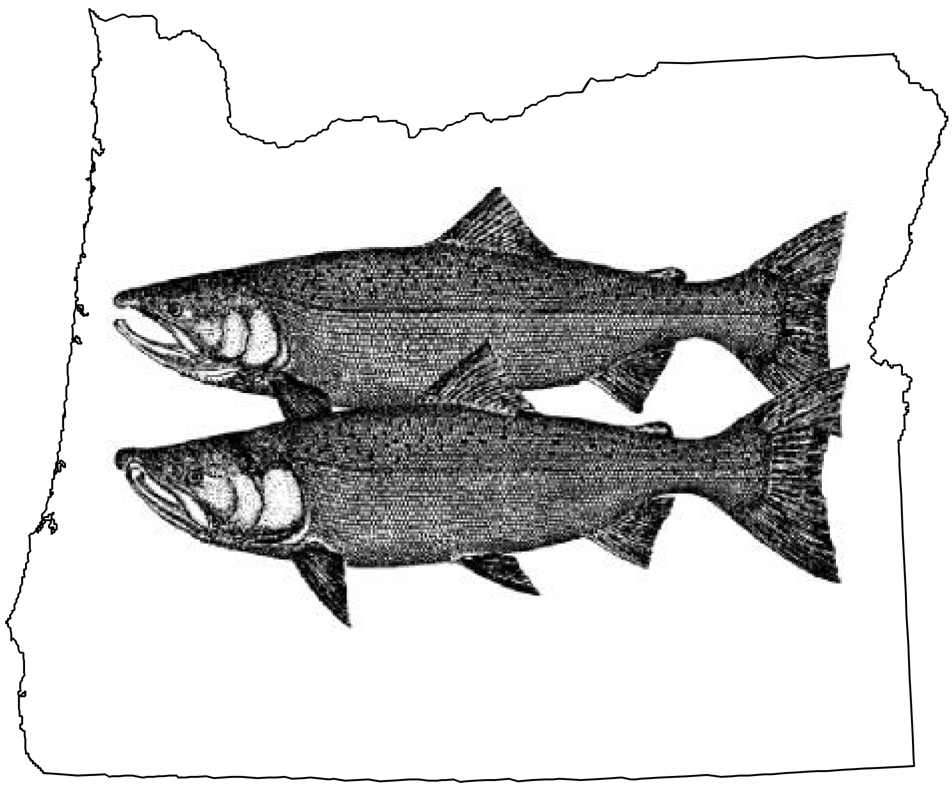
A DRAFT PROPOSAL
CONCERNING OREGON FOREST PRACTICES



Submitted by the National Marine Fisheries Service to
the Oregon Board of Forestry Memorandum of Agreement Advisory Committee
and the Office of the Governor

A DRAFT PROPOSAL
CONCERNING OREGON FOREST PRACTICES

This is a draft proposed on Oregon Forest Practices developed by the Northwest Region of the National Marine Fisheries Service (NMFS). It has been submitted to the Oregon Board of Forestry Advisory Committee as part of ongoing discussions of potential improvements in Oregon forest practices. The Advisory Committee is composed of Federal, state, industry, fishery and environmental representatives. The NMFS will work closely with the Committee during the remainder of the year in an effort to reach consensus on forest practices that landowners can implement to conserve salmon.

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EXECUTIVE SUMMARY

The National Marine Fisheries Service (NMFS) is submitting this forest practices proposal as a central part of the crucial effort to conserve West Coast salmon. This effort is being undertaken in close cooperation with the State of Oregon. This is the latest step in a process begun in early 1997, when NMFS and Oregon started fully working together to develop and implement the Oregon Plan—an ambitious and unprecedented state-led effort to cooperatively break down institutional barriers and fulfill the requirements of the Endangered Species Act (ESA).

In submitting the proposal, NMFS intends to assist the Board of Forestry Advisory Committee (hereafter: Advisory Committee) in developing new forest practices, rules, and programs—thus complying with the provisions of the Memorandum of Agreement between NMFS and Oregon. The ultimate goal is to ensure that forest practices in the State of Oregon have a high probability of maintaining or achieving properly functioning conditions in those aquatic habitats upon which coastal salmon rely for survival.

In April of 1997, NMFS and Oregon signed a Memorandum of Agreement (MOA) detailing how they would cooperate to further develop and implement the Oregon Plan. Both Oregon and NMFS have recognized from the outset that the Oregon Plan is a living document and that it will be modified and refined over time. The MOA contemplates that Oregon forestry practices will be adjusted to provide a high probability of protecting and restoring aquatic habitat on Oregon forest lands. Such adjustments are to be considered through a cooperative process, and the Oregon Board of Forestry will make final rulings on their implementation by June of 1999.

The NMFS began developing this proposal by convening three panels of independent scientists—the make-up of which was determined through consultation with the State of Oregon. The three panels covered the major issues identified in the Memorandum of Agreement—landslides, riparian management, and cumulative effects. In a series of meetings, these scientists reviewed prior analyses, developed overviews of current and historical habitat conditions, assessed current practices and alternative measures, and provided their individual views on potential improvements in forest practices.

The discussion group members found it uncertain to unlikely that the existing rules would achieve coho habitat objectives, particularly for small streams and in areas of high landslide risk. Acknowledging this, they identified important gaps in the current rules and practices and provided insight on improvements that could be made in several areas.

The scientists warned that salmon conservation on the Oregon Coast depends on more than improved forest practices. They especially urged that the low-gradient portions of coastal watersheds—the lowlands that had historically provided the majority of coho habitat—should be protected and restored. At the same time, they noted that improvements the steeper, upper portions of the watersheds were important. Due to extensive lowland degradation, existing coho populations are concentrated largely in upstream strongholds.

The scientists recommended improvements in a number of areas. These are reflected in the proposal and they include:

1. Improved riparian management for streambank stabilization, root strength, large woody debris recruitment and shade -- particularly for smaller, non-fish-bearing streams.

2. Stronger safeguards on non-fish-bearing streams to help improve habitat quality in areas that do contain fish.

3. Screening procedures to identify high-hazard, unstable slopes.

4. Comprehensive management plans to integrate road construction, maintenance and retirement.

5. Fish passage improvements.

6. Better and more rapid watershed analysis.

7. Improved methods for assessing and addressing cumulative effects.

Though the NMFS proposal was developed with the assistance of the members of the science discussion groups, it is important to note that the independent scientists are not the authors of the proposal. In submitting it, NMFS is not implying that there is complete consensus among the scientists about these matters, nor that the scientists endorse all elements of the proposal. It is not surprising that some scientific disagreements and uncertainties remain.

The intent of the proposal is to focus discussion on the key issues identified by the Memorandum of Agreement and the scientists. To promote this discussion, the proposal is submitted in draft form. As noted in previous meetings with the Advisory Committee, the proposal is emphatically not offered as a “take it or leave it” proposition. It reflects NMFS’ current thinking on a means to achieve properly functioning aquatic habitat conditions—and it also discusses a number of alternative approaches that have been found acceptable in the past. The NMFS believes that the proposal and alternative approaches will benefit from further discussions with the Advisory Committee and we will work to achieve as much consensus on these issues as possible. In addition, NMFS believes the Committee should explore the prospects for developing a long-term arrangement to provide stability and certainty for landowners while meeting the requirements of the ESA and providing a high probability of properly functioning habitat for salmon.

The proposal does not seek to restore pre-development conditions in Oregon forests and streams; as the science discussion groups noted, this is not possible. The proposal highlights the importance of protecting habitat that is still intact, attempts to reestablish functioning processes over the short term, and seeks to achieve a high probability of proper function supported primarily by natural processes over the long term. The NMFS acknowledges that attaining these goals will require a mix of active management and passive restoration, and there may be ways to accelerate and maintain the restoration process through experimental management activities. In the long-run, properly functioning condition requires the sustained presence of natural processes that create and maintain productive habitat. These natural processes are dynamic. They are frequently affected by management practices.

To ensure a high probability of restoring the salmon, it is necessary to rely on the best available scientific information and apply needed improvements across the landscape—this includes non-Federal lands. The measures in the Northwest Forest Plan will ensure that forestry on Federal lands is governed by stricter measures than will activities on non-Federal lands. Activities on non-Federal lands should complement those efforts and be consistent with present and future Habitat Conservation Plans negotiated with private landowners and the state.

The proposal presents a series of detailed measures to achieve properly functioning habitat condition. While these are written in the terms frequently encountered in forest practice rules, NMFS is leaving open at this time the question of whether all the changed practices should be codified in law or regulation or whether many could be pursued through agreements or other incentive-based mechanisms. That approach is consistent with the MOA, which provides that changes could occur in statutes, regulations, or other programs.

While the measures may appear unduly prescriptive to some, they are intended to be default interim measures, practices that can be refined as sound watershed analyses are completed. It is anticipated that these more refined analyses will permit significant additional flexibility in forest practices—an important and valuable incentive for landowners to complete the necessary watershed analyses. The proposal calls for improvements in watershed analysis and cumulative effects assessment that will help spur these important next steps.

The proposal includes objectives, default interim measures, and an opportunity to refine the measures through watershed analysis. The overall objectives provide connectivity between functioning habitats in both spatial and temporal terms. Species diversity is emphasized, and special attention is given to the need for mature trees in riparian and landslide-prone areas. Improved water quality and adequate stream flows are targeted as well. Disturbance-related factors such as landslides and sediment regimes are recognized as critical factors important to providing conditions that support salmonids. Furthermore, habitat refuges such as floodplains and off-channel ponds are emphasized, as is the important role of beavers in salmon restoration.

Specific draft measures provide for:

> Limited timber management in important riparian areas.
> Mature riparian forests.
> An inner zone protected to promote root strength.
> Adjustments based on site-specific information.

Moreover, for landslide-prone areas, the proposal incorporates:

> A screening procedure to identify high-risk sites.
> Tree retention in inner gorges and other high hazard sites.
> Road management plans.
> Fish passage criteria.

Watershed analysis is promoted in order to understand watershed-specific natural processes, identify site-specific measures, and help assess cumulative effects.

Two other Federal agencies have reviewed and contributed to this proposal. First, the U.S. Fish and Wildlife Service (FWS) provided preliminary materials identifying the draft proposals' possible benefits for non-anadromous fish and other wildlife species. The FWS will be expanding these analyses as the Advisory Committee discussions proceed. Second, the U.S. Environmental Protection Agency provided draft materials which evaluate the connection between the proposal, the Clean Water Act, and relevant Coastal Zone management statutes. Both agencies will make representatives available to the Committee over the course of its deliberations.

Finally, NMFS recognizes that the remaining discussions will consider an appropriate method for allocating the conservation burdens and resource risks given the depressed status of salmon stocks on the Oregon Coast. These discussions will also have to deal with the relative certainty that beneficial measures will in fact be implemented. This will influence the extent to which needed improvements can be reliably achieved through changes in Oregon statutes, Board of Forestry rules or the adoption or adjustment of other programs, including voluntary or incentive-based efforts. NMFS looks forward to the opportunity to work with the Advisory Committee on these important issues.

I. INTRODUCTION

The intent of this draft proposal is to provide the National Marine Fisheries Service's (NMFS) current views on needed changes in Oregon forest practices. The draft is being submitted to the Advisory Committee recently created by the Oregon Board of Forestry and the Oregon Governor's Office. The proposal is designed to stimulate a discussion of Oregon forest practices. The NMFS supports the Advisory Committee and intends to participate fully as the Committee addresses forest practices issues over the course of the next year.

This draft proposal partially fulfills the terms of the Memorandum of Agreement (MOA) between the State of Oregon and NMFS—signed by Governor John Kitzhaber and NMFS Regional Administrator William Stelle in April, 1997. The NMFS' coho listing decision and the commitments made by the State of Oregon as part of that decision are summarized in the MOA. This proposal is thus one facet of an ambitious and unprecedented effort on the part of the State of Oregon and the NMFS to cooperate in restoring Oregon coastal salmon populations and fisheries in a way that meets the requirements of the Endangered Species Act (ESA) and other applicable laws and regulations.

This proposal addresses Oregon forest practices and relates to matters under the jurisdiction of the State of Oregon respecting those practices. This is appropriate because forest practices have been (and continues to be) important factors affecting the long-term survival of coho salmon. In a report commissioned by the State of Oregon, Botkin et al. (1995) note that " . . . the relative importance of forest practices on the local extinction of salmon stocks varies with species. For steelhead and coho, forest clearing and the amount of forest cover present are major factors . . ."

The goal of this effort is to ensure high probability that productive and sustainable salmon populations will provide substantial environmental, cultural, and economic benefits in perpetuity. This proposal is intended to help conserve salmon populations by establishing and sustaining properly functioning habitat conditions throughout their range over the long term. This effort complements the salmon and fisheries restoration mission of the Oregon Coastal Salmon Restoration Initiative (hereafter, the OCSRI or "Oregon Plan").

It must be emphasized at the outset that, by themselves, improvements in Oregon forest practices will not restore coho salmon populations. It would be incorrect to assume that forestry should bear the entire burden of conservation, or that improvements in other areas of the life cycle are unnecessary or of lower priority. Indeed, as has been made clear in the Memorandum of Agreement, the Oregon Coastal Salmon Restoration Initiative and in NMFS' discussions with members of its Landslide, Riparian, and Cumulative Effects Science Discussion Groups, there are other areas of the coho salmon life cycle that require close attention, particularly the lowland habitats closer to the mouths of coastal watersheds that have been profoundly altered by agricultural practices, urbanization, and other development activities. The NMFS intends to continue working with the State of Oregon as a matter of the highest priority to ensure that these critical lowland habitat issues are addressed expeditiously.

In short, numerous parties—not just those engaged in forest practices—will have to make substantial contributions to the restoration effort at all stages of the life cycle or the effort will not succeed. These actions will necessarily include improvements in harvest and hatchery practices, agriculture and irrigation practices, urban and rural land development activities, and more.

The measures presented in this proposal will benefit all coastal anadromous fish species because they address the need to restore properly functioning flowing-water and riparian habitat conditions throughout the forested, upriver portions of watersheds. The riparian and aquatic habitat conditions necessary for the long-term survival of the various anadromous species in coastal Oregon are similar enough that measures benefitting one species should benefit all others living in a given watershed. Wherever these measures are fully implemented, they should address most (if not all) of the upriver freshwater habitat needs of the other anadromous species occurring in the same watershed. The other coastal anadromous species are the Umpqua River cutthroat trout, Oregon Coast steelhead, Klamath Mountains Province steelhead trout, chinook salmon, chum salmon, and coastal cutthroat trout. Thus, extending the measures to include the full range of the other anadromous species would enhance this conservation effect (see also Section VII for U.S. Fish and Wildlife Service comments on resident fish species and amphibians).

A. Overview of NMFS ESA Review and Listing Decision

In 1993, the NMFS received petitions to list coho salmon on the West Coast. Shortly thereafter, NMFS initiated a coast-wide status review of coho salmon from British Columbia to California. Based on this review, NMFS concluded that there are six evolutionarily significant units (ESUs) of West Coast coho salmon. In October of 1996, NMFS announced a final listing of the Central California Coast ESU as a threatened species and postponed for six months a decision on the status of the Southern Oregon/Northern California ESU and the Oregon Coast ESUs.

During this period of time, the State of Oregon had embarked on an unprecedented effort to devise a comprehensive Coastal Salmon Restoration Initiative—a major undertaking that became commonly known as the Oregon Plan. Based on its evaluation of the Oregon Coast coho ESU, and taking into account commitments made by the Oregon Governor’s Office in the Oregon Plan (including funding commitments by the State Legislature and voluntary commitments on the part of the forest products industry and others) NMFS concluded in April of 1997 that a listing was not warranted at this time. The Southern Oregon/Northern California ESU was listed as a threatened species (62 FR 24588). To make clear the basis for this decision and to establish a process for improving the Oregon Plan, NMFS and the State of Oregon entered into a formal, written Memorandum of Agreement.

