Oregon Department of Forestry's Best Management Practices Compliance Monitoring Project

SUMMARY

May 1999

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Josh Robben: Monitoring Specialist

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Introduction

The Oregon Department of Forestry (ODF) is conducting a Best Management Practices Compliance Monitoring Project (BMPCMP). This is a monitoring program which ODF has been directed to do, both through the governor's "Oregon Plan" for the recovery of salmon and watersheds, and at the direction of the Oregon State Board of Forestry.

Best Management Practices (BMP's) refers to forest practice rules and regulations that are designed to maintain water quality during forest operations. The BMPCMP is a three-year project that is primarily looking at how the department, landowners and operators are implementing the forest practice rules. The project may reveal areas where forest practice rule language can be clarified, administration of the rules can be improved, or where additional landowner and operator education is needed.

Data will be collected by ODF forest practice monitoring staff. This will be done in the field on randomly selected sites throughout the state. The random selection process allows for a statistically reliable sample of rule compliance, which ultimately results in a sound and defensible project. The first year of data collection (1998) was a "pilot" study. The pilot data were used primarily to determine the effectiveness of the field methods, improve the sample design, and make preliminary summaries on rule compliance. A pilot study report will be available in summer of 1999. Current field methods have been designed with a great deal of input from landowner groups, forest practice foresters, and review committees. The finalized protocol will be implemented in the summers of 1999 and 2000 with a final report to the Board of Forestry in 2001.

This document summarizes the goals, monitoring questions, study design and methods, and quality assurance/quality control program. For more detailed information please refer to the Best Management Practices Compliance Monitoring Project (Dent and Robben, 1999).

Committees and Coordinators

Internal Review Committee

John Buckman	Forest Practices Unit Forester: Pendleton
Dave Lorenz	Forest Practices Forester: Roseburg
Dave Morman	Forest Practices Policy Unit Manager: Salem
Scott Hayes	Forest Practices Operations Unit Manager: Salem
George Ponte	Forest Practices Forester: Prineville
Jeff Peck	F.A.C.T.S. Coordinator: Salem
Dan Shults	Forest Practices District Forester: Sweet Home
Gary Schulz	Forest Practices Unit Forester: Coos Bay
John Seward	Forest Practices Geotechnical Engineer: Roseburg
Mike Simek	Forest Practices Unit Forester: Columbia city
Tom Savage	Forest Practices Unit Forester: Tillamook
Cassandra Webber	Forest Practices Office Adminstrator: Salem
Kathy Wiggins	Forest Practices Forester: Coos Bay

External Review Committee

Chris Jarmer	Oregon Forest Industry Council (OFIC)
Jeff Lockwood	National Marine Fisheries Society (NMFS)
Dr. George Ice	National Council for Air and Stream Improvement (NCASI)
Rex Storm	Association of Oregon Loggers (AOL)
Dr. Paul Adams	Oregon State University (OSU)
Steve Hinton	Oregon Trout
Russell Harding	Department of Environmental Quality (DEQ)
Kaylor Martinson	Audubon Society
Terri Lamers	Oregon Small Woodlands Association (OSWA)
Jeff Boechler	Oregon Department of Fish and Wildlife (OSF&W)

Project Coordinators:

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Section 1. Study Proposal

1.1 Background

The goals and objectives of the Forest Practices Act and Rules drive the Oregon Department of Forestry's Forest Practices Program (FP Program). The objectives of the Forest Practices Act are to:

> "encourage economically efficient forest practices that assure the continuous growing and harvesting of forest tree species and the maintenance of forestland for such purposes as the leading use on privately owned land, consistent with sound management of soil, air, water, fish and wildlife resources and scenic resources within visually sensitive corridors as provided by ORS 527.755 that assures the continuous benefits of those resources for future generations of Oregonians." (ORS 527.630 Policy, Oregon Forest Practices Act)

The forest practice rules are designed to address these issues. The rules are categorized into divisions, and each division has a description of purpose. The purpose statements further refine the broad objectives of the rules and act.

