Riparian Function and Stream Temperature: Effectiveness of Oregon Department of Forestry's Protection Rules and Strategies

ODF Forest Practices and State Forests
Study Approach
Version 2.2: February 2003

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Riparian Function and Stream Temperature
ODF Forest Practices and State Forests Study

INTRODUCTION

The forest practices monitoring program (FPMP) has been monitoring stream temperature since 1994 and riparian stand structure and function since 1996. The early stream temperature studies compared conditions (e.g. rate of temperature change, 7-day moving mean of daily maximum, diurnal fluctuation) upstream of harvest units to conditions downstream of harvest units to evaluate the effectiveness of current rules in meeting Department of Environmental Quality (DEQ) water quality standards. This approach did not adequately address the effectiveness questions due to a lack of pre-harvest data. Pre-treatment data collection provides a comparison of the inherent variability between the harvested and unharvested reaches. Without this control period, differences are assumed to be a result of the treatment and not pre-existing differences. Later studies utilized pre-and post-harvest comparisons combined with the upstream control reach and resulted in greater certainty in results. Therefore the FPMP proposes that future monitoring, with the objective to evaluate effectiveness, utilize a pre/post harvest measurement design coupled with control reaches. This statistical design is referred to as before-after control-impact (BACI). The drawback of such a design is the inability to implement it on randomly selected sites. The value of a pre/ post-harvest study design outweighs the value of a random sampling design when evaluating the effectiveness of current forest harvest operations in maintaining stream temperature and riparian function (Osenberg et al 1992, Stewart-Oaten et al 1992, Sit and Taylor 1998). Findings from the study are to be peer reviewed.

The proposed project evaluates stream temperature and riparian condition before and after harvesting. Sites will be evaluated on both privately-owned and state-owed forestland. The FPMP will collaborate with Oregon Department of Forestry's State Forests Monitoring Program (SFMP). Opportunities also exist for incorporating biotic evaluations through partnerships with Department of Fisheries and Wildlife at Oregon State University (OSU) and the United States Geologic Survey (USGS).

OBJECTIVES AND MONITORING QUESTIONS

The objective of this study is to provide a coordinated monitoring effort with which to evaluate effectiveness of forest practices rules and strategies in protecting stream temperature, and promoting riparian structure that provides necessary functions for the protection of fish and wildlife habitat. The project will evaluate both privately and state-owned forest land. On privately owned, forestland, riparian management areas will be managed under current (at the time of harvest, no sooner than Fall 2003) forest practice rules as described in the forest practices act. On State-owned forestland, riparian management areas will be managed using riparian and aquatic strategies as described in the Northwest Forest Plan. These two approaches are referred to as "riparian rules and strategies" hereafter and are described in Appendices B and C. The specific monitoring questions include:

1. Are the riparian rules and strategies effective in meeting DEQ water quality standards regarding anti-degradation of stream temperature and the water quality standard?
2. Are the riparian rules and strategies effective in maintaining large wood recruitment to streams, downed wood in riparian areas, and shade?
3. What are the trends in riparian area regeneration?

4. What are the trends in overstory and understory riparian characteristics and how do they along with channel and valley characteristics relate to stream temperature and shade?

Forest Practices policy staff are currently evaluating the FPAC recommendations for riparian rule changes. It is anticipated that by Fall 2003 the finalized Riparian Rule Revision package will be before the Board of Forestry. We request landowners to use riparian prescriptions that reflect the proposed rule package at that time (see Appendix B for the current riparian FPAC recommendations). These are considered recommendations and are subject to change. By Fall 2003 proposed rule revisions should be finalized.

STUDY DESIGN

A pre/post- study design that establishes control, treatment, and downstream reaches, 2 years prior to harvest (See Figure 1) is proposed. Temperature, channel, overstory and understory riparian characteristics will be monitored two years prior to harvest and for 5 years after harvesting to evaluate harvest effects and recovery rates. The following criteria will be used to identify sites for this study.

- Sites will be volunteered by landowners. However, a randomized approach will be incorporated if the FPMP identifies more sites than can be monitored.
- The study will focus on the Coast Range georegion. The Coast Range georegion is a priority because of collaborative opportunities with the SFMP in the North West Oregon Area. Should more ODF funds become available the next priorities are Blue Mountain and East Cascade georegions.
- Riparian Prescriptions: Landowners have the option not to harvest within riparian management areas. However, this study will attempt to focus on managed RMAs (i.e. avoid no-cut RMAs) available under the Forest Practices Act and aquatic and riparian strategies. For example, under current forest practice rules landowners can harvest trees within the RMA using the general prescription as described in OAR 629-640-0100.
- Natural Disturbance: The sites should not have active beaver ponds and ideally no significant abandoned beaver ponds. Sites should have no recent impacts from debris torrents.
- Stream classification, this study will focus on Medium Type F and N streams, and Small Type F streams. Additional temperature data loggers are placed at influential tributary points within the study reaches.
- Stream reaches should be fairly uniform in *channel and valley morphology, stream flow, and riparian characteristics* within and between the study reaches.
- Treatment Reach: Identify sites that will be harvested 2 years (No sooner than Fall 2003) after the study begins, providing two years of pre-harvest data. Minimum length desired is 700 feet. Smaller reaches may have to be monitored if these longer reaches are not available. Ideally, the upstream end of the harvest unit should be no less than 1000 ft downstream of Type N/Type F transition point (Figure 1).
- Control Reach: These sites must have an upstream "control" reach of approximately 700 to 1000 feet (Figure 1). The control reach must remain unharvested for the duration of the study. Control is defined as a stream-adjacent and upland stand of 25 years or older, and approximately 200+ feet wide. If need be, the control reach can be established on a nearby stream, but this would be a last resort.
- Downstream reach: Intact riparian vegetation 700 to 1000 feet downstream of treatment reach (Figure 1). Ideally this would also remain unharvested for the duration of the study.

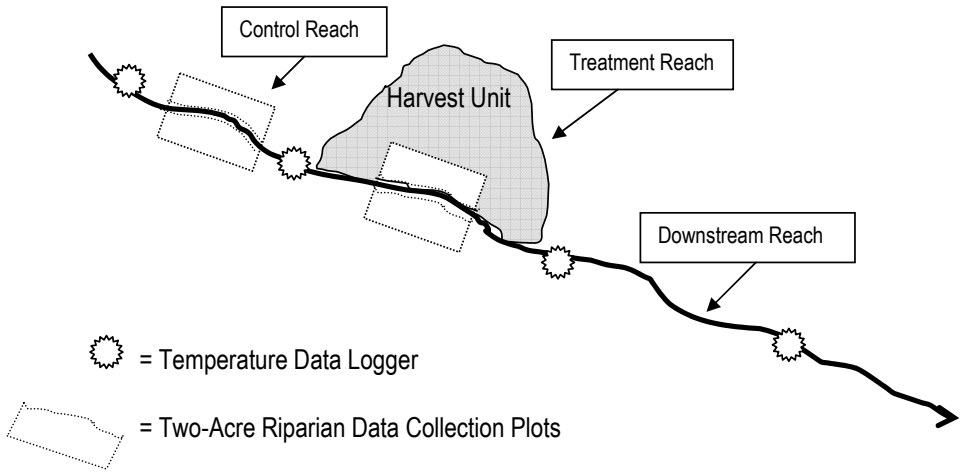

Figure 1. Schematic of study design and data logger placement. Additional data loggers are placed at influential tributary inputs.

