UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232

August 21, 2015

Jerome E. Perez
Bureau of Land Management State Director
Oregon State Office
P.O. Box 2965
Portland, Oregon 97208

Re: Review of Draft Environmental Impact Statement for the Revision of the Resource Management Plan of the Western Oregon Bureau of Land Management Districts

Dear Mr. Perez:

The National Marine Fisheries Service (NMFS) is pleased to provide comments on the draft environmental impact statement (DEIS) for the Revision of the Resource Management Plan (RMP) of the Western Oregon Bureau of Land Management (BLM) Districts of Salem, Eugene, Coos Bay, Roseburg, and Medford, and the Klamath Falls Resource Area of the Lakeview District, dated April 24, 2015. According to the DEIS, the BLM proposes to revise the resource management plans for each of the districts, and provide guidance for future management of approximately 2.5 million acres of public land in the coastal mountains and on the west slope of the Cascade Mountains in Oregon.

In April 2013, the BLM requested that NMFS, Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), Association of O & C Counties, Oregon Department of Fish and Wildlife, Oregon Department of Environmental Quality, and Oregon Department of Forestry provide feedback on the RMP. This team was called the Cooperating Agency Advisory Group (CAAG). As part of the CAAG, several committees were formed to assist the BLM staff with alternative development and data sources. For example, NMFS, EPA, and USFWS worked with BLM on an Endangered Species Act (ESA) Technical Team. The mission of this team was to develop riparian alternatives with the goal to protect fish and water quality. Please incorporate the comments we provided at the meetings of the Technical Team into the final environmental impact statement, as appropriate.

In addition to those previously provided comments, we have enclosed additional comments that have arisen following a thorough review of the DEIS. The comments are based on a review by my Oregon Washington Coastal Area Office staff, as well as by staff of NMFS' Northwest Fisheries Science Center (NWFSC).

We are providing these comments due to our responsibilities to manage, conserve, and protect marine and coastal living resources as provided under the ESA, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and the Fish and Wildlife Coordination Act. In all cases, the comments are relevant, either directly or indirectly, to our responsibilities under the aforementioned statutes, and are consistent with the agency's regulatory obligation to its trust resources.

These comments do not satisfy the obligation of the BLM to consult under the ESA or MSA on the selected alternative. The BLM signed an ESA Consultation Agreement with NMFS and USFWS, which identified responsibilities for each agency and defines the processes, products, actions, timeframe, and expectations for the consultation process. The following species of Pacific salmon and steelhead that are listed as threatened species under the ESA occur within the planning area for the proposed action: Lower Columbia River and Upper Willamette River Chinook salmon; Southern Oregon/Northern California Coast, Oregon Coast, and Lower Columbia River coho salmon; Columbia River chum salmon; Upper Willamette River and Lower Columbia River steelhead; southern distinct population of green sturgeon; and southern distinct population of eulachon. The NMFS has designated critical habitat for all of the above listed species except Lower Columbia River coho salmon, for which it has proposed critical habitat. The NMFS also designated essential fish habitat (EFH) under the MSA for Chinook salmon and coho salmon within the planning area. Additional EFH for species of groundfish and coastal pelagics occurs within areas that will be affected by BLM's actions.

The following is a summary of the major issues with the DEIS and with the preferred alternative that NMFS found in its review of the DEIS:

1. The riparian management scenario proposed in the preferred Alternative B, and Alternative C, would not adequately maintain and restore all of the riparian and aquatic habitat conditions and processes that are critical to the conservation of anadromous fish (in particular, wood delivery to streams, maintenance of stream shade and water temperature, and filtering of nutrients and sediment before delivery to streams).
2. The action alternatives do not incorporate a watershed-scale analysis or analytic protocol that establishes a necessary context to ensure that the plan, and subsequent projects under the plan, are consistent with, and further the conservation of, ESA-listed anadromous fish nor our other trust resources managed under the MSA.

My staff, in conjunction with EPA and BLM, has begun to formulate a framework that would help to address some of the issues that are listed above and described more fully in the enclosure. We would like to work closely with your staff to incorporate this framework into the proposed action before release of the FEIS. The key elements are listed below:

1. Identification and differential management of a network of aquatic-emphasis watersheds for fish recovery, public water supply, and water quality.
2. Use of watershed-scale assessment and planning to guide land management actions.
3. Protection of current high-quality fish habitat, in addition to restoration of habitat with high intrinsic geomorphic potential as is planned.

4. Adjusted riparian management areas (RMAs) with more conservative management in aquatic-emphasis watersheds.
5. Standards and guidelines (management objectives and direction) that are mandatory, but are selected based on type of management action and site conditions.

We appreciate the opportunity to comment on this DEIS and look forward to continuing to provide BLM with assistance on development of the FEIS. Please direct questions regarding this letter to Ken Phippen, 541-957-3385, Jim Muck, 541-957-3394, Mischa Connine, 503-230-5401, or Jeff Lockwood, 503-231-2249 in the Oregon and Washington Coastal Area Office.

Sincerely,

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Enclosure Comments on Draft Environmental Impact Statement for the Revision of the Resource Management Plan of the Western Oregon Bureau of Land Management Districts

cc: Richard Hardt, BLM
Teresa Kubo, EPA
Brenden White, USFWS
Paul Bridges, USFWS
Mark Brown, BLM
Cory Sipher, BLM
Scott Lightcap, BLM

Comments of National Marine Fisheries Service, West Coast Region On the Draft Environmental Impact Statement for Revision of the Resource Management Plan of the Western Oregon Bureau of Land Management Districts

August 21, 2015

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GENERAL COMMENTS ON CONSERVATION OF ESA-LISTED FISH

The following species of Pacific salmon and steelhead that NMFS has listed or proposed for listing under the ESA occur within the planning area for the proposed action: Lower Columbia River and Upper Willamette River Chinook salmon; Southern Oregon/Northern California Coast, Oregon Coast, and Lower Columbia River coho salmon; Columbia River chum salmon; Upper Willamette River and Lower Columbia River steelhead; southern distinct population of green sturgeon; and southern distinct population of eulachon. All of the above species are listed as threatened. The NMFS has designated critical habitat for all of the above listed species except Lower Columbia River coho salmon, for which we proposed critical habitat. The NMFS also designated essential fish habitat (EFH) under the MSA for Chinook salmon and coho salmon within the planning area. Additional EFH for species of groundfish and coastal pelagics occurs within areas to be affected by BLM's actions.

A watershed perspective is needed to identify and assess biological habitat refugia and highly productive habitat patches, and to assess connectivity between these areas and between fish population segments (Sedell et al. 1990, Naiman et al. 1992, Li et al. 1995, Bisson et al. 1997). For these reasons, habitat conservation and restoration strategies are most likely to be effective if carried out at the scale of the watershed (or composites of multiple watersheds in a species' range; Reeves et al. 1995, Frissell and Bayles 1996), not the stream reach (Reeves and Sedell 1992, Botkin et al. 1995, National Research Council 1996, Nehlsen 1997).

As described in previous meetings, NMFS would like to work with BLM to develop the following components of a comprehensive conservation strategy for ESA-listed fish:

1. Network of aquatic-emphasis watersheds for fish recovery, public water supply, and water quality.

   NMFS would like to work with the BLM to develop a network of aquatic-emphasis watersheds, that would be managed in a more biologically conservative manner, to provide an adequate level of confidence that habitat essential for recovery of ESA-listed species will be maintained and improve over time at the watershed scale.

2. Watershed-scale assessment and planning to guide recovery and other land management actions.

   The selected alternative in the FEIS should commit to continued use of existing Federal watershed analyses, source water protection plans, and local watershed analyses for planning and implementing land management actions, particularly in aquatic emphasis watersheds. The selected alternative should require use of watershed-scale information when planning actions at the reach scale, and updating existing watershed analyses with new information, as it becomes available.

3. Standards and guidelines to aid project development and implementation.

The selected alternative in the FEIS should include mandatory standards and guidelines to set sidebars for individual actions. Management activities should be constrained under the standards and guidelines depending on whether they would contribute to or delay attainment of the aquatic habitat objectives similar to those identified in the nine objectives of the aquatic conservation strategy of the Northwest Forest Plan. NMFS has been actively working with the BLM during our ESA Technical Team meetings to identify these types of management directions versus best management practices.

4. Provisions to protect and restore high-quality fish habitats.

   Successful conservation of ESA-listed fish will require the protection of currently functioning high quality or highly productive fish habitat, at the watershed scale, in addition to restoring habitat with high intrinsic geomorphic potential (IP).

DESCRIPTION OF THE ALTERNATIVES

Management Common to All Alternatives

The DEIS (p. 36-37) lists Riparian Reserve objectives common to all alternatives:

- Contribute to the conservation and recovery of listed fish species and their habitats and provide for conservation of special status fish and other special status riparian associated species;
- Maintain and restore riparian areas, stream channels and wetlands by providing forest shade, sediment filtering, wood recruitment, stability of stream banks and channels, water storage and release, vegetation diversity, nutrient cycling, and cool and moist microclimates;
- Maintain water quality and stream flows within the range of natural variability, to protect aquatic biodiversity, and provide quality water for contact recreation and drinking water sources;
- Meet Oregon Department of Environmental Quality (ODEQ) water quality targets for 303(d) water bodies with approved Total Maximum Daily Loads (TMDLs);
- Maintain high quality water and contribute to the restoration of degraded water quality
- downstream of BLM-administered lands; and
- Maintain high quality waters within ODEQ designated Source Water Protection watersheds.

The DEIS (p. 38) also lists one fisheries objective that applies to all alternatives:

- The BLM would manage riparian areas to maintain and improve the aquatic habitat across the landscape.

Riparian Reserve Management in Each Alternative

No Action Alternative (Current NW Forest Plan)

The greater of: two site-potential tree height (SPTH) or 300 feet slope distance for fish-bearing streams, one SPTH or 150 feet (ft) for perennial non fish-bearing streams, and one SPTH or 100 ft for seasonal or intermittent streams. The Riparian Reserve does not include an inner zone in which thinning is not permitted, but the NWFP restricts thinning only to actions which help to obtain ACS conservation objectives.

Alternative A

- One SPTH on either side of fish-bearing and perennial streams;

The Riparian Reserve includes an inner zone in which thinning is not permitted. Inner zone widths are:

- 120 ft on either side of perennial and fish-bearing intermittent streams; and
- 50 ft on either side of non-fish-bearing, intermittent streams.

Outside of the inner zone, the BLM would conduct restoration thinning as needed to ensure that stands are able to provide trees to form stable instream structures. In moist forests, the BLM would conduct restoration thinning without commercial removal of timber (i.e., coarse woody debris and snag creation only). In dry forests, restoration activities would include prescribed burning and thinning that would include removal of cut trees, including commercial removal, as needed to reduce the risk of uncharacteristic high-severity or high-intensity fire.

Alternative B (Preferred)

- One SPTH on either side of fish-bearing and perennial streams;
- 100 ft on either side of debris-flow-prone, non-fish-bearing, intermittent streams; and
- 50 ft on either side of other non-fish-bearing, intermittent streams.

The Riparian Reserve includes an inner zone in which thinning is not permitted. Inner zone widths are:

- 60 ft on either side of perennial and fish-bearing intermittent streams; and
- 50 ft on either side of non-fish-bearing, intermittent streams.

Outside of the inner zone, the BLM would conduct restoration thinning, which may include commercial removal, as needed to develop diverse and structurally-complex riparian stands**.**

Alternative C

- 150 ft on either side of fish-bearing and perennial streams; and
- 50 ft on either side of non-fish-bearing, intermittent streams.

The Riparian Reserve includes an inner zone in which thinning is not permitted. Inner zone widths are:

- 60 ft on either side of fish-bearing and perennial streams; and

- 50 ft on either side of non-fish-bearing, intermittent streams.

Outside of the inner zone, the BLM would conduct restoration thinning, which may include commercial removal, as needed to develop diverse and structurally-complex riparian stands.

Alternative D

- One SPTH on either side of fish-bearing and perennial streams;

The Riparian Reserve includes an inner zone in which thinning is not permitted. Inner zone widths are:

- 120 ft on either side of all streams

Outside of the inner zone, the BLM would conduct restoration thinning, which may include commercial removal, as needed to ensure that stands are able to provide stable wood to the stream.

OVERVIEW OF THE ACTION ALTERNATIVES IN RELATION TO THE NORTHWEST FOREST PLAN

All four of the "Action" Alternatives (Alternatives A-D) in the DEIS are a substantial departure from watershed and aquatic habitat protections currently in place under the NW Forest Plan. The DEIS estimates that the BLM has 938,467 acres of its land in Riparian Reserves. The Action Alternatives will open to timber harvest between 54-81% (509,000-780,000 acres) of the existing Riparian Reserve acreage, with the amounts varying by Alternatives A through D (see Table 1 below). Within Riparian Reserve areas open to thinning, between 75-100% of the existing trees may be removed, though this finding depends on how contradictory information within the DEIS is interpreted (discussed below in Riparian Wood section).

Although the DEIS proposes substantial reductions in Riparian Reserves and other protections (Table 1), the DEIS paradoxically concludes that for many parameters related to riparian and aquatic ecosystem conservation, Action Alternatives A through D will have little to no effect relative to the No Action Alternative or to each other (e.g., see DEIS Figures 3-51 through 3-57). The basis for this rather counterintuitive conclusion is unclear, and at variance with numerous published scientific findings, including the vast body of scientific literature that was used in the original development of the Riparian Reserve and Key Watershed systems (see FEMAT 1993 and USDA and USDI 1994).

Table 1. Comparison of the proposed DEIS alternatives in terms of Riparian Reserve acreage that will be open to timber harvest, either through transfer to commercial logging lands ("Matrix" lands) or by allowing heavy thinning (75-80% tree removal) in the outer zone of the Riparian Reserves. Alternative B is the DEIS Preferred Alternative and is the least protective of all the Alternatives, providing "no-cut" protection for <20% of the current Riparian Reserves. Table derived from data in DEIS Figure 3-88.

	DEIS Alternative				
	No Action	A	B	C	D
Total Riparian Reserve	938,467	676,917	382,805	372,739	714,629
Transferred to matrix lands	0	261,550	555,662	565,728	223,838
Heavy thinning in RR allowed	0	406,295	201,737	109,844	285,852
Total RR open to timber harvest	0	667,845	757,399	675,572	509,690
Total RR open to timber harvest (%)	0.0%	71.2%	80.7%**	72.0%	54.3%
Remaining "no-cut" acreage	938,467*	270,623	181,069	262,895	428,777
Remaining "no-cut" acreage (%)	100.0%*	28.8%	19.3%	28.0%	45.7%

*Not an absolute "no-cut", as the NWFP currently allows limited thinning under strict "standards and guidelines", if such thinning is necessary to meet ACS conservation objectives.
**The exact percentage will vary from between 80.7% and 83.2% depending on the amount of intermittent streams that are debris-flow prone (see above section on comparison of Alternatives).