B. Overview of 1997 Memorandum of Agreement

The MOA identifies a series of actions the State of Oregon and the NMFS committed to take while implementing the Oregon Plan. Most relevant for purposes of this proposal, section 7f of the MOA provides that NMFS will work with the State of Oregon to help adjust Oregon forest practices so they will provide a “high probability of protecting and restoring aquatic habitat on Oregon forest lands which are important for Oregon coastal coho.” Specific areas of concern include landslide prone areas; riparian buffers on medium, small and non-fish-bearing streams; and cumulative effects. The MOA notes that NMFS may propose alterations in forest practices that encompass changes in laws, rules, or other programs applicable to forest practices. Under the MOA, NMFS’ proposal is to submitted for review to the Independent Multi-disciplinary Science Team (created by the State of Oregon to provide scientific oversight of the OCSRI). The State of Oregon is to make necessary changes in law, rules or other programs no later than June 1, 1999. In turn, NMFS commits to participate actively in the state administrative and legislative processes as the changes are considered and to help ensure that timely progress is being made.

C. Pending Litigation

The NMFS’ decision not to list the Oregon Coast ESU under the ESA has not gone unchallenged. In fact, litigation against the decision proceeded almost immediately. Over a dozen conservation organizations changed the thrust of a pending lawsuit that had sought to compel NMFS to make a listing decision more quickly. The case proceeded in the Federal District Court in San Francisco, where on July 29, 1997, the court granted the plaintiffs’ motion to amend their complaint in <u>Oregon Natural Resources Defense Council v. Brown</u> (No. C-95-1844 SI). This allowed them to challenge NMFS’ decision not to list Oregon Coast coho salmon. Judge Illston dismissed all of the plaintiffs’ other claims in the lawsuit and granted the United States’ motion to transfer the case to Oregon. Judge Illston’s order, which governs the case in Oregon, states:

> As long as the Oregon Plan meets the ESA standards, the Secretary is entitled to base his decision on the effect the Plan will have on the Oregon Coast ESU. * * * Whether the MOA does bring the Plan into line is a factual determination which will entail detailed review of the MOA, the Plan, and ESA standards.

Order (July 29, 1997), p. 9. The case, <u>Oregon Natural Resources Defense Council v. Daley</u>, No. C97-1155-ST, is assigned to Magistrate Judge Stewart in Portland.

The plaintiffs alleged that the Oregon Coast coho ESU is endangered or threatened, that therefore NMFS had a non-discretionary duty to list the species under the ESA, that NMFS' determination that a listing was not warranted, and that its reliance on the Oregon Plan in making that determination was arbitrary and capricious. Specifically, plaintiffs alleged that:

> The Oregon Plan is inadequate to eliminate the danger of extinction for the Oregon Coast ESU because, among other reasons, it relies for the most part on voluntary action, and is therefore largely unenforceable; it consists largely of promises of future actions that are at best uncertain, particularly with respect to improving forestry and agricultural practices on private lands that impact coho habitat; and it does not govern actions on federal lands, which comprise more than one-third of the area included within the Oregon coast ESU.

Third Amended Complaint (filed Sept. 25, 1997), para. 29.

On October 3, 1997, the State of Oregon intervened as a defendant. On October 9, Judge Stewart established the following schedule and deadlines for dispositive summary judgment motions:

January 30, 1998	Plaintiffs' summary judgment motion.
February 27, 1998	Defendants' (US/OR) responses and cross-motions for summary judgment.
March 18, 1998	Plaintiffs' reply to responses and response to defendants' motions.
April 3, 1998	Defendants' replies.
April 13, 1998	Hearing on motions.

D. Process for Developing the NMFS Proposal

In developing this proposal, NMFS cooperated closely with the State of Oregon. As a first step, NMFS and the Governor's Office convened a Policy Group to discuss forest practices issues. The NMFS then worked with the state to identify three groups of scientists to provide independent scientific perspectives on the key scientific issues surrounding coho conservation and Oregon forest practices. These scientists (listed in Appendix I) met in three groups referred to as the Landslide, Riparian Management, and Cumulative Effects Science Discussion Groups. The members of these groups provided individual comments and evaluations, and the groups did not meet with each other.

In the course of this work, the Board of Forestry was approached by the Office of the Governor, fishery and conservation groups, and the forest products industry—all of whom urged the Board to create a formal Advisory Committee to help accelerate deliberations on potential changes in Oregon forest practices. In response to these requests, the multi-stakeholder, Ad Hoc Advisory Committee has been established and is in the early stages of its work. The NMFS is participating as an ex-officio member of the Committee.

In the meantime, NMFS has developed this proposal on forest practices. The proposal is being presented in draft form to help further the discussions with the Advisory Committee. This proposal draws on a variety of information sources—including the existing scientific literature, relevant legal and policy documents, and the expert opinions of the science discussion group members. The NMFS' staff has solicited scientific insights from members of the three science discussion groups through meetings and written comments. Those discussions and written materials and the expert opinions they represent have been very helpful in developing this proposal. However, NMFS does not suggest that the scientists engaged in the scientific discussions are the authors of this proposal or even that they endorse its contents. The measures selected for the proposal involve technical and policy considerations about which there may be legitimate scientific and managerial differences. The NMFS has made an effort to ensure that the science discussions focused on technical issues and avoided policy matters that are more appropriately resolved elsewhere.

II. LEGAL FRAMEWORK FOR NMFS' PROPOSAL

The ESA requires that NMFS determine whether a species is threatened or endangered "solely on the basis of the best scientific and commercial data available . . . after conducting a review of the status of the species and after taking into account those efforts . . . being made by any State or foreign nation, to protect such species" 15 U.S.C. § 1533(b)(1)(A). The NMFS carefully considered the habitat improvements provided in the OCSRI because its Biological Review Team concluded that habitat degradation is one of the primary concerns in evaluating long-term risks to the Oregon Coast coho ESU. The NMFS found that while the OCSRI contains many programs that will improve habitat conditions, there was still room for improvement:

> [o]verall, . . . the habitat measures of the OCSRI do not currently provide the protections NMFS considers to be essential to creating and maintaining the high quality habitat needed to sustain Oregon Coast coho over the long term across a range of environmental conditions (62 FR 24607).

The NMFS also found, however, that the Oregon Coast coho are not likely to become endangered "in the interval between this decision and the adoption of improved habitat measures" pursuant to the April 25, 1997, MOA. Thus, NMFS' determination that listing the Oregon Coast ESU is not warranted at this time is predicated upon an expectation that the deficiencies in the OSCRI's habitat measures will be remedied within a short period of time. With respect to the forestry measures, the MOA requires NMFS to re-evaluate the status of the Oregon Coast coho if adequate forested land protections are not adopted within two years (62 FR 24607).

The existing Oregon Forest Practices Rules were critically examined by public commenters when they were being revised over the two-year period from 1992 to 1994; those public comments are summarized in a 173-page document available from the Oregon Department of Forestry (ODF). During development of the 1994 revision, specific prescriptions, or Best Management Practices (e.g., stream buffer widths for fish streams), were negotiated by the Oregon Board of Forestry Advisory Committee. See Appendix IV, section D for administrative record information relating to this proposal.

A 1996 internal NMFS review of the Forest Practice Rules identified a number of specific ways they failed to either adequately protect or allow for restoration of anadromous fish habitats in coastal and western Oregon forested lands (six "issue papers" are included as Appendix IV of a January 2, 1997, memorandum from Rowan Baker, NMFS to Dan Avery, NMFS). The ODF prepared responses to NMFS' six "issue papers," and both agencies sent parts (or all) of the issue papers and their responses to various outside scientific reviewers for comment. The NMFS also commented on the Forest Practice Rules and enhancements added by the OCSRI in its analysis of habitat-related factors for decline prior to the coho listing decision (April 24, 1997, memorandum from Elizabeth Gaar, NMFS, to Jacqueline Wyland, NMFS). Many of the gaps in protection that NMFS identified were confirmed by several of the outside reviewers of the issue papers and ODF responses; these are discussed in Botkin et al. (1995), Murphy (1995), and Spence et al. (1996). The gaps identified include:

1. Lack of a process to assess, at the watershed scale, fish habitats and potential cumulative impacts from management.

2. No articulated method for identifying high-hazard slopes and no provision to fully protect high-hazard, landslide-prone slopes by prohibiting timber harvest where necessary.

3. No assurance that older or inactive logging roads would be treated to avoid delivering sediment to fish-bearing streams or blocking fish passage.

4. Lack of assurance that riparian buffers managed for timber production would contribute shade and LWD at the rates, sizes, and amounts necessary to provide instream and riparian function along fish-bearing and non-fish-bearing streams.

5. Lack of assurance that floodplain function would be protected, especially along fish-bearing streams.

6. Lack of a process to identify and relocate existing problem roads in riparian areas or landslide-prone areas.

To determine whether a listing is warranted NMFS must assess the probability that the species will survive over the long term; any species that NMFS determines is likely to become endangered or extinct in the foreseeable future warrants protection under the ESA (see 15 U.S.C. § 1532(20)). The prevailing scientific view is that long-term survival of imperiled salmonid species requires local populations and their habitats to be protected and restored. As the National Research Council (1996) concluded:

> The long-term survival of salmon depends crucially on a diverse and rich store of genetic variation. Because of their homing behavior and the distribution of their populations and their riverine habitats, salmon populations are unusually susceptible to local extinctions and are dependent on diversity in their genetic makeup and population structure. Therefore, management must recognize and protect the genetic diversity within each salmon species, and it must recognize and work with local breeding populations and their habitats.

These proposed changes reflect NMFS current thinking on the means to provide properly functioning habitat conditions on forest lands and thereby support well-distributed and diverse local breeding populations. These changes (or similar ones) are necessary for NMFS to find that the OSCRI's habitat improvements are sufficient to create and maintain the high quality habitat needed on the forested landscape to sustain Oregon Coast coho over the long term across a range of environmental conditions. If NMFS is unable to make this finding, it may be compelled to change the status of this ESU.

A. The Oregon Forest Practices Act

1. <u>Standards for Adopting or Amending Forest Practices Rules</u>

The Oregon legislature amended the Forest Practices Act in 1995 to require the Board of Forestry to make certain findings before it may adopt or amend rules that set standards for forest practices. See ORS § 527.713(5).   If a proposed rule or amendment would "provide new or increased standards for forest practices," the board may adopt such a rule only after finding that certain facts exist and that certain standards are met.[1]

The NMFS believes that its proposal satisfies all the requirements of this subsection, with the exception of ORS § 527.713(5)(f). NMFS is concerned that this provision makes it extremely difficult and costly, if not impossible, to adopt the forest practices rules that are necessary to protect coho habitat. This provision requires a determination of the degree that existing practices of forest landowners "are contributing to the overall resource problem," and a determination that the benefits of a proposed rule "are in proportion" to the degree that these practices are contributing to the problem. NMFS is not aware of any methodology to determine, with the quantitative precision demanded by this standard, just how much current forest practices are contributing to the decline of Oregon Coast coho, or of salmonids in general. There is widespread agreement that myriad factors contribute to salmon habitat degradation, as extensively documented in the OCSRI. Oregon has not attempted in the OCSRI to determine the degree to which any factor is contributing to the degradation of coho habitat, and NMFS is aware of no serious attempt by anyone to do so. NMFS doubts whether such a determination is possible.

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[1] The board must find that: (a) If forest practices continue to be conducted under existing regulation, there is monitoring or research evidence that documents that degradation of resources maintained under ORS 527.710 (2) or (3) is likely; (b) If the resource to be protected is a wildlife species, the scientific or biological status of a species or resource site to be protected by the proposed rule has been documents using best available information; (c) The proposed rule reflects available scientific information, the results of relevant monitoring and, as appropriate, adequate field evaluation at representative locations in Oregon; (d) The objectives of the proposed rule are clearly defined, and the restrictions placed on forest practices as a result of adoption of the propose rule: (A) Are to prevent harm or provide benefits to the resource or resource site for which protection is sought; and (B) Are directly related to the objective of the proposed rule and substantially advance its purpose; (e) The availability, effectiveness and feasibility of alternatives to the proposed rule, including nonregulatory alternatives, were considered, and the alternative chosen is the least burdensome to landowners and timber owners, in the aggregate, while still achieving the desired level of protection; and (f) The benefits to the resource that would be achieved by adopting the rule are in proportion to the degree that existing practices of the landowners and timber owners, in the aggregate, are contributing to the overall resource concern that the proposed rule is intended to address. ORS § 527.713(5).

Even if it were, NMFS further doubts whether it is possible to determine whether any proposed revisions in forest practices rules are "in proportion" to the contribution of forest practices to degradation of coho habitat.

Moreover, ORS § 527.713(7) requires a "comprehensive" economic impact analysis of any proposed rule change that would require new or increased standards for forest practices, prior to the close of the public comment period on the rule.[2] The analysis mandated by this provision is extensive and would be extremely costly. NMFS is concerned that the cost and time needed to satisfy this provision would make it impossible for the board to revise the forest practices rules consistent with the MOA and the conditions of NMFS' listing determination.

Consequently, the legislature may want to consider amendment of ORS § 527.713 to allow the necessary forest practices rule revisions to be adopted in a timely manner. If either subsection discussed above presents an insurmountable obstacle to adopting revised rules by June 1999, NMFS may be compelled to change the status of the Oregon Coast ESU.

2. The "Dominant Use" Policy (ORS § 527.630(1))

The Forest Practices Act provides that:

> [I]t is declared to be the public policy of the State of Oregon to encourage economically efficient forest practices that assure the continuous growing and harvesting of forest tree species and the maintenance of forest land for such purpose as the leading use on privately owned land, **consistent with the sound management of soil, air, water, fish and wildlife resources . . . that assures the continuous benefits of those resources for future generation of Oregonians** ORS § 527.630(1) (emphasis added).

The Board has discretion to adopt forest practices rules to implement this policy, and NMFS believes the changes it is proposing fall squarely within this policy: their purpose is to provide a high probability of the long-term survival of anadromous fish so future generations of Oregonians will have the benefit of these resources.

[2] That subsection provides: (7) If the board determines that a proposed rule is on the type described in subsection (1)(c) of this section, and the proposed rule would require new or increased standards for forest practices, as part of or in addition to the economic and fiscal impact statement required by ORS 183.335 (2)(b)(E), the board should, prior to the close of the public comment period, prepare and make available to the public a comprehensive economic analysis of the proposed rule. The analysis should include, but is not limited to: (a) An estimate of the potential change in timber harvest as a result of the rule; (b) An estimate of the overall statewide economic impact, including a change in output, employment and income; (c) An estimate of the total economic impact on the forest products industry and common school and county forest trust land revenues, both regionally and statewide; and (d) Information derived from consultation with potentially affected landowners and timber owners and an assessment of the economic impact of the proposed rule under a wide variety of circumstances, including varying ownership sizes and the geographic location and terrain of a diverse subset of potentially affected forest land parcels.

III. ECOLOGICAL BASIS AND OBJECTIVES FOR NMFS' PROPOSAL

In preparing this proposal, NMFS considered (1) The status of coastal coho salmon stocks, (2) their life cycle and biological requirements, (3) the importance of salmon habitat on non-Federal forested lands to the long-term survival of the species, (4) the best available approximations of the pre-European development conditions under which salmon evolved, and (5) the current status of coastal watersheds. Given this information, NMFS prepared the objectives for non-Federal forest lands that are given in section (D) of this chapter.

