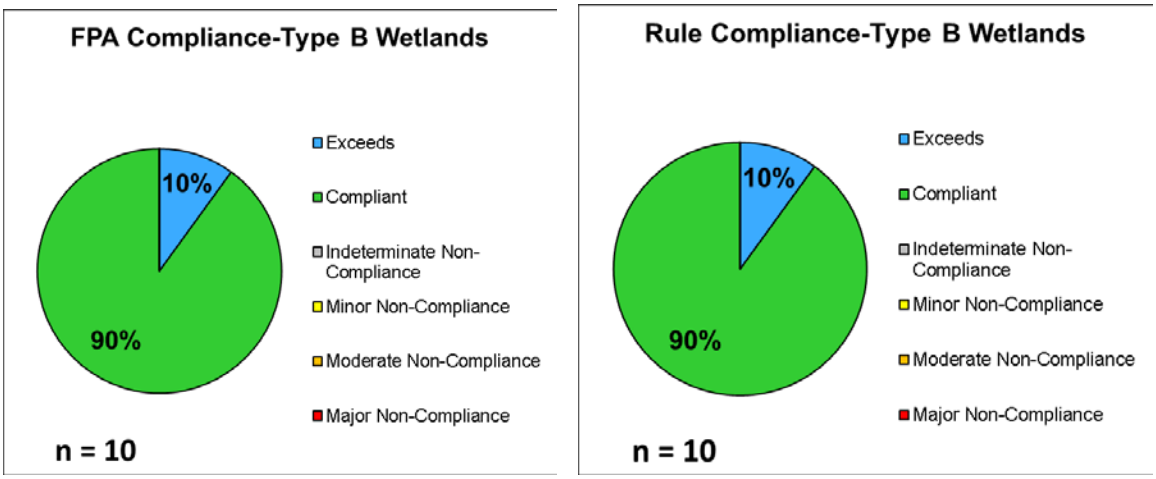


One Type A wetland management zone prescription was non-compliant with a 'Minor' rating for FPA because the Wetland Management Zone table had not been competed in the FPA . Another was non-compliant only with rule. It was rated 'Indeterminate' in severity because fish were present and the wetland should have had a Type F RMZ (WAC 222-30-020(7). The difference in buffer afforded by the Type A and that which would have been provided by the Type F resulted in the 'Indeterminate' non-compliance rating.

Statewide Type B Wetland Management Zones

Ten Type B wetland management zone prescriptions occurred in the sample and are presented in Figure 13.

Figure 13. Statewide Type B Wetland Management Zone Prescription Outcomes

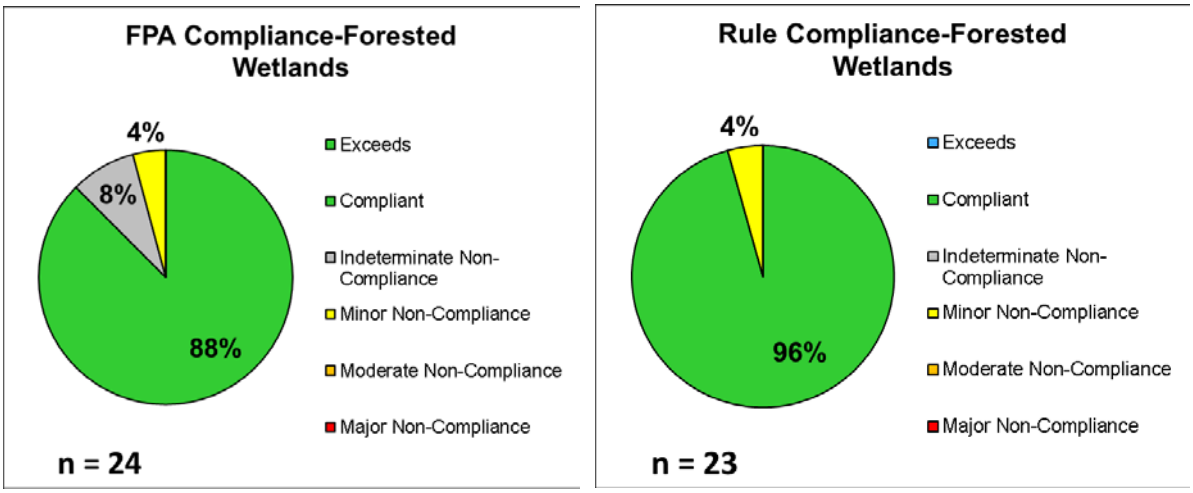


All ten Type B wetland management zone prescriptions were compliant. One received an 'Exceeds' rating for FPA and rule compliance.