DATA COLLECTION PARAMETERS

The following is a list of temperature parameters and a brief description of the collection procedures used historically for stream temperature and riparian monitoring. These are currently being evaluated for inclusion in the field protocol.

Photo Points

Methods as described in chapter 14 of the OWEB Water Quality Manual will be followed to establish photo points to document views of the riparian areas and stream reaches in the control, treatment and downstream reaches. Once the site is harvested a photo point will also be established that gives a "bird's eye" vantage point as well.

Temperature and Flow Measures

1. Hourly water temperature: Collected at upstream and downstream boundaries of the control, harvest and downstream stations using continuously recording temperature data loggers.
2. Hourly air temperature: Collected in the control and treatment reaches to track climatic differences between years.
3. Stream Flow is measured using a velocity meter and cross-sectional area at every water temperature station during the low flow period.
4. GPS locations: collected at each data logger location if possible, a minimum of one reading per site, at a nearby location where a reading is successful.

Comment [JPP1]: Note: Collection of air in both treatment and control was added by Review Committee input.

Shade and Channel Characteristics

The following parameters can influence temperature at the site or reach level. Data are collected at stations spaced 200 feet apart, throughout the control, treatment and downstream reaches. Each data collection station is marked with labeled flagging to facilitate repeat visits.

1. Buffer width: Slope distance on each side of the stream. If it is unharvested then 100+ is entered.
2. Buffer Height: Average height is estimated for each side of the stream.
3. Forest Shade Angle: Using a clinometer, measure the angles to the highest vegetative source of shade orienting yourself in four directions (upstream, left, right and downstream).
4. Forest and shrub canopy cover: Using a handheld densiometer measure the canopy cover orienting yourself in four directions (upstream, left, right and downstream).
5. Topographic shade angle: Using a clinometer measure the angle to the highest topographic source of shade orienting yourself in four directions (upstream, left, right and downstream).
6. Wetted Width: Using a surveyor's rod or tape measure the width of the wetted surface, subtracting mid-channel point bars that are out of the water.
7. Bankfull Width: Using a surveyors rod or tape measure the width of the channel at the average annual high water mark,
8. Thalweg depth: Measure the deepest part of the channel with surveyor's rod or tape.
9. Gradient: Measure the slope of the channel with a clinometer. One person stands at the top of a riffle or pool and another person at the top of an upstream riffle or pool. The downstream person looks upstream through the clinometer aiming at the other person. Before splitting up figure out the level where your eyes line up on the other person (i.e. at their hardhat, chin etc.) and aim for that point.
10. Channel incision and flood-prone width. Channel incision will be described as the ratio of the flood-prone width to the bankfull width. The flood-prone area is defined as the width measured at an elevation determined at twice the maximum bankfull depth. Flood-prone width will be measured with a hip chain or logger's tape.
11. Azimuth: Measured with a compass by orienting yourself downstream and with the direction of the valley (not a meander).
12. Substrate: Estimate the percent of channel bed composed of each size class of material (bedrock, boulder, cobble, gravel, sand or fines).
13. Topography. The site will be characterized by valley type. Slope will be measured along 3 transects through the plot, documenting all changes in slope and landform within 170 feet of the stream.
14. Shade. Shade will be measured using a fish-eye lens camera at the same stations where cover is measured. The camera will be leveled at 3 feet above the water surface. The benefits of this system over a densiometer include having photo documentation of the site, a hemispherical view that can be used to calculate direct solar radiation, and greater accuracy and precision.
15. Large Wood Survey: A tally is kept on all pieces of wood within and above the bankfull width.
16. Parent Geology: Parent geology will be collected as a parameter for each site from a secondary GIS source.

Riparian Structure Characteristics

The following measurements will be collected by a contractor/researcher and are subject to revision. A rectangular plot (500 by 170 feet) is used to survey overstory trees and snags, with fixed 1/100 acre circular plots embedded to survey regeneration, shrubs and herbs. Twenty-five

foot long transects from each fixed plot are used to survey downed wood (see Figure 2). The collection of plots is centered in each of the control and treatment reaches on both sides of the stream for a total of four plots per site (see Figure 1).

Laying out the Plots:

- Permanently mark the four corners of the 500 by 170 foot plot based on horizontal distance.
- Determine the azimuth of the stream valley through the study reach. Set an azimuth directly perpendicular the valley azimuth. Record both azimuths. Come in 50 feet from either side to establish the starting point for Line 1 or Line 5. Flag in the transects every 100 feet using the same perpendicular azimuth for each line. In general, data will be collected from the start of a given line by moving upslope along the transect and recording downed wood, attributed to a fixed plot, collecting regeneration, shrubs, and herbs on each fixed plot moving up the transect line. Overstory trees and snags will be added to the last plot on each line (i.e. furthest plot out - plots 5, 11, 17, 23, & 30) while cruising the trees/snags back down within that given 170 by 100 foot fixed plot area. Establish circular plot centers (25, 50, 75, 100, 125, and 150 feet from the stream channel) based on horizontal distance.

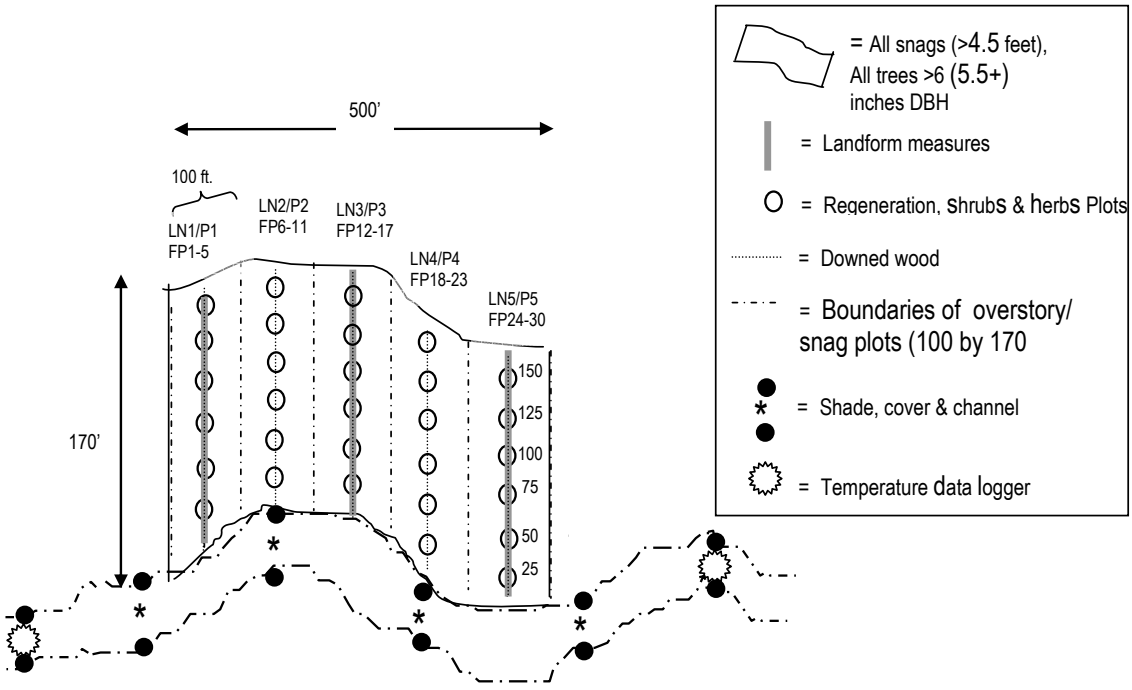

Figure 2. Plot design for vegetation, shade, and channel measurements. [Not to scale.]