A. Status of Coastal Coho Salmon Stocks

This proposal is driven by the depressed status of coho salmon along the west coast of Oregon, (as are a large number of related activities). Coho salmon are historically one of the most prized species of anadromous fish on the coast of Oregon. For decades, thousands of anglers from all over the country have traveled to the Oregon Coast to fish for coho salmon. Thousands more have depended for their livelihoods on the continued survival and health of this important resource. Unfortunately, as is the case with many anadromous fishery resources on the West Coast, the coho salmon have declined to extremely low levels, particularly in the past two decades. Abundance of wild coho salmon spawners in Oregon coastal streams declined precipitously during the period from about 1965 to about 1975 and has fluctuated at a low level since that time (Nickelson et al. 1992a). Spawning escapements for this ESU may be less than 5% of what they were in the early 1900s, and contemporary coho salmon production may be less than 10% of the historic production (Nickelson et al. 1992a). Average spawner abundance has been relatively constant since the late 1970s, but preharvest abundance has declined. Recent recruits-per-spawner ratios are below replacement levels and show no clear sign of reversing the generally declining trend (Weitkamp et al. 1995, NMFS 1997).

B. Life Cycle and Biological Requirements of Coho Salmon

Like many species of anadromous salmonids, coho salmon have a wide-ranging life cycle—depending for their survival on high quality environments from the headwaters of coastal streams down to the estuaries and on to the far reaches of the North Pacific Ocean. Any weakness in this habitat chain can have severe impacts on coho survival rates. The life cycle and biological requirements of this species are described below.

<u>Spawn timing.</u>

Most Oregon Coast coho salmon enter rivers from late September to mid-October. River entry timing is influenced by many factors, one of which appears to be river flow. Coho salmon wait for freshets before entering rivers, thus a delay in fall rains delays river entry and, perhaps, alters spawn timing. Peak spawning occurs anywhere from mid-November to early February.

Spawning habitat and temperature.

Although each native stock appears to have a unique time and temperature for spawning that theoretically maximize offspring survival, coho salmon generally spawn at water temperatures in the range of 10-12.8°C (Bell 1991). Bjornn and Reiser (1991) found that spawning occurs in a few third-order streams, but most spawning activity was found in fourth- and fifth-order streams. Nickelson et al. (1992a) found that spawning occurs in tributary streams with a gradient of three percent or less. Spawning occurs in clean gravel ranging in size from that of a pea to that of an orange (Nickelson et al. 1992a). Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools featuring suitable water depth and velocity (Weitkamp et al. 1995).

Hatching and Emergence.

The favorable range for coho salmon egg incubation is 10-12.8°C (Bell 1991). Eggs incubate for approximately 35 to 50 days (depending on water temperature) and fry start emerging from the gravel two to three weeks after hatching (Nickelson et al. 1992a).

Parr movement and smoltification.

After they emerge, the fry move into shallow areas near the stream banks. Their territory seems to be related not only to slack water, but to objects that provide points of reference to which they can return (Hoar 1951). Juvenile rearing usually occurs in tributary streams with gradients of three percent or less, although they may move up to streams of four- or five-percent gradient. Juveniles have been found in streams as small as one to two meters wide (November 12, 1996, personal communication, between K. Moore, Oregon Department of Fish and Wildlife (ODFW), and J. Wu, NMFS). At a length of 38-45 mm, the fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965; Nickelson et al. 1992a). Rearing requires temperatures of 20°C or less, preferably 11.7-14.4°C (Bell 1991; Reeves et al. 1987; Bjornn and Reiser 1991). Coho salmon fry are most abundant in backwater pools during spring. During summer, juvenile coho salmon are more abundant in pools of all types than in glides or riffles. During winter, juvenile coho salmon are most abundant in off-channel pools, beaver ponds, alcoves, and debris-dammed pools with complex cover (Nickelson et al.1992b, 1992c). The ideal stream channel for maximum coho smolt production would have a shallow depth (7-60 cm); fairly swift mid-stream flows (60 cm/sec); numerous marginal back-eddies, narrow width (3-6 cm); copious overhanging mixed vegetation (to lower water temperatures, provide leaf-fall, and contribute terrestrial insects); and banks permitting hiding places (Boussu 1954). Juveniles rear in fresh water for up to 15 months, then migrate to the sea as smolts between February and June (Weitkamp et al. 1995).

<u>Estuary and Ocean Migration.</u>

Little is known about coho residence time or habitat use in estuaries during their seaward migration, though it is usually assumed that coho salmon spend only a short time in the estuary before entering the ocean (Nickelson et al. 1992a). Growth is very rapid once the smolts reach the estuary (Fisher et al. 1984). While living in the ocean, coho salmon remain closer to their river of origin than do chinook salmon. Fisher et al. (1984) found that almost all of the coded wire-tagged juvenile coho salmon released from coastal Oregon were recovered further north than Oregon. After about 12 months at sea, coho salmon gradually migrate south and along the coast, but some appear to follow a counter-clockwise circuit in the Gulf of Alaska (Sandercock 1991). Coho salmon typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three year-olds. Some precocious males, called "jacks," return to spawn after only six months at sea.

<u>Food.</u>

The early diets of emerging fry include chironomid larvae and pupae (Mundie 1969). Juvenile coho salmon are carnivorous opportunists that primarily eat aquatic and terrestrial insects. They do not appear to pick stationary items off the substratum (Sandercock 1991; Mundie 1969).

C. Importance of Salmon Habitat on Non-Federal Forested Lands

The NMFS Biological Review Team (BRT) who conducted the coho status review described the importance of freshwater habitat relative to other factors for decline, including ocean conditions (NMFS 1997):

> With respect to habitat, the BRT had two primary concerns: first, that the habitat capacity for coho salmon within this ESU (Oregon coast) has significantly decreased from historic levels; and second, that the Nickelson-Lawson model predicted that, during poor ocean survival, only high quality habitat is capable of sustaining coho populations, and subpopulations dependent on medium and low quality habitats would likely go extinct. Both of these concerns caused the BRT to consider risks from habitat loss and degradation to be relatively high for this ESU.

Furthermore:

> If the severe declines in recruits per spawner of natural populations in this ESU (Oregon coast) are partly a reflection of continuing habitat degradation, then risks to this ESU might remain high even with full implementation of the hatchery and harvest reforms (of the OCSRI). While harvest and hatchery reforms may substantially reduce short-term risk of extinction, habitat protection and restoration were viewed as key to ensuring long-term survival of the ESU, especially under variable and unpredictable future climate conditions.

State and private lands cover 65% of the area in the Oregon Coast ESU. Federal lands in the area of the Oregon Coast ESU are managed under the Northwest Forest Plan (NWFP). While the NWFP covers a large area, its effectiveness in conserving Oregon Coast coho salmon is limited by the dominance of non-Federal lands in the area (particularly in the northern portion of the ESU) and by the non-uniform distribution of Federal lands in watersheds where the coho occur.

In some areas, Federal lands are concentrated in the headwater areas of watersheds, upstream of lower gradient river reaches that were historically important for coho salmon production. In other areas, Federal lands are distributed in a checkerboard fashion (particularly Bureau of Land Management (BLM) ownership), resulting in fragmented landscapes and a highly variable Federal ability to protect and restore watershed functions and salmon habitat. These Federal land distribution factors place constraints on the NWFP's ability to achieve, by itself, its aquatic conservation objectives at watershed and river basin scales; this, in turn, highlights the importance of complementary salmon habitat conservation measures on non-Federal lands to help coastal coho salmon survive over the long term (62 FR 24596).

Botkin et al. (1995) described the importance of a watershed-scale approach to salmon habitat management:

> As our discussion of the riparian zone and stream channels should make clear, it is simply not possible to manage individual segments of streams or rivers and their riparian settings and achieve any general system level response. The entire stream length, its riparian zones, and the rest of the watershed must be managed as a single unit.

Spence et al. (1996) discussed ecological linkages across lands under multiple ownership:

> The success of salmonid populations depends on the availability of high-quality habitats needed during each life stage . . . A strategy for non-federal lands should build upon existing conservation plans by re-establishing connectivity between

> habitat on Federal and non-federal lands, and by working towards protection of habitats that are poorly represented in Federal ownership, particularly the lower-elevation streams and habitats for resident species, including nongame fishes.

The National Research Council (1996) also noted the tension between the need to implement river-basin scale conservation and private property rights:

> . . . there is little doubt that over the last century land and water uses on many privately owned lands have continued to degrade in aquatic habitat and resulted in loss of the natural production capacity of these waters (Lichatowich 1989, Thomas et al. 1993, Moyle and Yoshiyama 1994). Uniform and consistently applied habitat-conservation strategies are not practiced on the scale of river basins, the scale most relevant to the metapopulation structure of Pacific salmon. The dilemma is clear. How can private property rights be respected while adequate habitat is provided for salmon across the landscape?

The Council described several elements of a possible solution to this dilemma:

> The committee believes that progress toward solving the dilemma is possible and recommends that attention be given to developing a *more equitable and more uniform system of habitat-protection requirements on private ownerships* across all land uses, establishing *joint planning groups* for entire river basins (or subbasins), where private landowners can participate in land-use policy decisions, investigating various *incentives* for landowners to practice improved environmental stewardship, and expanding programs that involve *the public* in monitoring and habitat-conservation projects. Those steps would benefit not only salmon but virtually all public values associated with aquatic-riparian ecosystems (emphasis as in original).

D. Pre-European Development Conditions

It is unrealistic to plan a return—over a large portion of the landscape—to the pre-European development conditions under which salmon evolved in the Pacific Northwest (Gregory and Bisson 1997). Nevertheless, estimates of these conditions provide points of reference for understanding how watersheds have changed and illuminate the direction that rehabilitation efforts should take for restoring the watershed, riparian, and stream channel functions that are most important to the freshwater life stages of anadromous salmonids. Various studies summarized by Botkin et al. (1995) show that since the beginning of European development in the Northwest, there has been a significant reduction in the amount of forest cover over 100 years old.

Members of NMFS' Landslide and Riparian Science Discussion Groups developed the following general overview (shown in italics below) of pre-European development conditions in coastal watersheds.[3]

Landslide Discussion Group:

1. *Prior to development, coastal river systems experienced periodic slides.*

2. *The river systems in their pre-development state were characterized by patches of sediment, large woody debris, and bedrock.*

3. *Extensive floodplains existed in the lower reaches of these watersheds.*

4. *Sediment retention was high due to the wood concentrations and floodplains.*

5. *The systems were dynamic. Fire, disease, and storms produced periodic pulses of change in coastal watersheds.*

Riparian Discussion Group:

1. *Stream and river channels were complex. Bedrock was present, but it was not as continuous as it is at present.*

2. *There was a mix of partial and complete burns in the watersheds.*

3. *There existed a wide variation in sediment production within and among basins.*

4. *Sedimentation occurred in pulses due to mass failures.*

5. *Instream sediment storage was enhanced and sediment transport was delayed by structure (e.g., large wood, boulders, etc).*

6. *Historical wood levels were higher than current levels, and patches were larger. Cycles in wood volumes were related to fire and flood cycles. There were periods of large and small volumes of wood, particularly in upland areas.*

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[3] These points are summarized from discussion group meeting notes and do not represent the full details of the topics discussed or suggest consensus in areas where it might not exist. They are provided to describe the general content of the discussions.

7. *Beavers were numerous in larger, lowland reaches and in the transition areas between uplands and lowlands.*

8. *Conifers were dominant in the uplands. Terraces typically had lower conifer volumes than did the uplands. Mixed conifers and hardwoods were found in the mid-elevation and lowland areas.*

9. *Riparian vegetation was variable. Conifers in riparian areas were larger than today.*

10. *The composition of lowland vegetation during pre-development times is poorly understood.*

11. *Active floodplains were a dominant feature in coastal watersheds.*

12. *Lowland floodplains may have had large conifers, especially in the spruce zone.*

13. *Fish populations were abundant, stocks were numerous, and their life histories were diverse.*

E. Status of Coastal Watersheds

The Oregon Coastal Salmon Restoration Initiative gives comprehensive descriptions of habitat-related factors for decline for coastal salmon. These include changes in channel morphology; stream substrate changes, loss of instream roughness; loss of estuarine rearing habitat; loss of wetlands; loss and degradation of riparian areas; water quality degradation (i.e., factors such as water temperature, sediment, dissolved oxygen, biological conditions, toxics, ph, and stream fertility); changes in flow; stream blockage/passage impediments; elimination of habitat; and direct take (OCSRI 1997).

The BRT's status review (1997) provides detailed reviews of the coastal coho's population status, trends, and risks; it also summarizes attempts to quantify overall anadromous fish habitat losses within the range of West Coast coho salmon:

> Gregory and Bisson (1997) stated that habitat degradation has been associated with greater than 90% of documented extinctions or declines of Pacific salmon stocks. It has been reported that up to 75% and 96% of the original coastal temperate rainforest in Washington and Oregon, respectively, has been logged (Kellogg 1992) and that only 10-17% of old-growth forests in Douglas-fir regions of Washington and Oregon remain (Norse 1990, Spies and Franklin 1988) . . . Approximately 80-90% of the original riparian habitat in most western states had

> been eliminated (NMFS 1996). For example, Edwards et al. (1992) reported that 55% of the 43,000 stream kilometers in Oregon were moderately or severely affected by non-point source pollution.
>
> Large, deep-pool habitats are a particular requirement of high quality stream habitat for coho salmon. FEMAT (1993) reported that there has been a 58% reduction in the number of large, deep pools on national forest lands within the range of the northern spotted owl in western and eastern Washington. Similarly, there has been as much as an 80% reduction in the number of large, deep pools in streams on private lands in coastal Oregon (FEMAT 1993). Overall, the frequency of large pools has decreased by almost two-thirds between the 1930s and 1992 (FEMAT 1993, Murphy 1995).

On private forest lands in coastal Oregon, large pools had decreased by an average of 80% when surveys taken from 1934 to 1946 were repeated approximately 50 years later. Large pools are important holding areas for adult anadromous salmonids migrating upstream and important rearing areas for the juveniles of certain species (Hicks et al. 1991, Montgomery et al. in press). Riparian areas and stream channels have been damaged by a wide variety of development activities in coastal watersheds, including agriculture, timber harvest, the use of splash dams, stream cleaning, urbanization, and gravel mining (FEMAT 1993, Botkin et al. 1995, National Research Council 1996, OCSRI 1997).

Botkin et al. (1995) described typical damage to riparian areas, floodplains and stream channels from non-forestry development:

> The depletion of riparian zones is most severe under agricultural, suburban, and urban land use. In these areas, large riparian trees have been removed to allow cultivation, efficient flood conveyance and view, and little recovery is ever allowed . . . In urban, commercial, and suburban land, the removal of riparian trees and the simplification of channels through diking for flood control and channel stabilization continue to spread with little regulation or mitigation. *A fundamental difference between riparian-zone depletion in forest lands and in other lands is that in agricultural and urban areas, the depletion is contiguous, permanent and extreme, and the problem is one of re-establishing riparian-zone functions rather than preserving them* [emphasis in original document].
>
> The most thorough documentation of alterations of channel and floodplain morphology and riparian vegetation in an agricultural region was that done by Sedell and Froggatt (1984) in the Willamette Valley. They found that logs had been pulled from the river, floodplain sloughs had been blocked and drained, very large roots, which provide buttresses against bank erosion and shelter for fish, had been removed, and flow had been gradually trained into a single channel. These

> changes have become permanent, resulting in a reduction of the valley-floor habitat accessible to salmon, reduction in the range and variety of rearing habitat, and a reduction in shade from the sun within these habitats. Along smaller rivers, we observed bank erosion as a result of clearing and cattle grazing, and in the lower reaches of rivers draining to the north coast, we observed seemingly unregulated grading and training of small rivers by private landowners trying to protect their property from river shifting or floods.