Statewide Forested Wetland Management Zones

24 forested wetland management zone prescriptions occurred in the sample and are presented in Figure 14. On was rated "Indeterminate" for rule compliance due to a question about whether a wetland at the head of a type Np constitute an associated wetland.

Figure 14. Statewide Forested Wetland Management Zone Prescription Outcomes



Three instances of FPA of non-compliance were discovered for this prescription. One was rated minor without comment. Two were rated indeterminate. On one the applicant did not record the existence of a forested wetland on the FPA, and it was rated 'Indeterminate' for FPA non-compliance. The other had no comment. Of the 23 FPAs assessed for rule compliance one of non-compliant with a 'Minor' rating.

SUPPLEMENTAL WATER INFORMATION OBSERVATIONS

In response to concerns regarding consistency and accuracy of the water type information, beginning in the 2008-2009 biennium, the Compliance Monitoring Program recorded observations of the stream physical criteria to determine if there were differences between those recorded in the Forest Practices Applications (FPAs) and what was observed on-the-ground by the compliance monitoring team. These observations were taken on the selected streams and wetlands in the applications. If, in the compliance monitoring review of those FPAs, the team members identified physical criteria which appeared to be different than described in the FPA, a Supplemental Water Information Form (SWIF) was completed to capture the discrepancy. Not all SWIF records indicate a water type difference. In some cases the water type was not in question by the compliance monitoring reviewers, but the bankfull width measurements were different. In other cases the compliance monitoring observation indicated reclassification from stream to wetland or vice versa. Indicators of possible unreported Channel Migration Zones were also a trigger for filling out Supplemental Water Information Forms

Table 4, below, displays the outcomes of the 91 streams and wetlands reviewed using the SWIF.

The term under-classified refers to typed waters or wetlands on the FPA that were observed by the compliance monitoring team to have physical characteristics indicating a higher classification. Over-classified means typed water or wetlands on the FPA for which the compliance monitoring team assessed physical criteria as indicating a lower classification. 'Indeterminate' means those streams or wetlands for which the review team did not have sufficient information to decide what criteria it met. An example would be a small flowing non-fish stream observed during the fall wet period. The compliance monitoring team does not know whether the stream flows in late August so they cannot say with certainty whether the stream is Type Ns or Type Np.

Table 4. Supplemental Water Information Form Review Outcomes

Water Type Appearing on FPA	Number of Waters Appearing in the Standard Sample	Number of Waters recorded on Supplemental Water Information Form	Number of Waters on SWIF Correctly Classified	Number of Waters with No Consensus	Number of Waters Indeterminate	Number of Waters Under-classified	Number of Waters Over-classified
Ns	84	26	6	2	2	4	12
Np	89	30	5	1	1	21	2
F or S	121	23	18	0	0	0	5
Unmapped	0	12	0	0	0	12	0
Total	294	91	29	3	3	37	19

For 2010-2011 the Compliance Monitoring Program evaluated 294 riparian feature-related prescriptions involving typed water or wetlands. The number of typed water or wetlands reported using supplemental forms totaled 91, which indicated questions regarding water types occurred at a rate of 31 percent. The total number typed waters on the FPA were under-classified was 13 percent while the number of over-classified was 6 percent. Type Np streams were under-classified most often, approximately 24 percent of

the standard sample; Type Ns streams were over-classified most often, approximately 14 percent of the standard sample.