1. Landform: Travel along the upstream and downstream plot boundaries, and at the 300 ft. transect. Starting at the stream edge record the length of the feature in terms of distance from stream, and the slope gradient (Figure 2).

2. Overstory Trees: Take the following measurements on all trees greater than 6 inches (5.5"+) DBH:
   - Block: Record which block the overstory trees are in (e.g. 100 block, 200 block etc.)
   - DBH (inches): Diameter at breast height.
   - Species (code): Document the species of each tree that is measured using a two letter code.
   - Slope Distance from stream (Ft): estimated to the nearest 5 feet. You may have a tree that has a slope distance of 185 feet even though you are within 170 feet horizontal distance of the channel.
   - Tree height (ft): Measure tree height on every 5th tree for each species, striving to collect heights for at least three trees per species and across the range of diameters (small-medium-large) for each species.
   - Live crown ratio: Measure the height to the base of the live crown on each tree that was measured for height.
   - Crown Class (code): Measure live tree crown class (e.g. Dominant, Codominate etc.)
   - Tree Lean Towards Channel (code): Yes, if greater than 20° towards channel, No if less than 20° or if leaning away from channel.
   - Damage: Each tree will be assessed primarily for broken/missing top damage.
   - Defect: Each tree will be assessed a percentage missing or unsound in the lowest, middle and top thirds of the tree bole.
   - Growth Indices: On site trees bored for age, measure and record the 10 year radial growth increment in 1/20th of an inch.
   - Blowdown: Will be tracked in the post-harvest seasons.
3. Snags: Take the following measurements on all snags greater than 4.5 feet tall:
   - Diameter
   - Distance from stream
   - Conifer/hardwood, species if known.
   - Decay class
   - Height: Dead trees that have their tops intact are not cruised for height – heights are assigned through use of the regression developed for the live trees. Dead trees with broken tops (more than 10% of the original height broken out) shall have their height estimated and recorded.
4. Shrubs: These measures are taken in the 12 foot radius circular plots along the 6 transects established 100 feet apart and perpendicular to the valley azimuth. Plots are 25, 50, 75, 100, 125 and 150 feet horizontal from the stream channel.
   - For each shrub, herb, and forb species observed record the percent ground covered by species and an average height for that species.
5. Understory Trees: These measures are taken in the 12 ft. radius circular plots along the 6 transects established 100 ft apart and perpendicular to the valley azimuth. Plots are 25, 50, 75, 100, 125 and 150 feet from the stream channel. Take the following measurements on all trees less than 6 inches (<=5.4") DBH that are within the plot.
   - Height
   - Live Crown ratio
   - species
6. Downed Wood: Volume per acre, decay class. The following along the 6 transects established 100 ft apart and perpendicular to the valley azimuth (Figure 2). For all downed wood that crosses the transect measure the:

- Diameter at the intersection with the transect line (inches)
- Distance from channel at the intersection with the transect.
- Large and small end diameter (inches)
- Length (feet)
- Species: Use tree species codes. If cannot identify then classify as hardwood unknown or conifer unknown
- Decay Class

PROPOSED DATA ANALYSIS APPROACHES

Temperature

Parameters: Rates of Change between years and between reaches, differences in frequency distributions diurnal fluctuation and of 7–day moving mean of daily maximum.
Statistical Tests:
Measure of Effectiveness:

- Less than 1°C (detectable level given current equipment) change in max 7-day moving mean (antidegredation)
- No change in frequency distributions (number of days over standard) (Numerical standard)
- No change in frequency distributions of diurnal fluctuation.
- No difference in rate of change through harvest unit as compared with control and pre-harvest period

Riparian Function

Parameters: Large Wood Recruitment and Shade (before/after comparisons, long term potential recruitment)
Statistical Tests:
Measure of Effectiveness:

- Shade: Less then 10% reduction in cover/shade year 1 after harvest
- Large Wood Recruitment (LWR): Less than 10% reduction in LWR immediately following harvest, model recruitment over time and compare to range of conditions from mature stands

Riparian Structure

Parameters: Species composition, diameter distribution, layering, regeneration, downed wood, snags, live crown ratio, growth rates
Statistical Tests:
Measure of Effectiveness:

- Diameter distribution is favorable for moving towards mature future condition, compare to range of conditions from mature stands/goals as described in aquatic strategies
- Multi-layered structure within x years (state forests aquatic strategies),
- No reduction in downed wood, wood loading of X cubic feet /acre
- Live Crown ratios greater 30%,
- Conifer regeneration (western Oregon)

SAMPLE SIZE NEEDED

An evaluation of sample size was performed with existing stream temperature data. Results suggest a sample size of 22 will provide 95% confidence in the ability to detect a 1° C change in temperature.

QUALITY CONTROL QUALITY ASSURANCE

Field Data Collection

Stream temperature: Follow established methods for "calibrating" temperature data loggers as described in the OWEB water quality guidebook. Temperature data are given a quality rating based on length of record and data logger problems (e.g. exposed to the air, malfunctions, etc.) that may have occurred during the period of record.

Shade and Channel: Test repeatability of measurements. Repeat measures with the same crew on the same site to test for measurement error within crews. Repeat measures with different crew on the same site to test for measurement errors between crews (if more than one crew is hired).

Riparian Characteristics: Data collection will be performed with a handheld computer and software with built in data checks. Ten percent of the plots and/or at least half of the sites will be check-cruised for accuracy.

Data Entry

An access database will be used with controls on data entry variables. Data will be printed out to compare to field sheets to check for data entry errors. Riparian data will not require data entry.

COOPERATORS

Study participants include: ODF Forest Practices Monitoring Unit; State Forests, Private Landowners, OSU Dept. of Fish and Wildlife, OSU Dept. of Forest Engineering, and DEQ.

REVIEW

This project approach, design, and proposed analysis will go through a review process. Reviewers include researchers, DEQ, ODF&W, stakeholders, researchers, and representatives of the environmental caucuses. A review team has been formed. A panel of scientists will be compiled for peer review of preliminary and final reports.

BUDGET

The project is estimated to cost $143,360 (Table 1). The estimate has not incorporated costs for biotic assessments and data collection is assumed for 60 sites in one georegion. Additional georegions would be more expensive than the Coast Range georegion because of additional equipment costs such as a flow meter and rod, YSI thermometer and data logger, and 300 data loggers rather than 150 data loggers.

TIME LINES

The project implementation should begin by late spring 2002 (Table 2). The pre-harvest period will continue through 2003. Riparian and channel data will be collected in its entirety during 2002,

2004 and during the last field season. A subset of data collection parameters will be collected every other year beyond that.

Table 1. Initial startup budget estimate (annual) for 60 sites in the Coast Range geographic region.

Channel, Shade, Temperature Measurements		Subtotal
Seasonals : Personal Services: 2@ salary range 12 (+380/mo overtime)	20,000	
S & S: 10,000/seasonal	20,000	
NRS1: 1 at step 4 for 5 months	13,280	
S & S:	10,000	
Vehicle (400/month)	2,000	
		Subtotal: 65,280
Contractor/Researcher Costs: Riparian Measurements		
Estimate/site=$1000/site	60,000	
		Subtotal: 60,000
Equipment		
Temperature Data Loggers (FPMP has 150 data loggers, assumes drop current study)	16,500	
Optic Shuttle	199	
Laptop	1300	
Software	81	
		Subtotal: 18,080
	Total =	**143,360**

Table 2. Proposed project time lines.