Botkin et al. (1995) also described the extent of agricultural development in western Oregon salmon habitats:

> Agricultural lands in western Oregon are heavily concentrated in the valley floors of the Willamette and upper Rogue Rivers, and in portions of the Klamath Basin, with smaller concentrations in the Umpqua Basin and along the lower reaches of rivers draining into Nehalem, Tillamook, and Yaquina Bays in the northern coast range. Of the total land area in the Oregon portion of the project's study area, approximately 10% is in agriculture. The percentage varies greatly among watersheds, from a high of 30% in the Middle Willamette watershed to zero percent in thirteen watersheds within the major river basins. For example, the Umpqua River basin includes 39,331 hectares in agriculture, which is only 3.2% of the basin's total area, and the Rogue River basin has 51,905 hectares in agriculture, 3.9% of the total area (Table 5). Riparian habitat loss in agricultural lands has not been documented as thoroughly as for forest lands, but our own field observations, sparse literature, and anecdotal evidence from fishery scientists indicate that, although localized, this loss is intense, and as noted previously, usually permanent.

Coho and steelhead populations were significantly reduced in watersheds with high forest fragmentation (cleared areas) in correlation regression analyses carried out by Botkin et al. (1995). Although agricultural and urban lands may be the most highly altered salmonid habitats in many coastal watersheds, habitat on forested lands is important today because most of the last strongholds for anadromous salmonids are located in forested areas (G. Reeves, U.S. Forest Service Pacific Northwest Research Station, pers. comm. in Riparian Discussion Group).

Roads, particularly roads to access timber harvest on state, Federal and private timber lands, are a prevalent feature of the coastal landscape. In general, roads have been a primary source of sediment impacts in developed watersheds (FEMAT 1993). Furniss et al. (1991) state that:

> Roads may have unavoidable harmful effects on streams, no matter how well they are located, designed or maintained . . . Roads modify natural hillslope networks and accelerate erosion processes. These changes can alter physical processes in streams, leading to changes in stream flow regimes, sediment transport and storage, channel bank

> and bed configurations, substrate composition, and stability of slopes adjacent to streams. These changes can have significant biological consequences that affect virtually all components of stream ecosystems.

Over the last century, forest practices have left many older roads and railroad grades, i.e., "legacy roads" on non-Federal forest lands in Oregon. These roads, built before the forest practices rules of 1971, are not regulated by the ODF. There is little information available on the density or sediment delivery potential of the legacy roads. A 1988 monitoring effort found these older roads were major sources of landslides. A 1995 monitoring project revealed that 29% to 39% of the forest roads surveyed on non-Federal lands deliver sediment to streams (ODF issues paper, September 2, 1997). One rough estimate of legacy road density is one mi/mi^2—compared to an estimated three mi/mi^2 for newer roads that are regulated by the ODF (K. Mills, ODF geologist, pers. comm. with R. Baker, NMFS, 1996).

According to the ODF, the older roads, which were constructed under different standards:

> "[H]ave in some cases created a 'legacy' of potential instability. Many landslides over the last few years occurred as the result of construction practices of many decades ago. Over-steepened fill and decomposing debris in fills can fail years after construction. Maintenance activities can reduce, but not eliminate, the potential for landslides on these older roads" (ODF issues paper, September 2, 1997).

Although legacy roads and the rest of the extensive road network present significant challenges to the restoration of salmon habitat, it is important to recognize that roads on industrial forest lands are the subject of a major effort by private landowners under the OCSRI to prioritize and carry out a road risk reduction program.

Large wood in streams, a key element for forming the pools and channel complexity that benefit salmonid habitat (Bisson et al. 1987), has been reduced through a variety of human activities that include past timber harvest practices and associated activities, as well as the mandated cleanup activities that removed wood from streams throughout the region from the 1950s through the 1970s (FEMAT 1993, Botkin et al. 1995). On forested lands in the Coast Range, non-random surveys conducted by the Oregon Forest Industries Council indicate that only 17% of the area's stream miles are at "desirable" level (as defined by ODFW) for large woody debris pieces/mile, and that only 23% are in a "desirable" condition for large woody debris volume (OCSRI 1997). These numbers may actually overstate the condition of coastal streams relative to historic conditions, as reference conditions for the benchmarks (i.e., "desirable" and "undesirable") were taken from both managed and unmanaged watersheds (K. Jones, ODFW, pers. comm. with J. Lockwood, NMFS, April 8, 1997). There is little hope for natural riparian recruitment of large wood into coastal streams in the near term on non-Federal lands—according to the OCSRI

(1997) large riparian conifers are at desirable levels along less than 1% of the streams on industrial and non-industrial private forest lands.

Under Section 303(c)(2)of the Clean Water Act (CWA), water quality standards are made up of the designated beneficial uses to be protected and narrative or numeric criteria designed to prevent impairment of those beneficial uses. Oregon has designated anadromous fish passage, salmonid fish spawning and rearing, and resident fish and aquatic life as beneficial uses to be protected in coastal basins (OAR Chapter 340, Division 41). To protect these and other beneficial uses, Oregon has also adopted specific numeric and narrative criteria that address thermal conditions (temperature), chemical parameters (e.g., dissolved oxygen, pH, and toxic substances), physical conditions (e.g., sedimentation), biological conditions, and the need to prevent degradation of high quality waters (OAR Chapter 340, Division 41). All of these standards are intended to work together to provide the thermal, chemical, physical, and biological conditions salmonids and other aquatic life require to survive and thrive in coastal water bodies (OCSRI 1997).

Water quality conditions in Oregon’s coastal water bodies have been monitored and analyzed by the DEQ (and others) for many years. Section 303(d) of the CWA requires each state to identify waters for which the existing pollution control requirements are not stringent enough to achieve state water quality standards. To prepare this "303(d) list," states must use all existing and readily available water quality data. The list must be updated biennially. The DEQ recently prepared its 1994/96 303(d) list of water quality-limited water bodies. A summary of the results of that effort shows that there are approximately 18,137 miles of streams in Oregon's coastal basins. Of that number, the DEQ assessed 6,086 stream miles (33.5%) using available water quality information. Of the 6,086 stream miles assessed, 3,035 stream miles (49.9%) were found to be water quality-limited, and 2,345 stream miles (38.5%) needed additional data or were of potential concern. Only 706 stream miles (11.6%) of those assessed were found to meet all state water quality standards (OCSRI 1997).

In Oregon, roughly 80% of the total stream miles assessed by DEQ for temperature (3656 miles out of 4481) failed to meet the state's temperature standard. Of these, 2658 miles (or 59%) are listed as temperature-impaired, and another 995 miles (roughly 21%) are listed as being of potential concern for temperature. Over 60% of the stream miles not meeting the temperature standard were in two basins in southwestern Oregon: the Rogue (with 913 stream miles listed and 243 miles of potential concern) and the Umpqua (with 779 miles listed and 296 miles of potential concern) (OCSRI 1997).

Migration barriers have significantly affected anadromous fish populations in the Pacific Northwest (Botkin et al. 1995; National Research Council 1996). The prevalence of culverts and road crossing structures that impede or block fish passage appears substantial. For example, in the 532 fish presence surveys conducted in coastal basins during the 1995 survey season, it was found that 14.8% (n=79) of the confirmed limits of fish use were due to human-created barriers.

Road culverts make up the largest percentage (96%) of the barriers; various types of dams constitute the balance. An additional 2.6% of the surveys identified culverts that were impassable to anadromous fish but had upstream populations of resident trout (OCSRI 1997).

The cumulative effects of land and water use over the past century have greatly altered the health of river basins in coastal Oregon. Spence et al. (1996) stated the problem as follows:

> The widespread decline of salmonid stocks throughout much of the Pacific Northwest has resulted from the cumulative effects of water- and land-use practices, fish harvest, hatchery practices, and natural fluctuation in environmental conditions. The term "cumulative effects" has been used generally to describe the additive or synergistic effects of these practices on ecosystems. Another comprehensive definition of cumulative effects is provided by Sidle (1989): "changes to the environment caused by the interaction of natural ecosystem processes with the effects of land use, distributed through time and space, or both."

The National Research Council (1996) made the following statement regarding cumulative effects:

> Habitat disturbances can be "cumulative" in the sense that different factors acting sequentially or concurrently can limit population size or growth during different phases of freshwater and estuarine rearing periods (Elliot 1985).

Although individual management activities by themselves may not significantly harm salmonid habitats, incrementally and collectively they may degrade habitat and cause long-term declines in fish abundance (Bisson et al. 1992). Changes in sediment dynamics, streamflow, and water temperature are not just local problems restricted to a particular stream reach, but problems that can have adverse cumulative effects throughout the entire downstream basin (Sedell and Swanson 1984; Grant 1988). For example, increased erosion in headwaters, combined with reduced sediment storage capacity in small streams, through the loss of stable instream LWD, can overwhelm larger streams with sediment (Bisson et al. 1992). Likewise, increased water temperature in headwater streams may not harm salmonids there but can contribute to downstream warming (Bisson et al. 1987; Bjornn and Reiser 1991).

Members of NMFS' Landslide and Riparian Science Discussion Groups made the following observations about current conditions in coastal watersheds relative to their best estimation of pre-European development conditions:[4]

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[4]These points are summarized from discussion group meeting notes and do <u>not</u> represent the full details of the topics discussed or suggest consensus in areas where it might not exist. They are provided to describe the general content of the discussions.

Landslide Discussion Group

1. *The river systems all along the coast have been profoundly altered.*

2. *The river systems have been degraded by splash dams, intentional removal of wood, altered frequency and magnitude of debris flows, lack of wood recruitment, reduction of beaver populations, agricultural practices, and other causes.*

3. *The features of degradation are a chronic problem over a large portion of the coastal watersheds and they have existed for a long period of time.*

4. *Increased debris flows have increased areas of bedrock in lower-order channels.*

5. *The total wood load in the watersheds has diminished over time and its component parts are now smaller than they were before development.*

6. *The systems remain dynamic, but the processes of succession have been interrupted on a broad scale.*

Riparian Discussion Group

1. *Within a relatively short period of time, several decades or so, there have occurred more abrupt deviations from previous cycles and variations and the rate of deviation increased.*

2. *Modeling results indicate that a major portion of coho production historically occurred in lowland habitats. These habitats were altered in the early 20th century and significant declines in coho production occurred at that time.*

3 . *Lowland floodplains have been converted to urban and agricultural development. Few lowland conifers now exist.*

4. *Average tree age and size class distributions in riparian zones have become younger and smaller.*

5. *Differing management policies altered riparian stand types and replanting led to conifer-dominated stands. For example, harvest without replanting often led to alder-dominated stands; harvest with restocking led to conifer-dominated stands.*

6. *Current volumes of instream wood are significantly lower, but remain variable. The size of existing wood is smaller.*

7. *The greatest reduction of instream wood volumes has occurred in the lower river reaches and lower gradient valleys.*

8. *Beavers are now concentrated more in headwaters and persist at less than 10% of their historical levels.*

9. *Stream channels have more exposed bedrock, which is variable between basins. Some lower-reach channel incision has occurred and the physical features and connectivity of off-channel depressions, side channels, and floodplain surfaces have been lost.*

10. *Channels are more effective at transporting sediment, and sediment retention times are lower.*

11. *Sediment production rates have increased on managed lands. These increases have occurred in pulses (e.g., landslides) and from chronic sources (i.e., surface erosion from roads).*

12. *Fire suppression is a dominant feature of land management.*

13. *Hydrologic disturbance regimes have not been significantly modified by hydroelectric and storage dams in coastal watersheds. The magnitude and effect of peak flow increases remain areas of technical debate. Small peak stream flows have been increased locally, but the effects of these localized changes diminish downstream. The change in the hydrologic regime does not in and of itself appear to be detrimental, but possible changes in peak flows—coupled with channel instability, increased sediment input, and other effects—could be detrimental. There are almost no quantitative data on these phenomena.*

14. *Lowland stream temperatures are warmer, particularly in agricultural areas.*

15. *Most fish populations and stocks are declining and are characterized by less diverse life histories.*

F. Objectives for Non-Federal Forest Lands in Coastal Oregon

1. <u>NMFS Objectives</u>

Given the importance of salmon habitat on non-Federal lands in Coastal Oregon and the substantial changes that have occurred since the beginning of European development, NMFS proposes a set of objectives to guide the land management changes needed to conserve and restore habitat important to Oregon coastal coho. As stated earlier, the overall goal is not a widespread effort to restore pre-European conditions. Rather, NMFS seeks a combination of habitat protection, restoration, and rehabilitation to provide the proper functioning habitat conditions needed to ensure the long-term survival of coastal coho salmon.

Proper functioning condition is attained when all of the individual habitat factors in a watershed operate together to provide a healthy aquatic ecosystem. Individual factors are measurable or qualitative variables (e.g., stream temperature and degree of sedimentation). The "properly functioning" values for those variables are determined by ascertaining (to the greatest degree possible using the presently available information) what levels are necessary to ensure the long-term survival of the species.

Because moving water habitats are inherently dynamic, proper functioning condition in these areas is defined by the *sustained* presence of unimpaired natural processes that maintain habitat productivity. Although the variables used to characterize functioning condition may entail instantaneous measurements, the variables are chosen—using the best available science—to assess processes, not states, and the proper functioning of these processes essentially constitutes a species' biological requirements (described in Section III. B. of this proposal).

Undeveloped or lightly developed watersheds (of which there are few in the Oregon Coast Range) contain remnant intact aquatic systems. According to the National Research Council (1996), such areas that are ecologically intact and fully functional can be protected by restricting, to the extent possible, human activities that seriously affect aquatic and riparian ecological functions. An example of this level of protection would be the roadless areas in key watersheds of the Northwest Forest Plan.

Degraded aquatic-riparian habitats that have the potential to recover functional characteristics can be addressed through natural (passive) restoration, active restoration, or some combination of both strategies. According to the National Research Council (1996), both strategies require the activities that are causing degradation to cease. The difference in these two strategies is the amount of human intervention in the restoration process, although the ultimate goal in either case is eventually to return to a self-sustaining, fully functioning ecosystem.

Where habitat changes are substantial and largely irreversible (e.g. due to channel constrainment by major roads, stream channel incision, or floodplain loss), the full restoration of ecological functions may not be possible, but some functions can be attained through habitat rehabilitation—defined by the National Research Council (1996) as a combination of restoration and substitution of artificial means for natural processes or features.

The NMFS believes these proposed measures, if implemented, will provide a high probability of protecting and restoring the aquatic habitat important to coastal coho (as the MOA requires) because:

1. They are designed using the best available scientific information to maintain, restore, and rehabilitate the essential functions of uplands, riparian areas, and stream channels that sustain proper functioning aquatic habitat.

2. Interim measures would be applied on non-Federal forest lands across the landscape (as are the current ODF rules).

3. They will encourage development of watershed-specific measures through watershed analysis.

4. They are supported by efforts to protect coho habitat strongholds through the Northwest Forest Plan (in the southern coastal basins) and negotiations on the proposed habitat conservation plan for state lands (in the northern coastal basins).