Water and Wetland Classification Emphasis Sample

Similar rates of water classification differences were reported for the 2008-2009 sample prompting clarifications to FPA processing in May 2011. The change addressed submission of a water type classification worksheet to document how water types were determined in the field. The Compliance Monitoring Program randomly sampled 37 FPAs approved from June 1 through September 30, 2011 to assess the outcome of FPA water classifications during that period. Compliance monitoring field reviews used the same questions as on the Supplemental Water Information Form except that Type F waters were not observed because of the low rate of differences shown during the 2008-2009 samples. The 37 FPAs contained 55 typed waters; Tables 5 and 6 display results of compliance monitoring observations.

Table 5. Water Classification Emphasis Sample Classification outcomes

FPA Water or Wetland Assessed	Number of Waters Identified in the Sample	Number of Waters Assessed as the type recorded on the FPA	Number of Waters Assessed as Indeterminate	Number of Waters Assessed as 'Not a Typed Water'
Ns	20	16	4	0
Np	18	14	4	0
Undifferentiated N (shows as "N" on hydro data)	2	1	0	1
Features the applicant assessed as not water	7	5	2	0
Type A Wetland	6	4	2	0
Type B Wetland	2	2	0	0
Total	55	42	12	1

[1] 50 FPAs were originally expected in the sample. Time constraints limited the sample to 37 FPAs which affected the proportionality among the six DNR Regions and resulted in some deviation in the order of the sample.

Table 6. Water Classification Emphasis Sample with Type F physicals

Water or Wetland as classified on the FPA	Number of Waters Sampled	Number of Waters that Met F physical criteria in a portion of the Stream Reach*	Number of Waters that met Type F physical criteria and had WTMF or ID Team documentation confirming FPA Typing	Number of Waters considered to be rule based Type F waters
Ns	20	4	0	4
Np	18	10	4	6
Undifferentiated N	2	0	0	0
Water deleted by applicant	7	1	0	1
A Wetland	3[1]	1	0	1
B Wetland	2	0	0	0
Total	55	16	4	12

*Features may meet Type F physicals within the reach observed but still meet "as on FPA" due to a previously approved water type modification form (WTMF) which included the feature

[1] Includes only Type A wetlands which were not listed as Type F associated on the FPA

Of the 55 typed waters and wetlands reviewed in Table 5, 76 percent met the Forest Practices Application classification and 22 percent were indeterminate. Table 6 shows Type F physical criteria were present on 29 percent of the reviewed waters. It should be noted, the fact that a stream meets Type F physical criteria does not necessarily mean it is Type F water. However, absent water type modification forms or interdisciplinary team documentation—either for the reach in question or downstream of it—a Type F buffer is required by the rules (WAC 222-16-031(3)(b)(i)). In this sample 22 percent of the assessed features had Type F physical criteria without documentation indicating otherwise.

Attempts to distinguish between Np and Ns streams were limited, both by the timing of most of the field reviews (rainy season) and lack of access on adjacent ownerships beyond the boundaries of the reviewed FPA.

Additional Type Np detail:

- Of 18 Type Np waters reviewed, 12 had the Water Type Classification Worksheet (WTCW) documentation as required.
- Of the 12 Type Np features with Water Type Classification Worksheet, four were observed to have physical characteristics inconsistent from those reported in the worksheet.

Additional Type Ns detail:

- Of 15 Type Ns features documented in the application using the Water Type Classification Worksheet, four were observed to have physical characteristics inconsistent with those reported in the worksheet.
- One Type Ns reviewed was a large secondary channel of a major river and clearly met Type F physical criteria.

Additional Type A Wetland detail:

- Four of the six Type A wetlands were found to meet Type F physical criteria, with three of those four were correctly identified as Type F water and given appropriate buffers. The fourth one was recognized as stream-associated wetland and buffered as such, but was labeled a Type Np on the Forest Practices Application despite meeting Type F physical criteria and not having approved WTMF documentation.

Details for features the applicant assessed as not a typed water:

- One of the seven met Type F physical criteria with no protocol survey or approved WTMF documentation.
- Another could not be assessed due to disturbance by activities associated with the harvest.