Unexplained in the DEIS is the scientific basis for concluding that the proposed, substantially smaller Riparian Reserves and the proposed increased timber harvest activities within the smaller Reserves are sufficient for the needs of salmon and other riparian-dependent species. The Riparian Reserves created by the Northwest Forest Plan (USDA and USDI 1994) were developed by a broad group of scientists and reflected the general scientific consensus at the time as to the level of protection needed for the recovery of salmon over a 100-year time frame and was considered by the federal courts to be the "bare minimum" necessary for the recovery of salmon. Several Riparian Reserve options proposed at that time were more protective than the current proposed BLM DEIS Reserves but were rejected as inadequate. Since that time, the scientific consensus has not changed, and available evidence suggests that implementation of the NWFP has in fact resulted in slowly improving habitat conditions for salmonids (see recent review in Frissell et al. 2014). The DEIS is (implicitly) making an extraordinary claim; that the FEMAT science team (and the Federal courts) were in error, and that up to 81% of the existing Riparian Reserve network can be opened for substantially increased levels of timber harvest (i.e. the Preferred Alternative B), with little effect on salmon and other riparian-dependent species and the habitat upon which they depend. It is an axiom in science that extraordinary claims require extraordinary proof, yet the DEIS provides little data or even logical cohesion in support of this extraordinary shift in fundamental scientific assumptions.

FEMAT (1993) articulated the Aquatic Conservation Strategy (ACS) with two spatial and two programmatic components for managing watersheds and riparian areas: (1) *Key Watersheds,* a land allocation comprising hydrologically discrete areas that putatively contain much of the remaining higher-quality aquatic habitat and offer the greatest potential protection for recovering at-risk fish species. These watersheds are priorities for active restoration, are subject to a “no net increase” mandate for road density and watershed analysis mandate for major land use activities. (2) *Riparian Reserves*, a land allocation of varying widths along streams and lakes where aquatic and riparian objectives receive primary emphasis and where management is constrained according to activity-specific standards and guidelines. (3) *Watershed Analysis* is an assessment procedure designed to recommend how to tailor management priorities and actions to the biophysical limitations and perceived restoration needs of individual watersheds. (4) *Watershed Restoration*, a long-term program of somewhat unspecified scope and content, but which may include such wide-ranging provisions as road decommissioning, instream habitat alterations, and other measures (USDA and USDI 1994).

Late Successional Reserves, Congressionally designated reserves, and administratively withdrawn areas are land allocations outside of the specific components of the ACS, but they provide additional protection for portions of watersheds, riparian and aquatic ecosystems, particularly in terms of how they regulate landscape-wide management disturbances. In turn, aspects of the ACS also help provide habitat and connectivity for terrestrial wildlife species (USDA and USDI 1994, p.7). Many birds, mammals, amphibians, and invertebrates benefit from roadless areas (Trombulak and Frissell 2000); require large trees or wood debris for nesting or other uses; or rely on riparian forests for refuge, foraging, or dispersal (Pollock and Beechie 2014). BLM’s large-scale re-formulation of the area and location of such forest reserves calls for a fundamental re-analysis of the adequacy of the DEIS alternatives to support the habitat conditions necessary for recovery of listed fish and conservation of other values fish and wildlife species. The DEIS lacks such an analysis, ignoring without explanation that FEMAT in 1993 provided an exemplary template for how to conduct such analyses in a defensible way using best available scientific information to inform planning design and NEPA analysis of large-scale forest management programs.

In proposing such substantive changes outlined in the Action Alternatives, the BLM needs to more clearly explain why they are proposing such a substantial departure from the science-based NWFP. For example, in addition to the land allocations, the ACS imposes constraints on habitat-degrading management activities in two other ways: (1) It provides binding *standards and guidelines* that explicitly constrain numerous potential management activities within riparian reserves and key watersheds and: (2) it requires all management activities on surrounding federal forestlands to be consistent with maintaining and restoring watershed functions and processes that are described in nine narrative ACS objectives. The activity-specific standards and guidelines were intended to prohibit and regulate activities in Riparian Reserves that retard or prevent attainment of the ACS objectives (USDA and USDI 1994). The requirement that management activities may not retard recovery is a potent requirement and one that appears to be absent in the DEIS. In order to ensure an action does not retard or prevent attainment of recovery, managers must ascertain the net effects of any proposed action on natural recovery processes at site-specific areas and larger spatial scales. This requirement addresses the observation (FEMAT, 1993) that past ecological degradation caused by numerous incremental harms often is not recognized. Cumulative effects across the landscape commonly offset gains from those passive or active management measures claimed to benefit ecological conditions and aquatic resource values.

During the mid-1990s, some federal agencies argued that site-specific failure to meet ACS objectives was broadly acceptable if unacceptable outcomes were not expected to be observed at larger scales.

However, courts have validated that the conservation burdens delineated in the ACS apply to both site- or project-specific as well as larger scales, such as a watershed, planning area, or national forest. The guiding language in the nine narrative ACS objectives directs managers to "maintain and restore" specifically identified ecological conditions and functions. Hence management activities that will affect aquatic ecosystems may be pursued only under a reasonable assurance that they are restorative or protective in nature. It is not sufficient that management activities produce acceptably small adverse impacts, or cause harms that might potentially be mitigated by other measures. Nowhere in the DEIS is language included upholding this central guiding tenet of the ACS, and the environmental effects of this omission, with its dramatic shift in the burden of proof for agency actions, could be substantial.

Courts have ruled that FEMAT (1993) embodies the best available scientific information pertaining to the impacts of forestry activities on salmon and their habitat in the Pacific Northwest federal forests and that the Plan adequately integrates FEMAT's scientific representations. Several scientific reviews (e.g., Reeves et al. 2006, Everest and Reeves 2006) have broadly concluded that while a great deal of new information has been published, the fundamentals and rationale of FEMAT and the ACS remain consistent with available scientific information. Nonetheless, the proposed DEIS substantially reduces the environmental protections in the NWFP while bringing little in the way of new science to the table to substantiate its assertions.

While the majority of distribution of salmon species in the Pacific Northwest lies downstream of federal forest watersheds, the federal lands provide important high-quality refugia for many populations (Burnett et al. 2006), and federal forests confer regional hydrologic benefit to water quality and ecosystem integrity downstream. Implementation of the ACS on federal forests has become a foundational baseline component for attainment of salmonid recovery under the Endangered Species Act and of water quality standards under the Clean Water Act. For example, federal ESA salmon recovery plans in Oregon and California rely heavily on Plan implementation (e.g., NMFS 2007a, p. 402-403, NMFS 2012, p. 3-48, 49). Furthermore, because of the extent to which ACS implementation is widely assumed to represent the federal contribution to aquatic ecosystem conservation, the proposed changes envisioned in the DEIS have regulatory implications for nonfederal lands. The DEIS should disclose the potential consequences of reducing aquatic resource protections for other agencies and conservation and land management efforts. For example, the underlying analyses of Habitat Conservation Plans granted to nonfederal landowners in the Pacific Northwest under the ESA, with assurances extending 40 to 50 years, explicitly rest on full ACS implementation on surrounding federal lands. (See e.g. WA DNR 1997). Similar expectations undergird the state of Oregon's restoration plan for salmon and water quality. In basins where water quality standards are not being met, state and federal regulators routinely consider the ACS to be an adequate implementation plan for BLM and Forest Service managers. Substantive alteration and weakening of the ACS threatens to upset a complicated web of region-wide conservation planning that is explicitly and implicitly dependent on the future habitat quality and recovery rate that the ACS is designed to achieve. A fundamental alteration of the ACS potentially re-opens all such agreements across the region to cascading re-analysis and renegotiation, and the DEIS should acknowledge and fully address possible consequences for these affected parties, and inform the public and other agencies of this exigency.

FEMAT’s Basis for the Design of Riparian Reserves

Based on the nested set of ecological rationales considered in FEMAT (1993), the ACS specified a set of “default” widths of the Riparian Reserve land allocation to be a) at least two site-potential tree heights on either side of fish-bearing streams, and b) at least one tree height on non-fish-bearing streams. Within these reserves, the conservation of aquatic and riparian-dependent terrestrial resources receives primary emphasis. Beyond these default delineations, Riparian Reserves must be drawn to protect areas susceptible to channel erosion and mass wasting. The Riparian Reserve widths were based on ecosystem process considerations (FEMAT 1993, Olson et al. 2007) and broadly specified population viability and habitat considerations for seven groups of salmonids and many terrestrial and avian species. Very few of the many completed watershed analyses offered a scientific rationale for reducing default Riparian Reserve areas in any location; a larger number identified site-specific reasons to expand Riparian Reserves beyond the specified default widths (Pacific Rivers Council 2008). The DEIS should explain the basis for concluding that smaller Riparian Reserves are adequate when FEMAT and the subsequent accumulation of scientific evidence suggests otherwise.

COMMENTS ON THE “AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES”

Stream Temperature and Shade

Stream temperature is discussed in the Hydrology section (p. 286) of the DEIS, which identified a key point related to stream shade and stream temperature between the alternatives:

- The BLM analyzed stream shading using two methods. By one method, all alternatives would avoid any measurable increases in stream temperature. The other method identified a small percentage of streams where forest management in the outer Riparian Reserve under Alternatives B and C would potentially affect stream temperature.

The DEIS uses stream shade (and only stream shade) to evaluate the changes in stream temperature because stream temperature is often correlated to the extent and quality of shading vegetation (see section below “Additional Comments on Stream Temperature” for a more expansive discussion of factors affecting stream temperature)

Method A

Method A uses the SHADOW model that is the basis for the Northwest Forest Plan Temperature Total Maximum Daily Load Implementation Strategies (Strategies) (USDA Forest Service and USDI Bureau of Land Management 2005) in analyzing the effects of proposed silvicultural activities on stream shade. The Strategies document provides several pathways for calculating the width of the riparian area adjacent to perennial stream channels that provides stream shade for the period of greatest solar loading (between 1000 and 1400 hours), known as the primary shade zone. It also provides the process for calculating the width of the riparian area that provides shade in the morning and afternoon (0600 to 1000 and 1400 to 1800 hours), known as the secondary shade zone. Fig. 11 of the Strategies indicates that 58% of the total solar radiation that could reach streams occurs between 1000 and 1400 hours, and that 42% of solar radiation occurs during the rest of the day. Although the Strategies include a set of nomographs designed to help land managers determine the amount of "effective shade[1]" provided under varying stream orientation, tree heights, and slope in situations where the managers do not choose to model the shade provided by a thinning prescription, in practice, most projects reviewed by NMFS that have used the Strategies at all have used neither the nomographs nor a model, but default values for the primary shade zone provided in Table 3 of the Strategies, which gives a minimum width for the primary shade zone of 50 to 60 ft that is commonly used as the size of the no-cut buffer in thinning proposals from administrative units that use the Strategies. Outside of the no-cut buffers, some administrative units are applying silvicultural prescriptions that require retention of 50% canopy closure from the outer edge of the no-cut buffer to the outer edge of the secondary shade zone, which is defined in the Strategies (p. 21) as the area that provides shade during the "morning and afternoon hours (e.g., 0600 to 1000 hours and 1400 to 1800 hours)."

Results.
The DEIS states (p. 295-296) that Alternatives A and D, and Alternative B and C are very similar in shading effects and are grouped together for discussion.

The results from Method A show that Alternatives A and D would overlay the primary and secondary shade zone plus an additional 20-foot retention (120-foot no-cut buffer, and 150-foot Riparian Reserve). Based on this, Method A shows that Alternatives A and D would be fully protective of stream shade.

The results from Method A show that Alternative B and C would match the primary shade zone (60-foot no-cut buffer), and the outer managed zone would exceed the secondary shade zone (60 to 100 ft). Alternative B would exceed the secondary shade zone by an average of 80 ft, and Alternative C would exceed the secondary shade zone by 50 ft. In addition, the outer managed zones would maintain a minimum 50% canopy cover, and a minimum of 80 TPA. Based on this, Model A shows that Alternatives B and C would maintain stream shading sufficient to avoid increases in stream temperatures.

NMFS' Comments on Method A.
We commented on the Strategies in a May 22, 2007, letter (Appendix 3 in NMFS 2007b), and again on July 23, 2010 (NMFS 2007b). Among other comments, NMFS noted that the Strategies lacks documentation of the data set used to develop the SHADOW model that is the basis for the Strategies, and includes no information about model validation, confidence limits and uncertainties[2]. We discussed these and other problems regarding the Strategies in a series of discussions with the USFS and BLM that culminated in a day-long workshop on September 2, 2009, that included representatives from USFS, BLM, NMFS, and EPA. In that meeting, the developer of the model described the basis of the model and how it was used to develop the Strategies. The NMFS and EPA identified the following problems with the Strategies:

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[1] Effective shade is defined in the Strategies document as: (total solar radiation - total solar radiation reaching the stream)/total solar radiation

[2] The USFS has since provided NMFS with documentation for the model, and we can provide this upon request. The NMFS has not evaluated this information to see how well it addresses our concerns regarding model documentation.

- The paper advocates thinning to improve stream shade but does not explain how removal of vegetation by thinning could increase shade.
- The paper does not recommend any limit on thinning to avoid cumulative effects in heavily thinned watersheds.
- Table 3 is relied on by the land management agencies to apply the strategy, but it does not include information for trees greater than 100 ft in height, and the land management agencies have been submitting some thinning proposals with trees greater than 100 ft in height. The land management agencies have since reported that a new version of the Strategies includes trees up to 140 ft in height in Table 3, and although NMFS has seen the new table, it not seen the entire new version.
- Table 3 assumes uniform slopes adjacent to streams and uniform, dense conifer stands adjacent to streams, but in the field these assumptions are not always met. For example, where dense hardwood stands predominate the near-stream zone shade, the consequences of thinning the conifer zone may differ from those predicted in the paper. Or, where slopes shift moving away from streams to a steeper condition, the distance from the stream where a tree of a given height could provide shade would increase. The paper does not include guidance for how to deal with these common situations.
- Fig. 2 in paper shows very little difference in stream temperature between 80% shade and 100% shade, but this was a modeled result and is not based on empirical data.
- Fig. 6 also focuses on the 80% shade value, and there is a risk that land managers will focus on this number and reduce shade to 80% in areas where site-potential shade is higher, even though this value has weak empirical support.
- Fig. 8 (relationship between angular canopy density and buffer widths) is based on only one paper from 1972. Other papers containing information on this relationship (e.g., Steinblums et al. 1984) should be included in the approach.
- The citation for Fig. 10 (relationship between angular canopy density and stream shade) is not included in the References section of the paper, but according to the model's developer it is based on model runs, not empirical data. The paper should discuss available empirical data on this relationship, such as is given in Teti (2006), which shows that effective shade continues to increase steadily, even at high values of angular canopy density, unlike the model results in Fig. 10.
- The Strategies document does not provide any data describing the amount of shade provided by retaining of the 50% canopy closure in the "secondary shade zone". We understand this to be a negotiated value.

Additional information about problems with the Strategies document is in a November 18, 2004, memorandum from Peter Leinenbach, EPA (Appendix 4 in NMFS 2007b) and a June 19, 2007, email from Greg Pelletier, Washington Department of Ecology, that is embedded in a April 7, 2009, email from David Powers, EPA (Appendix 5 in NMFS 2007b).

Method B

Method B, proposed by the EPA, presents a mechanistic modeling approach that uses the ODEQ shade model to develop shade loss tables for each alternative Riparian Reserve design. The rationale uses a before-after-control-impact design, where observed changes in stream temperature are due to the difference between pre-harvest and post-harvest monitoring (Groom *et* *al*. 2011a). The EPA methodology considers whether various widths and canopy cover densities in inner and outer zones of the Riparian Reserve would result in shade loss associated with management that would increase stream temperature. Although Groom *et al*. (2011a) determined that levels less than 6% shade loss would have no statistical effect on raising stream temperatures, the EPA has proposed an analytical threshold of no greater than 3% shade loss level, to allow for a factor of safety. In this analysis, shade loss levels greater than 3% would represent a risk of stream temperature increases. Method B may overestimate shade loss by not considering topographic shade; however, Method B tracks stream orientation in shade loss outputs.