The objectives below were derived from a variety of sources. These include the OCSRI (1997), discussions with the ODF and Governor Kitzhaber's staff, discussions with members of NMFS' Riparian and Landslide Science Discussion Groups, and the Northwest Forest Plan. These qualitative objectives are intended to complement the more quantitative objectives contained in the OCSRI (Appendix V); they can thus be used as benchmarks to help measure the effectiveness of the Oregon Plan. The NMFS helped develop many of the OCSRI objectives and generally endorses them, although some of the objectives need to be refined as additional quantitative information about our coastal watersheds is developed. Also, NMFS expressed other reservations about some of the OCSRI objectives in its analysis of habitat factors for decline of coastal coho (April 24, 1997, memorandum from Elizabeth Gaar, NMFS, to Jacqueline Wyland, NMFS).

Management across non-Federal lands in coastal Oregon should be designed to maintain and restore properly functioning habitat and overriding ecosystem processes in a timely manner, and thus meet the following ecological objectives over time.

1. Maintain and restore the spatial and temporal connectivity of salmonid habitat within and between watersheds. Improve understanding of floodplains and their vegetation, develop strategies for restoring this vegetation, and rehabilitate floodplain topography to restore hydrologic connections (i.e. surface and subsurface flows) between streams, floodplains, and uplands.

2. Maintain and restore the native compositional and structural diversity of plant communities in riparian areas and wetlands and thereby provide adequate summer and winter thermal regulation, supply organic input of leaves and insects, filter surface erosion, maintain bank stability, and supply enough well-distributed coarse woody debris to sustain stream channel complexity and stability.

3. Increase the number of mature trees in riparian areas, landslide-prone areas, runout paths, and deposition zones. This will increase delivery of large woody debris to coastal streams over time. The objective is to achieve a mature forest condition in the riparian areas along all perennial streams.

4. Maintain and restore the water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Reduce the number of state-listed water quality-limited streams. In the near term, increase shading in open reaches of perennial streams—particularly in lowlands—to reduce elevated stream temperatures, and explicitly protect wetlands. In the long term, approximate the natural character of shade in mature and late-successional stands along forested reaches.

5. Maintain and restore the sediment regime that supports, through channel morphology and substrate conditions, salmonid survival, growth, and reproduction in geologically-suitable reaches. Elements of the sediment regime include the timing, volumes, rates, and character of sediment input, storage, and transport. In the near term, reduce and minimize human-induced inputs of sediment into streams (e.g., from landslides, roads, and harvest units in forest lands) to minimal amounts.

6. Reduce and minimize the risk of landslides (which will affect their rate, magnitude, composition and therefore their consequences) from roads and harvest units to a minimal level, and increase the amount of large wood in landslides. When analysis tools become advanced enough to allow watershed-specific targets to be developed and justified, manage landslide risk so that forest practices will not adversely affect coho salmon habitat.

7. Maintain and restore sufficient instream flows to create and sustain riparian, aquatic, and wetland habitats, and retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows should be maintained where optimum and restored where they are not.

8. Increase the size and number of intact, functional local habitat refugia (e.g., floodplains, off-channel ponds, and tributary junctions) and watershed-scale "survival areas" (National Research Council 1996) by increasing short-term habitat protection under reduced-risk management. This will buffer the effects (and reduce the risks) of future development activities and disturbances until average habitat conditions have improved throughout coastal basins. Where key watersheds are unavailable under the Northwest Forest Plan, use blocks of state land with high-quality habitat to create the survival areas at the watershed scale.

9. Given the importance of beaver ponds in salmonid rearing habitat, and as sediment traps, improve riparian conditions and beaver management (at the watershed scale) to increase and maintain the number of well-distributed beaver populations.

In addition to meeting objectives of the coho salmon MOA, the measures contained in this proposal meet many of the objectives of other regulatory agencies involved in land management in the Oregon Coast Range. The U.S. Environmental Protection Agency (EPA) submitted comments (contained in Section VIII of this draft) on an earlier draft of this proposal indicating that NMFS' objectives were "consistent with the direction EPA is taking in its policies and programs under the Clean Water Act (CWA) and Coastal Nonpoint Pollution Control Program under Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA)." The EPA also stated that "the proposed interim measures outlined in Section V.A. are compatible with EPA's policy positions concerning both CWA implementation and CZARA Section 6217 issues and would satisfy many of EPA's outstanding concerns." Moreover, the U.S. Fish and Wildlife Service (FWS) analyzed the earlier draft proposal and indicated that the measures would benefit certain amphibians and resident fishes more than would the current forest practice rules.

IV. ALTERNATIVE MEANS TO ACHIEVE OBJECTIVES

As part of the effort to develop this proposal, NMFS asked members of the Riparian and Landslide Discussion Groups to review and comment on four sets of forest management practices.

1. The current Oregon Forest Practice Rules (Rules) with additional measures from the Coastal Salmon Recovery Initiative (OCSRI).

2. The Northwest Forest Plan (i.e., the Aquatic Conservation Strategy for Managing Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl).

3. The Port Blakely Tree Farms Habitat Conservation Plan (HCP) in southwest Washington (approved July 1996).

4. A “generic proposal” largely based on several completed and in-process HCPs in western Washington, Oregon, and California.

Additionally, members of the Landslide Discussion Group reviewed a strategy proposed by Louisiana-Pacific in California for coarse screening slope stability.

These sets of forest management practices were selected to provide reviewers with a range of forest practices designed to conserve habitats for anadromous salmonids in various coastal forests of western Oregon, Washington, and California. Other sets that were not selected for review would lie generally within the management range of those reviewed. Individual reviewers were also asked to offer any alternative measures they judged appropriate.

A. Description of Sets of Management Practices

<u>Oregon Forest Practice Rules.</u>

The Forest Practice Rules, which were extensively revised in 1994, were further enhanced by a number of voluntary measures described in the 1997 OCSRI. During development of the 1994 revisions, the ODF prepared several reports on the technical rationales for the specific measures (e.g., Report on the Analysis of Proposed Water Classification and Protection Rules, 1993, and Modeling Woody Debris Inputs and Outputs, 1993). These reports provide the data and analyses that support the goals, statements of purposes, desired future conditions, and prescriptions in the revised rules. Forested lands managed under the rules lie mostly in the headwaters and transition zones of coastal watersheds.

The Northwest Forest Plan.

Managing Federal lands under the Northwest Forest Plan's Aquatic Conservation Strategy takes into account seven key items: Objectives; relatively extensive riparian reserves (including landslide-prone areas) that can be adjusted by watershed analysis; key watersheds; standards and guidelines; watershed analysis; watershed restoration; and monitoring for compliance and effectiveness. An estimated 30% of the Oregon coastal coho habitat is within Federal ownership. Federally-managed lands are mostly situated in the headwaters and transition zones of coastal watersheds. Aquatic habitat quality varies across watersheds, depending on past management intensity, but it is generally better than on non-Federal lands.

The Port Blakely Tree Farms HCP in Southwest Washington.

The Port Blakely HCP covers 8000 acres in the Willapa Hills of southwest Washington. Lands are managed for a 70- year rotation, with several periodic commercial thinnings. Most of the forests and riparian areas now contain 50- to 70-year old conifers. Conservation measures in the HCP were developed to maintain streams that are now generally considered to be productive habitats. Riparian areas along fish-bearing streams will be protected during timber harvest and managed to achieve a mature forest condition. Landslide-prone sites will be identified and no harvest will be allowed on high-hazard sites. Partial harvest will be allowed on moderately unstable sites. Roads have been comprehensively inventoried and scheduled for upgrades within the first five years of the HCP. Although watershed analysis has not been conducted in the area, the landowner has addressed key questions similar to those in the mass-wasting and surface erosion modules of the Washington State watershed analyses (e.g., regarding surface erosion and fish passage).

The Generic Alternative.

The generic alternative was developed as a blend of conservation measures that could be applied to typical industrial forest lands in western Washington or Oregon. Specific measures would need to be tailored to the lands and operations of a particular landowner. Its key elements are:

1. Management objectives for resource protection.
2. Watershed analysis.
3. Protection of perennial streams with riparian buffers that have inner no-harvest zones (measured outside of any floodplain or channel migration zone), and outer management zones designed to grow large trees.
4. Protection of seasonal streams with riparian buffers that are less restrictive than along perennial streams.
5. Plans to inventory all roads and upgrade all sites that could potentially impact fish habitats.

6. Identification and protection of high-hazard sites in landslide-prone areas.
7. Monitoring for compliance and effectiveness.

B. Evaluation of Sets of Management Practices

<u>Overview of the physical aquatic system.</u>

The members of the Riparian Discussion Group developed an overview of the physical aquatic system in order to describe the relative contribution of the forested landscape to salmon conservation in the context of coastal watersheds. Their findings are described in italics below.

There are five principal parts of the physical aquatic system:

a. Small, intermittent streams in steep headwaters.
b. High-gradient, perennial streams.
c. Transition zone between high-gradient and low-gradient areas (channel gradients of about 1% to 8%).
d. Low-gradient areas (i.e., valley bottoms) containing terrace tributaries and small streams which are especially important for rearing.
e. Estuaries.

The upland streams in part (a), above, would be suitable for protection and rehabilitation. These areas affect temperatures and sediment levels and provide some wood downstream. The low gradient areas (d) that generated the greatest historical coho production and have experienced extensive losses. The largest changes have occurred in the low gradient areas and estuaries and these areas are most in need of improvement.

To protect and rehabilitate coho habitat, the initial focus should be on small streams in the transition (c) and low-gradient areas (d) of the watershed. Headwater areas (a) will require more time to improve. Work in the transition zone (c) may produce the most rapid results. The highest priority for action is in the small streams in low gradient areas (d). Some quick response may be achievable there, but the process may be complicated by diverse land ownership and management objectives.

<u>Evaluation procedure.</u>

The Riparian and Landslide Science Discussion Groups each developed a set of habitat-related objectives (later referred to as “ranking objectives”) that each group member used individually to assess and rank each set of management practices (Appendices II and III). The NMFS asked the members of each discussion group to use the following scale to rank each package of measures for the likelihood that it would meet the ranking objectives over time (assuming that the means were fully implemented).

1. Strong weight of evidence that measures will meet the objective(s).
2. Likely to achieve objective(s).
3. Uncertain ability to achieve objective(s).
4. Unlikely to achieve objective (s).
5. Strong weight of evidence that measures will not achieve objective(s).

The NMFS also asked each of the reviewers to: Comment on the technical feasibility of implementing the measures in each set; identify any barriers to full implementation and describe how they could be reduced or eliminated; comment on the strengths and weaknesses of specific components in each set; and recommend additional measures that may be needed to achieve the objectives.

In the summaries of comments received below, NMFS provides more details on the evaluation of the Oregon Forest Practice Rules as enhanced by the OCSRI measures than the other measures packages, due to the obvious importance of this set of measures.

<u>Evaluation of Oregon Forest Practice Rules.</u>

Rankings.

Members of the Riparian Discussion Group variably rated the ability of the existing Rules (as enhanced by the OCSRI) to meet the ranking objectives. Some members were not comfortable providing written rankings of the measures sets, preferring to emphasize comments on strengths and weaknesses, technical feasibility, and implementation barriers. The rankings, discussed in one of the meetings, were mainly in the range between likely and uncertain to meet the objectives for the areas of mass wasting and road maintenance and construction; between likely and unlikely for general riparian protection; uncertain for riparian protection of small non-fish-bearing streams; and uncertain to unlikely for restoration objectives. Several members thought some kind of watershed-scale assessment was needed to meet watershed-scale objectives.

Most members of the Landslide Discussion Group gave ratings ranging from “unlikely” that the ranking objectives would be met to “strong weight of evidence” that ranking objectives would not be met for the existing Forest Practice Rules with the OCSRI enhancements. Only one member gave a higher rating (uncertain) of the Rules ability to meet the ranking objectives.

Strengths/weaknesses of unstable slope delineation and protective measures.

Some members of the Landslide Discussion Group noted that the Rules (plus the OCSRI) had several strengths. These included: A recognition and definition, in a general way, of "high-risk sites" for landslides; and research and monitoring studies to assess the effectiveness of current forest practices. Most members of the Riparian and Landslide Discussion Groups found weak elements of the Rules (plus OCSRI) in this area. They noted that the Rules lacked criteria or methodology for delineating areas with high risks of mass wasting, lacked criteria for approving or rejecting written plans required in these areas, and lacked a provision for prohibiting harvest or roads in these areas, when needed. Two of the members of the Landslide Discussion Group said the absence of watershed analysis was a weakness that precluded the ability to tailor land management to specific landscapes. One member of the Landslide Discussion Group thought the Rules (plus the OCSRI) did not recognize the role of root strength on slope instability. One member noted that there was no evaluation of the consequences of mass wasting (e.g., recognition of debris-flow or channels prone to dam-break floods), nor any account of how that may affect the hazard or risk rating.

Strengths/weaknesses of riparian delineation and protective measures.

Several members of the Riparian Discussion Group noted that the Rules (plus the OCSRI) were weak with respect to the small size of riparian areas protected, particularly for small streams. Further, there was uncertainty about which small streams would be protected, particularly for seasonal streams, and there appeared to be only a small chance that any large trees would ever reach the streams because of the likelihood that they would be harvested over time. Several members of both the Riparian and Landslide Discussion Groups emphasized the need to grow and protect large trees along small streams (particularly those associated with landslide initiation and runout zones) to increase large woody debris loading in larger streams downstream.

Strengths/weaknesses of road maintenance and construction measures.

Two members of the Landslide Discussion Group noted potentially positive outcomes from the voluntary road risk reduction program on industrial forest lands. Several members of the Landslide Discussion Group thought criteria were needed to allow roads to be approved or rejected on unstable sites. The current requirement under the Oregon Rules (plus the OCSRI) to design stream crossings for a 50-year peak flow was seen as an improvement over earlier practices, but some of the Riparian Group members still considered it inadequate for meeting the objectives. Some members noted there are no guidelines or incentives for reducing overall road density, moreover there is no requirement to prepare road maintenance plans. Some members of both discussion groups noted that while the intent of the Rules for road-related resource protection is clear, the outcomes remain uncertain given the large amount of discretion in the

Rules regarding road maintenance. One member noted the need to guide road drainage management and other corrective actions taken during and after floods and other catastrophic events.

Strengths/weaknesses of watershed analysis and links to subsequent measures.

Several members of both Discussion Groups stated that the lack of an existing watershed analysis was a significant problem in that there was thus no method for selecting sites and techniques to protect or restore habitat, nor any means to guide development of site-specific measures. For example, landowners attempting to address landslides and their impact on fish habitat would be hampered without such an assessment. "Without a broad geographic perspective, landowners might assume that the individual effects of specific practices are not a factor in aquatic habitat degradation when in fact they may be a key to understanding and controlling habitat impacts," noted one member.

Strengths/weaknesses of restoration measures.

Several members of both the Riparian and Landslide Discussion Groups noted that restoration measures in the Rules suffered from the lack of a watershed perspective in that they might not be widespread enough to make a significant difference. One member said the provision for a "credit" allowing extra removal of riparian trees when wood is placed in streams would be detrimental to long-term recovery of riparian areas. Another member said:

> *Unless there is an improved understanding of (1) historical land use practices that have altered salmonid habitats, (2) hydrogeomorphic disturbance regimes and landforms, (3) the ecological functions of riparian vegetation, and (4) delineation of ecologically intact reference sites within specific watersheds, a continuation of instream enhancement projects will have a high likelihood of additional resource degradation.*

Technical feasibility and barriers to implementation.