RESULTS FOR ROAD ACTIVITIES

The Compliance Monitoring Program reviews only crossings on Type N streams—only because Type F and S crossings are regulated under Washington State Fish and Wildlife (WDFW) hydraulics permits. The road-related activities that were assessed include:

- Road construction
- Landings
- Road abandonment
- Type N stream crossings including fords that are identified on the approved FPA

Since establishment of the Compliance Monitoring Program in 2006, road observations have been separated into two categories:

- Roads located in proximity to typed water where sediment delivery could feasibly occur
- Roads located away from typed water where sediment delivery is less likely to occur

The former category always has been fully reviewed with observations recorded. The latter receives a notation of “No Potential to Deliver”. Previous reports included the number of roads with No Potential to Deliver, but did not include them in the calculations for compliance or non-compliance. In this report, as in previous Compliance Monitoring Program reports, the compliance table includes only those roads located where sediment delivery could feasibly occur. The figures, however, show both types of roads in the sample

Table 7 displays the Forest Practices Application and rule compliance results for road-related activities statewide for the combined 2010 and 2011 field seasons. Confidence intervals are expressed as lower and upper limits (percentages) and displayed for each compliance estimate in the tables. Methods used to estimate confidence intervals are described in Appendix A.

Table 7. Compliance on Approved FPAs for 2010/ 2011 Road Activities with 95% Confidence Intervals

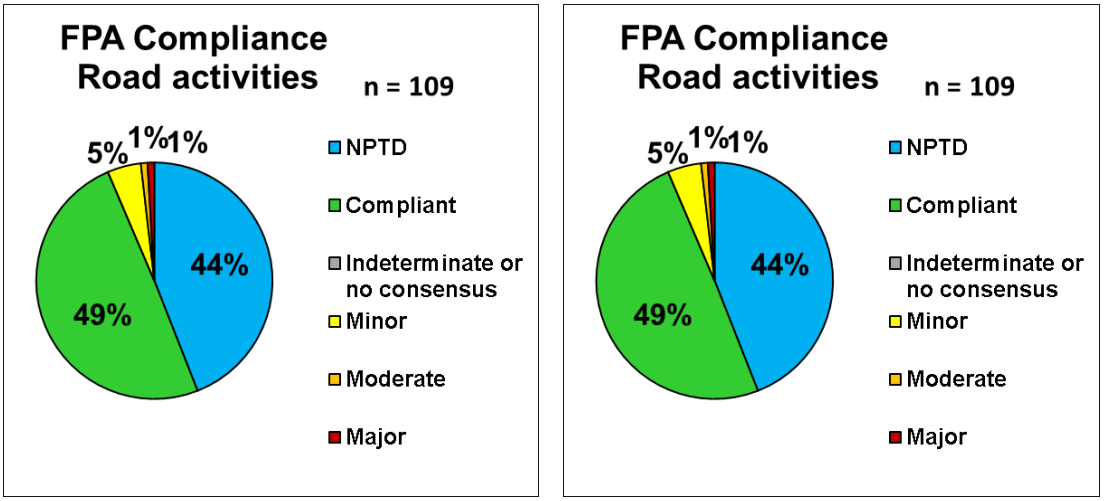
Statewide Road Activities 2010/2011 Biennium			
	Status of Compliance	Road activities FPA compliance	Road activities rule compliance
Small Forest Land-owners	Compliant	3	3
	Out of Compliance	2	2
	Percent Compliant	60%	60%
	95% Confidence Interval	(16, 94)	(16, 94)
	Activity Totals	5	5
Industrial Land-owners	Compliant	51	50
	Out of Compliance	5	7
	Percent Compliant	91%	88%
	95% Confidence Interval	(81, 97)	(77, 95)
	Activity Totals	56	57
All Land-owner Types	Compliant	54	53
	Out of Compliance	7	9
	Percent Compliant	89%	85%
	95% Confidence Interval	(78, 95)	(75, 93)
	Grand Totals	61	62

[a] These are combined ratio proportions (i.e., multiple activities possible on a single FPA)

Road Non-compliance Severity and Detail

Figure 15 displays the FPA and rule compliance outcomes for fully assessed roads. The roads with no potential to deliver sediments are included in the figure but not in Table 7 above.