Results.
In this analysis, the BLM and EPA calculated shade lost from the combination of the existing canopy density of the inner zone and the outer zone with an alternative's management direction to retain a specific threshold of canopy cover (Table 2 below, Tables 3-70 in DEIS, p. 289).

Table 2. Modeled shade loss for a 150-foot-wide Riparian Reserve, with a 60-foot inner no harvest zone, at various thinning intensities and initial canopy conditions (EPA 2014).

Scenario (Two Sided Treatments)	Stream Aspect			
	North South	NW/SE	East West	Average
Pre-harvest Condition - 80% Canopy Cover				
30 ft Clearcut 90 ft - Outer Thinning Zone 70CC 60ft - Inner Zone 80CC Stream	1.3	1.1	0.9	1.1
30 ft Clearcut 90 ft - Outer Thinning Zone 50CC 60ft - Inner Zone 80CC Stream	2.6	1.9	1.3	1.9
30 ft Clearcut 90 ft - Outer Thinning Zone 30CC 60ft - Inner Zone 80CC Stream	4.4	3.0	1.6	3.0
Pre-harvest Condition - 60% Canopy Cover				
30 ft Clearcut 90 ft - Outer Thinning Zone 50CC 60ft - Inner Zone 60CC Stream	5.7	4.9	5.6	5.4
30 ft Clearcut 90 ft - Outer Thinning Zone 30CC 60ft - Inner Zone 60CC Stream	9.7	7.7	6.9	8.1
Pre-harvest Condition - 40% Canopy Cover				
30 ft Clearcut 90 ft - Outer Thinning Zone 30CC 60ft - Inner Zone 40CC Stream	13.8	12.7	16.2	14.2

The DEIS states (p. 296-297) that as in Method A, the results are clustered: No Action and Alternatives A and D would have similar effects on stream shading, and Alternatives B and C would have similar effects on stream shading (Figure 1 below, Figures 3-89 from DEIS, p. 296).

For the No Action alternative, and Alternatives A and D, there would be 3-33 miles of fish-bearing and perennial streams that would currently be susceptible to shade reductions that could affect stream temperature, which amounts to less than 0.5% of the total fish-bearing and perennial stream miles.

For Alternatives B and C, there would be 275 to 372 miles of fish-bearing and perennial streams that would currently be susceptible to shade reductions that could affect stream temperature, which amounts to 5% of the total fish-bearing and perennial stream miles.

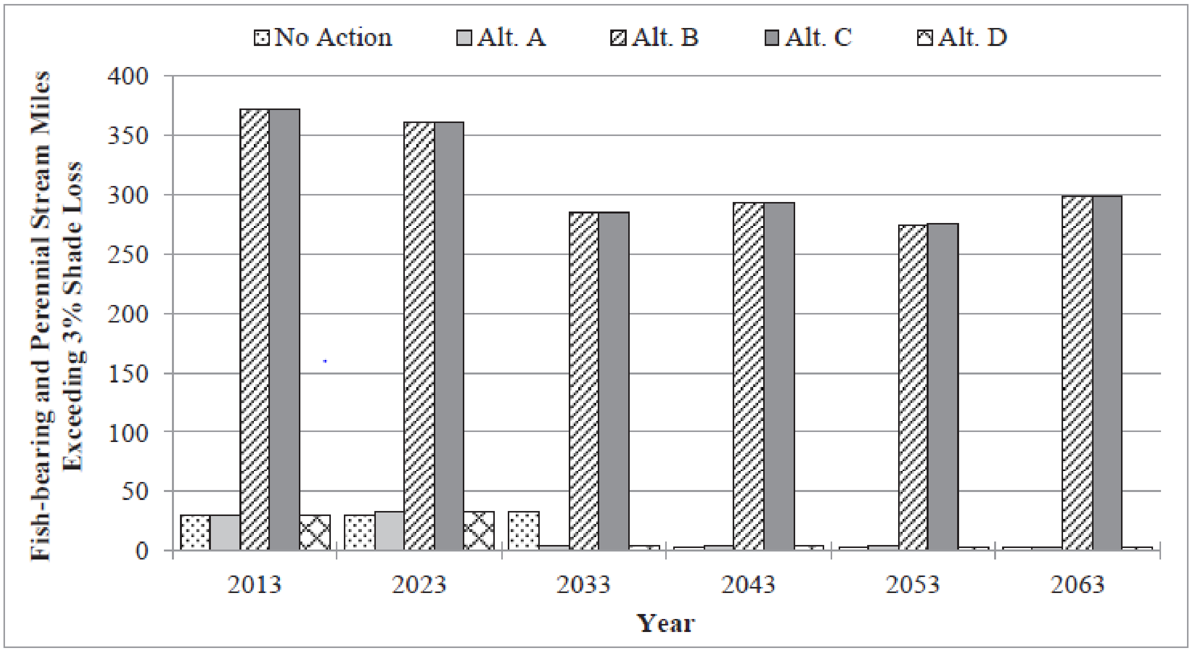

Figure 1. Fish-bearing and perennial stream miles exceeding 3% shade loss.

NMFS' Comments on Method B

The ODEQ model was used in the Method B analysis, which used algorithms of the Heat Source model. We were previously briefed on the scientific basis of the Heat Source model for stream temperature prediction (Boyd 1996) by its author during the development of the state of Oregon's water temperature standard, and are convinced that is adequately accounts for and allows quantification of all the important influences on water temperature of Pacific Northwest streams (i.e., stream channel hydraulics, flow routing, heat transfer, and effective shade).

NMFS' Recommendations on RMA Alternative Selection

Removing trees in riparian areas reduces the amount of shade which leads to increases in thermal loading to the stream (Moore and Wondzell 2005). In clearcuts, small effects on shade were observed in studies that examined no-cut buffers 46 m (150 ft) wide (Anderson et al. 2007, Science Team Review 2008, Groom et al. 2011a, Groom et al. 2011b). The limited response observed in these studies can be attributed to the lack of trees that were capable of casting a shadow >46 m (150 ft) during most of the day in the summer (Leinenbach 2011). Although clearcuts were used in these studies, the results demonstrate that vegetation that is 46 m (150 ft) away from streams contributes shade to streams in some situations.

The relationship between the width of no-cut buffers on thinning (versus clearcut) prescriptions and stream shade is difficult to generalize because of the limited number studies that have specifically evaluated these buffer conditions. As is seen in no-cut buffer widths with clearcut prescriptions, the wider no-cut buffers resulted in lower reductions of stream shade (Anderson et al. 2007, Science Team Review 2008, Park et al. 2008). In addition, the canopy density of the no-cut buffer appeared to have an ameliorating effect on thinning activities outside of the buffer, with higher protection associated with greater canopy densities in the no-cut buffer (Leinenbach et al. 2013). Finally, higher residual vegetation densities outside of the no-cut buffers were shown to result in less shade loss (Leinenbach et al. 2013).

Without site-specific information, we assume that no-cut buffer widths of 150 feet would be needed to fully protect shade (Anderson et al. 2007, Science Team Review 2008, Groom et al. 2011a, Groom et al. 2011b). We predict that Alternative B will decrease stream shade and increase stream temperature in some instances in the plan area. Streams most vulnerable to temperature increases from timber harvest would be streams with few trees and low canopy branch density (Brazier and Brown 1973, DeWalle 2010, Leinenbach *et al*. 2013). Alternative B would maintain a minimum of 80 TPA and 50% canopy cover in the outer zone and could ameliorate some of the effects of timber harvest outside of the Riparian Reserve; however, this would depend on stand density of the inner zone. In low density stands, a wider no-cut buffer would likely be needed to protect stream shade (Leinenbach *et al*. 2013). In addition, trees in the Riparian Reserve (140 to 240 feet) that are adjacent to regeneration harvest stands may be vulnerable to blowdown (Chan *et al*. 2006), thus emphasizing the importance of maintaining a larger no-cut buffer.

Alternatives A and D would provide no-harvest buffer widths of 120 ft on fish-bearing and perennial streams, with a Riparian Reserve of 1 SPTH, and would provide the majority of stream shade on most streams (Science Team Review 2008), and minimize increases in stream temperature (ODF 2015). Stream temperature is identified as a limiting factor for ESA-listed fish (NMFS 2013, ODFW and NMFS 2011). Of the Action Alternatives, Alternative A or D minimize temperature effects to ESA-listed fish and critical habitat.

<u>NMFS’ Recommendations on Harvest Land Base Alternative Selection</u>

The land use allocations common to all Action Alternatives are Congressionally Reserved, District Designated Reserves, Late-Successional Reserves, Riparian Reserves, Harvest Land Base, and Eastside Management Area. The DEIS states that (p. 41) the Harvest Land Base is comprised of the Uneven-Aged Timber Area and the High Intensity Timber Area (regeneration harvest with no retention). Although harvest can occur in all land use allocations, we are focusing our comments on the Harvest Land Base because of the potential for regeneration harvest in this land use allocations. The Harvest Land Base for the action alternatives is in Table 3.

Table 3. Harvest Land Base percentages for the various action alternatives.

Alternatives	Harvest Land Base
A	14%
B	22%
Sub-B	12%
C	30%
Sub-C	20%
D	26%

In the Pacific Northwest, there is conflicting information regarding the extent to riparian and upland forest needed to maintain natural stream temperature regimes, and more generally between the relative importance of factors contributing to stream temperature increases (Pollock *et al*. 2009). The microclimate impacts of upland forest removal such as increased air temperature, reduced relative humidity, and increased wind speed, extended hundreds of meters into adjacent forest, distances far greater than the width of most riparian buffers (Chen *et al*. 1992, 1995; Brosofske *et al*. 1999). Removing upland vegetation may increase stream temperatures by increasing surface runoff, which in turn can decrease aquifer storage and decrease ground-water inflow (Grant and Swanson 1990, Jones and Grant 1996, Coutant 1999).

Pollock et al. (2009) showed the percentage of the basin harvested explained 32 to 39% in stream temperature variation. Comparisons of temperature regimes between seven unharvested subbasins (with harvest levels between 25% and 100%) demonstrate that streams in unharvested basins have cooler temperatures that fluctuate less.

Although there are several other factors that contribute to stream temperature, including riparian vegetation, and physical variables (elevation, slope, aspect, etc.) (Pollock et al. 2009), it is apparent that upland harvest levels are a key variable that affects stream temperature. Alternatives A and Sub-B would minimize the percentage of Harvest Land Base within the plan area, and would minimize increases in stream temperature. Because stream temperature is a limiting factor for ESA-listed fish (ODFW and NMFS 2011, NMFS 2013), we recommend that the BLM select either Alternative A or Sub-B for upland harvest forest management to minimize effects on ESA-listed fish and critical habitat.

Additional Comments on Stream Temperature

Conservation (including restoration) of natural thermal regimes of streams and rivers was but one of many factors considered by FEMAT (1993) when ACS default riparian reserve widths were determined in the initial design of the ACS. In recent years the land management agencies and others have commonly assumed shade from riparian vegetation is the predominant proximate control on stream temperature, and some research has suggested that trees within 30 m or so of the stream margin contribute over 90% of the effective shade (e.g., Reeves et al. 2013). Furthermore, it has been suggested that headwater streams that do not carry water in summer should presumably not need shade to conserve summer thermal maxima in downstream waters. These two premises have become a primary rationale in the DEIS and elsewhere (e.g., draft congressional legislation) to reduce default Riparian Reserve widths for some stream types, with the intent of increasing the area of Matrix land or equivalent that is subject to commercial logging. From the perspective of temperature protection, at least four concerns cast doubt on this rationale for shrinking Riparian Reserves: Redundancy, shade density, groundwater, and channel migration. We discuss these concerns in turn below.

Redundancy: Most current analyses rest on a static view of riparian stand structure and function—that is, shade is modeled as a nearest single layer function of the existing standing trees only. The tree nearest to the stream margin is attributed as the contributor to shade, even though one or more trees standing behind it, slightly farther from the stream, may contribute shade as well. But when trees fall or die in the so-called "inner zone," then the "outer zone" trees become a non-redundant replacement source of shade. Obviously, if the outer zone trees have been logged, that functional redundancy is lost and any riparian disturbance, man-made or natural, may lead to incrementally reduced stream surface shade—and an increase in stream temperatures.

Shade Density: Whereas we measure canopy shade with fixed-resolution instruments, little is known about how measurements of shade translate to actual solar penetration. In the coarsest sense, a canopy densiometer is used to visually estimate canopy cover with only 17 sample points that are irrespective of solar path. Even more quantitative instruments, such as the Solar Pathfinder or SunEye have the tendency to overlook the value of small canopy gaps or multiple canopy thickness in reducing light intensity reaching the stream, as does the densiometer. "Redundant" tree canopies create a shade structure that is dense compared to that of a single tree, and this may substantially affect the actual solar energy reaching the water surface in ways that we that we seldom adequately measure.

Shade density and redundancy are likely two of the factors contributing to recent, state-of-the art analysis by Groom at al. (Groom et al. 2011a, 2011b, Oregon Department of Forestry 2015, additional papers currently in review) showing measurable temperature increases for virtually all logging prescriptions that result in removal of trees within 100 feet slope distance of small forest streams. Some individual sites showed temperature increases of several degrees Celsius, even with limited tree removal and shade reduction. This new research demonstrates that streams are far more sensitive to shade removal than previously appreciated, and even past thinning in Riparian Reserves under the NW Forest Plan ACS requirements as routinely implemented by BLM has likely caused water temperature increases that violate Oregon's "protecting cold water" criterion in the water temperature standard. BLM has been remiss in failing to address this research and considering its implications for past BLM practices and for the proposed stream protection measures in the current DEIS.

Groundwater: Thermal response is affected in numerous ways by near-surface groundwater, which affects both surface streamflow rate and the temperature of water at the point of delivery. After initial increases in base flow following logging, summer base flow can decline for many years as a consequence of rapidly re-growing second-growth vegetation and its evapotranspiration demand (Hicks et al. 1991, Moore and Wondzell 2005). Logging in the outer areas of Riparian Reserves or forested wetlands can contribute to or conceivably magnify this effect. Accordingly, in some Pacific Northwest watersheds, stream temperature is more strongly associated with catchment-wide logging than with streamside vegetation cover (Pollock et al.

2009). Stream warming in such watersheds (often containing gently sloping or hilly terrain and numerous forested wetlands) could be influenced by reduced canopy shade over large areas of near-surface groundwater. Warming also could be influenced by changes in shallow groundwater flux rates and the level of the water table (Poole et al 2008). Hence, stream temperatures in some circumstances can become warmer at their point of origin (in spring, summer and fall) following upslope watershed logging. Other research has established the importance of streambed hyporheic flow exchange in determining surface water thermal regime (Poole and Berman 2001, Baxter and Hauer 2000, Poole et al. 2008). The hyporheic zone may include extensive areas of shallow subsurface flow within montane alluvial valleys. In summer this subsurface pool may be dominated by spring snowmelt or cool rain runoff that cools surface streams when it discharges in midsummer (Poole and Berman 2001, Wondzell 2011). The extent of hyporheic storage and exchange bears a somewhat uncertain relationship to surface landforms, and until the decades after FEMAT, land management agencies lacked both the methods and incentive to accurately map these critically important areas (Torgersen et al. 1999, Baxter and Hauer 2000, Ebersole et al. 2003, Poole et al. 2004, Poole et al. 2008, Torgersen et al. 2012). Sediment accumulation in streambeds, or loss of step pools and other structures contributing to channel complexity—often formed by stable large wood—is thought to reduce entrainment of surface flows into, hence flow exchange with, the hyporheic zone (Moore and Wondzell 2005, Poole et al. 2008).