The Oregon Department of Forestry Forest Practices Act and Rules are considered a Best Management Practices (BMP's) Program. BMP's are defined as practices selected by an agency that are practical and effective at reducing non-point source pollution to standards compatible with water quality goals. Once an agency's BMP's are approved by the state water quality regulatory agency, they are certified as the water quality management plan (WQMP) for landowners that implement them. A WQMP illustrates how a landowner will achieve acceptable water quality. The Oregon Department of Environmental Quality (ODEQ) has approved the Oregon Forest Practices Act and Rules as an acceptable BMP program. When forest landowners properly implement BMP's they are actually implementing an approved WQMP, designed to maintain water quality. It is the responsibility of the Oregon Department of Forestry (ODF) to monitor the effectiveness and implementation of BMP's in achieving that objective.

The ODF achieves BMP compliance through a balanced program of rule education, technology transfer and enforcement. ODF employs 52 forest practice foresters (FPF's), stationed in 25 unit and district offices throughout the state. Through a series of inspections and site visits, FPF's work with landowners and operators to facilitate proper implementation or compliance with the forest practices rules. Not all operations are inspected by FPF's due to extreme workloads. Therefore, FPF's prioritize operations to determine inspection schedules. When rules are not properly implemented, and resource damage results from non-compliance, enforcement action is taken. The forest activities computerized tracking system (FACTS) and a civil penalties database can be queried to gage level of compliance based on the number of citations. While this is a valuable monitoring tool, a statistically reliable sample of BMP compliance is needed to monitor if the compliance program is producing desired results and to identify methods to improve compliance.

The goal of the Best Management Compliance Monitoring Project (BMPCMP) is to identify the level of overall forest operations in compliance with the forest practice rules and determine if adjustments to the compliance program or program administration are needed. The BMPCMP is one component of the forest

practices monitoring program (Dent, 1997: Forest Practices Monitoring Strategy). The strategy of the monitoring program is to monitor compliance separately from effectiveness and validation monitoring. The forest practices monitoring program currently coordinates separate projects to monitor the effectiveness of forest practice rules with regard to landslides, riparian function, stream temperature, chemical applications, and sediment from roads.

Due to legislative commitments within the Oregon Plan for Salmon and Watersheds, the initial focus of the BMPCMP will be on rules that are applicable to waters of the state. While the primary focus of the BMPCMP is on compliance, there are instances in which data will be collected on the effect of the forest activity on stream resources.

1.2 Objectives

The ODF BMPCMP will build on previous monitoring and research studies of forest practice rules, and learn from projects undertaken by other states. The specific objectives are as follows:

1) Determine, through statistically valid sampling, the level of operator/landowner compliance with best management practices (BMP'S).

2) Identify opportunities to improve program administration, operator education, and technology transfer or rule clarity.

1.3 Monitoring Questions

In order to meet these objectives we will answer the following monitoring questions:

1. *How often did operators comply with BMP's described in the forest practice rules pertaining to water protection, road construction and maintenance, harvesting, and high-risk sites?*

2. *How do the statistical sample results compare with results based on FPF inspections? Is there a correlation between number of FPF inspections and compliance rates?*

3. *Are there particular rules that consistently have a lower or higher level of compliance? If the former, can the guidance and/or rule language be modified to improve compliance? Are there educational and training opportunities/materials regarding those rules?*

4. *When BMP compliance is inadequate, to what extent are quality and function of riparian areas, stream channels and/or fish habitat compromised?*