Figure 15. Statewide Road Activity Outcomes



The ratings detail and causes for FPA non-compliance are:

- There was one instance rated 'Major' for the FPA because a 42-inch culvert was installed instead of the planned 48-in culvert.
- There was one instance rated 'Moderate' for FPA and rule non-compliance due to inadequate road fill at three water crossings.

Reasons for the six roads rated as 'Minor' ranged from a damaged cross drain end to abandoned crossings with over-steepened embankments and insufficient channel width.

Results for the Haul Route Sample

The 2011 sample year included a haul route sample observed on a subset of the standard sample FPAs. This sample required an inspection of haul routes along forest roads from the farthest points in the FPA to public access roads. In each sample, the entire road was observed if it was less than five miles long. If the entire road was over five miles, 5 one-half mile long road segments were observed. Within each half mile, every 0.1 mile segment was recorded as to its actual or potential delivery of sediment to typed water. The delivery assessment classifications are described in Table 8.

Table 8. Haul out Route Delivery Assessment Classifications

Delivery Assessment Classification	Delivery Assessment Classification Description
No Delivery	Complete disconnection of sediment delivery to typed water. Considered compliant.
De minimis	Overland flow from roads reaches typed waters, but sediment delivery is indeterminable from background levels of turbidity. Considered compliant.
Low	Low chronic or temporary delivery. Effects are observable at the site of entry (distance downstream less than one channel width) only, and not expected to magnify over time given the existing activity.
Medium	Measurable but non-critical levels of delivery. Visual plume at the reach scale.
High	Extensive or critical levels of delivery. Substantial violations of turbidity criteria or significant visual plumes that occupy the channel and goes beyond the reach scale (for example, around multiple bends in a stream).
No Consensus	The observers do not agree on the classification. Comments are essential to determine the scope of the difference, recording each observer's classification and the basis of disagreement.

The primary and secondary cause of the delivery also was observed. Delivery factors are described in Table 9.

Table 9. Factors Contributing to Sediment Delivery

Factor	Factor Description
Faulty cross drainage	Inadequate frequency of or non-functioning drainage structures that carry road prism runoff or seepage, allowing sediment delivery to typed water.
Inadequate water crossing structures	Absence of or non-functioning structures designed to pass typed water across a forest road resulting in sediment delivery.
Obstructed or bermed ditch line	Features of the road surface or ditch that divert water normally serviced by the ditch causing sedimentation of typed water.
Intercepted water	Water intercepted by road features and diverted to a channel other than its channel of origin prior to the road construction.
Contaminated ditchwater	Ditchwater containing suspended sediment that flows into typed water.
Ruts / inadequate crown	Perturbations of the road surface contributing sediments to runoff reaching typed water.
Driving in ditch line	Vehicular disturbance of stabilized ditches resulting in sediment reaching typed water.
Haul on native surface or inadequate rock	Road haul on a running surface containing fine particles that are captured by runoff and contributed as sediment to typed water.
Water channeled to eroding/failing slopes	Water flow or runoff across un-stabilized road features that contributes sediment to typed water.
Road fill failure	Sediment resulting from the effects of gravity on the fill (sumps, raveling, etc.) being deposited in or carried by runoff to typed water.
Cut slope failure	Sediment resulting from the effects of gravity on the cut slope (slumps, raveling, etc.) being carried by ditch flow to typed water.

Table 10 summarizes the delivery and compliance rates for sampled haul routes. No roads in the sample were classified as No Consensus.

Table 10. Haul Route Compliance Summary

No Delivery	De minimis	Low	Medium	High
89.8%	5.8%	3.7%	0.7%	0.00%
Compliant		**Non-Compliant**		
96%		4.4%		
Confidence interval				
(92%, 98%)				

Field personnel also observed where the side slope was either greater than or less than 60 percent. This is summarized in Table 11.