Several Discussion Group members noted that the voluntary nature of the enhancements in the OCSRI made their implementation uncertain. One member was concerned that the rules discouraged active management in the inner riparian zone and that this had negative long-term implications for riparian vegetation. One member noted that while the existing rules suffer from uneven application and enforcement, increased monitoring and scrutiny under the OCSRI would improve implementation. One member spoke of the need to provide better guidance for corrective actions after catastrophes (e.g., floods, mass failures, and fires). One member of the

Landslide Discussion Group thought the "burden of proof" needed to restrict land owner actions under the under the current Rules was a problem.

Members of the Landslide Discussion Group generally considered the measures in the Rules (plus the OCSRI) feasible, although one member said that feasibility could not be determined as there was no assessment of unstable slopes.   Members identified a number of barriers to the Rules' implementation. One member said there is no practical and up-to-date method for site-specific identification and evaluation of potentially unstable ground, and that any such methodology should be reviewed by experts. One member said that because identifying of "high risk areas" and "high risk sites" seemed to rely primarily on the landowner/operator, there might be great variability in interpretation of high risk areas and sites, particularly since the definition of such zones is broad. Several members noted that the scarcity of field personnel with the education and experience to determine "high-risk sites" was a barrier to implementation. Also, the Rules do not appear to use a no-road or no-harvest option very often—suggesting a barrier to mitigating landsliding. One member said the measures lacked adequate compliance monitoring.

<u>Evaluation of Northwest Forest Plan</u>

Some members of the Discussion Groups noted some specific shortfalls in this Federal strategy, they are: (1) The lack of watershed analyses to date; (2) the watershed analysis process is isolated from project planning;(3) the lack of a clear, consistent process for delineating landslide-prone areas; (4) the widespread efforts to add structures to streams without explicit goals, effectiveness monitoring, or rigorous experimental design.

<u>Evaluation of Port Blakely Habitat Conservation Plan (HCP)</u>

Members of the Discussion Group noted that the riparian conservation measures in the Port Blakely HCP, while appropriate for maintaining properly functioning riparian conditions, may not be rigorous enough to allow passive restoration of forested streams that are now in generally degraded conditions. Members of the Landslide Discussion Group had reservations about specific details of identifying possible mass wasting sites and protecting them. However, the road management provisions of this HCP could be a useful model for coastal Oregon.

<u>Evaluation of Generic Proposal</u>

Conservation measures included in the generic proposal come close to prescribing management that will both protect existing high-quality habitats and provide for passive restoration of currently degraded streamscapes. Specific weaknesses noted by the scientists include: (1) There should be a commitment to reduce road density; (2) watershed analysis needs clear goals for assessing and restoring natural processes and should include strong assessments of fish distribution, stock status, and key habitats; (3) effectiveness monitoring should be reported at intervals of three to five years and should be linked to adaptive changes in management; and (4) there should be a specific level of risk for which to manage.

Recommendations for Additional Measures

Members of the Riparian Discussion Group provided the following recommendations for additional measures: (1) Increase Riparian Management Zone (RMZ) size (and reduce activities in them), particularly for smaller streams; (2) identify watersheds to serve as short-term refugia and allow little or no timber harvest in them; (3) develop and use a simple, effective watershed analysis process; (4) manage near-stream areas to ensure tree regeneration; and (5) improve lowland streams and floodplains as well as forested lands. Several members of both discussion groups commented on the importance of retaining trees downstream of landslide initiation sites to reduce landslide runout distance and provide large woody debris.

Several members of the Landslide Discussion Group recommended a specific protocol for delineating landslide hazards; they advocated an explicit authority to control practices on private and public lands (including harvest and road mitigation or special management measures) with an option of "no cut" restrictions in “high hazard” areas. One member recommended a variety of management measures for “moderate hazard” areas; these included the use of extended rotation ages, partial harvests, low road densities, long-reach skyline systems, and minimal levels of burning and herbicide use for site preparation. Some members recommended using a “coarse screening process” for landslide hazard mapping. One member emphasized the importance of upgrading and maintaining the existing road system and setting standards for new roads on steep, landslide-prone terrain.

Some members recommended developing continuing education programs to train land managers and technical specialists in slope stability considerations. One member also recommended that the Oregon State legislature fund a hillslope geomorphology faculty position in the Geosciences department at either University of Oregon or Oregon State University in order to increase the pool of professionals in the region who receive formal training in hillslope processes. It was also suggested that the region develop a program to conduct basic research on watershed processes and applied research on management-related issues.

One member recommended that monitoring data be formally collected as a part of adaptive management efforts and suggested a periodic (5-year) review of watershed analyses, management plans, and monitoring data. One member recommended that NMFS hire personnel with the geomorphological expertise to participate in and evaluate watershed analyses.

V. DRAFT NMFS PROPOSAL ON OREGON FOREST PRACTICES AND OTHER APPROACHES

As a result of the work done by the Science Discussion Groups—as well as additional reviews of available literature and salmon protection and restoration plans—NMFS has developed the following draft proposal for discussion with the Oregon Board of Forestry Advisory Committee. This proposal reflects NMFS' current thinking on what changes in Oregon forest practices are needed and appropriate. It is followed by a number of other approaches that NMFS has used—in conjunction with Washington state government and a member of the forest products industry—to develop acceptable long-term agreements for conserving salmon populations.

A. Default Interim Measures

The following interim conservation measures should be employed to help ensure salmon survival until a scientifically-validated procedure for watershed analysis is developed and implemented in the Oregon Coast Range. These measures are designed to give a high probability of protecting and restoring the aquatic habitats important for Oregon coastal coho on Oregon forest lands. The NMFS expects that in many areas, site-specific measures will be developed using information obtained through watershed analysis. The successful outcome of this scenario depends not only on developing watershed analysis procedures, but also on developing an intergovernmental institutional structure that would review and approve (or reject) proposed measures following watershed analysis. Table 2 provides a synopsis of the measures and compares them to existing practices. The NMFS' proposals for watershed analysis are given in Section VI.

Although the interim measures are designed to provide a high probability of restoring and recovering Oregon coastal coho, the measures are not as conservative as Federal aquatic management has been previously (e.g., as detailed in the Northwest Forest Plan). The conservative nature of these interim measures reflects the natural variability of habitats and fish populations and acknowledges the natural disturbance regimes of coastal watersheds. The degree of risk for which steep forest lands would be managed to avoid shallow landslides is low, though difficult to quantify, thus reflecting the uncertainty inherent in identifying landslide-prone sites. Nonetheless, the Oregon coast may already have an elevated rate of sliding (relative to the rates before European arrival) and this condition will likely be maintained for some time even if forestry actions were to stop today (Benda and Dunne 1997a, 1997b, and Benda et al. in press).

These interim measures are intended to be flexible because they may be replaced with equivalent (or more conservative) site-specific measures where needed to meet regulatory requirements or conservation objectives. After completing watershed analysis, replacement measures also should give aquatic resources equivalent or better protection. The ODF, ODFW and DEQ should review these measures and make this determination. It is expected that this determination will use information gathered during watershed analysis.

1. Riparian and Stream Protection

Floodplain.

The presence and extent of a 100-yr floodplain or channel migration zone should be determined. This area, where present, typically includes low terraces, side channels, and associated wetlands. One simple way to estimate the width of this zone is by determining how wide the stream would be if it contained water flowing at twice its bank-full depth (Rosgen 1996). Where technical specialists are available (e.g., hydrologists or fluvial geomorphologists), floodplains should be locally delineated based on the best professional judgement. The entire stream channel and floodplain should be protected as a unit.

Differentiation of fish-bearing- vs. non-fish-bearing streams.

This should occur before management operations are prescribed. Ideally this would be based on field checks of fish distribution limits (e.g., using ODFW Stream Survey Protocols). Stream segments where road crossings or habitat manipulations that have blocked fish passage but where passage restoration is feasible should be defined as fish-bearing streams. Without field confirmation of the limits of fish distribution, stream segments in the areas of a proposed action should be treated as fish-bearing if conditions would allow fish to be present (e.g., if the channel gradient is less than 20%).

Fish-bearing streams.

A Riparian Management Zone (RMZ) should be delineated along each side of the channel. The width of this RMZ would be based on the height of one site-potential tree. The RMZ would be measured horizontally from the outer edge of any floodplain or channel migration zone. The RMZ would be extended to include streamside areas of highly unstable soils (e.g., inner gorges), seeps, or springs. Where windthrow is likely, the RMZ should be extended onto drier soils.

Within the RMZ, an inner zone 30 feet in width should be established; this represents one-half the crown diameter of a typical mature hardwood tree. This inner zone is designed to filter sediment and maintain stream-bank rooting strength. Generally no timber harvest or ground-based equipment operations should be allowed in the inner zone. Limited thinning, by retaining relative density[5] (Curtis 1982) of at least 50 (English units) at all times, is allowed within the inner zone to

[5] Relative density (RD) is a term used by foresters to describe even-aged stands of Douglas-fir, that incorporates both average tree diameters and total cross-sectional area of tree boles (i.e., basal area). RD equals basal area divided by the square root of the quadratic mean stand diameter. Unlike basal area, RD can be used in forest management to describe stand conditions of crown closure and mortality from competition. The RD is commonly

encourage rooting of densely-spaced young conifers while providing some natural mortality that could contribute LWD to the stream.

The remaining width of the RMZ would be managed to grow mature forest conditions typical of a 80- to 200-year old stand at that site. No more than two entries for timber management would occur per 50 years, and they would be spaced no closer than 15 years apart. No salvage logging of dead, dying, or down trees would occur within the RMZ. Yarding and felling should be directed away from the inner zone. Any yarding over the inner zone would require full suspension, and any trees within the RMZ that are damaged by cable yarding would be retained. A relative density (Curtis 1982) of at least 30 (English units) would be maintained during any timber harvest. The fullest and largest diameter trees in the RMZ should not be harvested. After the RMZ attains mature forest conditions—measured against the best available reference sites—there would be no further management and the stand should be allowed to grow.

A written plan should be required for timber harvest within an RMZ. Written criteria for approving written plans for management activities in RMZs should be developed by ODF in cooperation with other state and Federal agencies. These criteria should include provisions for compliance monitoring and adaptive management. Also, watershed analysis could be useful to determine stream reaches where active forest management would be desirable to encourage development of mature forest conditions that would enhance LWD recruitment.

Riparian sites that are dominated by hardwood trees include some sites that are expected to be disturbed over the long term by floods, debris flows, or other natural processes—so conifers would rarely dominate at any time. Other hardwood-dominated sites represent a legacy of conifer removal and would be suitable for silvicultural manipulation to replace alder with conifers. Hardwood conversion projects need to maintain shade and retain the values of existing conifers and durable hardwoods growing in the RMZ (e.g., myrtle and maple). If red alder is removed, these other trees species should not be removed.

Channels that are susceptible to debris flows—the determination should be based on previous events or modeling of local topography—should have barrier trees retained around alluvial fans to reduce debris flow runout distance and add to LWD to deposition reaches in streams. This would include all trees (ideally mature conifers) within one-half of a site-potential tree height of both sides of the fan. Managing for late-seral trees downstream of landslide-prone sites would also be expected to ameliorate impacts on the channel (see section on Mass-wasting for specific measures

expressed, in English units, as a range between zero and one hundred, where open-growing stands are <30, stands develop a closed canopy and begin competition mortality at about 55, and the maximum size-density relationship is attained at RD equal to 100. Maximum stand growth occurs between about RD 30 and 55. RD is considered much more objective and repeatable than canopy or crown closure. For well-stocked Douglas-fir stands, 70% crown closure is equivalent to RD 35 to 40. The term is more commonly used for even-aged upland stands than to prescribe management of riparian forests, which are typically uneven-aged and sparsely stocked with a variety of tree and shrub species.

to protect runout zones below potentially high-hazard slopes with a high likelihood of delivery to a stream).

Perennially-flowing non-fish-bearing streams.

A Riparian Management Zone (RMZ) should be delineated along each side of the channel. The width of this RMZ would be two-thirds of the height of a site-potential tree. The RMZ is measured horizontally from the outer edge of any floodplain or channel migration zone. The RMZ is extended to include streamside areas of highly unstable soils (e.g., inner gorges), seeps, or springs. Where windthrow is likely, the RMZ may be extended onto drier soils.

Within the RMZ, an inner zone 30 feet in width should be established; this represents one-half the crown diameter of a typical mature hardwood tree. This inner zone is designed to maintain stream-bank rooting strength and filter sediments. Generally no timber harvest or ground-based equipment operations should be allowed in the inner zone. Limited thinning, by retaining relative density (Curtis 1982) of at least 50 (English units) at all times, is allowed within the inner zone to encourage rooting of densely-spaced young conifers.

The remaining width of the RMZ would be managed to grow mature forest conditions typical of a 80- to 200-year old stand at that site. Silvicultural manipulation toward mature forest conditions is allowed without watershed analysis. No more than two entries for timber management would occur per 50 years and they would be spaced no closer than 15 years apart. No salvage logging of dead or down trees would occur within the RMZ. Yarding and felling should be directed away from the inner RMZ. Yarding over the inner zone would require full suspension, and any trees within the RMZ that are damaged by cable yarding would be retained. A relative density (Curtis 1982) of at least 30 (English units) would be maintained during any timber harvest. The fullest and largest diameter trees in the RMZ should not be harvested. After the RMZ attains mature forest conditions—measured against the best available reference sites— there would be no further management and the stand should be allowed to grow.

A written plan should be required for timber harvest within an RMZ. Written criteria for approving written plans for management activities in RMZs should be developed by ODF in cooperation with other state and Federal agencies. These criteria should include provisions for compliance monitoring and adaptive management. Also, watershed analysis could be useful to determine stream reaches where active forest management would be desirable to encourage development of mature forest conditions that would enhance LWD recruitment.

Channels that are susceptible to debris flows—the determination should be based on previous events or modeling of local topography—need to have barrier trees retained around alluvial fans. These include all trees (ideally mature conifers) retained within one-half of a site-potential tree height of both sides of the outermost channels of the fan. Managing for late-seral trees downstream of landslide-prone sites would also be expected to ameliorate impacts on the channel (see section on mass-wasting for specific measure to protect runout zones below potentially high-hazard slopes with a high likelihood of delivery to a stream).

Seasonally-flowing non-fish-bearing streams.

A Riparian Management Zone (RMZ) should be delineated along each side of the channel. The width of this RMZ would be one-half the height of a site-potential tree (i.e., 75- to 100-feet on the Oregon Coast). The RMZ is measured horizontally from the outer edge of the annual channel or any floodplain or channel migration zone. The RMZ is extended to include streamside areas of highly unstable soils (e.g., inner gorges), seeps, or springs. This RMZ may be partially entered for limited silvicultural treatments aimed at growing and retaining mature trees (e.g., pre-commercial and commercial thinning). Within the RMZ, a relative density of at least 30 would be maintained, while retaining the largest trees and allowing the greatest likelihood of recruiting woody debris to the stream. Note that RMZ widths include allowances for windthrow of about 15% within the first decade after the canopy has been removed in the adjacent upland forest, so there would generally not be a need to extend this RMZ to account for windthrow.

For side slopes less than 30%, the entire RMZ should be should be managed as provided above. For side-slopes over 30%, the following should apply: Delineate the first 30 feet from the edge of the channel, or 30 feet from the outer edge of an unstable area, or the extent of an inner gorge (where present), whichever is greatest, as a no-harvest inner zone. This inner zone is designed to maintain stream-bank and unstable area root strength, minimize sediment delivery from surface erosion, and help provide LWD for sediment storage. No ground-based equipment or yarding operations would occur in this zone. Between this inner buffer and the outer RMZ boundary, the following restrictions apply:

- Fell timber away from these watercourses. Yard with at least partial suspension or low-pressure ground-based equipment. Avoid locating tail-holds or guy stumps adjacent to streambanks, or within an inner-gorge. Avoid overloading streambanks with yarding debris. Retain all down wood, except for slash (defined as branches and limbs less than four inches in diameter, bark and split products).