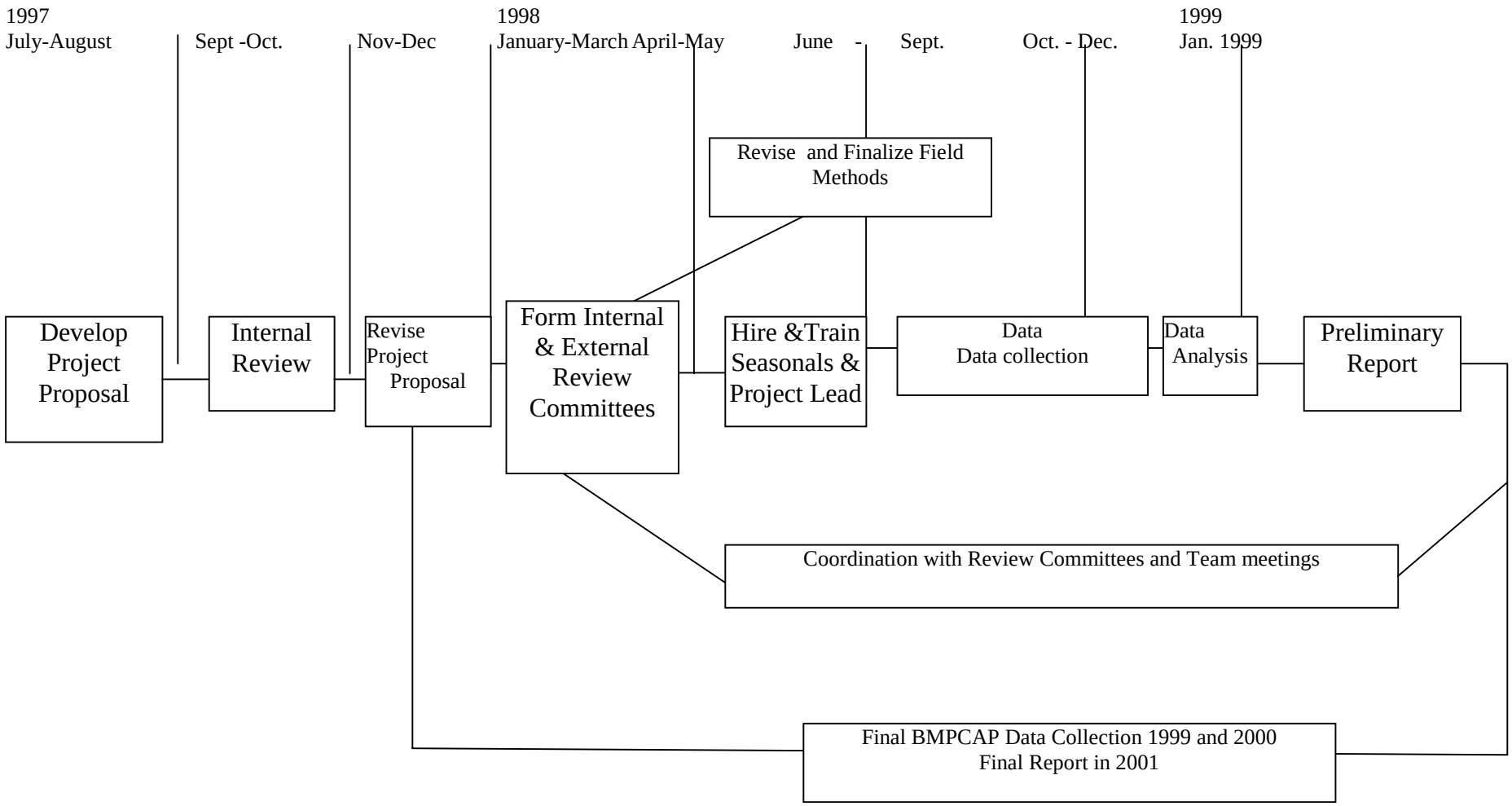
1.4 Time Frame

Project planning and protocol development took place from July 1997 through June 1998 (See figure 1). During that period the proposal was internally and externally reviewed. Following this review and revision process, the first year of project implementation began in the summer of 1998 **in the form of a pilot study**. Annual reports will be made to the Board of Forestry beginning in July of 1999. The finalized BMPCAP field protocol will be implemented in 1999 and 2000. A final report will be issued in 2001.