Table 11. Haul Route Compliance by Side Slope Categories

	No Delivery	De minimis	Compliant	Low	Medium	High	Non-compliant
slope>60%	84%	3%	87%	10%	3.5%	0.0%	13%
slope<60%	90%	7%	97%	3.0%	0.4%	0.0%	3%

Where actual or potential delivery of sediment occurred in the sample, field personnel observed the reason for the occurrence. This is shown in Table12.

Table 12. Percent of Non-Compliance by Cause

Primary Cause	Percent of non-compliance with this primary cause	Percent of this primary cause with secondary cause of obstructed or bermed ditch line	Percent of this primary cause with secondary cause of "Other"
Inadequate water crossing structures	55%	8%	8%
Contaminated ditchwater	18%	na	na
Other (describe in comments)	14%	na	na
Faulty cross drainage	4.5%	na	na
Ruts / inadequate crown	4.5%	na	na
Intercepted water	4.5%	na	na

na = not applicable

The predominate cause indicated for non-compliance was inadequate water crossing structures. Recorded comments most frequently indicated the cause as being the need for additional cross drains.

DISCUSSION

Fundamentally, there is no significant difference between this and the previous report. There is reduced occurrence of 'Major' and 'Moderate' ratings. Type Np prescription compliance rates were improved, but are tempered with the relatively high number of 'Indeterminate' decisions based on the presence of Type F physical criteria.

Sample sizes and field methods do not allow for a confident assessment of the patterns of non-compliance along Type S and Type F Riparian Management Zones. However, commonalities between the various prescriptions do appear to exist. The most consistent source of riparian noncompliance for these prescriptions is excess harvest in the outer zone. The specific cause for this is unknown, but the rule allowance to have the trees distributed through this zone may make tracking the number of trees that are being left during active harvesting difficult for some landowners and operators. Processes and procedures —such as clearly identifying and marking the trees that are to be left prior to initiating harvest—may reduce this source of noncompliance. Harvest within the inner zone also is relatively common as a source of non-compliance. It is not clear why. However, incorrectly measuring distances from the bankfull channel margin may lead to unintentional errors in leaving the required number of leave trees. Since identifying bankfull widths also seems to be a problem, the best opportunity to reduce this source of non-compliance may be to provide better assistance to landowners and operators in identifying where the edge of the bankfull channel exists. Tips on measuring and reminders on the how to measure horizontal distance also may be a good investment for reducing non-compliance. Similar to the issue of leaving outer zone trees, the non-compliance due to inadequate numbers of leave trees as part of conducting a Desired Future Condition Option 1 harvest may be best dealt with by encouraging processes for accounting and marking leave trees. Effort to ensure the DFC model is used appropriately also may be a worthwhile investment of time. Additionally, it is worth checking to ensure the model provides clear direction on the selection of species and the need to model each side of the stream and apply the output independently. All are also worth evaluating as steps for improving compliance.

Based on the information collected, a number of recommendations can be made for further improving riparian protection compliance. These include:

- Processes and procedures that result in clearly identifying and marking the trees to be left in the Outer Zone and in portions of the Inner Zone subject to timber removal prior to initiating harvest.
- Providing further assistance to landowners in identifying where the edge of the bankfull channel exists, as well as providing tips on measuring horizontal distance perpendicular from the stream.
- Much of the non-compliance associated with both the Type Np and Ns prescriptions appear related to potential misclassification of Type F waters. Programmatic changes that improve water typing decisions may help reduce much of this noncompliance.
- There is a need to evaluate how clear it is to landowners that they must retain documentation of compliance with the shade requirements when harvesting within 75 feet of a stream so that a lack of record keeping does not continue to be a source of non-compliance.

- Problems in stream typing may also have led one landowner/operator to buffer less of an Np stream than required. Unique to the Ns prescription is non-compliance associated with ground disturbance within 30 feet of the stream. No information was recorded to help determine why some sites had more ground disturbance than allowed. Although sites with excess ground disturbance account for only 3 percent of the samples, sampling in future years should intentionally describe the topographic and operational conditions associated with any harvests that have excess ground disturbance.

