January 21, 2010

MEMORANDUM

TO: Forest Practices Board

FROM: Walt Obermeyer, Compliance Monitoring Program Administrator

SUBJECT: 2008-2009 Biennial Compliance Monitoring Report

Attached is a copy of the 2008-2009 Biennial Compliance Monitoring Report. The report covers FPAs approved August 2006 through July 2008 and field reviewed by the compliance monitoring team in calendar years 2008 and 2009. A summary presentation is scheduled for the February 8th board meeting to provide an overview of the results and answer questions.

WO/

NATURAL RESOURCES

Forest Practices Compliance Monitoring Report 2008/2009

January 2011

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

Forest Practices Compliance Monitoring Report 2008/2009

January 2011

Forest Practices Division
2008 / 2009 Biennium
Compliance Monitoring Report

Walt Obermeyer
Forest Practices Compliance Monitoring Program

Alice Shelly
Terra Stat Consulting Group

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

Contents

Summary	2
Introduction	4
Context	4
Program Design Elements	5
Results	9
Appendices	27

All photos by DNR Forest Practices staff.

Forest Practices Compliance Monitoring Biennial Report 2008-2009

SUMMARY

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 program performed four samplings during the 2008-2009 Biennium, focusing on riparian and road-related activities. In order to provide better estimates of compliance for these activity types, the samples consisted of one large standard sampling, and three emphasis samples—each targeting a different area: 20-Acre Exempt Forest Practices Applications (FPAs), Alternate Plans, and Riparian/Wetlands activities. There also was an additional monitoring category for this 2-year sample period. The standard sampling included two separate compliance evaluations of observations at the activity site—checking for consistency with the conditions of the approved Forest Practices Application; and also checking for consistency with the Forest Practices Rule requirements. Previously, the assessment was performed only for the conditions of the approved application.

Forest Practices Compliance Monitroing team measuring leave tree diameter.

Washington State Department of Natural Resources (DNR) Forest Practices Program is charged with protecting public resources such as water, fish and wildlife, slopes and more on 12.7 million acres of private and state-owned forests.

The Compliance Monitoring Team is lead by DNR's Forest Practices staff and has additional representatives of the state Departments of Ecology and Fish and Wildlife. The disciplines included on the team are fish and wildlife biologists, geologists, hydrologists and forest practices foresters.

During the standard sampling for 2008-2009, there were 427 activities associated with 187 Forest Practices Applications for which the field team was able to make a determination on compliance—the teams were not able to make a determination for five activities associated with the applications. Results showed that road-related compliance was 79 percent and riparian/wetland activities were 78 percent compliant. This is not significantly different from the 2006-2007 results. Forest Practices Applications for the 2008-2009 Biennium were approved in 2008, before the results of the last report were published. Therefore, there was no opportunity to work on compliance issues using knowledge gained from the earlier sample.

Comparison of 'non-compliance severity ratings' (a classification based on compliance team consensus) for the 2008-2009 biennium was performed largely in the same manner as in the

previous biennium, using as the basis compliance with the conditions in the approved applications. Of the 72 non-compliant riparian/wetland activities, seven were major, 14 medium, and 43 low (This is quite similar to the 2006-2007 results). For the 18 non-compliant ratings for road-related activities, 3 were major, 4 medium and 11 low. This is somewhat different from the 2006-2007 results, which showed that of the 31 non-compliant road activities, none were major, 13 were apparent, 11 were minor and 7 had no consensus.

Under Forest Practices, water is assigned a specific category or 'Type' based on the presence of fish, perennial flows, and whether they are streams or wetlands. For 2008-2009, the Compliance Monitoring Program developed a 'Supplemental Water Information Form' to record observed differences between how a 'typed' water feature appeared during compliance monitoring, compared to what was recorded on the approved application. Each water type has specific riparian forest protections that the team was looking for. The team reviews only the stream or wetland reach (length) within the proposed boundary in the Forest Practices Application, whereas, a water type classification survey evaluates the entire reach to points at which the water type changes. The water body previously may have had a protocol survey establishing the water type. Although the compliance monitoring 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 that they are observing, and there may be a prior accepted protocol survey of which the team is not apprised.

Results of Compliance Monitoring

The results of the forest practices monitoring for 2008-2009 indicated the following regarding streams and riparian protections:

- 31 percent of observed reaches had features that suggested disagreement with the water type stated in the application.

Forest Practices Compliance Monitoring Team member measuring the 'bank full width' of the stream

- Of the 98 Type F (fish-bearing) or Type S (shorelines of the state) streams, 10 had greater measurable widths then reported on the Forest Practices Application, 8 of which would require larger riparian management zone (RMZ) buffer widths.
- Of the 89 Type Np streams (perennially flowing non-fish-bearing) observed, 21 had Type F stream physical characteristics required under WAC 22216-031 for at least a portion of the reach which would require larger RMZ buffer widths.
- Of the 84 Type Ns streams (seasonally flowing non-fish-bearing) observed, 12 did not exhibit the channel characteristics (generated by fluvial processes—e.g. scour and deposition of sediment) essential to be classified as a 'typed' water, and two had the features of a different stream classification which would require greater protection (i.e., they appeared to be perennially flowing or qualifying as fish-bearing).

These results indicate the need for more field verification of small Type F and Np streams during the Forest Practices Application approval process to improve riparian management zone compliance rates. In general, the water type maps are useful for screening, but should not be relied upon by landowners/ operators or regulatory staff as per WAC 222-16-031.

In the standard sampling documentation, the Program requires that the team note both whether activities were in compliance with the provisions in the approved Forest Practices Application, and also in compliance with the underlying forest practice rules. This 2008-2009 compliance monitoring report examines these two categories separately. Differences between application and rule compliance status were present in 19 instances or 4.4 percent of all activities. Of the 19 instances, 11 were FPA compliant but not rule compliant, and 8 were rule compliant but not FPA compliant.

Emphasis focus: 20-Acre Exempt Parcel Applications

The emphasis samples focused on three areas. The 20-Acre Exempt Parcel Applications and Alternate Plans were sampled in 2008. Wetland activities were sampled in 2009.

The 20-Acre Exempt Forest Practices Applications comprise less than 3 percent of total applications; they allow harvesting and road activities closer to the streams than are allowed under the standard rules. Compliance monitoring during the 2008-2009 period found a compliance rate of 62 percent regarding harvesting activities close to streams and wetlands. Review of observer comments on non-compliant forest practices activities indicates that what was proposed on the FPA was often not well implemented.

Emphasis focus: Alternate Plans

Alternate Plans fared better with a Forest Practices Applications compliance rate of 84 percent. Again, the frequency of this activity is small, less than 2 percent of all applications and the Compliance Monitoring Program only evaluated whether the applicant complied with the provisions written into their approved application since, in the case of Alternate Plans, the application conditions constitute the rules.

Riparian Management Zone stream-associated wetland.

Emphasis focus: Wetlands

Of the emphasis and standard samples, the Wetland activities emphasis showed the highest rate with Forest Practice Rule compliance at 93 percent for the combined types. The wetland Types showed the following compliance rates: Type A (non-forested with more than 1/2 acre with ponded water), 75 percent; Type B (non-forested of more than 1/4 acre), 95 percent; Forested Wetlands (more than 30 percent crown closure) 91 percent.

What we learned through 2008-2009 compliance monitoring

The compliance monitoring team measured the stream lengths within the boundary of the Forest Practices Application. For Type F or Type S streams, harvest activities in streamside forests that left too few trees per acre frequently had stream lengths which were longer than reported on the application. Under forest practices, a longer stream length increases the required riparian management zone acreage and subsequently the number of required leave trees. Similarly the no-compliant Type Np reaches also frequently were longer than reported on the application. This increases the required riparian management zone buffers, more than the amount that was actually retained.

Considerations to improve riparian compliance could be actions to assure that an accurate stream length is reported before the application conditions are established and approved. More field verification of small Type F and Np streams during the Forest Practices Application approval process likely would improve riparian management zone compliance rates. In general, the water type maps are useful for screening, but should not be relied upon by landowners/ operators or regulatory staff as per WAC 222-16-031.

One potential strategy to improve compliance for 20-Acre Exempt Parcel Activities may focus on performing inspections early in the operation to assure that the operator understands the commitments in the Forest Practices Application, and rule requirements. Because of the low frequency of these activities, the investment in inspections is small with a considerable opportunity for improvements in compliance.

Some possible actions to reduce the differences between water type characteristic in the Forest Practices Applications and those observed on the ground by the compliance monitoring team include the following: Assure that procedures are followed by requiring that Forest Practices Applications be submitted with a Water Classification Worksheet or description of how the water type was determined.