Given these uncertainties, and the increased importance of such groundwater source areas under future climate changes, any management change that increases the areal extent of logging in watersheds poses a risk of contributing to undesired stream warming. Notably, winter and spring stream temperatures can be of comparable importance to summer temperatures in meeting the habitat needs of species. In particular, temperatures of seasonably intermittent streams (even though they may be non-fish-bearing in summer or support salmonids only in early summer) can be important for salmon and other species in winter and spring (Wigington et al. 2006), and are directly and indirectly influenced by riparian canopy shade, thermal insulation, and other forest conditions that mediate water temperature fluctuations.

Channel migration: Over time, stream channels migrate and even small streams have secondary channels that may flow only during the rainy season. However, existing side channels and backwaters provide important rearing and refuge habitat for salmonids, and they are commonly unmapped or mapped poorly. In addition, if riparian buffers are narrowed, some of these channels may migrate outside the narrowed buffer and be exposed to direct sunlight and substantially warmed. For instance, the sources of LWD are impaired during channel migration where outer zones have been harvested. Washington state and private forest practices rules have included criteria designed to identify and protect channel migration zones for many years (Brummer et al. 2006); in the ACS, explicit rules for their delineation are left to watershed analysis. The DEIS needs to make clear whether and how canopy shade and other riparian forest functions will be maintained for channel migration zones, hence for future possible channel locations, for all stream types

Riparian Large Tree and Wood Production

Large living and dead riparian trees provide numerous ecosystem goods and services that help create and sustain structurally complex, biologically diverse and productive riparian and aquatic ecosystems. Such functions include but are not limited to carbon storage, retention of nutrients and sediment, creation of essential habitat for numerous aquatic and riparian-dependent species, regulation of temperature, and of increasing importance in a warming planet with increasing fire frequency, maintaining a moist, microclimate that can slow the movement of wildfires (see reviews in USDA and USDI 1994, Spies et al. 2013, Pollock and Beechie 2014, Frissell et al. 2014 and references cited therein). Large riparian trees that die and fall into and near streams, floodplains and wetlands regulate sediment and flow routing, influence stream channel complexity and stability, increase pool volume and area, and provide hydraulic refugia and cover for fish (Bisson et al. 1987, Gregory et al. 1987, Hicks et al. 1991, Ralph et al. 1994, Bilby and Bisson 1998). The loss of wood is a primary limiting factor for salmonid production in almost of watersheds west of the Cascade Mountains (ODFW 2005, Stout et al. 2005, ODFW and NMFS 2011, NMFS 2013) and is likely the cause for decline of numerous other aquatic, riparian-dependent and terrestrial species such that general declines in biological diversity in Pacific Northwest forests can largely be attributed to the loss of large wood (USDA and USDI 1994, Spies et al. 2013, Pollock and Beechie 2014).

The BLM proposes thinning in riparian reserves in all the four alternatives developed for the draft resource management plan (Figure 2). The conservation objectives given by BLM to conduct forest thinning in Riparian Reserves are to: (1) Create structurally complex forest habitat, to produce large wood for streams, or to reduce fire risk, with specific objectives varying by Alternative. All four Action Alternatives limit riparian thinning to stands less than 120 years old.

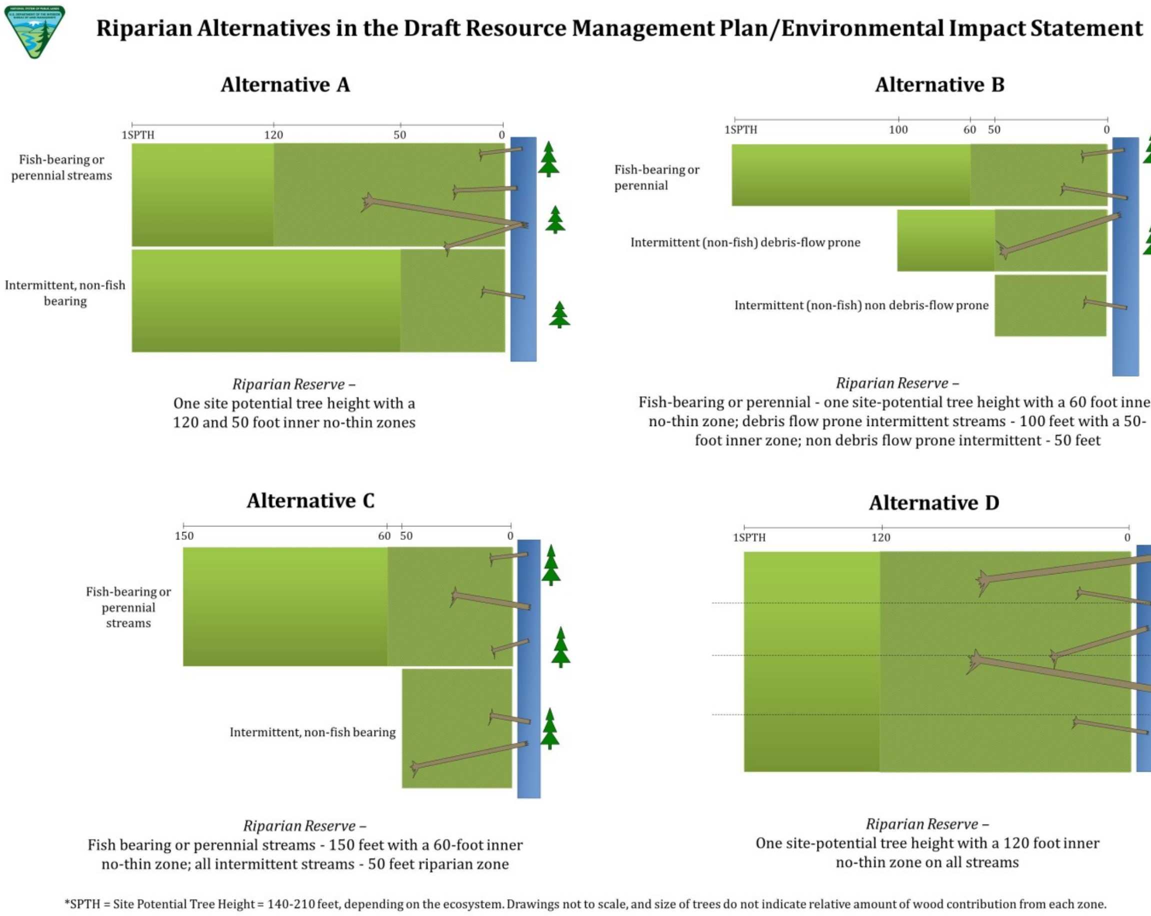

Figure 2. Draft alternatives for the DEIS. (Taken from BLM's riparian outreach meeting on 6/25/2015).

A recent review of the effects of forest thinning by a scientific panel for an interagency issue elevation (Spies et al. 2013) included the following conclusions that are relevant for the review of the four riparian thinning alternatives in the DEIS:

1. Thinning is most beneficial in dense young stands. The greatest ecological benefits of thinning come in dense plantations less than 80 years and especially less than 50 years old.
2. Higher densities stands are likely to see more benefit from thinning than lower density stands. In terms of dead wood production, stands at 450 trees per acre (TPA) will show more benefits to wood production from thinning than stands around 270 TPA.
3. Thinning generally produces fewer large dead trees. Thinning with removal of trees will produce fewer trees across a range of sizes over the life-time of the stand than those of non-thinned stands.
4. Thinning can accelerate large diameter trees. Trees with large diameter (greater than 40 inches) begin to appear in the thinned stand from 5 to 10 decades.

5. Ninety-five percent of near-stream wood inputs come from within 82 to 148 feet of a stream. Shorter distance comes from younger stands and longer distances come from older stands.
6. Thinning can increase the amount of pool forming wood when the thinned trees are smaller in diameter than the average diameter of pool-forming wood.

The BLM modeled the density of trees greater than 20-inch diameter breast height (DBH) (DEIS page 221) to assess delivery of large wood and small functional wood to streams. Only modeling or considering 20-inch dbh trees overlooks the importance of smaller wood in providing instream functions. For example, Beechie and Sibley (1997) determined that the minimum pool forming diameter of wood varies as a function of stream size and can be expressed by the equation:

$$\text{Minimum pool forming wood diameter} = 0.028*(\text{Bankfull Width}) + 0.0057,$$

and that pieces <6 inch diameter could form pools. By excluding all pieces of wood < 20 inches DBH from their analyses, the DEIS grossly underestimates the importance of wood to the formation of pool habitat, and by extension the importance of riparian forests with trees < 20 inches DBH to instream habitat.

The conclusion that only wood >20 inches diameter at breast height is 'functional' is contrary to published relationships between wood size and pool formation (Beechie and Sibley 1997, Bilby and Ward 1989), leading to the erroneous conclusion that significant timber harvest in riparian zones under thinning alternatives has little effect on habitat for anadromous fish. The model results from BLM show slight differences in potential wood recruitment between Alternatives A and D compared to Alternatives B and C, but the model run with all potential wood including trees <20 inches DBH showed that these differences would be much greater. Alternatives B and C will substantially decrease the total wood contribution to fish-bearing streams relative to the alternatives A and D, and the decreases will be long-term. This is because thinning will remove wood large enough to form pools from the riparian zone (if the term large wood is defined by its ability to form pools rather than the arbitrary value of >20 inches diameter) (Beechie et al. 2000).

Additionally, the DEIS emphasizes thinning in riparian areas for all stream sizes, but this will only benefit the habitat of anadromous fish under certain specific conditions (i.e., where there is sufficient instream wood already present to provide habitat functions during the lag between thinning a forest and recruitment of logs from the thinned forest to the stream, and where existing trees are too small to form pools when they fall into streams).

The majority of the wood recruited to a stream channel from adjacent riparian areas comes from within 30 meters (98 ft) of the channel (McDade et al. 1990, Van Sickle and Gregory 1990, Spies et al. 2013) (Figure 3).

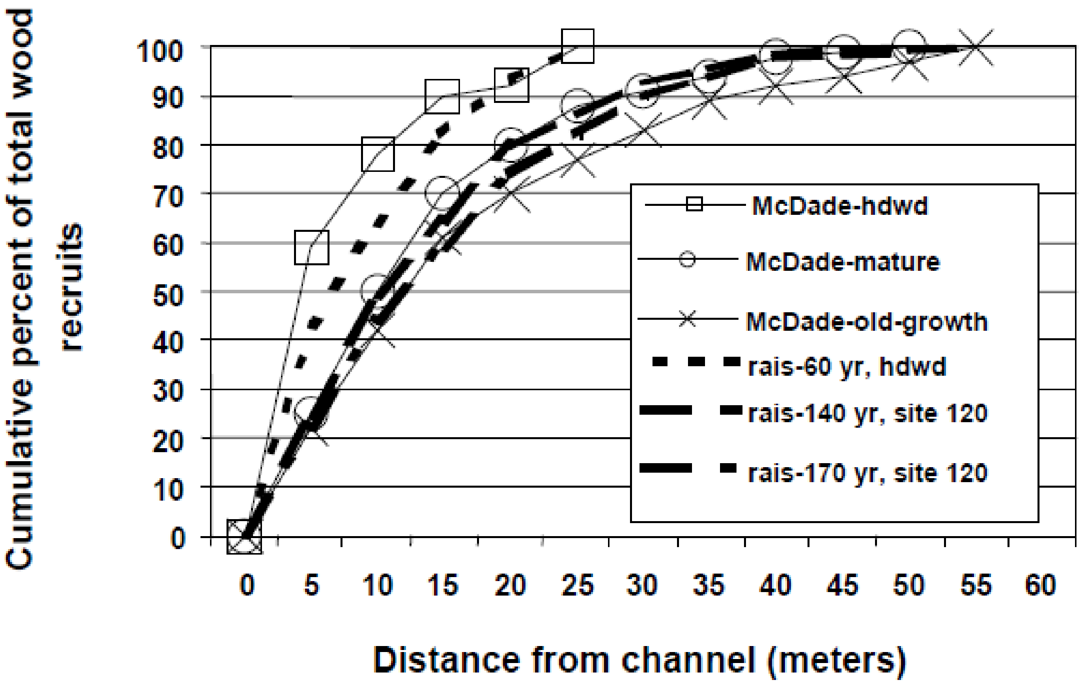

Figure 3. Comparison of predictions of total wood accumulation with distance from channel using the Organon forest growth model and RAIS instream wood recruitment model verse the observations of McDade et al (1990) for streams in the Cascade Mountains of Oregon and Washington. (Taken from Spies et al. 2013, page 18)

Alternative B (BLM's preferred action) and Alternative C in the DEIS BLM proposed thinning on fish-bearing or perennial streams with a 60-foot (18-meter) no-cut inner buffer. The outer zone (one site-potential tree height) would be thinned to no less than 80 trees per acre (TPA). An 18-meter buffer would include about 65 to 75% of the trees that could recruit to a stream (Figure 2). Under Alternatives A and D, the no-cut buffers of 120 ft (36 m) on perennial and fish-bearing streams would include about 90 to 95% of the trees that could recruit to a stream (Figure 2). The potential loss of 25 to 35% reduction of wood recruitment along fish-bearing and perennial streams under Alternatives B and C relative to a 5 to 10% reduction Alternatives A and D suggests that Alternative B and C pose a higher risk of not meeting the needs of ESA-listed species for habitat conservation and recovery. To further examine this issue, we consider the effects of outer zone management and modeling results below.

The reduction of number of stems in the outer zone of the Riparian Reserves also will limit potential wood recruitment to streams. Tree retention requirements for inner and outer zones of Riparian Reserves for Alternatives A, B, C, D are shown in Table 4.

Table 4. Tree retention requirements in Riparian Reserves for the various alternatives in the DEIS.

Tree Retention Requirements in Outer Zones of Riparian Reserves		
	Perennial and Fish-Bearing Streams	**Intermittent Streams – Outer Zone**
Alternative A	60 TPA	60 TPA
Alternative B	80 TPA	N/A
Alternative B Debris Flow		80 TPA out to 100 Feet
Alternative C	80 TPA	N/A
Alternative D	60 TPA	120 TPA

Alternative A maintains a 120-foot no-cut inner buffer for perennial and fish-bearing streams, and has a 50-foot no-cut buffer with retention of 60 TPA in the outer zone for intermittent streams. Viewed in isolation, the no-cut buffer and outer zone requirements for Alternative A will allow diminishment of wood recruitment to downstream areas inhabited by ESA-listed species. However, Alternative A allows only no-commercial removal of trees in the outer zone of Riparian Reserves. It is likely that the restriction of no commercial removal often will result in complete protection of all trees within one site potential tree height of all streams in Alternative A, due to the expense of thinning where trees cannot be sold. Alternative D has 120-foot no-cut inner buffer for all streams, with 60 TPA retention required in the outer zone and commercial tree removal allowed; therefore, it is likely to allow more removal than Alternative A in the outer zones. However, the 120-foot no-cut buffer will ensure a high amount of wood recruitment to all streams.