	Pre-harvest				**02Site Harvest**	**03Site Harvest**	**Post Harvest**			
	Spring 2002	May 2002	Spring 2003	May 2003	2004	2005	2006	2007	2008	2009*
Project review and input	X	X	X	X	X	X	X	X	X	X
Study site search	02Sites→									
			03Sites→							
Temperature and Flow Measures	02Sites	X		X	X	X	X	X	X	
			03Sites	X	X	X	X	X	X	X
Shade and Channel Characteristics	02Sites	X				X			X	
			03Sites	X			X			X
Riparian Structure Characteristics	02Sites	X				X			X	
			03Sites	X			X			X
Reports					Prelim→		Prelim→			Final

***** May go longer if 2003 sites are harvested later than fall 2004 – early summer 2005. Note: Additional sites added in 2003 (second group of sample sites) have same schedule, with dates offset one year later.

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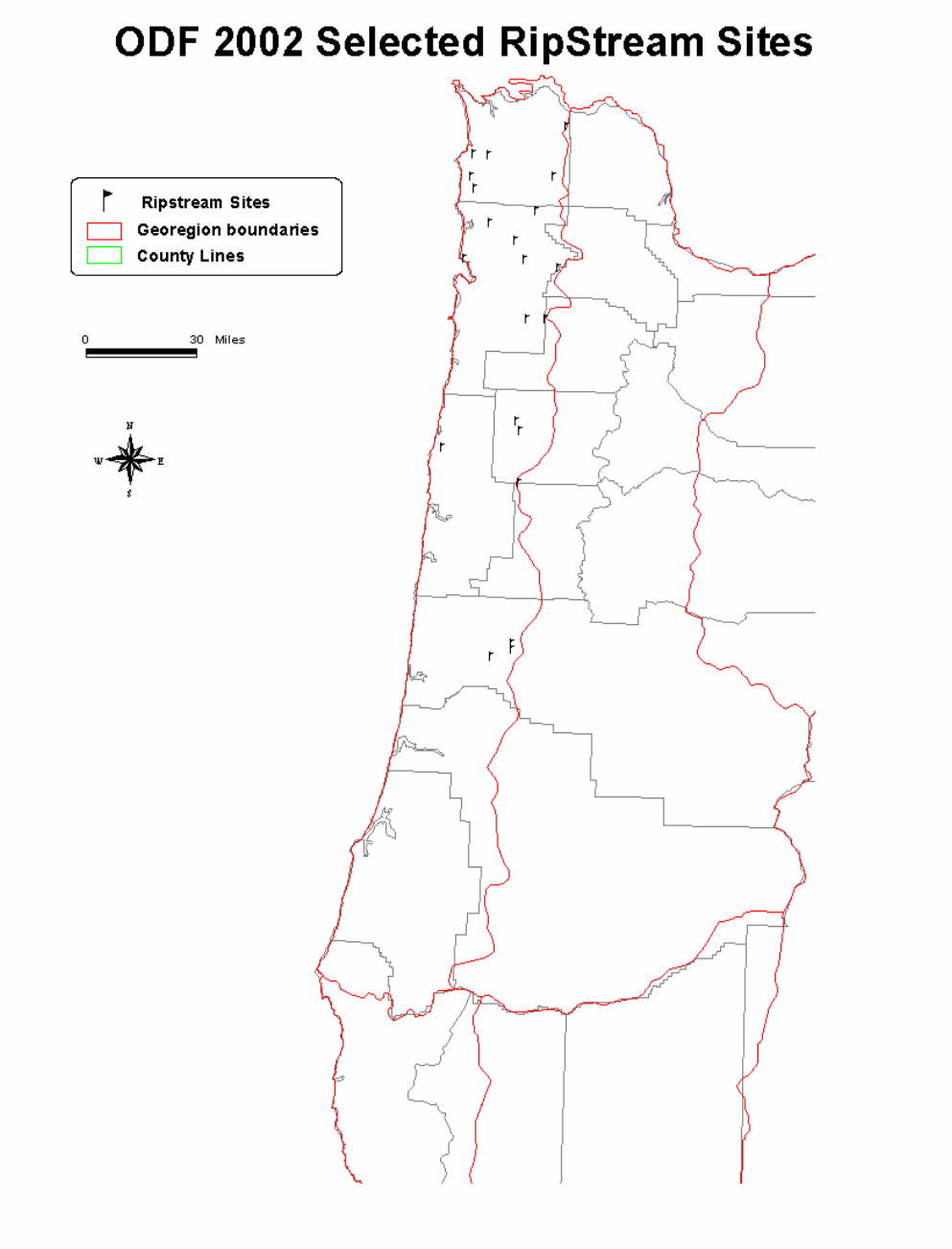
APPENDIX A: GENERAL SITE LOCATION MAP



APPENDIX B: FPAC RIPARIAN RECOMMENDATIONS

The following summarized riparian recommendations received either "consensus" or "strong agreement" among committee members. "Consensus" support means all committee members, present or represented by proxy at the meeting where the recommendation was discussed, expressed support. "Strong Agreement" means no more than three of the thirteen committee members expressed nonsupport. "Majority " support referenced in the body of the report means at least seven committee expressed support, but four to six committee members expressed nonsupport.

Only Recommendation V (changes focused to increase the protection and restoration of riparian functions) is provided here. The full FPAC report or any of the individual components, including the Introduction/Overview, can be found at the following web location:
http://www.odf.state.or.us/FP/CurrentEvents/CurrentEventsPg.htm

RIPARIAN FUNCTION

Recommendation V: The following list of changes are recommended to increase the protection and restoration of riparian functions. Further clarification and/or guidance on a number of these points will be needed to further develop these concepts.

1. Harvesting Cap 40%
   In western Oregon, manage any harvesting within the Riparian Management Area (RMA) so that the retained conifer basal area exceeds the basal area standard target, or 60 percent of the pre-harvest basal area, whichever is greater.

2. No Touch Area ½ of RMA
   The no-touch width will be equal to one-half the width of the entire RMA.

3. Largest Trees 10 Out of 20 Largest
   Retain 10 of the 20 largest trees per 1,000 feet outside of the no-touch width that will best achieve aquatic riparian functions. Subject to FPF approval, the landowner would identify tree locations in a written plan demonstrating how this objective will be met. There would be discretion to also consider operational issues and the value of the trees, as long as best achieving aquatic riparian functions remains the primary objective.

4. Type N Streams (Nonfish Bearing) Forest Practice Forester Discretion
   a. Small Type NT streams are: 1) Perennial Small Type N (temperature) streams that are tributary and contribute at least 30% of the flow to small and medium Type F streams and that have a drainage area larger than "X" acres (basin size to be set by georegion, 40 acres for the coast range). Initial classification will be based on basin size, but landowners may delist streams or stream segments verified as nonperennial. 2) Small Type N (torrent) streams with drainage basins greater than 30 acres, in which more

than 75% of the basin has been mapped as "high" or 50% "extreme" debris flow hazard (by the State Forester) and which have a high probability of wood delivery to Type F streams.

b. Small NT stream protection: 1) Up to the first 500 feet of Type NT (temperature) stream above the confluence with a Type F stream will have a 50-foot search zone, each side. Within the search zone, retain 4 square feet of trees per each 100 feet of perennial flow (up to 500 feet) and all nonmerchantable conifer on each side of the stream. Trees left along these streams to satisfy the basal area requirement can be counted as in-unit leave trees. 2) "Torrent" type NT streams will be protected as follows - FPF, working with the landowner, has discretion to direct retention of in-unit trees to 50' x 500' search zone (each side).