Another possible action would be to increase the rate of field reviews by the various agencies for proposed water type modifications, in order to increase their reliability.

INTRODUCTION

This report provides a measurement of how well timber harvest and other management activities in the private and state-own forests of Washington State complied with Forest Practices rules—regarding Forest Practices Applications that were approved between August 1, 2006 through July 31, 2008.

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

The report for 2006-2007 was published in early 2009 and can be found online at http://www.dnr.wa.gov/Publications/fp_cm_biennial_report_06-07.pdf. The areas covered in the 2008-2009 report are similar to the 2006-2007 report, providing a common basis for comparison of monitoring results between the biennia. Some restructuring of the document has been done to provide clearer explanation of concepts and processes. Additionally, the current report includes the results from three 'emphasis samplings,' which examined specific activities not included in the primary riparian and road activity sampling.

A context section is added to provide a more detailed understanding of the nature of Washington State's Forest Practices Rules and their relationship to the development and implementation of the Compliance Monitoring Program. Also explained is the role of stakeholders and their interaction with the program.

Context

Washington's Forest Practices Rules are complex and comprehensive in scope, containing detailed guidance and many prescriptions for how timber harvest or other forest management activities are to be carried out in ways that protect public resources such as water, fish and wildlife, slope stability, and more. The development of such scrupulous rules was necessary for several reasons. The citizens of Washington have long valued the protection of water and air for both the quality of life and their relationship to economic resources such as the commercial fishery. Tribes have an added interest in these resources to protection their treaty rights. Washington landscapes hold some of the highest producing coniferous forest types in the world, and these forests have a long history of providing high quality forest products. Protecting both the public natural resources, and economic viability of the timber industry continue to be the goals of the forest practices laws and rules since 1974.

The Compliance Monitoring Program's specific purpose is to assess, across the state, the level of compliance in all types of forest activities in riparian /wetland areas and those related to road

building and maintenance. Although the sample size is sufficient for that purpose, it is not large enough to be useful to assess the compliance of individual landowners or compliance differences in forest practices programs between DNR regions. DNR maintains a separate database to track violations and enforcement actions, but this is not a part of the compliance monitoring program. When the Compliance Monitoring Team encounters violations, the participating regional DNR Forest Practices staff initiate enforcement consistent with department policy.

The Forest Practices Rules prescribe a set of discrete conditions or limits that need to be met in the course of timber harvest or other forest practices activities. Either the Forest Practice activity as performed is in compliance or it is not. However, applying discrete rules to a site that is influenced by continuous and dynamic natural processes can result in some situations where the difference between compliant and non-compliant is extremely difficult to determine with confidence.

As the rules developed, particularly in the last decade, protection issues often were addressed using highly detailed prescriptions. With this detail rides an expectation of precision, based on the measurement of natural features.

> **For example,** this is particularly true in the treatment (protection) regarding timber harvest along the fish-bearing Type F streams. In Western Washington, the forested Riparian Management Zones widths depend on whether the 'bank full 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 bank full width recommend a number of transects (across the stream) taken at specified minimum 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 impossible to determine whether the stream is within or over the threshold. Therefore, in such cases, the review team cannot assess whether the operation is in compliance with the rules. Bank full 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 results. Because of the nature of rules and the design of the Compliance Monitoring Program, an activity is either in compliance or not; 99 percent compliant is still non-compliant.

The program initially used the conditions of the approved Forest Practices Application as the standard against which to measure compliance. During the first biennium observers found that there could be differences between what was approved and what was observed on site one- to-two years later. Site conditions may have changed, or the application may have been in error and the error was not caught prior to the activity. To provide a basis to analyze the conditions the Compliance Monitoring Program instituted a determination of compliance both with the rules and with the application.

Compliance Monitoring Program Design Elements

The population definition and sample period

The basic component for forest practices is the Forest Practices Application submitted by the landowner or operator. This document describes the various proposed activities and is used to track approval and enforcement. Within each application are listed all of the activities subject to the Forest Practices Rules. In the approval process these applications are reviewed by DNR and assigned a Forest Practice Class 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 activities. Based on that review, the application is either conditioned, approved, or disapproved and returned to the applicant to correct the information and/or prescriptions.

It is essential that the all activities be completed by the time of the Compliance Monitoring review, and since each application has a term of two years, a time frame is picked to allow for the completion of operations. For the sample period in this report, the population of applications is all those approved from August 1, 2006 to July 31 2008.

For this two-year period there were more than 8,300 Forest Practice Applications submitted from across the state. The desired margin of error (+/- 5 percent at the 95 percent confidence level) requires 200 FPAs in the sample. All applications for the sample period were assigned random numbers and ranked. The ranked list provided the order for selection of applications. Every application had an opportunity to be selected, proportional to the representation of that DNR region's FPAs in the statewide total.

Forest Practice Activities

Forest practices activities are operations subject to state Forest Practice Rules. Individual Forest Practices Applications generally contain multiple activities to which the Forest Practice Rules apply. The compliance review process evaluates one of each type of activity listed on the approved application. If more than one of the same activity types exists within the unit, only one activity of that type is selected randomly. The compliance monitoring program for 2008-2009 limited its review to harvest activities along riparian forests and those involved with road construction or maintenance. Riparian harvest options were selected for Type F and S (fish bearing streams), Type Np (non-fish bearing perennial streams), Type Ns (non-fish bearing seasonal streams) streams, and wetlands. Road work needed for harvesting such as construction, abandonment, landings and Type N stream crossings also were evaluated.

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 www.dnr.wa.gov/ under Forest Practices Program links.

These protocols are used in the field to determine whether or not the activity is compliant. If not compliant, a rating of one of three levels is applied— Minor, Moderate, or Major. In the case of compliant riparian activities where the operation maintained extra significant protection an "Exceeds" rating is given. Data describing on-site conditions and consistency of the application information with observed features also is recorded to provide context for analysis.

Activities not included in compliance monitoring summary report

The entire set of forest practices activities that were encountered in the field were not evaluated for compliance. Rather, the focus for this monitoring effort is on those that were deemed most important and measurable at the outset of the program. Other activities—those with insurmountable sampling and measurement challenges—were not evaluated or reported here. They include areas such as Forest Conversions to other uses (WAC 222-16-060), Aerial Sprays (WAC 222-38), and Cultural Resources definitions (WAC 222-16). Other activities that may be evaluated in subsequent years include Class II Applications (WAC 222-16-050 (3)) and Unstable Slopes (WAC 222-16-050 (d) (i)).

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 as individual categories have lower confidence, given the limited sample size. When Forest Practices Applications are selected for Compliance Monitoring, they are landowner blind.

Stream typing for riparian activities

Stream type is a fundamental aspect of determining which rules apply to any activity in a given Forest Practices Application. Determining which riparian forest protection strategies are required often cannot be completed without a protocol [fish] survey or the measurement of a stream's physical characteristics as defined in WAC 222-16-031. Applicants are required to either complete water type worksheets or complete protocol surveys. If the applicant wished to change the recorded stream type they are required to submit a water type change form.

While water type change forms and the water type on each application are open to all stakeholders for review, DNR Forest Practices Program staffing levels and other issues affect the frequency of these reviews. While stream typing is assumed to have been reviewed by multiple agencies and other interested parties before the application is approved, it is not necessarily the case, unless confirmed by some documentation on file with DNR. Nonetheless, stream typing on Forest Practices Applications is a point of high interest and ongoing concern for many stakeholders participating in the Compliance Monitoring Program.

The Compliance Monitoring Program does not change water types because that action has a defined process. The stream types as recorded in the Forest Practices Application documentation provide the basis for the compliances determination. Where the compliance monitoring review observes differences between information in the application and the on-the-ground features, a

Supplemental Water Information Form is completed. This form records features found only in the geographic limits of the review and as such is not sufficiently comprehensive to unequivocally determine stream type. The Supplemental Water Information Forms provide a basis to report the frequency of differences to suggest the magnitude of the issue to be addressed by the Forest Practices Program. Once the size and scope of problems are known, such information may be used to help frame solutions.

Well protected type Np stream crossing in new road construction.

COMPLIANCE MONITORING RESULTS

Results provided in this section address compliance rates from observations at the activity site, checking for consistency with the conditions of the approved Forest Practices Application, and also with the Forest Practices Rule requirements for those activities. This approach can inform DNR as to whether notable differences exist between the conditions required on approved applications and those required by the rules. To examine this, we evaluated the approved forest practices applications for which proposed activities had been completed. The outcome of field reviews estimate 78 percent of harvest or other activities along stream-side or riparian areas, and 79 percent of road-related activities for the 2008-2009 sampling period are in compliance with the information provided on the approved Forest Practices Application (FPA). Based on compliance monitoring team observations, a slightly lower percentage of riparian-related activities (77 percent) and road-related activities (79 percent) are compliant with the rules.