Alternatives B and C have 60-foot no-cut buffers and require retention of 80 TPA in the outer zone for perennial and fish-bearing streams, but of these two Alternatives, only Alternative B requires retention of any trees for intermittent streams, and only if those streams are prone to debris flows (80 TPA out to 100 ft from the stream). Under Alternative B, the 50-foot no-cut buffer is large enough to capture most or all of the area where standing trees are likely to be directly entrained by debris flows, but 80 TPA is a heavy thin that will limit the number of stems available for recruitment into the debris flow entrainment area. Also, wood recruitment on non-debris flow streams is also important to fish habitat since wood in these streams supports nutrient processing and sediment retention. Therefore, the Riparian Reserves proposed in Alternatives B and C for non-fish-bearing streams are likely to diminish wood recruitment, water quality and fish habitat quality in downstream areas. Particularly Under Alternative C, a lack of retention of riparian trees along intermittent streams means that wood recruitment, water quality and fish habitat quality in downstream areas likely will be significantly degraded.

NMFS 2010 previously modeled how thinning to 55 TPA outside of a range of no-cut buffers affects instream delivery of wood (Figure 4). Although leaving 60 TPA under Alternatives A and D in the outer zone would provide slightly more wood to the stream than the 55 TPA that we modeled, the exercise demonstrates that a 60-foot no-cut buffer with thinning in the rest of the riparian area out to one-site-potential tree height (as in alternatives A and D) will result in significant diminishment of wood recruitment to streams relative to a 60-foot no-cut buffer (as in Alternatives B and C).

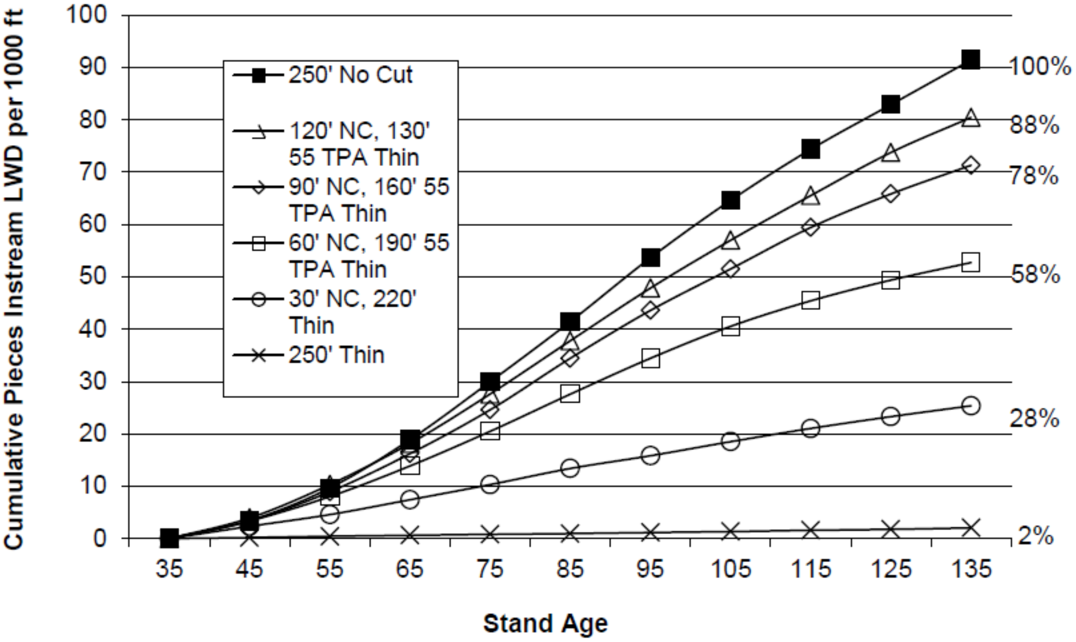

Figure 4. Comparison of the model effect of various no-cut buffer width adjacent to a 55 TPA thin on cumulative large wood inputs from the modeled stand to a stream 100 years post thinning for a young, managed Douglas-fir stand in the northwest Oregon. Percentages on the right of figure are relative to a 250 foot no cut buffer, a width equal to the site potential tree height for the area. Forest growth was simulated using Organon and wood inputs were simulated using Streamwood. Stand data used in the simulation were provided by the Siuslaw National Forest and are included in their East Alsea Landscape Management Plan. The pre- and post-thin tree size and density is typical of the stands in the project where thinning is proposed. (Figure from NMFS 2010).

The range of no-cut buffer widths and thinning regime examined are for comparative purposes only and is not meant to imply that they are all appropriate for meeting ACS objectives. Note also that the simulation does not predict the total amount of wood that will be in the stream, because it does not include existing instream wood loads, wood losses due to downstream transport, and wood delivery from upstream sources and from stands on the opposite bank. It simply predicts the *relative* effect of different management options on the delivery of instream wood from a stand.

Eleven years after thinning young conifer stands, the stands produced fewer dead trees than un-thinned control stands, although residual live trees grew faster than the control (Dodson et al. 2012). Dead wood production in thinned stands was less than in un-thinned strands, and dead trees had to be artificially created to accelerate the development of snags to meet old growth objectives (Garman et al. 2003).

Overall, the information reviewed above indicates that of the Action Alternatives, Alternatives A and D are most likely to support the habitat needs and recovery of ESA-listed species, due to the combination larger no-cut buffers on fish-bearing and perennial streams and retention requirements in the outer zones of Riparian Reserves, relative to Alternatives B and C. Of the Action Alternatives, Alternative D has the most conservative riparian prescriptions for inner zones of Riparian Reserves, and Alternative A likely often will result in the most conservative prescriptions for inner and outer zones of Riparian Reserves because they prohibit commercial tree removal. The riparian prescriptions for Alternatives B and C do not protect enough trees in the inner and outer zones of Riparian Reserves adjacent to waters supporting ESA-listed species or in upstream waters that provide downstream ecological benefits to support the habitat needs and recovery of ESA-listed species.

The DEIS recognizes the numerous ecosystem functions that Riparian Reserves provide, but in all four Action Alternatives, proposes at a minimum, to reduce by half the width of all Riparian Reserves along fish-bearing streams, from two site potential tree heights (SPTH) to 1 SPTH, with no explanation as to why the rationale in the NWFP for creating 2 SPTH Riparian Reserves was no longer relevant. Within these reduced Reserves, the DEIS envisions allowing extensive "restoration" thinning in all the Action Alternatives, under a set of guidelines that are considerably less restrictive than the existing ACS Standards and Guidelines. These proposed new guidelines would allow 75-80% tree removal within portions of the Riparian Reserves, the exact amount varying by Alternative. We do note, under current NWFP implementation (No Action Alternative), extensive management is occurring within the Riparian Reserves.

With regards to riparian functions, interpretation of the effects analysis in the DEIS is hampered by contradictory statements and data, largely pertaining to the proposed level of timber harvest within the portions of the proposed Riparian Reserves. General descriptive sections of riparian management in the DEIS assert that tree removal in the outer Riparian Reserves will be in the upwards range of 75-80% removal (e.g. 60-80 TPA retention in stands that average 316 TPA- DEIS Figure 3-51) whereas the analytical section of the DEIS indicates about 62% average removal (i.e. 120 TPA retention/196 TPA removal- see DEIS Table C-12). The thinning also appears to "proportional", rather than "from below", meaning that most of the large diameter overstory trees will be removed along with the smaller understory trees, rather than removal of only the smaller trees, which is at variance with the goal of producing large diameter trees, and ultimately, large diameter wood to preserve and restore the natural ecosystem functions of wood upon which stream and river health depends. Further, in some instances the amount of tree removal is described in terms of canopy cover, whereas elsewhere it is described in terms of relative density. Thus it is unclear to what is likely to actually happen on the ground in Riparian Reserves if the RMP is implemented remains vague and very unclear in the DEIS.

The stated purpose for "restoration" thinning in Riparian Reserves is to create structurally complex forest habitat (Alternatives B and C), to produce large wood that is of a size sufficient to remain "stable" in streams (Alternatives A and D), to reduce fire risk (Alternative A) or the non-conservation goal of allowing for commercial harvest (Alternatives A, B C and D), but specific criteria or determining when such “restoration” is needed are lacking. This creates substantial ambiguity and uncertainty as to the extent to which timber harvest in Riparian Reserves will occur. A common timber harvest goal in Riparian Reserves is “restoration” thinning for the purposes of creating a “complex forest habitat” but neither of these terms are defined anywhere in the document. In the scientific literature, complex forest habitat is generally synonymous with late-successional habitat and is characterized by abundant large live trees, large standing snags, large down wood on the forest floor and in streams, and a multi-layered canopy, while restoration thinning in the Pacific Northwest, is generally defined as silvicultural activities that accelerate the development of late-successional forest structure. Further, including commercial harvest as a goal of Riparian Reserve thinning creates an inherent conflict in thinning objectives. Commercial thinning generally removes larger trees because they have value as wood products, yet these trees, whether living or dead, are needed to accelerate the development of structurally complex forests and their associated aquatic systems. This also creates a contradictory incentive for restoration thinning, in that for a thinning operation to be commercially viable, then a high number of large trees need to be removed, which results in degradation of Reserve forests rather than restoration. We see no ecosystem benefit to the removal of large diameter wood from forests and could find no scientific literature demonstrating forest ecosystems and habitat for fish and wildlife benefits from the removal and continued depletion of large wood, while an abundance of literature exists discussing the benefits of large wood in forest ecosystems , and to its shortage in most previously logged forests (e.g. see FEMAT 1993, USDA and USDI 1994, Spies et al 2013, Frissell et al. 2014, Pollock and Beechie 2014, and references cited therein).

There are numerous contradictions and ambiguities in the RMP DEIS that make it challenging to follow the logic path whereby the conclusion was reached that there was minimal differences between Alternatives A through D relative to the No Action Alternative and to each other. Much of the confusion is generated in the Fisheries, Forest Management and Hydrology sections of the Affected Environment Chapter (RMP Vol 1, p. 217-320) that tries to reconcile riparian tree growth and wood production data from a 2013 growth and yield modeling simulation using the proprietary model “Woodstock” with a growth and yield and wood modeling effort from the 2008 Western Oregon Plan Revision (WOPR) FEIS.

The DEIS asserts (p. 225) that there will be no difference in large wood production among the Alternatives. This assertion is clearly in error, for reasons discussed below, but it is also problematic because the basis for this statement was based on the obscure and poorly described wood modeling exercise performed as part of the 2008 WOPR FEIS (which was subsequently withdrawn, in part due to extensive criticism as to its technical merits). We examined the 2008 analysis and found that there was little demonstrated rational basis for the conclusions reached, that only cursory data were presented and that the modeling program (OPTIONS) used to generate the data was itself obscure, not publically available and likely proprietary (a web search found no documentation of an OPTIONS model). Without access to the model data outputs, the model itself and an understanding of the assumptions built into the model, and with only a cursory summary of the findings, we were not able to understand the rational basis for the 2008 WOPR FEIS conclusions, and by extension, the 2015 DEIS conclusions that there is no difference between the Alternatives with regard to the production of instream large wood. Further we dispute such conclusions. There is no rational, scientific basis for the RMP’s conclusion that heavy thinning (i.e. 75-80% tree removal) within 50-60 feet of streams (e.g. see Alternatives B and C) will not reduce riparian and instream large wood abundances (see McDade et al. 1990, the USDA and USDI 1994, Spence et al 1996, and more recently, Spies et al. 2013, as well as Pollock et al. 2012 and Pollock and Beechie 2014).

The DEIS (p. 226) similarly concludes, this time using the 2013 "Woodstock" analysis, that there are minimal differences among the alternatives on the production of very large diameter (> 20-inch dbh) trees over time. Again, the basis for such conclusions was not presented, nor was the fact disclosed that BLM's conclusions run counter to published scientific findings as to the effects of thinning on the development of large diameter trees and large wood in western Oregon (see Pollock et al. 2012, Pollock and Beechie 2014). The data from these (peer-reviewed) publications suggests that over the long-term (e.g. 100 years), heavy thinning (e.g. reducing densities to 60-100 TPA) substantially reduces the abundance of such very large diameters trees, and that even more moderate thins to 160 TPA do not increase the number of large diameter trees. For large wood production, the same trends apply, but are even more amplified, with heavy thinning causing about a 75% reduction in large (> 20-inch dbh) wood production over the course of 100 years. Thus in the context of "restoration thinning" to restore "complex forest habitat" in Riparian Reserves, there is little evidence to suggest that thinning accelerates the development of structurally complex forest habitat, and ample evidence to suggest that heavy thinning substantially delays the development of complex forest habitat. The DEIS also indicates (p. 229) that the management direction for restoration thinning includes "ensuring that stands are able to provide stable wood to streams", but provides no indication as to what forest conditions would call for such thinning and what type of thinning would produce such stable wood. Further, the criteria for what constitutes "stable wood" is not explained, nor are any criteria for determining under what conditions and what level of thinning is likely to accelerate the development of "stable" wood. In particular, the DEIS produced no evidence to suggest that the intensity of thinning proposed will produce more "stable wood".

Recommendations:

Thinning goals need to be quantifiable and independently verifiable.

Thinning within Riparian Reserves should be limited to very specific conditions that can be identified a *priori*. Specific, quantitative criteria are needed for establishing when thinning is appropriate in Riparian Reserves and other reserve areas where conservation values are emphasized over timber harvest values. Consistent with the stated intent of both the NWFP and the DEIS, thinning should only occur when and where it can be specifically demonstrated to be likely to accelerate the rate of complex forest structure. Consistent with the NWFP, complex forest structure should continue to be defined as ongoing production of the structural characteristics of late-successional forest structure, primarily production of large diameter live trees, large diameter snags, large down wood on the (riparian) forest floor and large down wood in streams and other water bodies such as wetlands and lakes. In the context of complex forest development, large diameter is usually considered 50 cm (20-inch) dbh or greater. The use of large diameter live tree and dead wood production as metrics for forest complexity has an advantage over numerous other metrics in that they can easily be modeled with widely used, non-proprietary, publically available growth and yield models such as the Forest Vegetation Simulator from the U.S. Forest Service. The use of one of these metrics alone is not appropriate because this can lead to misleading conclusions. For example a common mistake by forest restoration practitioners is to only consider the production of large diameter live trees and not the production of large diameter dead trees (the BLM DEIS is one such example). Such an omission can lead to the creation of structurally simple forests that have no large diameter snags or down wood and thus have limited ecological value. The use of other indicators of forest complexity, such as a multi-layered canopy, are also problematic because these are not easily modeled and relationships between "multi-layeredness" and the particular needs of species has not been well established. This is in marked contrast to the numerous and detailed associations that have been identified between many taxa and large dead wood, inclusive of species- specific size preferences, decay class preference, location and orientation within the forest ecosystem.

Thinning proponents also need to be cognizant of the fact that natural disturbances will naturally reduce tree densities regardless of any management actions and that variation in the processes and rates of natural tree death is important towards developing structurally complex and diverse forests (see Pollock and Beechie 2014). Assertions that thinning will improve habitat conditions should be viewed cautiously and with skepticism. The burden of proof should remain on thinning proponents that thinning is likely to accelerate attainment of conservation goals (Harmon et al. 1986, Hansen et al. 1991, Fetherston et al. 1995, Bull 2002).