5. In-growth 25% Adjustment for Small Streams

The standard target will be recalculated for small Type F streams using the same per-acre basal area as large streams, minus 25 percent for in-growth. The standard target will also be recalculated for medium Type F streams, using the same per-acre basal area as large streams.

6. Riparian Specialist

The Oregon Department of Forestry will designate a riparian specialist in each administrative area who will be available to inventory and prepare riparian prescriptions for landowners, at their request. These specialists will be new positions funded by funds other than the harvest tax.

7. Similar Prescriptions for All Large and Medium Streams

Large and medium Type N stream prescriptions will be the same as the equivalent size Type F.

8. Monitoring

The effectiveness of the small Type N stream prescription will be a monitoring priority.

9. Alternative Vegetation Retention Prescriptions

The existing alternative vegetation retention prescriptions (e.g., hardwood conversions) may be applied to all riparian management areas (RMAs).

10. Preventing Sediment Delivery

The purpose statement for harvesting rules will be modified to better describe the objective of preventing sediment delivery to channels. The current requirement not to locate skid trails within 35 feet of Type F or D streams will be extended to all streams. Skid trails will be defined as an excavated trail used to yard logs with more than one turn.

11. Measurement of Riparian Management Area/Channel Migration Zone

The riparian management area (RMA) will be measured from the current points of measurement except for areas designated by the State Forester as a channel migration zone (CMZ). A CMZ is an unconstrained reach of stream that, in the judgment of the forester, is likely to have channel movement that can go outside the RMA widths within the period of a rotation (50-100 years). Within the CMZ, the no-touch area will be measured from the high-water mark of the channel (same as current rules). The outer edge of the CMZ will be based upon guidance to be developed by a technical committee. Retained trees in the CMZ shall be no less than the basal area standard target.

12. Type N and Small Type F Streams
Landowners would get credit for in-unit leave trees.

13. Conceptual Agreement About the Use of "Stratification"
In recognizing that riparian stands are not homogenous and that applying a single target for the RMA can prevent appropriate management in patches with conifer "over" stocking, agreement was reached on the concept of stratification. The details of how to do it in the field are to be developed. Stratification could allow an RMA to be divided into segments with a different management approach applied to each segment based on the specific conditions in the segment.

14. "Provide for Placement of Large Wood" is Supported as a Concept
(See "Subcommittee" Riparian Option under Riparian Functions for more information.)

Management Standards for Aquatic and Riparian Areas

The *Northwest Oregon State Forests Management Plan* uses a blended approach for the aquatic and riparian strategies. The first component is the landscape management strategies described in Chapter 4 of the plan. Over time, these strategies will create properly functioning riparian and aquatic conditions and processes. The second component a set of more site-specific strategies for aquatic and riparian areas is discussed in detail in this appendix.

The second component of the blended approach is a set of more site-specific or prescriptive strategies designed to protect key resource elements or provide for specific functional elements not necessarily addressed by the landscape strategies.

In Chapter 4, Aquatic and Riparian Strategy 2 states:

Apply management standards for aquatic and riparian areas. Establish and maintain riparian management areas adjacent to all streams, in accordance with the standards described in the proposed *Western Oregon State Forests Habitat Conservation Plan*, and Appendix J of this plan.

The site-specific, prescriptive standards in this appendix will guide forest management activities to achieve properly functioning aquatic and riparian habitat conditions over time. Management actions will be consistent with these standards, except where specific exceptions are documented and authorized by the District Forester. As information from monitoring efforts, watershed assessment and analysis, and other sources becomes available, specific standards may be changed or modified as necessary to meet the overall goal of maintaining and restoring properly functioning aquatic habitats.

Riparian Management Areas (RMAs)

Riparian management areas will be established immediately adjacent to waterways for the purpose of protecting aquatic and riparian resources, and maintaining the functions and ecological processes of the waterways. Within these areas, special management considerations and operational restrictions will be applied, and the protection of aquatic resources will be a high priority.

The width of riparian management areas will vary by the type and classification of the water body. These widths were developed by considering the functions and processes to be achieved or maintained by management activities. The width of a riparian management area (RMA) is measured horizontally beginning at the average high water level of the water body, or the edge of stream-associated wetland, side channel, or channel migration zone (whichever is farthest from the waterway), and extending toward the uplands. The width of these areas will be expanded, if necessary, to fully encompass certain sensitive sites such as inner gorge areas, or other special sites noted in the management prescriptions. See the "Key Terms" box on the next page for definitions.

Riparian management area widths are intended to be averages applied over the length of a management site. The actual extent of a specific RMA can be varied to tailor vegetation retention to site-specific conditions, or to address special resource considerations. For example, an RMA boundary will be expanded where a potentially unstable slope adjacent to a stream could deliver materials to the stream. The intent of this action is to increase the potential for large wood delivery should a disturbance event occur. Variations in RMA design will always be completed in a manner consistent with the management objectives for the specific aquatic or riparian area.

On the next several pages, guidelines are given for defining the four zones of a riparian management area and classifying streams. See "Basic Concepts for Aquatic and Riparian Conservation" in Chapter 4 for discussion of the functions and processes of healthy aquatic systems and the desired future condition for streams.

Key Terms

Active channel width — The average width of the stream channel at the normal high water level. The normal high water level is the stage reached during average annual high flow. This high water level mark often corresponds with the edge of streamside terraces; a change in vegetation, soil or litter characteristics; or the uppermost scour limit (bankfull stage) of a channel.

Average high water level — The stage reached during the average annual high flow period. This level often corresponds with the edge of streamside terraces, marked changes in vegetation, or changes in soil or litter characteristics.

Bog — A wetland that is characterized by the formation of peat soils and that supports specialized plant communities. A bog is a hydrologically closed system without flowing water. It is usually saturated, relatively acidic, and is dominated by ground mosses, especially sphagnum. Bogs are distinguished from other wetlands by the dominance of mosses and the presence of extensive peat deposits.

Channel migration zone (CMZ) — An area adjacent to an unconfined stream channel where channel migration is likely to occur during high flow events. The presence of side channels or oxbows, stream-associated wetlands, and low terraces are indicators of these zones. The extent of these areas will be determined through site inspections using professional judgment.

Inner gorge — An area next to a stream or river where the adjacent slope is significantly steeper than the gradient of the surrounding hillsides. In the absence of an on-site inspection and determination by a Department of Forestry geotechnical specialist or other qualified person, these areas are defined as having a slope gradient adjacent to the stream of 70 percent (35 degrees) or greater, and where the height of the slope break is at least 15 feet (measured vertically) above the elevation of the channel.

Guidelines: The Four Zones of a Stream Riparian Management Area

Riparian management areas established along streams will contain four zones. The purposes and differences between these four zones are defined below and on the next page.

Aquatic zone — The aquatic zone is the area that includes the stream channel(s) and associated aquatic habitat features. This zone includes beaver ponds, stream-associated wetlands, side channels, and the channel migration zone. The other zones of a riparian management area are established upslope from the outer edge of these features.