Table 1 displays the application compliance results for riparian and road-related activities statewide for the combined 2008 and 2009 field seasons. Table 2 shows Forest Practices Rules compliance for the same set of applications. Confidence intervals (CI), expressed as lower and upper limits (percentages), are displayed for each compliance estimate in Tables 2 and 3. Methods used to estimate CI are described in Appendix A.

Table 1. Compliance with Approved FP Application for All Activities Statewide 2008/2009 Sampling Period

All Activities Statewide 2008 / 2009 Biennium				
	Status of Compliance	*Riparian*	*Road*	*Totals*
Small Forest Land-owners	Compliant	51	15	66
	Out of Compliance	16	4	20
	Percent Compliant	76%	79%	77%
	95% CI	(66, 86)	(53, 100)	(67, 86)
	Activity Totals	67	19	86
Industrial Land-owners	Compliant	211	59	270
	Out of Compliance	56	16	72
	Percent Compliant	79%	79%	79%
	95% CI	(74, 84)	(68, 89)	(74, 84)
	Activity Totals	267	75	342
All Land-owner Types	Compliant	262	74	336
	Out of Compliance	72	20	92
	Percent Compliant	78%	79%	79%
	95% CI	(74, 83)	(69, 89)	(74, 83)
	Grand Totals	334	94	428

Table 2. Compliance with FP Rules for All Activities Statewide 2008/2009 Sampling Period

All Activities Statewide 2008 / 2009 Reporting Period				
	Status of Compliance	*Riparian*	*Road*	*Totals*
Small Forest Land-owners	Compliant	49	16	65
	Out of Compliance	17	3	20
	Percent Compliant	74%	84%	76%
	95% CI	(64, 84)	(67, 100)	(68, 85)
	Activity Totals	66	19	85
Industrial Land-owners	Compliant	209	58	267
	Out of Compliance	58	17	75
	Percent Compliant	78%	77%	78%
	95% CI	(73, 83)	(66, 88)	(73, 83)
	Activity Totals	267	75	342
All Land-owner Types	Compliant	258	74	332
	Out of Compliance	75	20	95
	Percent Compliant	77%	79%	78%
	95% CI	(73, 82)	(69, 88)	(73, 82)
	Grand Totals	333	94	427

Results for Riparian Forest-related Activities

Table 3. Types of Riparian Activities reviewed during 2008/2009 compliance monitoring

Western Washington	Eastern Washington	Statewide
No RMZ or no Inner Zone Harvest Option 1-Thinning from Below Option 2- Leaving Trees closest to water	No RMZ or no Inner Zone Harvest Ponderosa Pine Habitat Type RMZ[1] Mixed Conifer Habitat Type RMZ[1] High Elevation Habitat Type RMZ[1]	Wetlands Type N RMZ Riparian Salvage Harvest

[1] These activities were observed for, but did not occur in the sample.

Table 4 shows the status of application compliance on riparian management zone-related activities for Type F (fish-bearing streams) and Type N (non fish bearing streams, both perennial and seasonal) streams, and wetlands. Each activity option has a unique set of timber harvest requirements, and includes the use of a corresponding set of protocols and questions to determine compliance status. Requirements for Type N streams can be different for Eastern and Western Washington, but we do not separate these results in this report. Wetland rules are consistent

across the state. Small Forest Landowners and Industrial Landowners requested that DNR show results for their respective landowner status. Note that the sample size for a number of Small Forest Landowner activities is small and inferences regarding those are subject to the wide confidence interval. Table 5 shows the corresponding rule compliance.

Compliance Monitoring team reviewing harvest/riparian management zone interface.

Table 4. Compliance with Approved FP Applications for 2008/2009 Riparian Harvest Activities with 95% confidence intervals

Eastern and Western Washington Riparian Activities 2008/2009 biennium														
		Western Washington				Eastern Washington				Statewide				
	tus of Compliance	No Inner Zone	Entry RMZ	FC Option 1	FC Option 2	Inner Zone	o Entry RMZ	nderosa Pine	Mixed Conifer	Type Ns	Type Np	Wetland[a]	Salvage	Totals[a]
Small Forest Landowners	Compliant	5	5	0	1	1	1	0	0	15	10	12	1	51
	Out of Compliance	5	3	2	0	0	3	0	0	0	2	0	1	16
	Percent Compliant	50%	63%	0%	100%	100%	25%	na	na	100%	83%	100%	50%	76%
	Confidence Interval	(19, 81)	(25, 91)	na	na	na	(1, 79)	na	na	(79, 100)	(52, 98)	(98, 100)	na	*(66, 86)*
	Total	10	8	2	1	1	4	0	0	15	12	12	2	67
Industrial Landowners	Compliant	25	2	5	19	8	7	0	0	67	54	19	5	211
	Out of Compliance	13	4	3	5	3	1	0	0	2	23	1	1	56
	Percent Compliant	66%	33%	63%	79%	73%	88%	na	na	97%	70%	95%	83%	79%
	Confidence Interval	(49, 80)	(5, 77)	(25, 91)	(58, 93)	(40, 94)	(48, 100)	na	na	(90, 100)	(59, 80)	(86, 100)	(37, 100)	*(74, 84)*
	Total	38	6	8	24	11	8	0	0	69	77	20	6	267
All Landowners	Compliant	30	7	5	20	9	8	0	0	82	64	31	6	262
	Out of Compliance	18	7	5	5	3	4	0	0	2	25	1	2	72
	Percent Compliant	63%	50%	50%	80%	75%	67%	na	na	98%	72%	97%	75%	78%
	Confidence Interval	(48, 76)	(24, 76)	(19, 81)	(60, 93)	(43, 94)	(36, 90)	na	na	(92, 100)	(62, 81)	(91, 100)	(36, 97)	*(74, 83)*
	Total	**48**	**14**	**10**	**25**	**12**	**12**	**0**	**0**	**84**	**89**	**32**	**8**	**334**
	Indeterminate	0	0	0	0	0	1	0	0	0	2	0	0	3

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

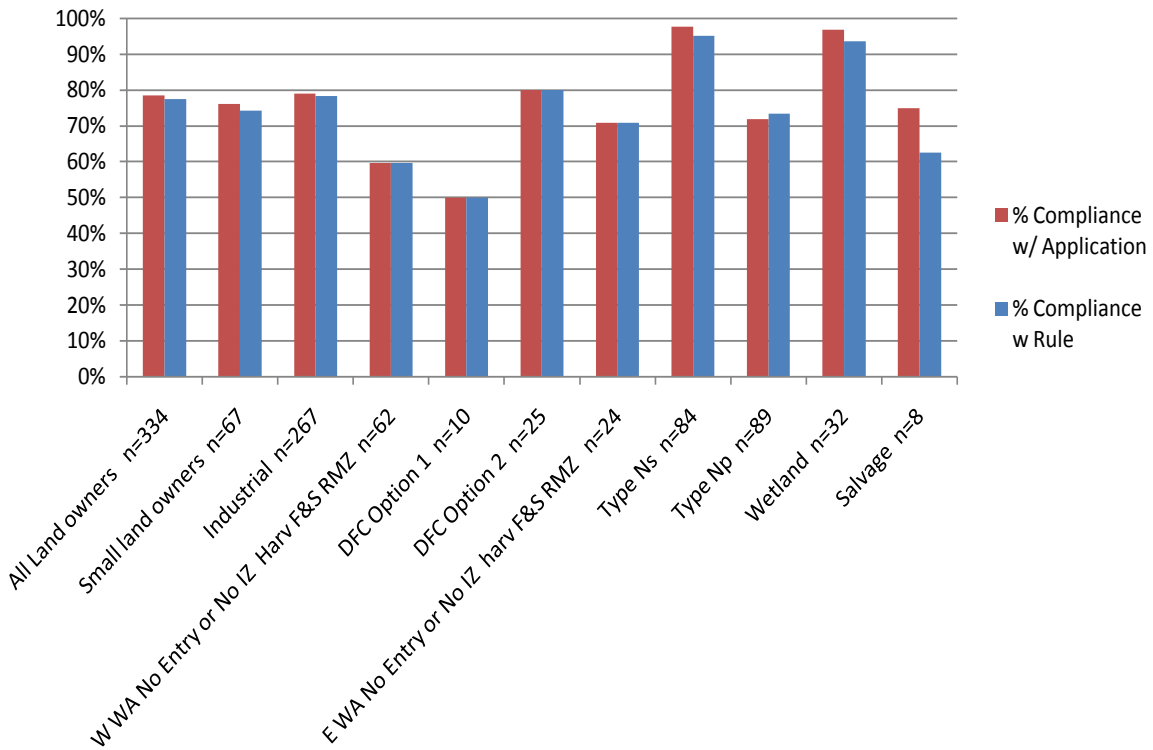
Table 5. Compliance with Forest Practices Rules for 2008/2009 Riparian Harvest Activities with 95% confidence intervals