Default Thinning Standards

If proponents of a "restoration" thinning project in Riparian Reserves do not have the time or inclination to use a forest growth model for a site-specific assessment of whether a proposed thin is likely to meet restoration standards and guidelines and achieve restoration objectives, then at a minimum, default standards need to be applied (though if there is no site-specific evaluation, then it is difficult to understand on what basis it was concluded that restoration thinning was needed). Based on the best available scientific information (see Pollock et al 2012, Pollock and Beechie 2014, Frissell et al. 2014), we suggest the following minimum default thinning standards:

- Maintain a minimum 120 ft liner no-thin buffer on perennial and fish-bearing streams, and at least 50 ft linear foot no-thin buffer on intermittent streams
- Retain a sufficient number or trees per acre in the outer zone of the Riparian Reserve to provide large wood recruitment, wind buffer to prevent inner buffer blow downs, and contribute to nutrient filtration
- Retain the largest trees (i.e. thin "from below")
- Leave all felled, girdled or tipped trees onsite as snags or down wood
- Do not remove shade tolerant species or species that are uncommon in the stand.
- A site visit is required by a forester and a written determination must be made, along with explanation, that thinning at the site is likely to accelerate attainment of Riparian Reserve conservation objectives.

Nutrient Loading

The DEIS does not disclosed impacts to surface waters and fish habitat on and downstream of BLM lands from nutrient leaching associated with BLM forest treatments, nor does the DEIS consider possible management practices to mitigate harm to downstream waters from nutrient loading. The role of forested riparian buffers in retaining nutrients mobilized by upslope forest disturbances, or delivered to watersheds in precipitation and forest fertilization, is globally recognized, but not addressed in the DEIS. The DEIS needs to adequately address the environmental consequences of reducing stream riparian protections, in particular buffer widths, for water quality and fish habitat, particularly downstream of BLM forest lands. The DEIS needs to assess the environmental consequences of logging and vegetation removal within forested buffer zones along streams, where the nutrients mobilized by vegetation disturbance are released in close proximity to surface waters, and not exposed to the full filtration capacity of a streamside forest buffer. Fully accounting for nutrient retention functions of riparian forests was not done in FEMAT (1993) because the scientific information was not then available. More recent studies (e.g. see Nieber et al. 2011 and Sweeney and Newbold 2014, and references cited therein) suggest that unlogged forest buffers in excess of about 150 ft slope distance from surface waters and stream channels, including headwater channels with intermittent or ephemeral flow, are needed to mitigate nutrient leaching associated with upslope logging the maximum degree practicable (that is, with 90% of mobilized nutrients recaptured and retained in soils and vegetation). Greater than 150 ft is warranted where soils are coarse-textured, or skeletal and highly porous (common with steeper slopes and rocky talus).

Forested buffer zones are commonly prescribed to reduce nutrient delivery to streams in agricultural landscapes (Sweeney and Newbold 2014). Logging and fuels management treatments that disturb green vegetation generate increased nitrogen leaching from forest soils that enters streams and wetlands by both surface and subsurface flow paths (Wenger 1999, Gomi et al. 2002, Kubin 2006). Any ground-disturbing activity or condition (such as a road network) tends to mobilize phosphorus in association with soil erosion. Logging disturbs vegetation and soils over large areas, and scaled over large landscapes or river basins, initial disturbance of forested lands tends to generate larger net increases in nutrient loading than repeat disturbances of already-altered agricultural or urban lands (Wickham et al. 2008; note this observation is from a large population of monitoring sites and remains true even though agricultural lands are commonly more heavily fertilized than forest lands). Over time, nutrient loading to headwater streams transfers downstream, where nutrients accumulate in rivers, lakes, estuaries, and nearshore marine ecosystems (Freeman et al. 2007). For all of these reasons, forestry operations have been identified as a major contributor to nutrient loading, eutrophication, and associated impairment of water quality in Pacific Northwest lakes (Blair 1994, Dagget et al. 1996, Oregon DEQ 2007), rivers, and estuaries (Oregon DEQ 2007), most of which contain ESA-listed species.

Cumulative nutrient impairment of down-stream receiving waters can occur without violation of nutrient standards in headwater streams, simply as a consequence of sustained increases in loading from storm water runoff from forest roads and periodic logging. In effect, logging alters the entire regime of nutrient and sediment export, and nutrient losses to surface waters are endemic and widespread consequences of logging and other disturbance of forested watersheds.

The question of what role Riparian Reserves play in nutrient retention has received insufficient consideration in the Pacific Northwest. Research on the nutrient retention efficiency of various forested buffer widths from the Upper Midwest and other regions (Nieber et al. 2011, Sweeney and Newbold 2014) suggests that average phosphorus and nitrogen retention is around 80% for undisturbed buffer zones of 30 m (98 ft) wide. Extrapolation suggests that buffers of 45 m (150 ft) or greater might be necessary to attain 90-99 percent retention of nutrients mobilized by upslope disturbance. These distances are likely too small for Pacific Northwest forests, where slopes are steeper, soils tend to be more porous, and macropores or channeled flow from uplands are more common than in the Midwest (all factors identified in Nieber et al. [2011] as reducing retention efficiency).

By virtue of their high density of surface channels across most mountainous landscapes, headwater streams with seasonal flow receive a large portion of the nutrients mobilized by up-slope disturbance (Gomi et al. 2002, Freeman et al. 2007). Therefore, full protection of wide Riparian Reserves along even the smallest stream channels (and surface-connected wetlands) is likely necessary for effective nutrient retention when surrounding uplands are disturbed. Channel network expansion from gully erosion (Reid et al. 2010) or roads (Wemple and Jones 2002) and channel simplification through loss of wood or sediment increases also reduces retention efficiency of nutrients, sediment, and organic matter in headwater systems. Moreover, thinning or other disturbance of vegetation or soils within the Riparian Reserve could short-circuit the benefit of riparian forest buffers, by creating a near-stream source of nutrients that is not fully mediated by the retention capacity of the default-width riparian zone.

Based on these considerations, the following management measures could partially mitigate nutrient loading from upslope forest practices: (1) Maintain a site-potential-tree height Riparian Reserve on all streams with sufficient number of trees per acre to contribute to nutrient filtration; (2) Maintain a minimum 120-foot linear no-thin buffer on perennial and fish-bearing streams, and 50-foot linear no-thin buffer on intermittent streams to mitigate the effects of up-slope logging on nutrient loading to both freshwater ecosystems and downstream marine environment; (3) Minimize livestock grazing in Riparian Reserves; (4) Engage in road network reduction and reconfiguration of remaining roads to reduce their hydrologic connectivity to surface waters to reduce downstream nutrient loading; and (5) Conduct assessments of the effects of management actions on nutrient loading to downstream receiving waters, including lakes, wetlands, reservoirs, mainstem rivers, estuaries, and the nearshore marine, should be included in environmental assessments, environmental impact statements, watershed analyses, and ESA consultations for aquatic species.

Sediment

Sediment is discussed in the Hydrology section (p. 286), and two key points were identified regarding the effects of timber harvest and roads on sediment delivery to streams and landslide risk. The identified key points are related to increases in peak flow between the alternatives. The stated key points are:

- Less than 1% of the Harvest Land Base would be have susceptibility to landsliding with the potential to deliver sediment to streams over time under any alternative. Alternative C would have the highest acreage of regeneration harvest in areas with susceptibility to landsliding, and Alternative D would have the lowest acreage.
- Under all alternatives, potential sediment delivery to streams from new road construction would constitute less than a 1% increase above current levels of fine sediment delivery from existing roads.

Effects from Roads and Timber Harvest Activities.

The DEIS states (p. 231) that "Under each of the alternatives, the estimated amount of additional sediment delivered to stream channels from roads in the first decade would be less than a 1% increase from the current amounts. At this level, there would be no detectable effect to fish or stream channels from additional sediment. At the site scale, small accumulations of fine sediment could begin to fill pool-tails, or these fines become embedded in gravel substrates used for spawning. These sediments would be flushed during subsequent high flows and dispersed downstream where no discernable effect would be detected. Under all alternatives, the increase in fine sediment delivery to streams would not increase more than 1% above the current conditions, and would therefore be below the threshold for measurable effects on fish survival at this scale of analysis."

The DEIS further states (p. 231) that "As sediments are flushed from road surfaces, there could be some short-term increases in in-stream turbidity that would be dispersed within about 500 feet downstream from the source. This would result in a short-term and localized effect to fish that would elicit non-lethal stress or physical movement out of the stream reach until turbidity levels return to ambient levels."

The DEIS states (p. 230) that "Cederholm (1981) concluded that there was a two percent decrease of egg to emergence survival of salmonids for each one percent increase in fine sediment over natural levels at the watershed scale. Suttle et al. (2004) suggest there is no threshold below which fine sediment is harmless to fish, and the deposition of fine sediment in the stream channel (even at low concentrations) can decrease the growth of salmonids."

The DEIS states (p. 231) that "As sediments are flushed from road surfaces, there could be some short-term increases in in-stream turbidity that would be dispersed within about 500 feet downstream from the source. This would result in a short-term and localized effect to fish that would elicit non-lethal stress or physical movement out of the stream reach until turbidity levels return to ambient levels." There is a time lag of years to decades between a change in sediment supply and a change in morphology of a downstream reach (Kelsey 1982a, 1982b, Madej and Ozaki 1996, Beechie 2001, Beechie et al. 2005), and the amount of sediment determines channel and habitat response. The time lag is due to the time required for sediment to travel from its source to the reach of concern (Kelsey 1982a, 1982b). Once sediment enters a stream reach, its persistence is partly a function of the sediment transport capacity of the reach (Benda and Dunne 1997b), and both the timing and persistence of changes in the morphology of downstream reaches are related to the rate at which sediment moves through a channel network (Madej and Ozaki 1996). Therefore, timing of sediment input to a stream is not always equal to timing of impact on salmonid fish, and sediment input timing cannot be considered a reasonable criterion for concluding that erosion has little effect on these fish.

The majority of the suspended sediment analysis focuses on the effects from new road construction. Although the DEIS identifies the level of suspended sediment generated from existing roads, there is no analysis of effects to ESA-listed fish compared to natural, background levels of suspended sediment. We recommend that the FEIS include a modified sediment analysis that avoids the assumption that the timing of sediment delivery is more important than the volume, that considers effects of both the existing road network and proposed roads, and that includes consideration of long-term sediment routing and effects.

The DEIS does not analyze the effects of the RMA alternatives on suspended sediment. Living tree roots help stabilize soil. Timber felling kills the roots, which increases the probability of slope failure (Swanston and Swanson 1976), particularly on steep slopes (i.e., >70% concave, >80% planar or convex slopes) (Robison et al. 1999). This also increases the potential of sediment delivery to the stream network. The occurrence probability is related to the harvest intensity, soil properties, geology, unit slope, and precipitation level. Depending on the prescription used, thinning and regeneration harvest will greatly reduce the number of living trees within the treated stands. As the roots of harvested trees die and decompose, their effectiveness in stabilizing soils will decrease over time. However, the remaining trees in the thinning units are likely to experience rapid growth from decreased competition and, as a result, increase their root mass and ability to stabilize soils in the treated stand.

Several studies document the ability of buffer strips to reduce erosion and sediment delivery. Vegetated buffer areas ranging in width from 40 to100 feet appear to prevent sediment from reaching streams (Corbett and Lynch 1985, Burroughs and King 1989, Gomi et al. 2005). Lakel et al. (2010) concluded that streamside management zones (buffers) between 25 and 100 feet were effective in trapping sediment before it could enter streams. Ground-based yarding can be accomplished with relatively little damage to the existing shrub and herbaceous ground cover, thus limiting the exposure of bare soil and maintaining important root structure that holds soil in place. Skyline or multi-spanning yarding systems reduce soil impacts because the logs are suspended above the ground throughout much or all of the yarding process. Helicopter yarding also reduce soil impacts because logs are fully suspended above the ground.

Because buffer widths needed for sediment filtration vary from 40 to 100 feet or more depending on slope, parent rock type, and other factors (Corbett and Lynch 1985, Burroughs and King 1989, Spence et al. 1996, Gomi et al. 2005), we predict that Alternative B will increase fine sediment yield to streams in the plan area. Alternative D would provide the largest no-harvest buffer widths of 120 feet on all streams, and would be effective in filtering sediment before reaching streams. Stream-side buffers are not effective in removing sediment carried in channelized flows (including intermittent streams) that originate outside of the buffer and continue through it (Belt et al. 1992). As stated above, suspended sediment could be routed to LFH and cause adverse effects. Sediment and its harms do not disappear because they are flushed downstream of BLM lands. They simply mix with sediments from other sources and are deposited in streambeds, and then are periodically mobilized in seasonal storms. Both while in streambeds, lakes and estuaries, and when suspended in subsequent secondary transport, sediments derived from BLM actions contribute to cumulative and sustained impairment of habitat critical for listed salmon and other fishes in river and lake basins of the region. The DEIS substantially misrepresents the physics of sediment routing and dispersion, hence fails to address its biological impact on salmon habitat and populations.

Landslide-Prone Areas

The DEIS (p. 306-307) states that “In this analysis, the BLM evaluated the risk of landslides by measuring relative landslide density using the geographic information system mass wasting hazard model within NetMap (Miller et al. 2003, Benda et al. 2007, and Miller and Burnett 2007). The NetMap model produces a naturally occurring landslide susceptibility from geologic and landform factors, but independent of vegetation factors. The modeling is based on landslide inventories from the Coast Range, Western Cascades, and Klamath Provinces. The model produces a spatially distributed estimate of landslide density by mathematically matching observed landslide locations with topographic attributes including slope, convergence (bowl-shaped landforms), and watershed area, using a digital elevation model. BLM used the channelized mass wasting delivery model in NetMap to determine susceptible areas from the hill slope relative landslide density that could deliver to any stream channel."

The DEIS states (p. 307) that "The BLM added forecasts of future timber harvest under each alternative to the NetMap model outputs. In this analysis, the BLM assumed that regeneration harvest would increase the relative landslide density. In this analysis, the BLM assumed that commercial thinning would not affect landslide risk. The BLM did not account for the continuing effect of regeneration harvests that the BLM has conducted within the past ten years. As described in the Forest Management section in this chapter, the BLM has conducted only a very small acreage of regeneration harvests in the past ten years." Although regeneration harvest has a higher likelihood of increasing landslide frequency, thinning can also increase the frequency of landslides, depending on the harvest intensity. Reduced shear strength, associated with increased saturation, results from decreased tree canopy interception and reduced transpiration (Swanston 1973, Harr and McCorison 1979, Keim 2003, Johnson *et al*. 2007). We recommend that BLM analyzes the potential effects of thinning on landslide risk, particularly in areas that will receive high intensity thinning prescriptions (>80 trees per acre, posting thinning).