1.5 Approach and Focus

Determining Overall Compliance Rate: A field-based data collection method will be used to address overall compliance and rule implementation. There will be a limited amount of data collected on impacts to stream resources. Sites will be randomly selected and surveyed by 2-person BMP field team and an experienced former FPF. At each site the crew will determine rule compliance and resource protection. The crew will gather numerical information to be used to evaluate compliance, while a former FPF will provide a qualitative compliance assessment in the field. The focus will be on practices that can affect waters of the state. Therefore road, harvest, water protection, and high-risk site rules will be evaluated. A separate inventory will be done on new-road and road-reconstruction sites to assess fish passage.

Figure 1. Time table flow chart for the BMPCMP



Section 2. Study Design

2.1 Pilot Study

The 1998 field season was used to test field methods and implement the pilot study. From April through June, the field methods were refined through a series of field visits to different harvest units and districts. Once the protocol had been refined, data collection began for the pilot study on 52 randomly selected sites. Data from the pilot study were used to evaluate the effectiveness of the protocol and revise it accordingly. The data were also valuable for estimating the total number of samples needed to have a statistically sound study. Finally, with the protocol found to be effective, the data were used to provide preliminary findings on BMP compliance. These preliminary findings reported an average compliance rate of around 97% for all of the FP rules considered. Data collection for the BMPCMP will begin May 1999.

2.2 Defining the Population

Site Parameters

The focus of this BMPCMP is to monitor forest operations that affect the waters of the state. In addition the focus is on sites which must comply with recent rule revisions. Therefore, potential operations must meet the following criterion to be field surveyed:

- harvest units associated with a stream,
- harvest units that were started and completed (or inactive) in the 1998 calendar year (one-half to 2.5 years) prior to data collection.

Sites will be randomly selected from the population of operations that meet these criteria. The sample size needed to achieve a 5% precision is estimated to be 200 based on the pilot study results. These 200 randomly selected sites will be evaluated during the 1999 and 2000 field seasons. Extra sites will be randomly selected to use as backup in the event that property access is denied to some of the initial randomly selected sites.

Prior to data collection for the 1999 field season a query of the FACTS database was performed. This query identified a total of 4075 sites that met the initial criterion (see Table 1).

Stratification and Random Selection

There are three characteristics that warrant further consideration in our sampling design. These include:

- heightened concern with fish-bearing streams,
- regional differences in the numbers of notifications and rule requirements, and
- differences between industrial and non-industrial landowners.

Therefore, the sample will be stratified by stream classification, district, and ownership.

Stream Classification Stratification. Of the 4075 sites that met the initial criterion, roughly 44% are fish-bearing streams (F), 22% are Domestic (D) or Neither (N), and 34% are unknown (Table 1). The sample will be biased to capture more fish-bearing streams. This is warranted because of the critical issues surrounding fish habitat. In addition, most fish-bearing streams will have a type N associated with them, enabling the capture of data for both type N and Type F streams from one site. Therefore, 60% of the sites will be from sites known to be fish-bearing streams. The remaining 40% will be partitioned according to the relative proportions of N and unknown streams. Therefor 10% of the sites will be known N or D streams and 30% will be unknown.

District Stratification. A 5% sample will be randomly selected from each district with a minimum of ten sites for each district. This technique will weight the sample to reflect the number of notifications per district.

Landownership Stratification. The landowner classes include: Industrial, Non-industrial, and Other. The sample will be weighted proportionate to the average size of an operation for each landowner classification.

For example, while the number of notifications for industrial versus non-industrial is comparable (2037 and 1594), the average size of an operation is larger for industrial (137 acres) than for non-industrial (64 acres). Therefore, the sample will be weighted to capture more industrial operations. The relative proportions based on acreage are shown in Table 2.

Table 1. Distribution of BMPCMP population among districts.