Eastern and Western Washington Riparian Activities 2008/2009 biennium														
		Western Washington				Eastern Washington				Statewide				
	Status of Compliance	No Inner Zone	No Entry RMZ	DFC Option 1	DFC Option 2	No Inner Zone	No Entry RMZ	Ponderosa Pine	Mixed Conifer	Type Ns	Type Np	Wetland[a]	Salvage	Totals[a]
Small Forest Landowners	Compliant	5	5	0	1	1	2	0	0	12	10	12	1	49
	Out of Compliance	5	3	2	0	0	2	0	0	2	2	0	1	17
	Percent Compliant	50%	63%	0%	100%	100%	50%	na	na	86%	83%	100%	50%	74%
	Confidence Interval	(19, 81)	(25, 91)	na	na	na	(7, 93)	na	na	(58, 98)	(52, 98)	(96, 100)	na	*(64, 84)*
	Total	10	8	2	1	1	4	0	0	14	12	12	2	66
Industrial Landowners	Compliant	24	3	5	19	8	6	0	0	67	56	17	4	209
	Out of Compliance	14	3	3	5	3	2	0	0	2	22	2	2	58
	Percent Compliant	63%	50%	63%	79%	73%	75%	na	na	97%	72%	89%	67%	78%
	Confidence Interval	(46, 78)	(12, 88)	(25, 91)	(58, 93)	(40, 94)	(36, 97)	na	na	(90, 100)	(61, 81)	(76, 100)	(23, 95)	*(73, 83)*
	Total	38	6	8	24	11	8	0	0	69	78	19	6	267
All Landowners	Compliant	29	8	5	20	9	8	0	0	79	66	29	5	258
	Out of Compliance	19	6	5	5	3	4	0	0	4	24	2	3	75
	Percent Compliant	60%	57%	50%	80%	75%	67%	na	na	95%	73%	94%	63%	77%
	Confidence Interval	(46, 74)	(29, 82)	(19, 81)	(60, 93)	(43, 94)	(36, 90)	na	na	(88, 99)	(63, 82)	(85, 100)	(25, 91)	*(73, 82)*
	Total	48	14	10	25	12	12	0	0	83	90	31	8	333
indeterminate		1	0	0	0	1	0	0	0	1	1	0	1	5

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

Figure 3 displays compliance percentages for riparian activities for grouped categories. Methods for estimating confidence intervals are described in Appendix A. The error bars show the lower and upper limits of a 95 percent confidence interval. Confidence Intervals are wider in activities where the number of occurrences is lower.

Figure 3. Percent Compliant for All 2008/2009 Riparian Harvest Activities



Results for Road Activities

Road-related activities include the following features of forest practices transportation:

- Road construction
- Landings
- Road abandonment
- Type N stream crossings including fords that are identified on the approved Forest Practices Application.

To determine compliance, the monitoring team had to examine the road-related activities, each of which requires a unique set of rules with corresponding sets of protocols. The Compliance Monitoring Program reviews crossings on Type N streams only. Type F and S crossings are regulated under WDFW hydraulics permits and are not included in Compliance Monitoring review.

Table 6 displays the application compliance results for road-related activities statewide for the combined 2008 and 2009 field seasons. Table 7 shows the corresponding results for rule compliance. Confidence intervals (CI), expressed as lower and upper limits (percentages), are displayed for each compliance estimate in the tables. Methods used to estimate confidence intervals are described in Appendix A.

Table 6. Compliance on Approved FP Applications for 2008/ 2009 Road Activities with 95% confidence intervals

Road Activities Statewide 2008/2009 Biennium						
	Status of Compliance	*Road Construction*	*Road Abandonment*	*Landings*	*Crossings*[a]	*Totals*
Small Forest Land-owners	Compliant	5	1	1	8	15
	Out of Compliance	1	0	1	2	4
	Percent Compliant	83%	100%	50%	80%	79%
	95% Confidence Interval	(37, 100)	na	na	(57, 91)	*(53, 100)*
	Activity Totals	6	1	2	10	19
Industrial Land-owners	Compliant	22	11	3	23	59
	Out of Compliance	5	1	2	8	16
	Percent Compliant	81%	92%	60%	74%	79%
	95% Confidence Interval	(62, 93)	(62, 100)	(15, 94)	(55, 100)	*(68, 89)*
	Activity Totals	27	12	5	31	75
All Land-owner Types	Compliant	27	12	4	31	74
	Out of Compliance	6	1	3	10	20
	Percent Compliant	82%	92%	57%	76%	79%
	95% Confidence Interval	(65, 93)	(65, 100)	(19, 90)	(62, 90)	*(69, 89)*
	Grand Totals	33	13	7	41	94
	Indeterminate	0	0	0	0	0

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

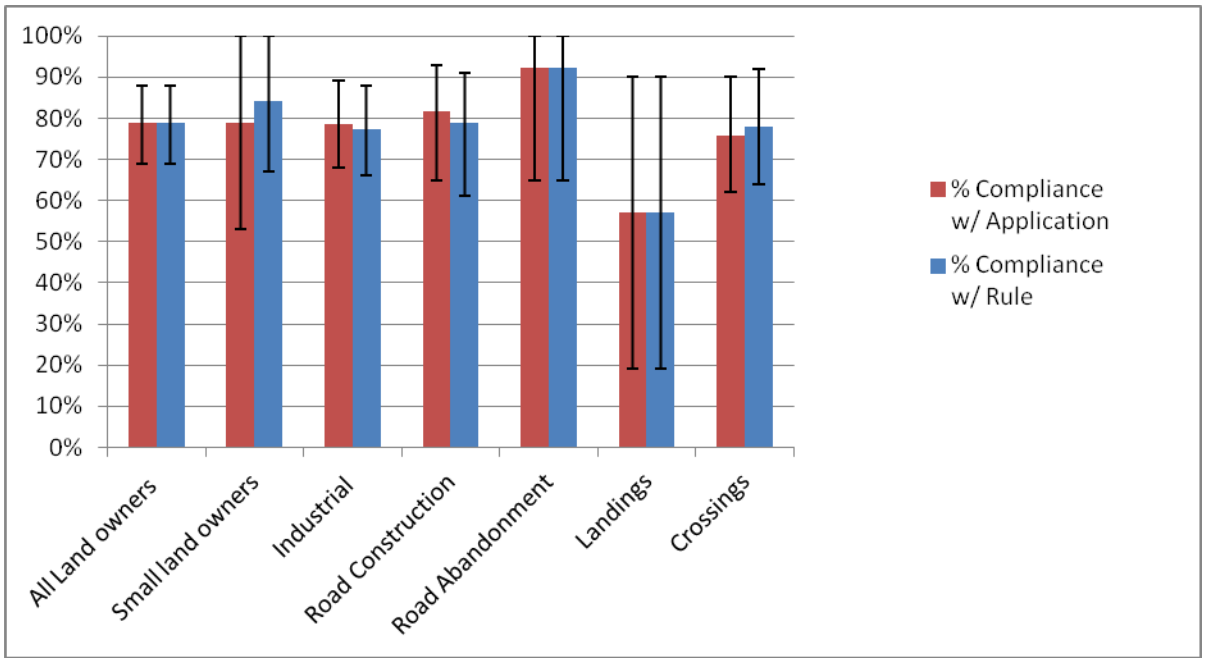
Table 7. Compliance with FP Rules for 2008/2009 Road Activities with 95% confidence intervals

Road Activities Statewide 2008/2009 Biennium						
	Status of Compliance	*Road Construction*	*Road Abandonment*	*Landings*	*Crossings*[a]	*Totals*
Small Forest Land-owners	Compliant	5	1	1	9	16
	Out of Compliance	1	0	1	1	3
	%Compliant	83%	100%	50%	90%	84%
	Confidence Interval	(37, 100)	na	na	(70, 100)	*(67, 100)*
	Activity Totals	6	1	2	10	19
Industrial Land-owners	Compliant	21	11	3	23	58
	Out of Compliance	6	1	2	8	17
	%Compliant	78%	92%	60%	74%	77%
	Confidence Interval	(58, 91)	(62, 100)	(15, 94)	(57, 91)	*(66, 88)*
	Activity Totals	27	12	5	31	75
All Land-owner Types	Compliant	26	12	4	32	74
	Out of Compliance	7	1	3	9	20
	%Compliant	79%	92%	57%	78%	79%
	Confidence Interval	(61, 91)	(65, 100)	(19, 90)	(64, 92)	*(69, 88)*
	Grand Totals	33	13	7	41	94
	Indeterminate	0	0	0	0	0

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

Figure 3 displays compliance percentages for road-related activities. The error bars in the figure reflect the lower and upper limits of a 95 percent confidence interval. Methods for determining these intervals are described in Appendix A: Statistics.