Stream bank zone — The stream bank zone is the land closest to the stream, including the stream banks. Most riparian functions are supported to some extent by vegetation in this zone, including providing aquatic shade, the delivery of down wood and organic inputs (leaves and tree litter) to the stream and riparian area, stabilizing the stream bank, contributing to floodplain functions, and influencing sediment routing processes.

- The stream bank zone is defined as the area within 25 feet of the outer edge of the aquatic zone for all streams. This zone exists on both sides of a stream.

Inner RMA zone — The inner RMA zone is the next area away from the stream, adjacent to the stream bank zone. Vegetation within this zone contributes substantially to desired riparian functions, including providing aquatic shade, delivering a high proportion of the potential large wood available, and contributing organic inputs to the stream. Vegetation within this area also provides some protection to certain aspects of riparian micro-climate. Because vegetation in this zone has a relatively greater role in supporting riparian functions and processes, a high priority is being placed on management actions in this area.

- The inner RMA zone extends from 25 feet (the outer edge of the stream bank zone) to 100 feet from the stream. This zone exists on both sides of a stream.

Outer RMA zone — The outer RMA zone is the portion of the riparian management area farthest away from the stream. Vegetation within this zone may still contribute to certain riparian functions and processes, but to a lesser extent than the two zones closest to the stream. The primary functions provided by vegetation in this area include additional contributions of large wood to the riparian zone and stream channel, and the protection of riparian micro-climate. In some cases, the outer zone may also partially buffer the two inner zones from certain disturbance events such as windthrow.

- The outer RMA zone extends from the edge of the inner zone at 100 feet out to 170 feet from the stream. This zone exists on both sides of a stream.

Guidelines: Stream Classification

Determination of the applicable management standards for riparian areas is based on a stream classification system. Streams are grouped into two major categories based on the primary beneficial uses of the stream. Streams are further classified according to size, based on average annual flow. Flow pattern (perennial and seasonal) is also considered for small non-fish-bearing waters. This classification system is generally consistent with the method used for administration of the Oregon Forest Practices Act, as described in the Department of Forestry's Forest Practice Technical Note FP1 — Water Classification (Oregon Department of Forestry 1994).

Beneficial Use Classifications

Streams, and other aquatic habitats, are classified into two major groups based on the presence or absence of certain fish species. The following definitions will be applied in classifying streams.

Fish-bearing (Type F) — Waters that are inhabited at any time of the year by anadromous or game fish species, or by fish species that are listed as threatened or endangered under either federal or state Endangered Species Acts.

Non-fish-bearing (Type N) — Waters that are not fish-bearing (see previous definition).

Stream Size Classifications

Streams are further classified by size, based on estimated average annual flow. The following definitions apply to these size categories.

- **Small —** Average annual flow of 2 cfs (cubic feet per second) or less.
- **Medium —** Average annual flow greater than 2 cfs, but less than 10 cfs.
- **Large —** Average annual flow of 10 cfs or greater.

Flow Pattern Classifications

Small non-fish-bearing (Type N) streams are also classified according to the flow pattern exhibited in normal water years. For the purposes of this plan, the following definitions will be used.

- **Perennial Type N streams —** streams that are expected to have summer surface flow after July 15.
- **Seasonal Type N streams —** streams that only flow during portions of the year; these streams are not expected to have summer surface flow after July 15.

Some seasonal non-fish-bearing streams are further classified as:

- **Seasonal high energy streams —** Seasonal streams with physical conditions that favor the periodic transport of coarse sediments and woody materials during high flow events. For the purposes of this plan, and in the absence of specific geomorphologic identification, stream reaches with an average gradient exceeding 15 percent, and an active channel width of five (5) feet or more will be defined as seasonal high energy streams.
- **Potential debris flow track reaches —** Potential debris flow track reaches are reaches on seasonal Type N streams that have been determined to have a high probability of delivering woody debris to a Type F stream.

Oregon Department of Forestry field staff will make the determination of the probability that a reach will deliver woody debris to a Type F stream, using the following criteria:

1. The seasonal stream reach must terminate at or below a high risk site. High risk sites include:
   a. Active landslides (slopes with tension cracks, unvegetated soil scarps, or jackstrawed trees caused by slope movement).
   b. Slopes steeper than 80 percent, excluding competent rock outcrops.
   c. Headwalls or draws steeper than 70 percent.
   d. Abrupt slope breaks, where the lower slope is the steeper and exceeds 70 percent, except where the steeper slope is a competent rock outcrop.
   e. Incised channels (hill slopes adjacent to the channel and steeper than the upland slope) with slopes steeper than 60 percent.
   f. Any other site determined to be of marginal stability by a Department of Forestry geotechnical specialist.

2. The path of a potential debris flow and the likelihood that a debris flow will reach a Type F stream. If any one of the following three conditions is present along the path from the high risk site to the Type F stream, then a debris flow is likely to stop and the stream reach would be determined to have a low probability of woody debris delivery:
   a. The presence of a channel junction that is 70 degrees or more, provided the channel downstream of the junction is less than 35 percent gradient.
   b. The presence of a stream reach which is less than 6 percent gradient for at least 300 feet.
   c. An average slope from the high risk site along the potential landslide path to the stream that is less than 20 percent.

Management Standards for RMAs

The following standards will guide management activities so that properly functioning riparian and aquatic conditions will be created over time. These standards will apply until alternative standards are identified through the adaptive management process. As new information and a better understanding of the watershed functions and processes become available, this knowledge will be integrated into the management of riparian and aquatic habitat through the adaptive management process. The management standards are presented in Tables J-1 and J-2.

Table J-1. Management Standards for Type F Stream RMAs

All Stream Sizes: Large, Medium, and Small	
Stream bank zone 0-25 ft.	• No harvest. • Less than 10% vegetative disturbance. • Full suspension required during cable yarding. • No ground-based equipment operation. • Leave any trees damaged or felled from yarding activities.
Inner RMA zone 25 to 100 ft.	• Manage for mature forest condition.[1] • No management activity where mature forest condition (MFC) exists, or where conditions are suitable for development of MFC in a reasonable time frame without further treatment. • Actively manage where necessary to achieve the desired future condition in a timely manner. • Minimum 15-year interval between harvest entries, and minimum number of entries necessary to achieve the desired future condition. • Partial cutting will maintain a conifer density of at least SDI 25%, and will retain at least 50 TPA. • No more than 10% vegetative disturbance allowed from cable yarding. • Full suspension wherever possible, or one-end suspension on all cable-yarded material. • Ground-based equipment operation limited to area more than 50 ft. from aquatic zone and slopes less than 35%, and allowed on no more than 10% of area. • Leave any trees damaged or felled from yarding activities and additional felled, girdled or topped trees to contribute toward down wood targets.[2] • Retain all dead and down material that was present prior to the operation.
Outer RMA zone 100 to 170 ft.	• Retain at least 10 to 45 [3] conifer trees and snags per acre (15 to 70 trees per 1,000 ft. of RMA). [4] • Retain all snags as safety permits. • Less than 10% ground disturbance from yarding activities. • Retain all dead and down material that was present prior to the operation.

1. Desired mature forest condition consists of a stand dominated by large conifer trees, or where hardwood-dominated conditions are expected to be the natural plant community, a mature hardwood/shrub community. For conifer stands, this equates to a basal area of 220 square feet or more per acre, inclusive of all conifers over 11 inches DBH. At a mature age (80-100 years or greater), this equals 40-45 conifer trees 32 inches in DBH per acre.
2. Up to 10 trees per acre will be retained as felled, girdled, or topped trees during partial cutting, to reach a target of 600-900 cubic feet per acre of hard down wood.
3. Outer zone tree retention target will be increased when less than the target number of conifers is present in the inner zone. The process for calculating the outer zone retention target is described in the section following the RMA prescription tables.
4. All trees retained will be dominant or co-dominant conifer trees (if available). In order to balance the need for short-term and long-term recruitment of large wood to the aquatic zone, preference will be given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.