District Name	Total Population
Tillamook	126
Astoria	147
Forest Grove	632
W. Oregon	562
Linn	204
Clack.-Marion	350
S.W. Oregon	212
Douglas	266
Coos	490
E. Lane	310
W. Lane	286
Cent. Oregon	145
N.E. Oregon	236
Klam.-Lake	109
Total	**4075**

Total Fish	1796	44%
Total N & D	909	22%
Total Unknown	1370	34%

Table 2. Landowner population characteristics.

Landowner Class	Number of Notifications	Average Acres	Total Acres	Percent of Total
1 State, Local & Other	444	72	31184	8%
4 Non-indust.	1594	64	101464	25%
5 Industrial	2037	137	274282	67%

Some of the BMP sites will have culverts to be assessed for fish passage. However, it is uncertain how large of a sample will be generated from the random selection. Therefore, in order to insure adequate sample size, fish passage will also be addressed with a separate but related study. A separate query of the FACTS database revealed 2792 road-reconstruction or new-road activities. From this population, 100 sites will be randomly selected and monitored by a second fish-passage field team during the summers of 1999 and 2000. The purpose is to determine if new stream provide juvenile fish passage and provide for a 50-year design flow. There is a chance that a randomly selected site will be included in both the BMP and fish-passage samples. The BMP field team will monitor such sites. In addition, all BMP sites will be monitored to determine if fish passage is provided regardless of the age of the road.

2.3 Rule Focus

Forest practice rules that will be monitored for this project are referenced in Table 2. The randomly selected sites will be assessed in the field for compliance with all water protection, harvest, and road rules that apply to the site. Refer to the detailed methods section for more information. The general approach is to incorporate yes/no answers, measurable aspects of the rules, and rating methods. BMP field team will also document volunteer activities implemented in support of the salmon plan and instances where a

landowner has exceeded compliance.

Table 2. Forest practice rules that will be monitored during the BMPCAP.

DIVISION ###__DESCRIPTION	
Rule Number	Rule description
DIVISION 605__PLANNING FOREST OPERATIONS	
629-605-140	Notification – Types of Operations
629-605-150	Notification – When, Where, and How
629-605-170	Written Plans
DIVISION 610__REFORESTATION RULES	
629-610-040	Time Allowed for Reforestation
629-610-090	Land Use Changes
DIVISION 615__TREATMENT OF SLASH	
629-615-100	Maintenance of Productivity and Related Values
629-615-200	Mechanical Site Preparation near Waters of the Sate
629-615-300	Prescribed Burning
DIVISION 620__CHEMICAL AND OTHER PETROLEUM PRODUCT RULES	
629-620-100	Preventing, Controlling, and Reporting Leaks
629-620-400	Chemicals Application
629-620-800	Notification of Community System Managers
DIVISION 625__ROAD CONSTRUCTION AND MAINTENANCE	
629-625-100	Prior Approval
629-625-200	Road Location
629-625-300	Road Design
629-925-310	Road Prism
629-625-320	Stream Crossing Structures
629-625-330	Drainage
629-625-340	Waste Disposal Areas
629-625-410	Disposal of Waste Material
629-625-420	Drainage
629-625-430	Stream Protection
629-625-440	Stabilization
629-625-500	Rock Pits and Quarries
629-625-600	Road Maintenance
629-625-650	Vacating Forest Roads
DIVISION 630__HARVESTING	
629-630-100	Skidding Yarding Practices
629-630-200	Landings
629-630-300	Drainage Systems
629-630-400	Treatment of Waste Materials
629-630-500	Harvesting on High Risk Sites in Western Oregon
629-630-600	Felling; Removal of Slash
629-630-700	Yarding; Cable Yarding Near Waters Of the State
629-630-800	Yarding; Ground-based Equipment near Waters of the State
DIVISION 635__WATER PROTECTION RULES	
629-635-130	Written Plans for Streams, Lakes, Wetlands, and Riparian Management Areas