Figure 3. Percent Compliant for All 2008/2009 Road Activities—Error bars show the lower and upper limits of a 95% confidence interval



Professional Judgment of Non-compliant Ratings

Though it is beyond the scope of this program to quantify resource damage, the field review team observed three levels of noncompliance based on the team's experience and professional judgment. The non-compliance rating categories are:

- **Minor:** Trivial or minor negative impacts of short duration over a small area, such as a few trees harvested in the inner or outer zones of a Riparian Management Zone (RMZ) or evidence of small sediment deposits that potentially contributed briefly to perennial water.
- **Moderate:** Apparent and potentially longer-term impacts to resources such as the complete removal of outer RMZ trees or significant under-stocking of leave trees in the inner zone. Undersized culverts, un-stabilized banks and small but visible sediment plumes in flowing streams and water bodies.
- **Major:** Evident damage or high potential damage such as harvest in the RMZ core zone, or cut or fill slopes directly contributing visible volumes of sediment to 'typed' water.

The Compliance Monitoring field teams were able to generate consensus qualitative non-compliance ratings for a majority of all activities in the sample set. It is important to note that these qualitative non-compliance ratings have no statistical application, but are useful to characterize the resource risks

associated with non-compliance. Although the process was qualitative, these ratings suggest that professional judgment calls of a “major” non-compliant level are not common.

Figure 4 Non-compliance with Approved Applications for Riparian Activities based on Professional Judgment of the Field Review Teams

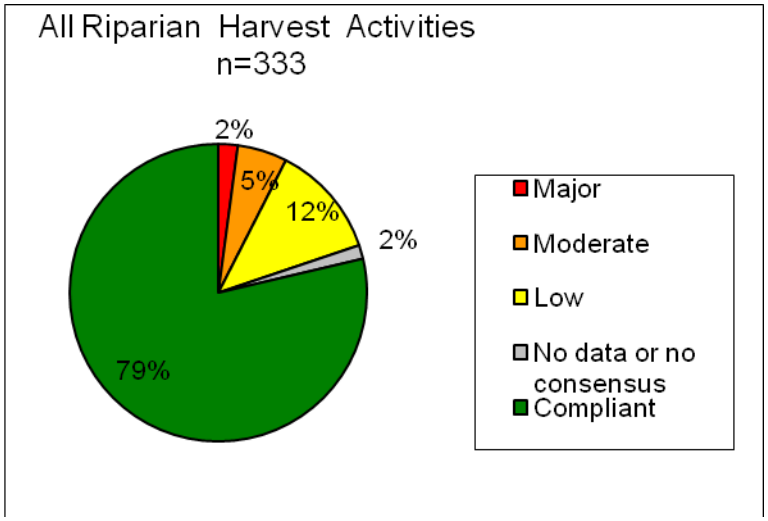
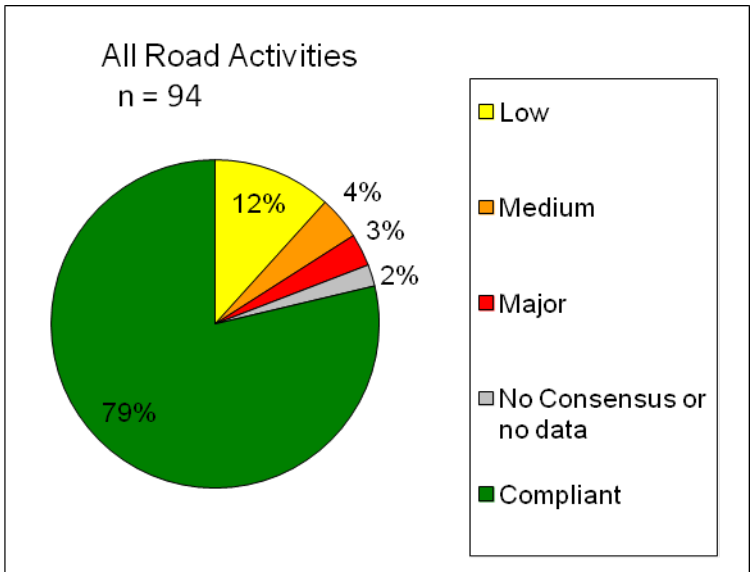


Figure 5 Non-compliance with Approved Application for Road Activities based on Professional Judgment of Field Review Team



SUPPLEMENTAL EMPHASIS SAMPLES

Three 'emphasis samples' were completed during the 2007 through 2009 sample seasons. They include Wetland Activities, Alternate Plans, and riparian activities in 20-acre Exempt Parcels. These activities are less frequent and therefore not well represented in the standard sample. Emphasis samples are intended to provide a better understanding of the compliance levels for these activities. Note that for Forest Practices Applications for Alternate Plans and 20-Acre Exempt activities, only compliance with the conditions of the approved application was considered. It is assumed for these activity types that the conditions written into the approved applications represent compliance with the rules.

Emphasis focus: Wetlands

There were 656 applications containing wetland activities. Of the 230 applications reviewed, 69 had completed activities for which compliance could be assessed. Regarding the other applications, harvest activities adjacent to wetlands may not have taken place yet. Thus we estimate that the actual population of Forest Practices Applications that included wetlands for the 2008/2009 Biennium was approximately 197 (656 * 69/230). Tables 8 and 9 display application and rule compliance for individual wetland activities and total wetland activities. Figure 6 displays the same results in graphic form.

In addition to the detailed review of the selected feature, each Forest Practices Application in the sample was reviewed to verify the typing of all wetland features present. Table 10 displays the comparison of wetland types as recorded on the FPA typing with Compliance Monitoring Review team's observation of the feature.

Emphasis focus: Alternate Plan

There were 59 Forest Practices Application containing alternate plan activities, with no more than one activity per application. A total of 32 applications were assessed for compliance, and 27 (84 percent) of these were compliant with the application (Table 11, Figure 7).

Other activities such as road construction and type N or F stream standard prescriptions also were assessed on these applications, with multiple activities on some applications. The compliance percentage for these other activities was 78 percent.

Emphasis focus: 20-Acre Exempt Emphasis

There were 79 applications containing 20-Acre Exempt Parcel activities, with no more than one activity per application. A total of 45 applications were assessed for compliance, and 28 (62 percent) of these were compliant with the application (Table 11, Figure 7).

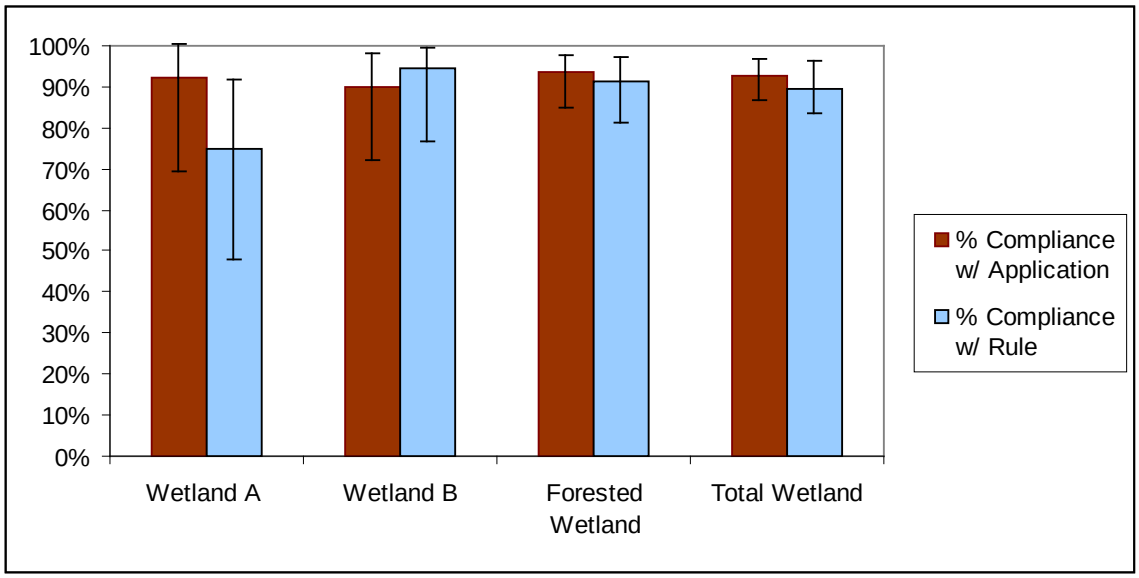
Table 8. Compliance with Approved Applications for Wetland Activities with 95% confidence intervals