- Avoid road work and any ground-disturbing timber harvest activities during wet periods (typically more than two inches in 24 hours). Assess areas of exposed soil disturbed by roading or yarding for mitigative treatments (e.g, placing organic debris across yarding roads to reduce erosion, mulching with straw, and grass seeding). Avoid locating roads, borrow-pits or landings on the alluvial fans of these watercourses. Manage and improve roads to minimize delivery of sediments and water into these channels. Avoid introducing ditch drainages into existing watercourses.

Channels that are susceptible to debris flows—the determination should be based on previous events or modeling of local topography—should have barrier trees retained around alluvial fans. This would include all trees (ideally mature conifers) within one-half of a site-potential tree height of both sides of the fan. Managing for late-seral trees downstream of landslide-prone sites would also be expected to ameliorate impacts on the channel (see section on Mass-wasting for specific measure to protect runout zone below potentially high-hazard slopes with a high likelihood of delivery to a stream).

2. Road Management Plans

In order to protect anadromous fish, roads would be constructed, reconstructed, maintained, and operated in such a way that only a minimal amount of road-related sediment reaches watercourses, fish movement is not restricted, the natural drainage network and hydrology are maintained, and chemicals do not come in contact with water. The best way to avoid these impacts may vary depending on the landscape and the proposed action. Due to the dense road networks already existing on most forest lands in Oregon, it may be difficult to avoid adverse effects on salmon habitat at the project level. Therefore, NMFS encourages the development and implementation of a road management plan at the ownership or, preferably, the watershed-scale, before further timber management takes place, including emergency and exemption activities. A road management plan should be submitted to the State Forester for review and approval.

The road management plan should describe the measures designed to ensure fish passage for all life stages; upgrade stream-crossing structures to accommodate a 100-year design flow (including likely debris); assess and either relocate or decommission any existing roads on potentially unstable sites or floodplains that could deliver sediments to streams; upgrade road surfaces and maintenance procedures to avoid surface erosion into streams; and incorporate any other site-specific measures necessary to avoid, minimize, and mitigate adverse effects on fish habitats.

The following management should be implemented for all roads in a harvest area (or otherwise identified for use during timber harvest).

A. Fine sediment discharge from road surface erosion.

To avoid or minimize fine sediment discharges, road construction, maintenance, and operation should follow these guidelines:

- Look for opportunities to decommission roads throughout a given watershed, especially those road segments located within or next to RMZs and landslide-prone areas. Balance the economic costs resource risks by annually scheduling about 10 to 20% of the total necessary upgrades within each watershed.

- Before developing a comprehensive management plan avoid building new roads and stream crossings in RMZs. New *temporary* roads may be constructed across RMZs before a comprehensive road management plan is developed if there is no water in the stream channel during road construction and use, and if the roads are constructed, used, and properly closed in the same season.

- New roads should be located in landslide-prone areas only after a comprehensive road management plan has been approved. Also, a coarse-screening procedure for identifying high-hazard sites for shallow slope failures should precede siting of any new roads (see section V.3.A). Consider the following methods (from Weaver and Hagans 1994) during road design: Outsloping, rolling dips, critical dips, and water bars. Avoid road construction during the winter period (October 1 - April 30). Steep segments of temporary roads (i.e., >7%) should be surfaced and have adequate drainage structures. The road should be no wider than the largest single piece of equipment, with turnouts at appropriate intervals. Roads should not cross headwalls or convergent, small-scale features known as bedrock hollows. Temporary roads should be constructed, used, and properly closed in the same season.

- Temporary roads should be promptly decommissioned after timber harvest using the following methods: Pull back all perched fill and sidecast material, remove culverts and pull fill back from the stream crossings, treat road surfaces and ditches to disperse runoff and prevent surface erosion, remove potentially unstable road material, mulch/seed exposed soil surfaces, outslope road or install cross drains or both, remove outside road berms, and eliminate inside ditches.

- Surface all existing RMZ roads with high-quality, clean rock. Any roads that could deliver sediment into an RMZ should be treated to avoid it, e.g, by surfacing, sediment traps, rolling grade, or additional cross-drains.

- Ensure adequate numbers of cross-drains on all roads by considering: Hillslope gradient, position of the road on the hillslope, and soil erosivity. See Montgomery (1994) for methods to design adequate cross-drain spacing.

- Avoid hauling or skidding in wet weather conditions (typically two inches of precipitation in 24 hours), especially during the winter period (October 1 - April 30). Hauling or skidding should not resume for 48 hours after precipitation ends or until road surfaces and ditches are not flowing with water.

- Open roads (permanent and seasonal, active and inactive), stream crossings, and their erosion structures should be inventoried and maintained on an annual fixedschedule basis and after large storm events. Closed, abandoned, or decommissioned roads should be monitored and their erosion structures should be maintained on an annual basis.

B. Local changes in water routing due to extension of the channel network or floodplain encroachment.

In order to minimize changes in water routing, management actions should follow these guidelines:

- Keep road drainage from disrupting the natural routes of hillslope ground and surface waters. In a harvest area (including the haul route), existing roads and runoff ditches should be constructed so that runoff is not intercepted and concentrated into streams or onto high risk sites (e.g., road fills; convergent slopes, bedrock hollows, or inner gorges).

- Valley-bottom roads that encroach on floodplains need to be assessed to identify and treat those road segments that could be relocated. Abandoned road segments and drainage structures should be scheduled for obliteration (e.g., by removing fills and culverts) with the objective of restoring floodplain function.

C. Impacts on fish passage (primarily due to culverts).

Existing culverts and other stream crossings boundaries should be inventoried and, if necessary, reconstructed to accomplish the following:

- Provide passage for both juveniles and adults in current and historic anadromous fish streams so that historical distribution patterns are restored. Stream crossings should meet NMFS' fish passage criteria (Appendix VI).

D. Impacts on water temperature and volume through removing water for land management (e.g., dust abatement and wildfire suppression).

In order to prevent water withdrawal impacts accomplish the following:

- Avoid removing water from perennial streams unless the pump intake meets NMFS' screening criteria for screen mesh size and approach and sweeping velocities (Appendix VII). In addition, prevent adverse effects on instream flows, sediment levels, and water quality.

E. Mass soil movement due to failed roads, blocked culverts, and landings.

To avoid or minimize the potential for mass wasting to be triggered by roads, landings, and culverts, the following restrictions should apply:

- Existing culverts should be inventoried and, if necessary, reconstructed to meet or exceed 100-year flood hydraulic criteria. Balance the costs and risks by annually scheduling about 10 to 20% of the total necessary upgrades in each watershed.

- Roads and stream crossings should be reconstructed to eliminate the potential for stream diversions and minimize the potential for fill failures. Crossings should be reconstructed in such a way as to minimize sediment input to streams if they do fail.

- Neither roads nor landings should be constructed on potentially unstable areas that have a medium or high likelihood of delivering sediment to channels (see section B in Potentially Unstable Areas). This includes headwalls or bedrock hollows situated at or above the origins of defined channels. Existing roads and landings built in these potentially unstable areas should be scheduled for removal or relocation to stable areas.

- Annually assess the condition of all culverts and ditches, stabilize stream crossings, and identify and correct all unstable or failing road or landing features before the winter season (October 1 - April 30).

F. Impacts of chemicals (herbicides, pesticides, rodenticides, fire retardant, dust abatement, oil and fuel, etc.) on juvenile fish growth.

To avoid the detrimental effects of chemical application and transport on fish and their habitat, these guidelines should be followed:

- There should be no chemical applications—in particular herbicides, dust abatement sprays, and fire retardants—in the RMZ inner zones.

- There should be no chemical applications—in particular herbicides, dust abatement sprays, and fire retardants—within or along roads located in RMZs.

- There should be no fuel facilities, or equipment storage, cleaning, or parking on roads located in RMZs.

- A spill plan should be developed before fuel, oils, or other chemicals are transported along any roads.

G. Impacts of wildfire suppression due to fire line construction, fire camps, and staging areas.

Wildfire suppression has been included in this section because of the similarities of its impacts to those of road-related activities. The guidance provided here is meant to help firefighters protect fish habitat during and after their engagement in suppression activities. These guidelines should not be seen to limit fire suppression options during wildfire emergencies. To minimize the impact of wildfire suppression activities on anadromous fish, managers should incorporate the following guidelines into their wildfire preparedness strategies:

- Avoid constructing fire lines in RMZs. An exception to this standard applies when such fire lines are needed protection of life or property.

- Fire camps, base camps, and staging areas should be located away from RMZs.

- After the emergency is over, control the erosion from fire lines, camps, staging areas, and other disturbed soil surfaces.

- When possible, contact NMFS for technical assistance if wildfire emergencies arise that may affect anadromous fish or their habitat. This technical assistance will consist of recommendations on how to conserve anadromous fish during the fire fighting efforts.

3. <u>Potentially Unstable Areas Prone to Landslides</u>

Mass wasting is a part of a watershed's natural disturbance regime. It is sometimes beneficial to coho salmon habitats—providing stream systems with coarse sediment and large woody debris. Nonetheless, the potential for *increasing* mass failure, (i.e., shallow landslides), above natural levels should be minimized (Frissel et al. 1997). This can be accomplished by carefully delineating potentially unstable areas and limiting or avoiding timber management activities on there. Though roads are common sources of slope failures, even the relatively small increases in slope failures expected to result from timber harvest are a concern because of the great extent of timber harvest in the Oregon coast region and the high sediment loads currently found in many fish-bearing streams (Benda et al. In press). Conversely, stream segments that are deficient in coarse sediments and LWD, but that would be responsive to those inputs, should be identified as important areas to target for eventual delivery of those inputs.

The current understanding of slope failures cannot predict which particular slopes will fail at a given time. However, sites with a high potential for slope instability can be identified. In order to ensure the long-term survival of coho salmon, sites containing high-risk roads and slopes should receive a high degree of protection.

To reduce the adverse effects of shallow landsliding on salmonid habitats two basic approaches can be followed: a coarse screen, and a fine screen consisting of detailed field, and aerial-photograph analyses (possibly with improved computer modeling). These methods are explained below.

A. Coarse Screen.

The NMFS proposes to engage in a cooperative effort with the ODF to make available a set of potential shallow landslide maps for the entire Oregon Coast Range. These would be generated by a computer-generated slope stability analysis (SHALSTAB). Papers developing the model and showing its application include: Dietrich et al. 1992, 1993, 1995; Montgomery and Dietrich 1994; and Montgomey et al. in press. Recently, Pack and Tarboton (1997) showed the model accurately delineating the pattern of landsliding in British Columbia. This model will use digitized 7.5 minute USGS quadrangle maps with enhanced topographical contours at 10-meter intervals. These maps, and the model that created them, will be made available at nominal cost to all parties.

The model assigns to each 10-meter topographic cell a relative hazard rating (low, medium, or high). These relative hazard areas will be mapped, and each hazard rating will consequently be assigned corresponding practice measures: standard practices, limited practices, or no practices (see Table 1, below, for definitions of the practices). The approach of rating hazards and identifying measures to reduce them is intentionally conservative and should enable landowners to identify which parts of their land need more intensive inspection. Some inner gorges (See Kelsey 1988 for a definition) may not be included in the model results and would need to located by field surveys, since these features do not typically show up on topographic maps. Without investing in more intensive inspection (i.e. a fine screen), the landowner may simply implement the measures detailed in Table 1. It is expected, however, that if substantial parts of an ownership fall in the high hazard category, a landowner would likely arrange a more intensive analysis in order to refine the specific areas needing protection while making timber available for harvest.

B. Fine Screen (intensive slope stability analysis).

Through a combination of field work, aerial photograph analysis and, possibly, further computer modeling, the relative slope stability hazard rating for a given area may be reassigned. The NMFS expects that—relative to the coarse screen—the specific areas of high hazard will change under a fine screen analysis and in most cases they will be reduced to a tightly defined site or group of sites. Specific ways that such analysis may change the outcome of the coarse screen are: (1) Show that the thresholds for setting high and medium hazards should be altered based on the occurrence of observed landslides; and (2) show that specific sites rated at high or medium hazard are incorrectly identified due to inaccurate local topography, absence of a soil mantle, lack of delivery to a channel, etc. Slope failure sites may include bedrock hollows, steep inner gorges, steep planar slopes, dam-break floods initiation points, deep-seated failures, and some poorly-drained, road-associated cuts and fills. The relative potential of delivering sediment to a perennial channel (defined as any channel segment with continuous, mostly surface flow, except in drought years) will be determined, and the NMFS matrix in Table 1 will then be used to assign forest practices.

Estimation of Delivery to a Stream. It is difficult to define precisely the delivery potential for sites yet to fail. Hence, unless it can be shown otherwise for a specific site, the delivery hazard should be considered the same as the predicted stability hazard (e.g., a site rated as having a high hazard rating would also be considered to have high delivery potential as well). But a slope hazard analyst may use available criteria (in conjunction with a runout model) to estimate actual delivery potential.

The potential for sediment to be delivered to a stream from a mass failure can be determined by evaluating a number of factors: Hill-slope gradient and distance from the toe-slope to the stream, presence or absence of a runout zone, length of a runout zone, presence of hillslope channels that would deliver directly to a stream, and presence and size of any topographic benches (Forest Practices Code of British Columbia 1995). There are several models that could be used to predict paths of debris flow runout (e.g., Benda and Cundy 1990, Fannin and Rollerson 1993), and NMFS encourages their application and refinement.

One set of criteria for approximating the likelihood of sediment delivery to a stream from shallow rapid landslides is based on data collected in the Queen Charlotte Islands of coastal British Columbia (Forest Practices Code of British Columbia 1995). It is described below:

> **Low**: Slopes in the potentially unstable area have gradients less than 35%, and the toe of the slope is more than 150 feet from the stream, or the hillslopes are steeper than 35% and

have an associated toe located at least 300 feet from the stream. There is no aerial-photo or field evidence of landslides entering the stream.

Medium: Hill-slopes in the potentially unstable area have gradients less than 35% and the toe of the slope is 60 to 150 feet from the stream, or the hillslopes are steeper than 35% and have an associated toe located 150 to 300 feet from the stream. Where confined, steep-gradient tributary channels join the stream, there is a relatively flat segment of the tributary that is 150 to 450 feet long. There is limited potential to deliver sediment to a perennially flowing stream, based on runout models that assess channel gradient and tributary junction angle.

High: Hill-slopes in the potentially unstable area have gradients less than 35% and the toe of the slope is less than 60 feet from the stream, or the hillslopes are steeper than 35% and have an associated toe located less than 150 feet from the stream. Confined, steep-gradient channels connect directly to the stream. Evidence shows there is high potential to deliver sediment to a perennially flowing stream (e.g., aerial photo or field evidence of landslides that have already delivered sediment, or runout models that assess channel gradient and tributary junction angle).

C. Watershed analysis.

Watershed analysis is described in section VI; it is described here as well because it may use fish habitat conditions to further refine the relative slope hazard rating. In addition to the intensive analysis described in (B) that quantifies the pattern of landsliding, watershed analysis should also provide a quantitative statement about the condition of the channel system with regard to fish habitat and use (spawning, rearing, and passage). This analysis must include a detailed history of land-use and channel change and provide specific evidence of the relationship between fish population survival and channel conditions. Results of this analysis may then be used to alter the shallow landslide relative hazard rating and, thereby, alter the measures applied in the NMFS matrix. The hazard rating should be increased if reaches are discovered in which any additional sediment loading would be detrimental. The hazard rating may be reduced if it can be quantitatively shown that increased landslide potential in the landscape relative to current conditions would be beneficial (e.g., by increasing the delivery of suitably-sized LWD and gravels). In order to permit such a lowering of hazard rating it must be quantitatively shown that improvement in coho survival or habitat conditions would likely *require* an increased slope failure potential. This will require demonstrating knowledge of all factors affecting long-term survival of coho in the watershed, including channel and riparian conditions, and slope stability conditions across that particular watershed.