Table 2 Continued

DIVISION 640__WETLANDS AND RIPARIAN MANAGEMENT AREA	
629-640-100	General Vegetation Retention Prescriptions for Type F Streams
629-640-110	Live Tree Retention Credit For Improvement of Type F Streams
629-640-200	General Vegetation Retention Prescriptions for Type D and N Streams
629-640-300	Alternative Vegetation Retention Prescriptions
629-640-400	Site specific Vegetation Retention Prescriptions for Streams and Riparian Management Areas
DIVISION 645__RMAS AND PROTECTION MEASURES FOR SIGNIFICANT WETLANDS	
629-645-010	Live Tree Retention for Significant Wetlands
629-645-030	Soil and Hydrologic Function Protection for Significant Wetlands
629-645-040	Understory Vegetation Retention for Significant Wetlands
DIVISION 650__RMAS AND PROTECTION MEASURES FOR LAKES	
629-650-010	Live Tree Retention for Lakes
629-650-020	Soil and Hydrologic Function Protection for Lakes
629-650-030	Understory Vegetation for Lakes
DIVISION 655__PROTECTION MEASURES FOR OTHER WETANDS, SEEPS, AND SPRINGS	
629-655-000	Protection Measures for Other Wetlands, Seeps, and Springs
DIVISION 660__SPECIFIC RULES FOR OPERATIONS NEAR WATERS OF THE STATE	
629-660-040	Stream Channel Changes

Teams will assess:

- Riparian Management Areas: vegetation retention requirements, basal area, ground disturbance, erosion, and accumulation of slash in the stream
- Roads, landings, culvert size, fill depth, rill/gully erosion, drainage effectiveness, fill/waste/ & sidecast stability, etc.
- Slash Treatment: prescribed burning, mechanical site prep., erosion
- High-risk sites: road construction, slash. erosion
- Skid Trails: skid trail locations, drainage, stream crossings, erosion
- Fish Passage: when applicable will be assessed, but a separate inventory has been developed to specifically monitor this issue
- Yarding Corridors: vegetation and soil disturbance
- Permanent and Temporary Stream Crossings: stability, drainage, erosion, etc.

2.4 Discovery of Non-compliance

Cooperative relationships with participating landowners are critical to this study. Landowners are fully within their rights to deny access to their land. More importantly, landowner cooperation results in availability of related information that otherwise may not be gleaned from a site evaluation.

This project is designed to assess compliance, not to bring about enforcement. Therefore no enforcement action will be initiated as a result of this monitoring project. Likewise, this project will have no bearing an enforcement action established prior to this monitoring effort.

There may be a situation where the monitoring team detects resource damage resulting from a previously undetected non-compliant operation. Through a process of cooperation with all the parties involved, unsatisfactory resource conditions will be addressed. The goal of this policy is to encourage cooperation so that we might better understand our program and improve compliance at a larger scale. This is also in accordance with the goal of the BMPCMP, which is to determine BMP compliance and provide alternatives for improvement. Anonymity will be afforded to landowners and operators whom cooperate with this study.

2.5 Resources

Personnel

Other states have used an interdisciplinary team approach in some cases achieving greater acceptance of results on the part of reviewers. Participants included representatives from other agencies and interest groups. However, due to time constraints, participants could not commit for the duration of the field season. Therefore the statistical validity of the studies were brought into question. Success of this project requires consistent evaluations between sites. Therefore, a single crew will be used during 1999 and 2000 field seasons, as in the 1998 pilot study. Refer to the Quality Assurance/quality Control Section for details on crew consistency.

It is imperative that the project is lead by someone with personal experience in forest practices. Therefore the following arrangement has been implemented:

Project Coordinators: Jim Ziobro, ODF Enforcement Coordinator; Liz Dent, ODF Monitoring Coordinator. Jim and Liz have jointly worked in the development of this proposal. The proposal has been subject to internal and external review during its entire development. They will continue to be involved with study implementation, data analyses, and project reports.