The DEIS states (p. 307-308) that "The BLM did not include potential increases to relative landslide risk from new road construction in this analysis. This is a change from the methodology described in the Planning Criteria (USDI BLM 2014, p. 81). Roads do have the potential to increase landslide risk (Miller and Burnett 2007, Weaver and Hagans 1996). However, under all alternatives, the BLM would construct few miles of new roads relative to the existing road system (see Trails and Travel Management in this chapter). Furthermore, most new roads under all alternatives would be built on stable areas such as ridge top locations, and would mostly be short spurs to the existing collector roads." The BMPs direct the BLM to locate temporary and permanent roads and landing on stable location, and to minimize construction on steep slopes, slide areas, and high landslide hazard locations. Since this is a BMP and not a Management Direction, there is an element of uncertainty related to the location of road construction. Based on this, we recommend that the FEIS should include a comprehensive analysis of landslide risk from new road construction.

Roads

The DEIS needs to better address road management issues as they relate to sediment production and discharge to streams. The DEIS should assess the extent to which drainage improvements are needed to reduce erosion and apply appropriate and effective BMPs to the existing cooperative BLM-private forest road system across western Oregon. The DEIS should explain plans to reduce watershed, water quality and fishery impacts from roads, inclusive of reduction of road extent through limits on new road construction, decommissioning of existing roads, and drainage improvements to "stormproof" roads that will remain on the landscape permanently. Monitoring results reporting the effects of NWFP implementation to date included a measure the level of fine sediments in stream habitat. Reductions in fine sediments that indicate habitat improvement in streams have only been observed in a handful of watersheds under extensive (National Forest) ownership where aggressive road removal and road network reductions, coupled with drainage upgrades of remaining roads were implemented early in the NW Forest

Plan period (Gallo et al. 2005, Reeves et al. 2006). The DEIS should (but does not adequately) address the longstanding need for systemic reforms of road systems and road management with the attendant need for erosion control and sediment reduction on BLM lands and the cooperative road network that extends to intermingled and adjacent private, tribal and other lands.

Roads are ecologically problematic in any environment because they affect biota, water quality, and a suite of biophysical processes through many physical, chemical, and biological pathways (Trombulak and Frissell 2000, Jones et al. 2000, Al-Chokhachy et al. 2010). The magnitude of existing road impacts on watersheds and streams on federal lands in the PNW may equal or exceed the effect of all other activities combined. Firman et al. (2011) reported that density of spawning coho salmon across coastal Oregon streams was negatively associated with road density. Kaufmann and Hughes (2006) found that road density in Coast Range streams was associated negatively with 25-50% of the variability in condition of aquatic vertebrate assemblages. More recently, Meredith et al. (2014) showed that the abundance of habitat-forming wood in Columbia Basin streams declined with proximity to roads, and the effect was roughly the same magnitude as that of natural climate and vegetation differences or long-term livestock grazing. The DEIS fails to address this body of science that identifies a wide range of mechanisms of road impact on streams and provide a comprehensive understanding of existing impaired conditions of road-affected ecosystems, and which implicates long-lasting and severe cumulative impact to fish and wildlife if extant sediment conditions are maintained or not improved.

Roads are necessary to support logging, mining, grazing, and motorized recreation, but the existing federal forest road system far outstrips the extent of those demands. The number and poor condition of USFS and BLM roads, the agencies' inability to prevent current roads from deteriorating and harming streams, and the pervasive effects of roads on the physical and biological environments were recognized in FEMAT (1993), but are minimized in this DEIS. In addition, forest roads have been the subject of high-profile national dialogue and policy reviews since the development of the NWFP (Gucinski et al. 2001, Pacific Rivers Council 2008). The ACS's primary means of protecting streams from roads and encouraging effective restoration are twofold: First, ACS objectives discouraged locating roads within Riparian Reserves, and second, roadless areas were to be maintained and overall road density reduced in Key Watersheds. For a small number of Key Watersheds where road network reduction has been pursued, agency monitoring efforts have reported improvements of certain instream habitat conditions, a response not detected elsewhere (Gallo et al. 2005, Reeves et al. 2006). Alternatives that reduce the size of Riparian Reserves could result in the construction of roads and landings in closer proximity to streams, increasing the likelihood of sediment delivery and alteration of near-stream hydrology. This needs to be disclosed and its potential effects analyzed and considered in the DEIS.

Reducing road density in critical watersheds, improving road drainage and stream crossings, and addressing other road-related factors that affect streams and aquatic biota pose central challenges to forest planning and management. The ACS and other operative policies have lacked sufficient means and impetus to accomplish this in the past 20 years. Based on the work of Frissell et al. (2014) and others, we identify six policy changes that could help achieve needed road reductions: (1) Prohibit the construction of new permanent and "temporary" roads that are hydrologically connected to streams or cross areas at high risk of landslides; (2) Allow no net increase in road density in any watershed. New "temporary" roads and landings should be considered to be roads and counted towards road density levels for at least several decades after decommissioning; (3) Establish unambiguous standards and metrics for net road density reduction, which include adequate accounting for landings and the impacts of so-called "temporary" and decommissioned roads and landings; (4) Improve the system of classification (e.g., road type, use) and inventory (e.g., whether a road is active or decommissioned), and mapping (i.e., update maps to reflect current conditions) to ensure that agency bookkeeping of road miles corresponds with actual field conditions. This provision is necessary because at present many roads "disappear" when dropped from the inventory, but they in fact remain on the landscape causing watershed impacts. Also, lax road mapping programs and narrow definitions of what constitutes a road can significantly under represent the actual road densities; (5) Establish a target for road density in each watershed based on watershed conditions that will elicit a positive biological response. Require each proposed forestry and other development project to meet a target of incremental reduction of road density until road density in the affected watershed is lower than the target established on the basis of biological response; and (6) Roads for which there are not adequate funds for maintenance and upkeep should be decommissioned. These six actions should be considered by the BLM in the DEIS as steps that could effectively help to ensure that alternatives are sufficient to provide for protection and restoration of fish habitat and stream resources, and reasons provided if they are not adopted in the decision.

Hydrology

This section (p. 217) identified a key point related to increases in peak flow between the alternatives. The stated key point is:

- Less than 2 percent of the decision area would susceptible to peak flow increases over time under any alternative. The No Action alternative and Alternatives A and D would result in slight decreases and Alternatives B and C would result in slight increases in the number of subwatersheds susceptible to peak flow increases over time.

The DEIS states (p. 299) that "In this analysis, the BLM addressed effects on peak flow in the rain-on-snow hydroregion only, because there is little evidence that the forest harvest activities can elevate peak flows in the rain hydroregion or snow hydroregion (Grant *et al*. 2008)."

Peak flow analysis in the DEIS (p. 300) considers the largest spatial scale (sixth-field subwatersheds, 10,000-40,000 acres in size, that is generally acceptable to recognize any change in magnitude of peak flows, obscuring dispersed localized impacts that may be occurring at a finer scale.

The BLM compared the total open area for each rain-on-snow subwatershed for each alternative and time period to the rain-on-snow response curve from Grant *et al*. (2008) that were constructed from data at the site scale (few to hundreds of acres). Response curves for the rain-on-snow hydroregion developed by Grant *et al*. (2008) indicate that a mean of 19% of a watershed area with roads would need to be harvested to detect a change in peak flow response.

The DEIS states that there are 96 subwatersheds that are predominately rain-on-snow dominated (38 with BLM administered lands) in the planning area. The BLM determined that 7 of the 38 subwatersheds would be susceptible to detectable change in peak flow response.

The DEIS states (p. 302-303) that "Gravel bed channel types with a 1 to 2 percent gradient are most likely to be affected for any detected peak flow increase from forest management and roads shown in Figure 3-94. Generally, these gravel bed stream types are a small proportion of total stream miles (less than 10%) in any subwatershed in the decision area. Most streams in the decision area are cascade or step-pool channel types. The predominance of cascade or step-pool channel types and the general absence of sand-bed channel types in the decision area reduces the likelihood that any peak flow increases would result in changes to channel structure in the decision area." The gross geomorphic effects of these dispersed increases in magnitude might be small due to resilience of channels (Grant *et al*. 2008); however, a variety of effects (fine sediment transport, reduced streambank stability, reduced large wood retention) may result in significant effects to ESA-listed fish habitat at the stream reach scale.

Base flow is another critical environmental attribute for salmonid fish (Moore and Wondzell 2005). Summer base flows can be reduced by post-logging vegetative regrowth (Hicks et al. 1991). Even a small proportional reduction in summer low stream flow in streams that are small, have naturally low base flow, or have seen recent influxes of bedload sediment, can lead to loss of flow connectivity, trapping of fish in isolated habitats, and inhibiting of migration, increased predation, and direct dewatering mortality, many cases can have severe consequences for fish and wildlife. The only place in the DEIS where base flow is mentioned is in relationship to stream temperature under the Climate Change section (p. 156-157). A more complete base flow analysis is needed in the DEIS that accounts for the direct, indirect (delayed or downstream) and cumulative effects of management activities (in particular the effects of timber harvest and roads) on water quantity. Thinning near streams may have proportionally larger consequences for summer flow depletion because rapidly re-growing vegetation after logging can most directly affect groundwater storage near the stream channel. This impact needs to be analyzed and addressed given the reduction of riparian reserve widths under the action alternatives, which would allow greatly increased vegetation removal within the zone where vegetation transpiration most directly affects subsurface water conditions are tied to surface streamflows.

Fire Management

The DEIS does not address the likely effects of fire management on riparian and aquatic habitat, particularly in regards to sediment production, riparian forest condition, effects of post-fire salvage logging and increased road construction. Below we review the current science on the effect of management actions related to fire as they pertain to the health of Riparian Reserves and associated aquatic habitat and provide suggestions for additional effects analysis that should be completed as part of the DEIS "Affected Environment and Environmental Consequences" analysis.

The DEIS should succinctly summarize its assumptions and conclusions about acres affected by fire in past decades, how much and which areas are expected to be affected by fire in the future, and how these together affect vegetation successional patterns and states, and potential timber production, particularly, from NMFS perspective, in regards to the effect on the condition of Riparian Reserves. It appears from information presented in Appendix C that these factors have been modeled by BLM, it does not appear they have been presented in a way that the analytic, model inputs, and model results can be reviewed and their veracity validated by independent readers or any third party. This is particular critical given climate change model predictions that are consistent with increased area affected by wildfire in the planning region (Mote et al. 2014, DellaSala et al. 2015, Littell et al. 2009a,b)

The DEIS should also specifically identify the protocol, and acres subject to salvage logging post-fire in the planning period under each alternative. This is not only because fire affects potential timber yield. But also because post-fire logging is known to pose extreme risk of harm to soils, watersheds, fish and wildlife habitat (Beschta et al. 2004, Karr et al. 2004), and for the projections of BLM's programmatic impact to these resources in the DEIS to be valid, the effects of potential post-fire salvage logging must be estimated and accounted for. Note that this does not require a site-specific analysis—only an appropriate scaling of area effects and associated magnitudes of impact of fire and post-fire salvage allowed under each alternative, analogous to the analyses done to estimate vegetation changes and timber volumes.

Just as one example of the importance of accounting for fire and post-fire conditions clearly, did the analysis of sediment generation from roads consider the consequences of fire on sedimentation and erosion, which typically greatly magnifies erosion and sediment delivery form roads in fire-affected watersheds? Given increased soil erosion proneness and soil moisture post-fire, did that analysis of road-related sediment (DEIS Chapter 3, p, 286, "Key Points" and subsequent section) account for the effects of salvage logging that can be reasonably certain to follow wildfires during the years of plan implementation? This is of particular concern because given how the DEIS proposes to alter the extant rules governing watersheds and riparian reserves under the NW Forest Plan Aquatic Conservation Strategy, it appears to set the stage for expedited post-fire logging, in particular in and near streamside zones that currently fall within default Riparian Reserve designations. If BLM did not account for sediment impacts due to post-fire salvage logging, then the BLM's conclusion (p. 286) that "under all alternatives, potential sediment delivery to streams from new road construction would constitute less than a one percent increase above current levels of fine sediment delivery from existing roads" is erroneous and misleading. Erosion and sediment delivery will likely increase in a near exponential fashion given an incremental increase in the density and spread of roads across the landscape, coupled with an observed and likely continued increase in climate variability that forces both the increased size and severity of fires and increased intensity of storms and flooding in post-fire wet seasons (Battin et al. 2007, Furniss et al. 2010). Alternatives that rely on expansion, rather than reduction, of the extant road network as is the directive under the NWFP and "No Action" alternative, will exacerbate this interaction, greatly magnifying erosion and sediment deposition in streams and its harmful consequences. More this projected magnification of erosion and sedimentation does not account for road maintenance shortfalls responsible for recurring significant erosion damage from the existing road network.

Appendix H reports on a Nature Conservancy region-wide modeling exercise that attempts to relate fuels and vegetation types to possible fire response. The resolution of the mapping and modeling precludes the identification of riparian areas in his analysis, yet we know that riparian areas have unique moisture, topographic, and vegetation, and fuels conditions that in many fire conditions result in different fire behavior and effects than occurs on adjacent uplands (Dwire and Kauffman 2003, Bêche et al. 2005, Pettit and Naiman 2007, Messier et al. 2012). Given the disproportionate importance of riparian vegetation and streamside slopes to watershed integrity, fish and wildlife habitat, and recovery of ESA listed and otherwise threatened salmonids, how does BLM relate the upland modeling results to riparian and stream conditions? How are the consequences of upland fuels and fire management for streams and watershed functions accounted for in the DEIS? Because upland fire behavior is sometimes strongly influenced by adjacent upland fire behavior (Messier et al. 2012) but at other times (under different fire and weather conditions) strongly decoupled from adjacent uplands (Pettit and Naiman 2007), how can BLM explain differences among the alternatives in fuel treatment effect on watersheds, streams, and riparian-dependent fish and wildlife, and account for these in the comparison of alternatives and the evaluation of an eventual decision? Why can't fire regimes be restored in conservation lands through the restoration of prescribed fire in them, with minimal direct disturbance of soils, rather than through commercial logging and mechanized fuels treatments that actively disturb soils and promote erosion and sedimentation? At present these critical ecosystem relationships, effects, and consequences are not sufficiently analyzed or addressed in the DEIS. Therefore the very important causal linkages between upslope forest management practices justified by BLM on the basis of fire, and the condition of streams and other water bodies cannot be evaluated with information disclosed in the DEIS.

In addressing the consequences and effects of thinning, fuels management and fire dynamics on watershed functions and stream and wetland resources, it is critical that BLM account for the three factors: 1) direct adverse effects of fuels treatments on soils and water that create a compelling need to clearly evaluate tradeoffs between fuels treatment and fire effects; 2) differential response of riparian and upland forests to thinning treatments that affect the effective duration of fuel treatment effects, and 3) the small probability of co-occurrence of fire and the limited time window of possible effectiveness of fuels treatments after initial treatment (Rhodes and Baker 2008).

Current ACS language allows the agencies to "apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain…objectives." The agencies carry a project-specific burden to establish the need for thinning and that outcomes are ecologically restorative. Recently the USFS and BLM have pressed to increase in the average size of thinning projects apparently to reduce the number and cost of site-specific environmental analyses by broadening their scope. BLM in the DEIS apparently presumes (with little explicit rationale) extensive use of mechanical harvesting methods in conjunction with commercial timber sales to thin trees in riparian areas and other areas where conservation values are putatively given highest priority. In wetter forest types, the primary claim that thinning is restorative rests on the assumption that the growth rate and vigor of those trees left alive after thinning will likely improve, thereby hastening the future development of larger-sized trees. In drier forests, the primary rationale is that thinning is needed to promote a generalized reduction in fuel loads, thereby presumably reducing the risk, or severity, or rate of spread, of wildfire and that thinning can increase fire resistance of selected individual trees.