Table J-2. Management Standards for Type N Stream RMAs

Large and Medium Type N Streams	
Stream bank zone 0-25 ft.	• No harvest. • Less than 10% vegetative disturbance from cable yarding. • Full suspension required. • No ground-based equipment operation. • Leave any trees damaged or felled from yarding activities.
Inner RMA zone 25-100 ft.	• Manage for mature forest condition.[1] • No management activity where mature forest condition target already exists. • Actively manage where beneficial to achieve desired future condition. • Minimum 15-year interval between harvest entries, and minimum number of entries necessary to achieve the desired future condition. • Partial cutting will maintain a conifer density of at least SDI 25%, and will retain at least 50 TPA. • No more than 10% vegetative disturbance allowed from cable yarding. • Full suspension wherever possible, or one-end suspension on all cable-yarded material. • Ground-based equipment operation limited to area more than 50 ft. from aquatic zone and slopes less than 35%, and allowed on no more than 10% of area. • Leave any trees damaged or felled from yarding activities and additional felled, girdled or topped trees to contribute to down wood targets.[2] • Retain all dead and down material that was present prior to the operation.
Outer RMA zone 100-170 ft.	• Manage to retain at least 10 conifer trees and snags per acre (15 trees per 1,000 ft. of RMA).[3] • Retain all snags as safety permits.

1. Desired mature forest condition consists of a stand dominated by large conifer trees, or where hardwood-dominated conditions are expected to be the natural plant community, a mature hardwood/shrub community. For conifer stands, this equates to a basal area of 220 square feet or more per acre, inclusive of all conifers over 11 inches DBH. At a mature age (80-100 years or greater), this equals 40-45 conifer trees 32 inches in DBH per acre.
2. Up to 10 trees per acre will be retained as felled, girdled, or topped trees during partial cutting, to reach a target of 600-900 cubic feet per acre of hard down wood.
3. All trees retained will be dominant or co-dominant conifer trees (if available). In order to balance the need for short-term and long-term recruitment of large wood to the aquatic zone, preference will be given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.

Table J-2 continued. Management Standards for Type N Stream RMAs

Small Perennial Type N Streams (applied to at least 75% of reach)[1]	
Stream bank zone 0-25 ft.	• No harvest. • No ground-based equipment operation.
Inner RMA zone 25-100 ft.	• Manage to retain at least 15-25 conifer trees and snags per acre (25-40 trees per 1,000 ft. of RMA).[2,3] • Retain all other snags as safety permits. • Within 500 ft. of a confluence with a Type F stream, retain all hardwoods, non-merchantable trees, and other conifers as necessary, to achieve 80% shade over aquatic zone. • Retain all dead and down material that was present prior to the operation.
Outer RMA zone 100-170 ft.	• Manage to retain 0-10 conifer trees and snags per acre (0-15 trees per 1,000 ft. of RMA).[2,3] • Retain all snags as safety permits.

1. Prescription to be applied to at least 75% of perennial stream reach, including the first 500 ft. above the confluence with a Type F, and areas that meet the definition of a Special Emphasis Area (SEA) according to the definitions in the section following these tables.
2. All trees retained will be dominant or co-dominant conifer trees (if available). In order to balance the need for short-term and long-term recruitment of large wood to the aquatic zone, preference will be given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.
3. In meeting the tree retention target for the inner and outer zones, preference will be given to retaining trees within the inner zone. Where there are sufficient trees within the inner zone to meet the combined target for the two zones (40 trees per 1,000 ft.), then no additional leave trees are required in the outer zone.

Table J-2 continued. Management Standards for Type N Stream RMAs

Small Seasonal Type N Streams: High Energy Reaches (applied to at least 75% of reach)[1]	
Stream bank zone 0-25 ft.	• No harvest. • No ground-based equipment operation.
Inner RMA zone 25-100 ft.	• Manage to retain at least 15-25 conifer trees and snags per acre (25-40 trees per 1,000 ft. of RMA).[2,3] • Retain all other snags as safety permits. • Retain all dead and down material that was present prior to the operation.
Outer RMA zone 100-170 ft.	• Manage to retain 0-10 conifer trees and snags per acre (0-15 trees per 1,000 ft. of RMA).[2,3] • Retain all snags as safety permits.
Small Seasonal Type N Streams: Potential Debris Flow Track Reaches (applied to at least 75% of reach)[1]	
Stream bank zone 0-25 ft.	• No harvest. • No ground-based equipment operation.
Inner RMA zone 25-100 ft.	• Manage to retain at least 10 conifer trees and snags per acre (15 trees per 1,000 ft. of RMA).[2,4] • Retain all other snags as safety permits. • Retain all dead and down material that was present prior to the operation.
Outer RMA zone 100-170 ft.	• Retain trees and snags sufficient to meet landscape management strategy targets.
Other Small Seasonal Type N Streams (applied to at least 75% of reach)	
Stream bank zone 0-25 ft.	• Maintain integrity of stream channel. • No ground-based equipment operation.
Inner RMA zone 25-100 ft.	• Manage to retain at least 10 conifer trees and snags per acre where operationally feasible (16 trees per 1,000 ft. of RMA).[2] • Retain all other snags as safety permits. • Retain all dead and down material that was present prior to the operation.
Outer RMA zone 100-170 ft.	• Retain trees and snags sufficient to meet landscape management strategy targets.

1. Prescription to be applied to at least 75% of stream reach, including the first 500 ft. above the confluence with a Type F stream.
2. All trees retained will be dominant or co-dominant conifer trees (if available). In order to balance the need for short-term and long-term recruitment of large wood to the aquatic zone, preference will be given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.
3. In meeting the tree retention target for the inner and outer zones, preference will be given to retaining trees within the inner zone. Where there are sufficient trees within the inner zone to meet the combined target for the two zones (40 trees per 1,000 ft.), then no additional leave trees are required in the outer zone.
4. To maximize the influence of retained trees on debris flow processes, preference will be given to retaining these trees as close to the stream channel as operationally feasible, or on adjacent slope features that exhibit a high potential for failure and delivery to the stream.

Increasing Outer Zone Conifer Retention on Type F Streams

On Type F streams, in situations where the number of conifers available for retention within the inner zone is not adequate to achieve the large wood delivery potential of a mature forest condition, additional conifers will be retained in the outer zone to provide additional large wood recruitment potential.

This additional outer zone target will apply when the number of conifers of suitable size (11 inches or greater DBH) in the inner zone is less than the mature forest condition target of 45 TPA (100 trees per 1,000 lineal feet of stream for a 100-foot inner zone).

The number of additional conifers to be retained in the outer zone will be equal to the deficit from the inner zone target, adjusted to account for the different widths of the zones. For example, if the inner zone has an average of 70 suitable conifers per 1,000 feet of stream, then the additional retention level for the outer zone would equal 30 times 0.7, or an additional 21 conifers per 1,000 feet of outer zone.