		Wetland A	Wetland B	Forested Wetland	Total Wetland
SFLO	Compliant	8	6	23	37
	Out of Compliance	1	2	3	6
	Percent Compliant	89%	75%	88%	86%
	Confidence Interval	(58, 100)	(41, 94)	(73, 96)	(76, 96)
	Total	9	8	26	43
Industrial	Compliant	4	12	22	38
	Out of Compliance	0	0	0	0
	Percent Compliant	100%	100%	100%	100%
	Confidence Interval	(49, 100)	(78, 100)	(87, 100)	(98, 100)
	Total	4	12	22	38
Total	Compliant	12	18	45	75
	Out of Compliance	1	2	3	6
	Percent Compliant	92%	90%	94%	93%
	Confidence Interval	(69, 100)	(72, 98)	(85, 98)	(87, 97)
	Total	13	20	48	81

Table 9. Compliance with FP Rules for Wetland Activities with 95% confidence intervals

		Wetland A	Wetland B	Forested Wetland	Total Wetland
SFLO	Compliant	5	7	20	32
	Out of Compliance	3	1	4	8
	Percent Compliant	63%	88%	83%	80%
	Confidence Interval	(31, 87)	(54, 99)	(66, 94)	(68, 92)
	Total	8	8	24	40
Industrial	Compliant	4	11	21	36
	Out of Compliance	0	0	0	0
	Percent Compliant	100%	100%	100%	100%
	Confidence Interval	(49, 100)	(76, 100)	(87, 100)	(97, 100)
	Total	4	11	21	36
Total	Compliant	9	18	41	68
	Out of Compliance	3	1	4	8
	Percent Compliant	75%	95%	91%	89%
	Confidence Interval	(48, 92)	(77, 100)	(81, 97)	(83, 96)
	Total	12	19	45	76

Figure 6. Percent Compliant for Wetland Activities with 95% Error Bars



The wetland emphasis in general shows the compliance rates exceeding th 85 percent goal set by the program. The excepton was type A wetland rule compliance, which has a relativly small sample size.

Table 10. Comparison of Wetland Type Classification

FPA typing	Associated Type F	Type A	Type B	Forested Wetland	Not Wetland	Indeterminate or No Data	Total
Type A	11	4	3	2	1	1	22
Type B	5	1	11	1	1	12	31
For Wetland	3	0	2	34	8	30	77
Not wetland	0	1	1	1	0	1	4

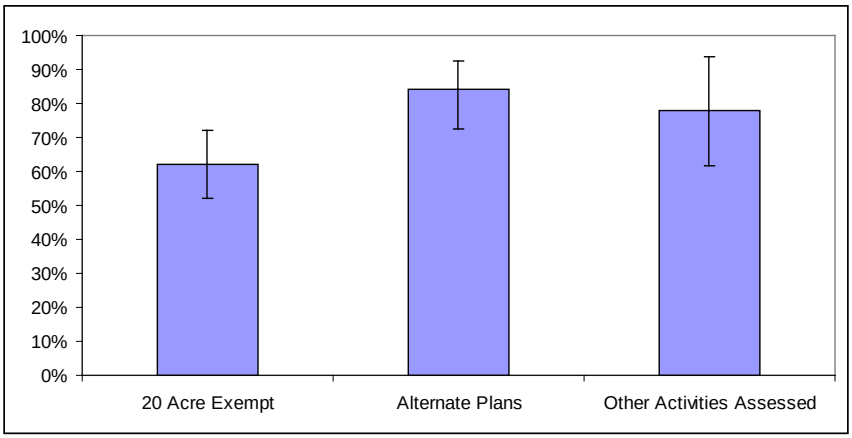
Team recording results after on-the-ground compliance review.

Table 11. Compliance with Approved FP Application for 20- Acre Exempt and Alternative Plan including 95% confidence intervals.

		20 Acre Exempt	Alternate Plans	Other Activities Assessed
SFLO	Compliant	28	13	8
	Out of Compliance	17	3	4
	Percent Compliant	62%	81%	67%
	95% Confidence Interval	(52, 72)	(62, 93)	(39, 95)
	Total	45	16	12
Industrial	Compliant	n/a	14	13
	Out of Compliance	n/a	2	2
	Percent Compliant	n/a	88%	87%
	95% Confidence Interval	n/a	(69, 95)[a]	(69, 100)
	Total	0	16	15
Total	Compliant	28	27	21
	Out of Compliance	17	5	6
	Percent Compliant	62%	84%	78%
	95% Confidence Interval	(52, 72)	(72, 92)[a]	(62, 94)
	Total	45	32	27

[a]The upper confidence interval for this case is the maximum possible compliant, based on known population size.

Figure 7. Compliance with FP Application for 20-Acre Exempt and Alternate Plan activities, with 95% error bars



Alternate plans compliance rates nearly met the 85% program goal but 20 ac exempt activities fell well short.

Supplemental Water Information Results

In response to concerns regarding consistency and accuracy of the water type information, for 2008/2009, the Compliance Monitoring Program recorded observations of the stream features to determine if there were differences between the Forest Practices Applications or Stream GIS layer and what was observed on-the-ground by the monitoring team. These observations were taken on the selected water features within FPAs. If in the Compliance Monitoring review of those applications, the team members identified water features which appeared to be different than as described on the

application, a Supplemental Water Information Form (SWIF) was completed to capture the discrepancy. Not all records indicate a water type change. In some cases the water type was not questioned, but the bank full width measurements were different. In others the observation indicated reclassification from stream to wetland.

There were 296* Riparian Management Zone-related activities involving flowing or open standing water evaluated during the 2008-2009 sample period. The number of features reported using a SWIF totaled 91 indicating questions arose regarding 31 percent of all the water features in the sample.

Tables 12 through 15 shows where differences indicated either a lower or higher water classification when comparing the Forest Practices Application to the Supplemental Water Information Form. Of the 37 instances, 24 increased in classification (larger stream or fish bearing, etc) and 13 decreased.

Table 12- Count, by group, of Ns features reviewed in Supplemental Water Information Forms

Ns Sampled	Total inconsistent observed	No Change	Ns to no Water	No Consensus	Ns Indeterminate	Ns to Np	Ns to F	Ns to B wetland
84	26	6	12	2	2	1	1	2

Table 12 shows that when Ns data is inconsistent with observed conditions, the most frequent occurrence is that no water feature was present.

Table 13 – Count, by group , of Np features reviewed in Supplemental Water Information Forms

Np Sampled	Total inconsistent observed	No change	Np to no Water	Np to Ns	No Consensus	Np to Indeterminate	Np to F
89	30	5	1	1	1	1	21

Table 13 shows that when Np data is inconsistent with observed conditions, the change is most often associated with Type F physical characteristics or fish being present.

Table 14- Count, by group, of F or S features reviewed in Supplemental Water Information Forms

F or S Sampled	Total inconsistent observed	F to Ns	F to Np	No Change
121	23	2	3	18

*This excludes wetlands observations because the SWIF was not designed to evaluate wetland features.

Table 15 Count, by group, of Un-mapped Features reviewed in Supplemental Water Information Forms

Grand Total	Unidentified to Ns	Unidentified to Np	Unidentified to F
12	7	3	2

Table 16 displays those instances where the Compliance Monitoring team found bank full width measurement differences from the application. The category "Increase in Threshold" includes both western and eastern Washington type F streams where the respective values of 10feet and 15feet require changes in Riparian Management Zone protection widths.

Table 16- Type F Bank Full Width measurement differences

F or S Sampled	Total inconsistent width observed	Increase in Threshold	CMZ omitted from bank full width	Width Increases but stream remains under 10 ft
121	11	8	1	2

Table 17 indicates inconsistencies between the Forest Practices Application and Compliance Monitoring team-observed Channel Migration Zone (CMZ) characteristics. These occur on Type F streams or Ns streams observed to have Type F physicals.

Table 17 –Channel Migration Zone Differences

F or S Sampled	Total observed inconsistent CMZ	Unreported CMZ	CMZ not in width	Indeterminate
121	6	2	3	1

Table 18 displays Supplemental Water Information Form observations where a transition in water types (mapping or field location) appeared to be at the wrong location of the stream. These affect the compliance of the associated RMZs.