Regardless of silvicultural intent, mechanized treatments in Riparian Reserves can disturb vegetation and soils in close proximity to surface waters, where the risk of sediment delivery and other impacts is high (Rashin et al. 2006, Dwire et al. 2010). Logging activity that disturbs soils within riparian buffers can also reduce the buffer's effectiveness to retain sediment and nutrients delivered from upslope sources. Thinning or other disturbance of coniferous or deciduous trees and shrubs within riparian and wetland areas can cause decades of diminished summer low flows (after an initial few years during which low flows may increase), as a consequence of increased water demand by rapidly re-growing vegetation (Hicks et al. 1991, Moore and Wondzell 2005). In addition, thinning and yarding of logs from near-stream areas requires or encourages the construction of roads in close vicinity to streams, where the likelihood of sediment delivery and other impact from roads is increased (Luce et al. 2001). Bryce et al. (2010) found that for sediment-sensitive aquatic vertebrates and macroinvertebrates, minimum-effect levels for percentage fines were 5% and 3%, respectively, meaning that even small increases in fines can adversely affect salmonids and their prey.

Mechanized thinning and fuels operations usually require higher-density road access to be feasibly implemented. Mechanical treatments for fuels reduction are particularly problematic because recurring entries at roughly 10-year intervals are necessary to sustain the desired conditions (Martinson and Omi 2013); such a forest management regime strongly favors, if not requires, a permanent, high-density road network. Many thinning projects involve road and landing construction and reconstruction, as well as elevated haul and other use of existing roads, all of which significantly contribute to watershed and aquatic degradation. Even if constructed roads and landings are deemed "temporary," their consequent impacts to watersheds and water bodies are long lasting or permanent. The hydrological and ecological disruptions of road systems and their use (Jones et al. 2000, Trombulak and Frissell 2000, Gucinski et al. 2001, Black et al. 2013), exacerbated by other effects of vehicle traffic, will likely outweigh any presumed restorative benefit to streams and wetlands accruing from thinning and fuels reduction. In recent years, the prospect of future thinning or fuels reduction projects often has become the basis for the USFS or BLM to avoid or delay decommissioning environmentally harmful roads, even when fiscal resources were available for the work. Prescribed fire without extensive mechanical treatment is of much less concern, as it is more feasible to apply in sparsely-roaded wildlands, entails far less soil disturbance, and if conducted in proper times and places it can more adequately mimic the ecological effects of natural wildfire.

Substantial questions remain about the putative ecological benefits of thinning and fuels reduction in the DEIS. This is critical because in its overall presentation of information in the DEIS, BLM suggests or implies that the desired ecological benefits outweigh the adverse environmental effects of logging and fuels treatments—in fact to the extent that detailed and substantive analysis of the tradeoffs is not warranted. Dispute among federal agencies about claimed ecological benefits of thinning in moister, Douglas-fir-dominated forest types (widespread in the Pacific Northwest) led to an interagency scientific review in 2012-2013 (Spies et al. 2013). That panel concluded that increased tree growth might be better obtained from thinning very young, high-density stands--which very seldom produces commercially saleable logs. They further concluded that thinning produces unusually low-stem-density forests and causes long-term depletion of snag and wood recruitment that is likely detrimental in most Riparian Reserves (Spies et al. 2013, and see Pollock et al. 2012, Pollock and Beechie 2014). Further depletion of wood recruitment in headwater streams can adversely affect the behavior of debris flows in Pacific Northwest watersheds in ways that further reduce residual wood debris and its important functions over extensive portions of streams and rivers (May and Gresswell 2002), where present-day wood abundance is decimated compared to historical conditions (Sedell et al. 1988, Pollock and Beechie 2014). Finally, recent reviews also raise compelling, unanswered questions about the effectiveness of thinning forests for attempted control of insect outbreaks (Black et al. 2013, Six et al. 2014).

The effect of thinning on fire behavior and effects within riparian areas has been little studied. For western North American forests in uplands the literature is replete with ambiguous and conflicting results regarding the effects of thinning and other mechanical fuels treatments on fire severity, rate of spread, and recurrence. Moreover, the probability of a fire burning through a treated stand within the limited time window of potential effectiveness of a fuels treatment has been shown to be very small

(Lydersen et al. 2014, Rhodes and Baker 2008). Any presumed benefit is even less persistent in Riparian Reserve areas where woody vegetation regrows rapidly after treatment, and where in moister forest types fire tends to recur with lower frequency. Equally important, we question whether managers should be striving to reduce fire severity in riparian areas as a rule, considering that high-severity fire plays a natural and historical role in shaping riparian and stream ecosystems (Gresswell 1999, Minshall 2003, Benda et al. 2003, Malison and Baxter 2010). Other natural forest disturbances, including windthrow, insect outbreaks, and landslides on forested slopes, appear to play a similarly important role in generating pulses of wood debris recruitment to streams, establishing a long-lasting source of ecological and habitat complexity.

Considering the newer scientific literature showing often difficult-to-justify costs and recognized inherent risks of adverse impact associated with such operations in sensitive areas, balanced against the uncertainty in intended benefits, consistent with Frissell et al. (2014), the following planning and policy measures should be considered as guidelines for determining the scope, scale, and location of thinning and fuels reduction actions entailed under the DEIS: (1) Thinning and fuels reduction by means of mechanized equipment or for commercial log removal purposes should be generally prohibited in Riparian Reserves and Key Watersheds; (2) Any thinning or fuels treatment that does occur as a restorative treatment in Riparian Reserves (e.g., to remove non-native tree species from a site) should retain all downed wood debris on the ground; and (3) Thinning projects that involve road and landing (including those deemed "temporary") construction and/or reconstruction of road segments that have undergone significant recovery through non-use should also be prohibited, due to their long term impacts on critical watershed elements and processes.

The BLM should account in this DEIS for recent and current scientific findings as cited above, and explain clearly their scientific and operational bases for thinning and fuels reduction programs, weighing costs against environmental consequences explicitly and with full disclosure of assumptions, risks, and uncertainties.

Management After Natural Disturbances

"Salvage" logging of dead or dying trees after fires, insect outbreaks, and other disturbances in Pacific Northwest forests continues to be undertaken in the region, and its effects are a recurring ecological concern (see review by Lindenmayer and Noss 2006). Soon after the NWFP was adopted in 1994, the scientific community began to weigh in on the inadvisability of post-disturbance logging. Scientists have catalogued the critical importance of large standing live trees, snags, and downed wood from fallen trees in the post-disturbance recovery of natural forests, including stand successional pathways, watershed processes, and wildlife and fish habitat (e.g., Gresswell 1999, Minshall 2003). Numerous scientific syntheses provided precautionary advice against post-fire logging on a wide range of causal grounds (e.g., Beschta et al. 2004, Karr et al. 2004, Lindenmayer et al. 2004, Lindenmayer and Noss 2006, Donato et al. 2006, Noss et al. 2006). More recent work has identified the potential importance of pulses in trophic energy following high-severity wildfire (Malison and Baxter 2010) for persistence and recovery of aquatic and riparian species. This new information builds on a more longstanding recognition that wildfire, that among its many other effects, plays an important long-term role in the generation of complex wood debris structures in streams (Minshall 2003). Other reviews focused on plant and landscape ecology broadly call into question the effectiveness of salvage logging insect-infested trees to control insect outbreaks (e.g., Black et al. 2013, Six et al. 2014). Similar concerns about the consequences of salvage logging curtailing natural ecosystem recovery processes pertain to salvaging of stands affected by any natural mortality agent, such as windthrow or volcanism. Post-disturbance logging was not expressly ruled out in the NFP and ACS, and as a consequence, large post-fire salvage logging projects have been pursued by the BLM and USFS in some areas, including on occasion within Key Watersheds, Riparian Reserves, Late Successional Forest Reserves, and designated critical habitat of listed species (see DellaSala et al. 2014). Scientific consensus on the inadvisability of post-disturbance logging largely emerged in the years just after FEMAT, hence it is incumbent on BLM to strengthen aquatic protections to reflect such sources as the recommendations in Beschta et al. (2004), Karr et al. (2004), and Black et al. (2013). It is incumbent on BLM to explain its rationale if it chooses to not implement such recommendations to improve watershed, water, and fish resource protection from post-fire logging.

Climate Change

The DEIS does not adequately address the current scientific understanding of the breadth of ways that anticipated climate change will alter the way we expect ecosystems to respond to forest management actions, particularly in regards to aquatic resources (e.g., see Dale et al. 2001, Dalton et al. 2013). BLM should review the relevant literature and identify actions and policies that could explicitly reduce the risk of future resource harm, including to salmonid fishes and stream habitat, from anticipated climate change. In general for this region, hydrologic model predictions stepped-down from regional and global circulation models project increased stream and lake warming (varying magnitude across the seasons); more intense winter precipitation events, including flood and wind disturbance of riparian forests; earlier snow pack melting except for the highest elevation watersheds; and likely increased intensity and duration of droughts (Battin et al. 2007, Dalton et al. 2013). In very general terms, most climate change scenarios suggest larger and higher severity wildfires than seen in recent decades, and generally elevated evapotranspiration that could further reduce low summer streamflows. Luce and Holden (2009) documented a widespread pattern of declining summer streamflow over recent decades at gauging stations across the Pacific Northwest.

Climate changes will likely exacerbate existing (ongoing) trends in watershed degradation by affecting key processes or factors (stream thermal regimes, surface flows, groundwater and floodplain connectivity, landslide rates, fuels, fire, invasive species, and post disturbance human responses, to name but a few). Most climate change adaptation strategies call for strategic removal of non-climate stressors, because these will likely be more tractable or remediable than climate stressors (ISAB 2007, Furniss et al. 2010). No formal review of the ACS has apparently been conducted by the USFS or BLM to determine what, if any, science-based changes to the ACS best address future climate scenarios. However a review of the climate literature as it pertains to forest ecosystem management does not lend support to diminishing currently protective provisions of the ACS, such as the riparian reserve reductions contemplated in the DEIS.

At present, NWFP ACS stream and wetland protection requirements are integral to assuring streams, wetlands, and other water bodies have a high level of resilience in the face of increasing climate stress. Complex natural riparian vegetation communities and natural accumulations of large wood (resulting in concentrations of stored sediment) in and near floodplains are instrumental in creating and maintaining conditions that support hyporheic flow exchange. Wide Riparian Reserves provide not only shade, but essential protection and support for the natural processes that maintain and regenerate the suite of hydrologic and geomorphic elements that help buffer streams against climate forcing. Beyond current practices, extensive forested north-facing slopes can moderate some climate influence on watersheds, and localized springs, and extensive shallow alluvial aquifers that store water seasonally can moderate summer streamflows and both summer and winter temperatures (Poole and Berman, 2001, Isaak et al. 2010, Wondzell 2011). BLM should identify and evaluate new planning elements and practices to recognize and protect vegetation, soils, and hydrologic functions of such areas from the adverse effects of roads and timber harvest, and mechanized fuels reduction projects.

Intact watersheds are often seen to be less vulnerable to storms, floods, droughts, wildfire, and other extreme events, and are expected to be more resilient to future climate change than highly altered watersheds. Streams and rivers affected by reduced alluvial groundwater storage and diminished hyporheic buffering, fragmentation and loss of biological habitat connectivity, and a less intact native biota, are likely to respond more quickly and with greater volatility to climate change, as are engineered systems such as roads and dams. Watershed resilience in the face of climate change can best be maintained by protecting and restoring the suite of natural processes and conditions that characterize natural forested riparian areas and floodplains (Seavy et al. 2009, Furniss et al. 2010). This is exactly what the ACS was originally designed to accomplish. Reducing riparian protections on the basis of narrowed, single-factor considerations such as proximate stream shade undermines the comprehensive protection of stream and riparian processes that the ACS was designed to maintain and restore. Finally, under changing climate, some management practices that seemed to produce desirable outcomes in the past may not do so in the future. For example, the putative effectiveness of forest thinning at altering fire behavior could become even more uncertain if weather extremes become more of a top-down driver of fire behavior (see Martinson and Omi 2013) in future climates (Dale et al. 2001, Westerling et al. 2006).

The following are some recommendations for management response to increase resilience of riparian and aquatic habitats and salmonids to foreseeable climate change threats (see Frissell et al. 2014); they are relevant to this DEIS and should be considered by BLM and the basis for their adoption or rejection should addressed in the document. (1) ACS protections for Riparian Reserves should be sustained and strengthened to better protect and restore natural ecosystem processes that confer resilience to climate change, as detailed in our other recommendations; (2) an interagency scientific conservation design effort is needed to expand and reconfigure some present Key Watersheds to ensure they better encompass specific areas that are likely to be topographic and hydrologic buffers to future climate change impacts; and (3) the direct and indirect effects of management actions on the integrity and capacity of stream and watershed ecosystems for resilience to climate change be analyzed in every environmental assessment, environmental impact statement, watershed analysis, and ESA consultation.

NMFS' Recommendations on RMA Alternative Selection

The Preferred Alternative (Alternative B) and Alternative C do not provide sufficient and protective riparian management strategies to ensure the conservation of our trust resources managed under the ESA and MSA; therefore, we cannot recommend either of these alternatives for further consideration.

Alternatives A and D have promise, but must be paired with sufficient landscape level strategies not yet incorporated in any of the alternatives presented in the DEIS. The lack of a landscape level conservation strategy, similar to key watersheds, hampers even the two most conservation crafted action alternatives. Lessons from the NWFP ACS suggest strong standards and guidelines, paired with management direction focused on aquatic conservation, demonstrate the need to carry forth concepts of the NWFP ACS to ensure future conservation of our trust resources. Also, as in the NWFP ACS, some landscape level analyses combined with a strategic watershed restoration program are needed to maintain, protect, and recover ESA-listed species. The following is a summary of the major issues with the DEIS and with the preferred alternative that NMFS found in its review of the DEIS:

1. The riparian management scenarios proposed in the preferred alternative B and alternative C would not adequately maintain and restore all of the riparian and aquatic habitat conditions and processes that are critical to the conservation of anadromous fish (in particular, wood delivery to streams, maintenance of stream shade and water temperature, and filtering of nutrients and sediment before delivery to streams).
2. The action alternatives do not incorporate a watershed-scale analysis or analytic protocol that establishes a necessary context to ensure that the plan, and subsequent projects under the plan, are consistent with, and further the conservation of, ESA-listed anadromous fish nor our other trust resources managed under the MSA.

My staff, in conjunction with EPA, U.S. Fish and Wildlife Service, and BLM, have begun to formulate a framework that would help to address some of the issues that are listed above. We would like to work closely with your staff to incorporate this framework into the proposed action before release of the FEIS. The key elements are listed below:

1. Identification and differential management of a network of aquatic-emphasis watersheds for fish recovery, public water supply, and water quality.
2. Use of watershed-scale assessment and planning to guide land management actions.
3. Protection of current high-quality fish habitat, in addition to restoration of habitat with high intrinsic geomorphic potential.
4. Adjusted RMAs with more conservative management in aquatic-emphasis watersheds.
5. Standards and guidelines (management objectives and direction) that are mandatory, but are selected based on type of management action and site conditions.
6. Manage under the expectation climate change will alter the current environmental conditions in an adverse way for cold water species, including anadromous fish.

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