In no case shall the number of conifers required to be retained in the outer zone exceed the inner zone target for mature forest condition. This means no more than 70 conifers per 1,000 feet of outer zone or 45 TPA are required. In addition, no trees shall be required to be retained in the outer zone in locations where, due to topography, they would have no opportunity to reach the area within the channel migration zone and thus potentially function as large wood in the stream channel. All conifers retained under this strategy shall meet the conifer retention criteria as described in footnotes to Tables J-1 and J-2: dominant or co-dominant trees, with preference given to retaining trees on adjacent slopes, trees leaning toward the aquatic zone, and trees closest to the channel.

Perennial Type N Stream Special Emphasis Areas

On small Type N streams, the required riparian management areas will be located to provide protection to the following special emphasis areas. These special emphasis areas may be especially important to certain species (such as amphibians), or to the functions and processes within a watershed.

SEEPS AND SPRINGS IN INNER RMA ZONE, CONNECTED TO AQUATIC ZONE

The 25-foot stream bank zone of the stream, which is the no-harvest zone, will be extended around the outer perimeter of side slope seeps and springs that are within 100 feet of the aquatic zone and connected to the channel via overland flow. The inner zone will follow that boundary.

Source Areas of Perennial Streams

The 25-foot stream bank zone, which is the no-harvest zone, will be extended for a distance of 100 feet above the initiation point of perennial flow.

STREAM-ASSOCIATED WETLANDS

The 25-foot stream bank zone, which is the no-harvest zone, will be extended around the outer perimeter of the wetland area.

INNER GORGE AREAS

- A no-harvest zone will be extended to the top of the slope break that defines the inner gorge.
- If the slope break is less than 100 feet from the edge of the CMZ, then the applicable inner zone standard will be applied for the remaining distance (out to a maximum of 100 feet), and the applicable outer zone standard will be applied out to 170 feet.
- If the slope break is greater than 100 feet from the edge of the CMZ, then the outer zone standard will be applied from the slope break out to 170 feet.

STREAM JUNCTIONS

The 25-foot stream bank zone (no harvest) will be extended for a minimum of 100 feet upstream and downstream, on each stream, where two or more small Type N perennial streams intersect.

SIGNIFICANT WATERFALLS

- A significant waterfall is one that has an identifiable splash zone. The splash zone is the area immediately adjacent to the stream channel that is occupied by vegetation commonly associated with wet areas, i.e., mosses, maidenhair or licorice fern, and other hydric species.
- For these sites, the stream bank zone (no harvest) will be extended around the outer perimeter of the splash zone of the waterfall.

Landscape Green Tree Retention and RMA Conifer Retention Targets

It is recognized that conifer trees retained on the landscape during regeneration harvests provide benefits to both upland and riparian species, as well as contributing to aquatic habitats. Although any given tree or group of trees retained may provide multiple benefits, it is assumed that it would be undesirable for all leave trees to be concentrated in riparian management areas, with few or none in upslope areas, or vice-versa. Therefore, the following standards and guidelines will be used in accounting for the required RMA and landscape-level live tree retention targets.

Management Standards

- Conifers retained to meet the requirements in the inner zone of streams managed for mature forest condition (Type F, and large or medium Type N) will not be counted towards achieving the landscape-level live tree retention standard.
- Conifer trees retained to meet the requirements on all other RMA zones may be counted towards achieving the landscape-level leave tree retention standard.

Management Guidelines

- On regeneration harvest units, leave trees should be arranged to meet the intent and functional objectives for both riparian and upslope habitat values.
- On average, at least 25 percent of the leave trees required to meet the landscape standard should be located in riparian areas that extend well into upslope areas, or in upslope areas that are outside of riparian areas.

Other Aquatic Habitats

The northwest Oregon state forests contain other aquatic habitats besides streams, such as wetlands, lakes, ponds, bogs, seeps and springs. The management objectives for these waters are generally similar to the objectives for streams, but the specific prescriptions are sometimes different. The following strategies apply to these other aquatic habitats.

Prescriptions

The prescriptions for other aquatic habitats are presented in the following two tables.

Key Terms

Wetland — An area that is inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The process used to determine the presence of wetlands will be consistent with the method described in the 1989 *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (USDI Fish and Wildlife Service et al. 1989).

Bog — A wetland that is characterized by the formation of peat soils and that supports specialized plant communities. A bog is a hydrologically closed system without flowing water. It is usually saturated, relatively acidic, and is dominated by ground mosses, especially sphagnum. Bogs are distinguished from other wetlands by the dominance of mosses and the presence of extensive peat deposits.

Table J-3. Management Prescriptions for Lakes, Ponds, and Wetlands

Greater Than 1 Acre

- Establish a 25-foot no harvest zone, starting from the high water line, or wetland boundary (whichever is greater).
- Establish a riparian management area (RMA) of 100 feet from the high water line, or wetland boundary (whichever is greater).
- Manage vegetation to achieve and maintain mature forest conditions.
- The site-specific prescription will classify the wetland.

From 1/4 Acre to 1 Acre

- Establish a 25-foot no harvest zone, starting from the high water line, or wetland boundary (whichever is greater).
- Establish a riparian management area (RMA) of 50 feet from the high water line, or wetland boundary (whichever is greater).
- Within the RMA, harvest activities will retain at least 50% of the existing live tree basal area, or 110 square feet of basal area per acre (whichever is greater). Retained trees will generally be representative of the existing diameter classes and species distribution, with a preference for retaining trees greater than 20 inches DBH.
- If the waterway is inhabited by fish, or is identified as an important area for temperature-sensitive amphibian species, at least 80% shade will be maintained over the aquatic area.
- The site-specific prescription will classify the wetland.

Less Than 1/4 Acre

- Establish an RMA of 50 feet for waters containing fish (Type F), or 25 feet for non-fish-bearing (Type N) waters. These areas will be measured from the high water line, or wetland boundary (whichever is greater).
- For Type F waters, harvest within the RMA will retain at least 50% of the existing live tree basal area, or 110 square feet of basal area per acre (whichever is greater). Retained trees will generally be representative of the existing diameter classes and species distribution, with a preference for retaining trees greater than 20 inches DBH.
- For Type N waters, hardwood trees and brush will be retained to protect the hydrologic functions and wildlife habitat values of the site.
- If the waterway is inhabited by fish, or is identified as an important area for temperature-sensitive amphibian species, at least 80% shade will be maintained over the aquatic area.

Stream-Associated Wetlands

- Stream-associated wetlands are considered to be components of the aquatic habitat of streams, and will be managed according to the objectives and prescriptions specified for the associated stream.

Table J-4. Management Prescriptions for Estuaries, Bogs, Seeps, and Springs

Estuaries
• Establish a 25-foot no harvest zone, starting from the high water line or estuarine wetland boundary (whichever is greater). • Establish a riparian management area (RMA) of 200 feet from the high water line, or estuarine wetland boundary (whichever is greater). • Manage vegetation within the RMA to achieve and maintain mature forest conditions.
Bogs
• Establish a 25-foot no harvest zone, starting from the high water line or wetland boundary (whichever is greater). • Establish an RMA of 100 feet from the high water line or wetland boundary (whichever is greater). • Manage vegetation within the RMA to achieve and maintain mature forest conditions.
Seeps and Springs
Where possible, these aquatic areas should be incorporated into the RMAs of adjacent streams, and vegetation retention provided according to the stream prescription. In practice, this may simply require adjusting the boundary of a stream's RMA to fully encompass the spring or seep. Other management considerations for some of these areas were described earlier in the section titled "Perennial Type N Stream Special Emphasis Areas."