Table 18 Steam Type change (break) differences captured on Supplemental Water Information Form

F or S Sampled	**Total observed inconsistent type breaks**	**F -N break**	**F location**	**Includes pond**
121	6	3	2	1

Riparian Non-compliance Analysis for Westside Type F or S water

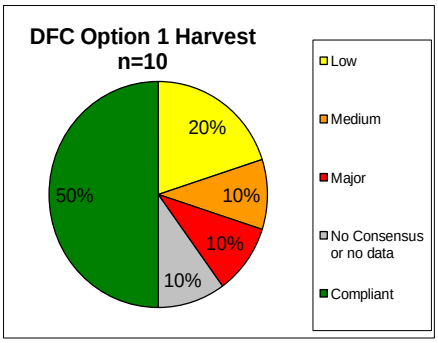
The original mandate of the Compliance Monitoring Program was to report whether the rules were being followed in the course of activities regulated under Forest Practices. Upon the publication of 2006-2007 Biennial report in 2009 it was noted that riparian-related activities in forests along type F Westside streams had a noticeably lower rate of compliance. The question was raised as to why this non-

compliance was happening. Explicit observations that might offer additional information to answer that question had not been planned into the 2008/2009 sample design, and the sampling was well under way at publication of the 2007/2008 report. The decision was made to attempt to resolve this question using the existing observations from the data acquired from the 2008/2009 data.

Individual questions on the Compliance Monitoring sampling form provided the data for examination. The approach was to use individual questions asked about each activity, and associate the frequency of that question's answer to non-compliant riparian-related activities.

DFC Option 1

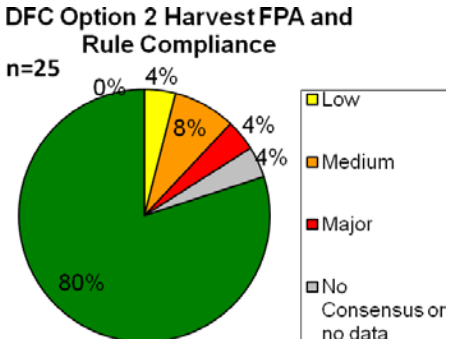
Figure 8 – Westside Riparian Forest Desired Future Conditions Option 1 Sampled Outcomes



In the 10 samples of Westside Riparian Forest Desired Future Conditions Option 1, five were non-compliant. Of these, three indicated the leave tree size composition did not meet the Forest Practices Application specifications, one had a Riparian Management Zone length shorter than was indicated in the application, and one appeared to be a conversion to a non-forestry land use.

DFC Option 2

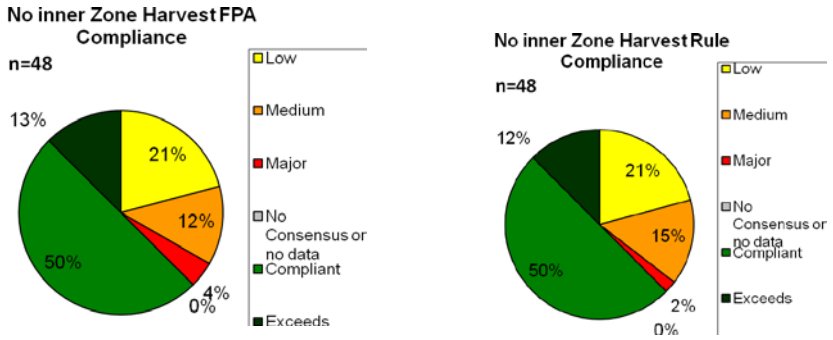
Figure 9 - Westside Riparian Forest Desired Future Conditions Option 2 Sampled Outcomes



Westside Riparian Forest Desired Future Conditions Option 2 activites showed 5 out of 25 being non-compliant. Of those, three maintained too few leave trees of sufficient diameter, one used an incorrect stand table and the other had harvest in the core zone.

Western Washington No Inner Zone harvest

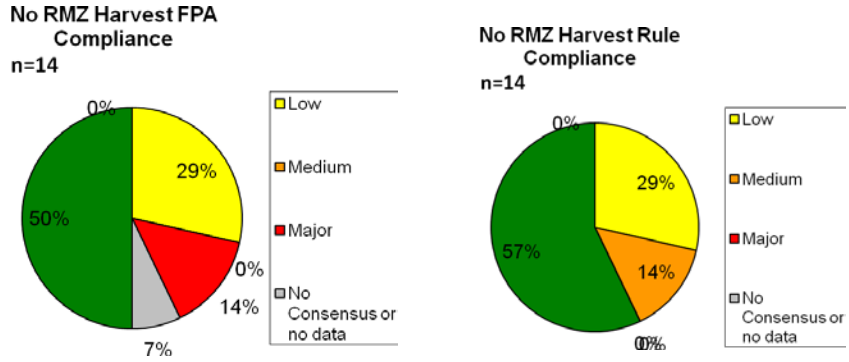
Figure 10 No Inner Zone Westside Riparian Management Zone harvest Sampled Outcomes



Non-compliant No Inner Zone harvests were most frequently caused by the cutting of Inner Zone trees, accounting for 13 cases. To few outerzone trees accounts for four instances.
Harvest of core zone trees caused the one instance of a major noncompliant call.

Western Washington No Entry Type F or S Riparian Management Zone

Figure 10 – Western Washington No Entry Riparian Management Zone Sampled Outcomes



All six instances of non-compliant No Entry RMZ had at least a few trees cut in the outer zone. In two cases harvest also was observed in the inner zone. The observations did not detail whether the outer zone leave trees met the 20 conifer trees per acre requirements for no inner zone harvest.

DISCUSSION

This section provides some interpretation of the results including postulation regarding some root causes of why non-compliance occurs regarding forest activities guided by Forest Practices Rules. Additionally discussed are differences in compliance of Applications and Rules occurring on any one activity.

Standard sample activities with lower compliance rates include Type F Riparian Management Zones. All these prescriptions have in common a 'trees per acre' requirement so that accurate measurement of those acres is critical. The acreages are calculated using the length of the Riparian Management Zones in the harvest unit as one of the area dimensions. Inspection of the data showed that an inaccurate measurement of insufficient length was common to many of these non-compliant activities. If the correct length had been reported on the application, in many cases the non-compliance would have been avoided by having an accurate calculation of acreage.

Activities along Type Np Riparian Management Zones are similarly subject to accurate length measurements to maintain the correct proportion of buffer. Again, many of these non-compliant activities showed longer measured lengths on the ground than stated on the Forest Practices Application. Again noncompliance may well have been avoided with buffers of the correct length.

In the emphasis samples, 20-Acre Exempt Parcel activities showed low compliance. The data indicated what was planned was not always what was performed. As an infrequent activity, it typically is associated with Small Forest Landowners. An approach to improvement may be performing inspections early in the operation to assure that the operator understands Forest Practices Rule requirements and the conditions of their application.

The Supplemental Water Information Forms illuminated the need to focus effort to assure correct water typing. The data indicates that there are differences for about a quarter of the team observations of these riparian features. Resolving these differences will require better pre-application Water Type assessments.

Some concern was stated regarding the effects of indeterminate compliance assessment on the sample (either no consensus or indeterminable by the review team). These numbers are quite small. Though noted in tables 4 and 5 they cannot be included in the sampling estimates and are disregarded.

The differences between rule and application compliance can be better under stood by the table and chart in Appendix B. There are 7 different outcomes of rule and application compliance in the data. Of 425 rule- to- application comparisons only 21 do not match.

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 are described below with examples.

Simple Proportions

The first type of compliance proportion is a simple proportion. For example, the proportion of Forest Practices Applications with road construction activities that were compliant for these activities. One and only one road construction activity is measured on each FPA that has a road construction activity. 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.

Example

The proportion of road construction activities that are compliant is an example of a simple proportion. For this biennium, there were 74 FPAs containing road construction activities that were tested for compliance. Of these, 63 were compliant.

n = 74
X = 63

63/74 = 0.851 (85% compliant)

$\nu 1 = 24$
$\nu 2 = 126$
$\varpi 1 = 128$
$\varpi 2 = 22$

$$LCL = \frac{63}{63 + (74 - 63 + 1) * 1.754} = 0.750(75\%)$$

$$UCL = \frac{64 * 2.072}{74 - 63 + (64) * 2.072} = 0.923(92\%)$$

Ratio Proportions

The second type of proportion is actually a ratio of two random variables, with the denominator being the total number of activities (within a subcategory) sampled. For example, when we look at compliance for all riparian activities, there are often multiple riparian activities on a single FPA. Because this number varies across FPAs (i.e., some FPAs have 1, some have 2 or more activities in the subcategory), it is a random variable. This is true for any displayed subcategory that represents multiple activity types, such as "Western Washington Type F Streams" (up to three activity types), as well as for total compliance rates (e.g., all riparian activities.) 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 activities divided by the total number of activities 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

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

In the above equation, N is the total number of Forest Practices Applications submitted in the two-year period that contain road and riparian activities. This number was not known, but was estimated based on the proportions of sampled FPAs containing road and riparian activities for each year.