Project Leaders: Conrad Tull and Joshua Robben. Conrad is a recently retired FPF with 40 years of experience in forestry. His intimate knowledge of rule application provides the needed insight to this project. Conrad will serve as the project lead, working seasonally from March to September. He will provide input on revising this proposal and methods. His responsibilities will include project

coordination with landowners, crew coordination, FPF interviews and site compliance assessment documentation. Josh is an assistant in the Monitoring Program and was a member of the 1998 BMPCMP Pilot Study. He will be responsible for project coordination, crew training, crew supervision, crew coordination, and data management.

BMP Field Team*:* Two seasonal employees, David Bergvall and Brett Morrissette, have been hired as the BMPCMP crew for the 1999 field season (May to October). The initial month will involve studying the forest practice rules and going out with Josh, Conrad, and Liz to increase experience in landowner/operator interactions, rule application, and situations where interpretations must be made of how the rules should be implemented. During the next four months they will conduct the numeric data collection protocol on approximately half of the 200 randomly selected sites.

Private Landowners: The landowner is an important resource to this project. By granting the team access, the landowner facilitates an opportunity to demonstrate the effectiveness of our administrative program. In addition, the landowner can provide the team with critical information about the history of the site (i.e. harvest date, system used, site prep methods, voluntary measures).

Other Agencies/Interest Groups: The interdisciplinary team approach is valuable for increasing acceptance of the final results. However, to maintain statistical validity, participation must be consistent. Therefore, agencies and interest groups will be given the opportunity to participate on an observational basis with specific landowner permission. This means that if someone other than those named above want to observe data collection techniques, they may accompany the monitoring team to the site, **only when landowners permit**. Other agencies and interest groups have been provided an opportunity to give input on study design through the external review committee.

Internal Review Committee. The internal review committee consists of an FPF from each area, forest practices policy and operations units representatives, unit and district foresters. This committee has been kept appraised of the project proposal as it develops and given opportunity to help shape it's direction. In addition, once the project has begun, committee members will function as liaisons between the field and staff office by providing field offices with any reports that are generated from the study, and giving feedback from the field to the project coordinators and lead (see Introduction for committee members).

External Review Committee. The external review committee consists of representatives from OSU, NCASI, OFIC, key environmental groups, OSWA, OAL, DEQ, NMFS and ODF&W (see Introduction for committee members).

Section 3. Study Methods

3.1 Field Methods

This section summarizes specific assessment methods used at each site. For detailed information on methodology refer to the 1999 Best Management Practices Compliance Monitoring Project (Dent and Robben, 1999).

Unit-level Data Collection and Compliance Assessment

In an effort to answer the monitoring questions ODF developed a protocol with two approaches to data collection: (1) numerical data and (2) compliance rating data. A 2-person BMP field team surveyed the unit-level sites collecting numerical data. At each unit-level site the BMP field team gathered numerical data based on rule requirements and the forest practice rules and statute guidance manual. Data were also collected on erosion and sediment delivery, and riparian characteristics since interpretation of compliance often hinges on whether sediment was delivered to the stream or not. The team and project had oversight by an experienced former FPF who evaluated each unit using a compliance rating system. Both approaches assessed the same rules. The combined assessments will provide greater understanding of compliance and the affects of non-compliance on water and riparian resources.

Data Parameters

Six rule divisions are assessed: Treatment of slash (division 615), Road construction and maintenance (division 625), Harvesting (division 630), Chemical and other petroleum products (division 620), Water protection rules (division 635), and Wetlands and riparian management areas (division 640). Roughly 150 rules can potentially be assessed at any given unit so the methods will not be described in detail. Please refer to the BMP Compliance Monitoring Project for detailed description of the data collection.