Road activity compliance improved, nearing 90 percent and the new haul route survey reported that haul routes reached 96 percent compliance.

APPENDIX A

Statistical Methods

Methods for Confidence Intervals

There are two types of compliance proportions estimated in this report, simple proportions and ratio proportions. Estimation for both types is described below with examples.

Simple Proportions

The first type of compliance proportion is a simple proportion. For example, consider the proportion of FPAs with road construction prescriptions that were compliant for these prescriptions. One and only one road construction prescription is measured on each FPA that has a road construction prescription. This is a binomial proportion, and 95 percent confidence intervals were estimated using the F-distribution as described in Zar (1996; p524):

$$LCL = \frac{X}{X + (n - X + 1) * F_{\alpha(2),\nu 1,\nu 2}},$$

$$UCL = \frac{(X + 1) * F_{\alpha(2),\varpi 1,\varpi 2}}{n - X + (X + 1) * F_{\alpha(2),\varpi 1,\varpi 2}},$$

where

LCL = Lower Confidence Limit

UCL = Upper Confidence Limit

X = The number of compliant activities

n = the total number of activities,

F = the F-distribution critical value for the given alpha and degrees of freedom,

$$\nu 1 = 2(n - X + 1)$$

$$\nu 2 = 2X$$

$$\varpi 1 = 2(X + 1)$$

$$\varpi 2 = 2(n - X).$$

These binomial confidence intervals are not symmetric.

Because there is a finite population of FPAs, we correct the confidence intervals by the finite population correction factor. The overall population size is not known, but can be estimated based on the number of FPAs that were opened and were found to be part of the population containing road or riparian prescriptions. We estimate N as follows:

$$\hat{N} = \frac{n_1 \times F_1}{f_1} + \frac{n_2 \times F_2}{f_2},$$

where
F_1 = the total number of FPAs approved in Year 1,
f_1 = the number of FPAs evaluated for membership in the population ("opened") in Year 1,
n_1 = the number of FPAs opened that contained road/riparian prescriptions in Year 1,
F_2 = the total number of FPAs approved in Year 2,
f_2 = the number of FPAs evaluated for membership in the population ("opened") in Year 2, and
n_2 = the number of FPAs opened that contained road/riparian prescriptions in Year 2.

The finite population correction factor (FPCF) is $1 - \frac{n}{\widehat{N}}$.

For the 2010-2011 biennium, the estimated population size is 2059, and the FPCF is 0.904.

To correct the confidence intervals for the finite population, we follow the equation in Zar (1996, p 527) as follows:

$$LCL_c = \frac{X - 0.5}{n} - \left(\frac{X - 0.5}{n} - LCL\right) \times \sqrt{1 - \frac{n}{\widehat{N}}}$$

$$UCL_c = \frac{X + \frac{X}{n}}{n} + \left(UCL - \frac{X + \frac{X}{n}}{n}\right) \times \sqrt{1 - \frac{n}{\widehat{N}}}$$

Example

The proportion of road construction prescriptions that are compliant is an example of a simple proportion. For this biennium, there were 61 FPAs containing road construction prescriptions that were evaluated for application compliance. Of these, 54 were compliant.

n = 61
X = 54

54/61 = 0.885 (89% compliant)

$\nu 1 = 16$
$\nu 2 = 108$
$\varpi 1 = 110$
$\varpi 2 = 14$

$$LCL = \frac{54}{54 + (61 - 54 + 1) * 1.929} = 0.778(78\%)$$

$$UCL = \frac{55 * 2.558}{61 - 54 + (55) * 2.558} = 0.953(95\%)$$

Correcting for finite populations:

$$LCL_c = \frac{54 - 0.5}{61} - \left(\frac{54 - 0.5}{61} - 0.778\right) \times \sqrt{0.904} = 0.783\ (78\%)$$

$$UCL_c = \frac{54 + 0.885}{61} + \left(0.953 - \frac{54 + 0.885}{61}\right) \times \sqrt{0.904} = 0.950\ (95\%)$$

In this case, the FPCF did not make a big difference to the confidence bounds.