These confidence intervals are symmetric.

Example:

Out of 174 FPAs reviewed, there were 234 road activities tested for compliance. Of these, 203 activities were in compliance with relevant rules.

$$\hat{p} = \frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i} = \frac{203}{234} = 0.868(87\%)$$

The population size, N is estimated as follows. In 2006, there were 4671 total FPAs submitted. Of the FPAs opened, 104/201 (52 percent) had activities in our population. Applying the 52 percent to 4671 yields an estimate of 2417 FPAs with road/riparian activities in 2006. In 2007, there were 4588 total FPAs, and 60 percent of the 341 FPAs that were opened had road and/or riparian activities. This yields an estimate of 2758 FPAs with road/riparian activities. Therefore, we estimate a total population size of 5175 FPAs with road/riparian activities. Note that this estimate is only being used as a finite population correction factor. Since the sampling proportion is fairly small (100/5000), this estimate does not have a large affect on the final result.

N = 5175
n =174

The quantity $\sum_{i=1}^{n} (y_i - \hat{p}x_i)^2$ is calculated for each FPA, so can not be easily displayed. However, note that for each FPA, it is simply the number of compliant road activities minus 0.868 times the total number of road activities.

$$SE(\hat{p}) = \frac{\sqrt{174 \cdot (1 - \frac{174}{5175}) \cdot 44.24}}{\sqrt{(174-1)} \cdot 234} = 0.028$$

$t_{.025,173} = 1.974$

$0.868 \pm 1.974 \cdot 0.028$
= $0.868 \pm 1.974 \cdot 0.028 = 0.868 \pm 0.055$

Thus, the 95% confidence interval is (81, 92%).

Wetlands, Alternate Plans, 20-acre Exempt

For simple proportion estimates within these groups, the population size (number of FPAs including these activities) is smaller and known, or can be closely estimated. For these cases, a finite population correction was applied, again following Zar (1996, p527):

$$LCL_{FP} = \frac{X - 0.5}{n} - \left(\frac{X - 0.5}{n} - LCL \right) \cdot \sqrt{1 - \frac{n}{N}} \text{, and}$$

$$UCL_{FP} = \frac{X'}{n} - \left(UCL - \frac{X'}{n} \right) \cdot \sqrt{1 - \frac{n}{N}},$$

$$\text{where } X' = X + \frac{X}{n}.$$

Note that a finite population correction factor is already included in all of the confidence intervals for ratio estimates.

Also for these groups, for both simple and ratio proportions, there are times when the estimated confidence limits are above (or below) the possible limit of the estimate. For example, if there are 75 total applications, and 5 of the 40 sampled were non-compliant, then the maximum percent compliant is 70/75 = 93 percent. If the estimated UCL is 95 percent, we reset the UCL to the maximum of 93 percent.

References

Cochran, William G. (1977). Sampling Techniques. John Wiley & Sons, New York.
Zar, Jerrold H. (1996). Biostatistical Analysis. Third Edition. Prentice Hall. Upper Saddle River, New Jersey.

APPENDIX B
RULE – FP APPLICATION COMPLIANCE COMPARISONS

Table B1 displays the count of combinations of application and rule compliance observations for each activity. Chart B1 shows the same data graphically. The combination descriptions are:

C-C	Both compliant
OC-OC	Both non-compliant
C-OC	FPA compliant – rule noncompliant
OC-C	FPA Noncompliant – Rule compliant
C-IND	FPA compliant – Rule indeterminate
IND-IND	FPA indeterminate - Rule indeterminate
IND-C	FPA indeterminate- rule compliant

Table B1- Count of Combinations of Application and Rule Compliance Observations

Count of FPA_ID	FPA-Rule Status							
activity	C-C	OC-OC	C-OC	OC-C	C-IND	IND-IND	IND-C	Grand Total
Road Construction	25	5	2	1				33
Road Abandonment	12	1						13
Landings	4	3						7
N pernanent crossings	26	6	1	2				35
N temp Crossings	2	1						3
N Fords	2	1						3
Salvage	5	2			1			8
WW No O Z Harv	7	6		1				14
WW No IZ Harv	29	18			1			48
WW DFC1	5	5						10
WW DFC 2	19	4	1	1				25
WW Np	46	19		1		1	1	68
WW Ns	69	2			1			72
EW No O Z Harv	7	3	1	1		1		13
EW No IZ Harv	9	3						12
EW Np	15	3						18
EW Ns	9		1		1			11
Wetland A	2		1					3
Wetland B	9	1						10
Forested Wetlands	19							19
Grand Total	321	83	7	7	4	2	1	425

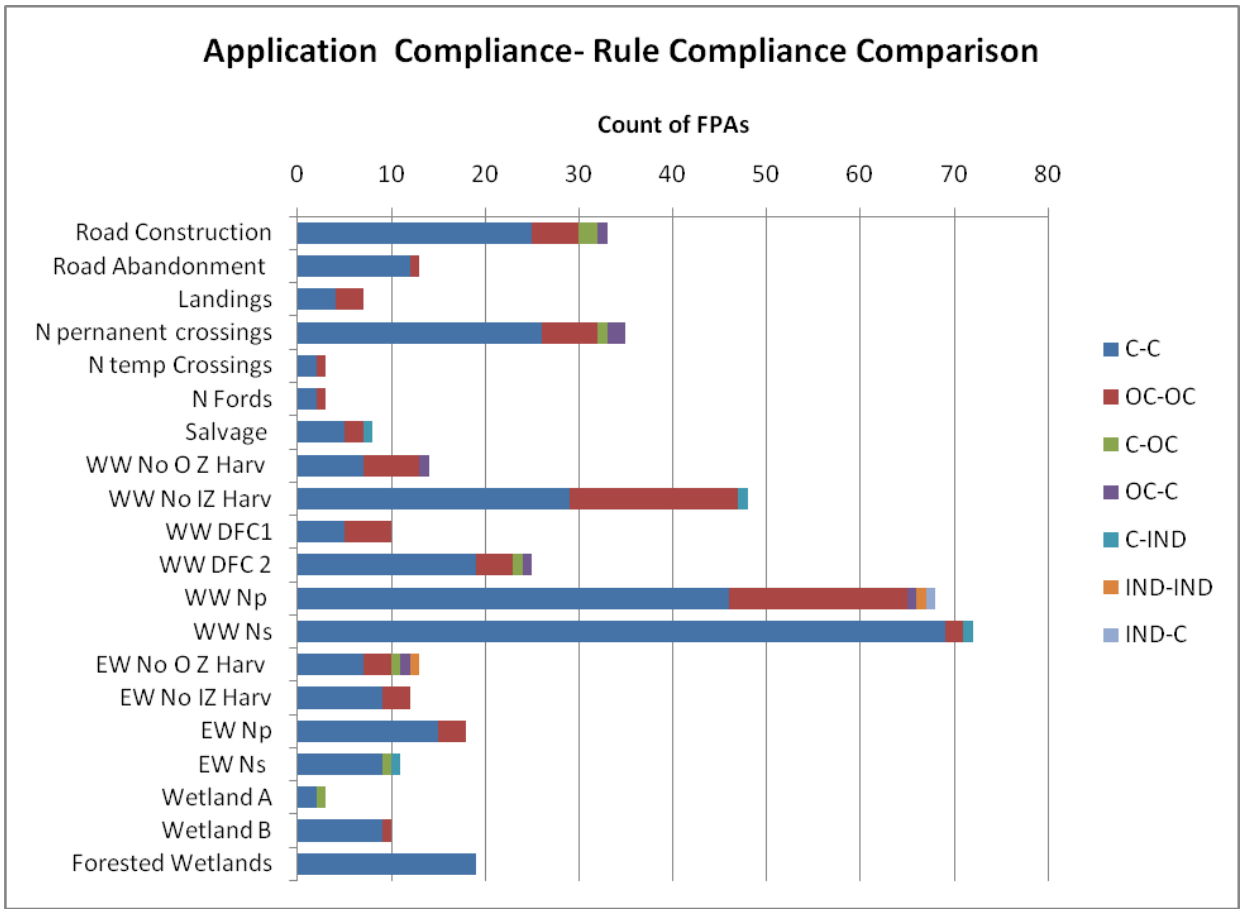



Chart B1- Count of Combinations of Application and Rule Compliance Observations