Detailed Numeric Documentation (Crew)

The numerical data are a combination of quantitative data and categorical data. For example in the case of riparian management areas the BMP field team will conduct data collection along transects spaced 200 feet apart for the entire length of the RMA. Along each transect the team will document: area (quantitative) and source (category) of vegetation and ground disturbance, accumulations of slash in the channel (category), width of no-cut buffer (quantitative), sediment delivery (quantitative and source category), and ground and vegetative disturbance on stream and riparian resources (categorical). In addition, if the area is managed for a basal area target the team conducts a 100% cruise of conifers and other trees and snags that can count towards basal area target (quantitative). A similar approach is used for written plans, wetlands, felling, yarding, treatment of slash, road maintenance and drainage, stream crossings, landings, and high-risk sites.

Compliance Assessment Methodology (Former FPF)

The compliance rating system provides qualitative data for each rule for the entire RMA as exceeds compliance, meets compliance, minor infraction, or non-compliance and describes the source of non-compliance. The practice is rated as:

EX: Exceeds rule requirements
MT: Meets rule requirements
NC: Non-compliance.

If there is a non-compliant practice the project lead will note if it was administrative, potential resource issue or an actual impact on stream resources. The overall compliance data and rating system will be compared with the detailed data to interpret rule and operation compliance. A similar approach is used for written plans, wetlands, felling, yarding, treatment of slash, road maintenance, road drainage, stream crossings, landings, and high-risk sites.

The dual design (numerical and rating data) is unique to the ODF BMP compliance monitoring project. All other states rely almost exclusively on rating data to determine compliance. The value of the numerical data is that it provides a non-biased method of determining compliance. In addition, it can be used in

concert with the qualitative data to quantify the potential impact to the resource in instances where non-compliance is identified. Finally the two datasets can be compared with each other. If there is good agreement then a well-trained crew should be able to collect data on compliance, reducing the dependence on an experienced FPF to visit every site.

The disadvantage of numerical data is that some of the rules and guidance do not provide numerical definitions of compliance and rely on professional judgement to determine compliance. This is due in part to the huge variability in conditions that can not be accounted and regulated for. Thus language like "minimize and avoid" is used to provide flexibility. The desired outcome it that the most appropriate practice for the particular set of conditions is applied. Out of 160 rules to be assessed at the unit level, have numerical data associated with them while all 160 have qualitative data.

3.2 Quality Assurance and Quality Control

What follows is the Quality Assurance/quality control (QA/QC) plan for the BMPCAP. It is designed to:

- assure repeatability between measurements and between field teams
- assure the field teams are trained and prepared
- assure reliability of data

Precision and Accuracy

During each of the two years of this project there will be only one field team. The field team will revisit some units previously measured and repeat the measurements. Data can be compared between site visits to determine the precision and accuracy of the methods and the repeatability of the field team. The relative standard deviation (coefficient of variation) can be calculated as measure of precision (EPA 1996). A low relative percent difference between two samples from the same reflects precise measurement. We will also test precision with multiple teams by conducting measures on units by both team. We can then compare the data to determine the precision between teams.

The project coordinator will implement periodic evaluations of the field team performances. This will be done by accompanying the teams in the field throughout the field season. The project lead will be intimately familiar with the data collection procedures and provide constant oversight to the field teams.

Procedure

Standardized methods have been developed for data collection procedures. Emphasis will be put on consistent implementation of the methods between sites and throughout the season. This includes proper use of equipment, keeping equipment in good working order, and taking the same measurements, in the same fashion on all the sites. Proper use of the standardized methods will result in comparable data between units.

Training

There will be a one month training period in which field teams spend one week in the office studying the forest practice rules, guidance, and BMPCMP protocol. Two weeks will be spent in the field, looking at operations and discussing the protocol and raising questions. The final week will be spent implementing the protocol on units. Split teams will assess each unit, so that differences in measurements can be detected and discussed.

Documentation and Records

Data will be collected and recorded on field data sheets developed and refined during the pilot study. The crews will spend 2 to 3 days a month in the office entering data into a computer spreadsheet (EXCEL, QUATTRO PRO or ACCESS). Printouts will be made of the spreadsheet files to check for data entry errors. Data will be backed up onto two different hard drives and CDROM. Field data sheets will be filed for permanent records.

References

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