Ratio Proportions

The second type of proportion is actually a ratio of two random variables, with the denominator being the total number of prescriptions (within a subcategory) sampled. The only prescription type that falls into this category for this biennium is wetlands, because there can be multiple types of wetland prescriptions on a single FPA. Because this number varies across FPAs (i.e., some FPAs have 1, some have 2 or more prescriptions in the subcategory), it is a random variable. In this case, the estimated proportion of activities that are compliant is:

$$\hat{p} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i},$$

which is the total number of compliant prescriptions divided by the total number of prescriptions that were sampled across all FPAs (*n* is the number of FPAs sampled).

A 95 percent confidence interval for the proportion compliant is formed as follows:

$$\hat{p} \pm t_{.025,(n-1)} \cdot SE(\hat{p})),$$

where $t_{.025,(n-1)}$ is the 97.5th percentile of the student-*t* distribution with (*n*-1) degrees of freedom, *n* is the number of sampled FPAs, and

$$SE(\hat{p}) = \frac{\sqrt{n \cdot (1 - \frac{n}{N}) \cdot \sum_{i=1}^{n} (y_i - \hat{p} x_i)^2}}{\sqrt{(n-1)} \cdot \sum_{i=1}^{n} x_i}$$ (Cochran, 1977, p32).

These confidence intervals are symmetric. Note that the FPCF is already built in to this equation. Also, *n* in the above equations is the total number of FPAs sampled, not just those with wetland prescriptions. It is possible for the upper confidence bound to exceed 100% - in these cases the confidence bound is set to100%.

Example

Out of 861 FPAs reviewed, there were 39 wetland prescriptions tested for application compliance. Of these, 35 prescriptions were in compliance with the application.

$$\hat{p} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i} = \frac{35}{39} = 0.897(90\%)$$

The quantity $\sum_{i=1}^{n} (y_i - \hat{p}x_i)^2$ is calculated for each FPA, so cannot be easily displayed. However, note that for each FPA, it is simply the number of compliant wetland prescriptions minus 0.897 times the total number of wetland prescriptions.

$$SE(\hat{p}) = \frac{\sqrt{197 \cdot (0.904) \cdot 3.737}}{\sqrt{(197-1)} \cdot 39} = 0.0472$$

$$t_{.025,196} = 1.972$$

The CI is:
$0.897 \pm 1.972 \cdot 0.0472$
$= 0.897 \pm 0.0932$

Thus, the 95% confidence interval is (80%, 99%).

Haul Route Compliance

On each sampled Forest Practices Applications (subset of standard sample), a single haul route is selected for sampling. The length of the haul route will differ among FPAs. If there are multiple haul routes, the route most likely to have carried the heaviest loads is selected – this is a biased selection. The route is divided into equal length sections, and each section is evaluated for compliance. The percentage of sections that are compliant is the statistic attributed to each FPA.

The summary statistic is the average compliance across FPAs. The average will not be weighted by the length of available haul routes, because the statistic of interest is compliance of FPAs, rather than compliance of haul routes.

The distribution of this statistic is not known. The proportion of segments compliant on a single FPA could be assumed binomial, except that the segments are not independent. The distribution of proportions across FPAs could be assumed normal as a distribution of averages, but because the proportions are near 1, they do not have a normal shape. Therefore, we form 95% bootstrap confidence intervals for the average FPA haul route compliance.

Bootstrap confidence intervals are based on assuming that the best estimate of the distribution of the statistic comes from the empirical (observed) dataset. A large number of samples with replacement are taken from the existing data set, and the resulting distribution of the summary statistic is evaluated. A 95% confidence interval can then be formed by the 2.5^{th} and the 97.5^{th} percentiles of the summary statistic distribution. We further adjust the confidence intervals for bias and skewness, using the bias-corrected accelerated estimates suggested by Efron (1987). Estimates were made in R (version 2.13.0) using package “boot”.

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