D. Allowable activities.

Depending on the relative slope hazard rating of a particular unstable area, either standard practices, limited practices, or no practices should be used, as presented in the following matrix:

Table 1. Recommended Outcome of Landslide Risk Determinations

POTENTIAL TO DELIVER SEDIMENT TO STREAM	LIKELIHOOD OF FAILURE: LOW	MEDIUM	HIGH
LOW	Std. Practices[1]	Std. Practices	Ltd. Practices
MEDIUM	Std. Practices	Ltd. Practices[2]	No Practices
HIGH	Std. Practices	No Practices[3]	No Practices

[1] *Standard practices*: No special restrictions on timber operations and road construction as long as action is in compliance with the other sections of these and any other applicable rules.

[2] *Limited Practices*: Some land management practices may occur under the review and guidance of a professional geotechnical expert. All limited practices should be considered experimental and be designed with a high degree of resource conservatism. Examples of limited practices are: Rotation lengths of at least 70 to 80 years, selective harvest with full suspension yarding, maintaining root strength of harvested hardwood trees to encourage stump-sprouting, reducing road densities in upstream sub-basins to less than 2 mi/mi^2, avoiding prescribed burning or use of herbicides, and varying the buffer width next to bedrock hollows—depending on the risk of sediment delivery.

[3] *No Practices*: These areas should be closed to all timber management activities. Existing roads across unstable areas should be field-reviewed by a professional geotechnical expert to determine which road segments are likely to fail. These segments should be scheduled for removal or prescribed stabilization within a relatively short time period, i.e., two to five years. *Further protection of these sites will be provided by identifying and retaining all vegetation along the predicted runout tracks—from the potential initiation site to the predicted deposition site—inclusive.*

There are many other specific measures that can be implemented to avoid or minimize sediment delivery to streams. These will need to be developed in consultation with the individual landowners. Two useful references are *Handbook for Forest and Ranch Roads: A Guide for Planning, Designing, Constructing, Maintaining, and Closing Wildland Roads* (Weaver and Hagans 1994) and *A Guide for Management of Landslide Prone Terrain in the Pacific Northwest* (Chatwin et al 1994).

4. <u>Additional Measures for Improving Protection</u>

The State Forester should designate salmon-bearing streams as “Biological Sites that are Ecologically and Scientifically Significant” under OAR 629-665-000 through 010. These areas would then be protected under the specified resource site protection rules—requiring inspection by the State Forester, a written plan if the operation conflicts with site protection, and mitigation to eliminate the conflict. These sites should be GIS-mapped by the Department of Forestry within a specified timeframe.

The Board of Forestry should obtain written plans for all forestry activities within 300 feet of all Type F streams and within landslide high-hazard zones (mapped using the coarse screening procedure described in section V(A)(3) of this proposal). Written plans should specify the mitigation measures that will be taken to minimize, and if possible, eliminate any adverse impacts on riparian areas and salmonid habitats located either within or downstream of the plan area. At a minimum, written plans should include: (1) A general description of physical conditions in the plan area—including general soils and topography information, vegetation and forest stand conditions, and watershed and stream conditions; (2) the locations of areas with moderate or high hazard ratings for slope failure or surface erosion; (3) wet-period operation plans to minimize erosion; (4) the locations of all existing roads (active or inactive) including a description of problem areas needing correction (e.g., failed stream crossings, failing fills or cut-slopes, sites of surface erosion into streams, and areas of inadequate road drainage).

5. Active and Passive Restoration Strategies

The NMFS believes that this draft proposal incorporates elements of both active restoration (e.g., road restoration and riparian tree manipulations) and passive restoration (i.e., protecting and recovering natural processes that create and maintain productive fish habitats). Passive restoration that recognizes natural variability and strives to recover ecological processes within the expected disturbance regime will likely be effective in aiding long-term survival of wild salmonids (Bisson et al. 1997). Considering the generally impaired current habitat conditions in many watersheds due to a century or more of human development and the expected slow rate of recovery of riparian forests amid continued adverse impacts, the widespread success of passive restoration will not be apparent for many decades. Therefore there may be room for projects aimed at short-term restoration that also remove adverse impacts.

Active restoration needs to include both the removal of high-impact, human-caused disturbances in salmonid habitats, and the manipulation of key streams, riparian vegetation, as floodplain features to accelerate the development of desired ecological conditions (National Research Council 1996). Well-intentioned restoration that provides only transient benefits without removing adverse impacts will likely not achieve the desired improvements (Beschta et al. 1994). Furthermore, restoration that ignores the dynamic nature of fish populations and habitat conditions will likely be ineffective (Bisson et al. 1997). Active restoration that manages toward attaining a perceived minimum standard, with little regard for natural variability, is likely to be less useful in providing long-term productive habitats than an approach that works to restore ecological function.

Certain restoration activities such as bank stabilization, placement of instream structures, importing spawning gravel, etc., often involve altering critical coho salmon habitat parameters. Restoration activities may increase sediment levels, alter or divert stream flows, change channel geometry, reduce future LWD inputs, and block migration. If done properly, many of these impacts will be temporary in nature (e.g., increased sediment levels) and habitat condition will eventually improve. If improperly planned and executed, restoration activities can provide only temporary improvements ('band-aids') or, in the worst cases, actually degrade coho salmon habitat (National Research Council 1996). For example, a riparian tree harvest that would result in less shade or potential LWD recruitment may be a serious concern where current conditions are degraded with respect to water temperature and instream LWD. Placing stream weirs in a channel that is rich in sediment deposits may result in stream-bank scour and channel shifting. In order to conserve coho salmon, restoration activities that involve management within or adjacent to watercourses should not be proposed as part of a timber harvest unless an adequate watershed assessment has shown them to be necessary.

The existing protocol for placing LWD into streams (ODFW and ODF 1995) helps guide project managers in the use of appropriate methods of doing so, but the question of where to do such placement while ensuring future LWD recruitment remains. Currently the Oregon Forest Practice Rules require the basal area target to be reduced by up to 24% for LWD placement. This could greatly reduce LWD recruitment at a specific site, depending on how much the riparian stand is depleted to provide LWD pieces. Trees cut for instream placement should not come from the inner RMZ, and should be removed from the outer RMZ only if the stand is well stocked and the individual trees would likely not naturally fall in the stream. Without a watershed-scale analysis of current conditions and potential LWD recruitment—similar to the method for riparian wood assessment in the Washington Watershed Analysis Manual—it would be difficult to select appropriate sites for instream LWD placement. For example, pieces of woody debris may be placed in stream segments that are not responsive to wood inputs or that may require specifically large-sized pieces of LWD to function (Montgomery et al. 1996).

Another example of restoration is beaver management. This may involve maintaining or improving water and vegetation conditions to provide good beaver habitat or reducing conflicts between beavers, road drainages, and fish passage and perhaps even relocating animals to more favorable habitats (USDA 1986, Finnigan and Marshall 1997).

6. Monitoring and Adaptive Management

Baseline Conditions

It is necessary to have good knowledge of baseline conditions in order to assess the degree to which current watershed, riparian, and instream conditions are properly functioning, and determine the likely impacts of a proposed action upon fish or wildlife. Some baseline conditions are known for many segments of some fish-bearing streams, but there are generally not characterized at the watershed and basin scales in western Oregon.

The Oregon Watershed Assessment Manual (currently under development) is designed to guide local citizen groups in selecting areas in which to improve water quality and restore fish habitat. The assessment is diagnostic rather than prescriptive, and may be a useful way to prepare an indicator of watershed health. The watershed condition evaluation is based on assessments of the following: Fish barriers; distribution and quality of fish habitats; sediment sources; riparian conditions (shade, LWD recruitment potential, and instream LWD conditions); water quality; water uses; and hydrologic condition. The draft manual is currently being reviewed and is expected to be field- tested before spring 1998.

Compliance or Implementation Monitoring

Another step in monitoring is assessing whether management measures are actually implemented as prescribed. Based on results from several Federal programs, Spence et al. (1996) recommends key elements for a successful compliance monitoring program:

> Foremost, implementation monitoring programs must be adequately funded and staffed by ecologists with experience in geomorphology, hydrology, soils, vegetation ecology, fisheries ecology, database management and GIS, and geography. Specific objectives, project specifications, and tracking criteria must be included in plans, and remote sensing and periodic site visits are essential. Information will be most useful if it is entered into a computerized database, using standardized streamlined forms, portable data recorders, or both. Periodic status and trend reports should be produced and the program should be technically re-evaluated every few years. The National Research Council (1996) concluded that many restoration projects failed because project specification were ignored, insufficient ecological knowledge was incorporated in the planning and installation, specific objectives and criteria for tracking and redirection were lacking, and pre- and post-evaluations were lacking.

The ODF is responsible for monitoring best management practice (BMP) implementation. Through the Rules and also through management on state forest lands, the ODF has implemented

BMPs to reduce adverse effects from individual actions and sites. However, the BMPs do not evaluate the appropriateness of a proposed action within the context of current watershed health, nor do they consider the synergistic and temporal effects of other individual actions in the watershed. Therefore, the BMPs' results must also be analyzed at the watershed-scale. This may either become part of a refined watershed analysis or a separate assessment of cumulative effects altogether.

According to the *Forest Practices Monitoring Program, Riparian Inventory Field Guide* (ODF 1997), a protocol has been developed, and sampling and analysis have been designed to guide the collection of field data for characterizing riparian and instream conditions across the seven forest geo-regions of Oregon. The primary goal of this project is to evaluate the effectiveness of the 1994 stream rules in terms of their ability to maintain stand basal area and stream shade, and the potential for LWD recruitment in the future. Apparently, 35 sites were sampled in 1997 and data are now being analyzed. Ideally, this would be part of an ongoing effort to periodically assess forest practice rule effectiveness at the same riparian sites over at least one harvest rotation.

The OCSRI mentions several voluntary measures to monitor surface erosion from roads. The extent to which these voluntary measures will actually be done is uncertain.

Any changes in the Forest Practices Rules resulting from this proposal should be monitored for compliance to ensure that the conservation measures are being implemented. Annual reports should include: Numbers and acreage of harvest units adjacent to or within riparian and landslide-prone areas; miles of road constructed or reconstructed that are adjacent to or within riparian and landslide-prone areas; number of sites field-checked for slope stability; numbers and acreage of limited practices; numbers and mileage of comprehensive road plans completed; numbers of stream crossing upgrades—with mileage of any improvement in fish passage; and, numbers and mileage of roads relocated away from riparian or landslide-prone areas.

Another part of implementation monitoring is to teach field personnel how to put measures into practice and understand the rationale behind those measures. This approach may involve field guides, onsite training, pre-work review after floods and storms, post-project field reviews, and practitioner workshops.

Effectiveness Monitoring

This type of monitoring examines whether project compliance maintains or improves habitat conditions and salmonid populations. Usually the term is limited to evaluating individual management practices rather than the total effect of a set of practices. Therefore, effectiveness monitoring designed to answer questions about cumulative watershed effects would need to be designed specifically for that scale and purpose. See discussion of this issue in section VI.E.

Effectiveness monitoring is structured around key questions that are carefully constructed to assess certain management measures' effects upon specific fish habitat parameters (based on a biological objective). Typical parameters are riparian forest (stand ages, stand species composition, degree of canopy); water quality; channel characteristics (geomorphic type, widths, depths, gradient, surface area, pool depths, pool location, pool frequency, substrate conditions, bank conditions); floodplain features (presence of side channels, associated terrace tributaries, extent of altered floodplains); and large woody debris (number of pieces, size category, tree species, shape, decay category, location, relation to pool).

Specific key questions are selected to enable future managers to meet ecological objectives and regulations or design improved management. Specific triggers, on which adaptive management is based, may frame some key questions. For example, Is the density and composition of riparian forest stands (measured every 10 years) contributing to properly functioning condition of the riparian and instream habitats in basin X?

The ODF also proposes to monitor the effectiveness of current forest practices regarding management related landslides. "While such an effort is long overdue, and in great part unnecessary because of the extensive amount of previous work that has shown road construction and timber clearing practices to greatly accelerate landslide rates, more study of a complex issue has rarely done harm. Conversely, no amount of study can substitute for actually doing something to address the known cause of a problem" (pers. comm., D. Montgomery, University of Washington, Seattle, WA, 1997).

Results stemming from effectiveness monitoring of the OCSRI forest practice measures should be reported about every three to five years and should be used to guide the periodic management measure evaluations.

Research and Validation Monitoring

This monitoring element includes gathering more information on species or habitats of concern, testing the critical assumptions on which management is based, and gaining the understanding needed to refine management decisions. Strictly speaking, validation monitoring is done to evaluate the cause and effect relationships between habitat conditions and management measures and the biota these measures are intended to benefit.

Examples of research topics are: Determine how to design and manage riparian buffers that maintain wind-firm streamside forests; determine how to safely harvest timber on hillslopes with high landslide potential; determine when conditions necessitate buffers along small seasonal non-fish-bearing streams; and determine how to design and manage such buffers. Another set of research topics are the Benchmark Analyses that need to be done to validate the assumptions and analytical procedures used in watershed analysis. (See section VI. D. for more details.)

Monitoring to validate the expected biological response of the forest practice measures should be based on a collaborative synthesis of ongoing studies by a variety of land management groups and regulatory agencies. Monitoring to validate the scientific basis of watershed analysis, i.e., the Benchmark Analyses (see section VI.D.), should occur before watershed analysis procedures are widely adopted. Further, there should be a continuing commitment to conduct Benchmark Analyses and adjust analytical procedures and management measures as necessary.

Adaptive Management

Adaptive management is an approach that incorporates various levels of monitoring to allow actions to move forward in the face of some uncertainty regarding consequences. Adaptive management allows ongoing modifications of management practices in order to respond to new information and scientific developments. In some cases, the "new information" may include provisions for specific triggers or thresholds that are the subject of monitoring.

Adaptive management is composed of three elements: (1) An initial program design that incorporates conditional statements, i.e., "if A, then B;" (2) monitoring, usually for effectiveness, to determine an action's impact; and (3) specified changes in operations or management measures in response to new information. In addition, a dispute resolution procedure may need to be provided.

Generally, adaptive management triggers must be specified as part of the initial set of management measures (or the process for establishing triggers must include a schedule for their development). If a trigger is specified in the initial screening process (e.g., allowing best available scientific and commercial data to dictate the nature of a management change), then monitoring can be designed to answer that question, and monitoring results would allow managers to redesign the process to incorporate the best data. For example, a trigger may be established that for a particular process of screening projects sites to identify high-hazard landslide-prone areas, the best available scientific and commercial data will be used where this data would reasonably increase the accuracy of the screening. As monitoring indicates a need to improve screening accuracy, and better knowledge become available, then managers would be obligated to improve the screening process.

Triggers for adaptive management need to be developed collaboratively with land managers and regulators. For example, the results of two consecutive periods of monitoring for compliance or effectiveness may show that forest practices are having an adverse effect on habitat conditions related to forest practices. This would trigger a review and adjustment of relevant measures aimed at reversing the adverse trend. Subsequent monitoring would show whether further adjustments were needed.

Another example of a trigger would be to experimentally test a previously untested assumption within watershed analysis. As the results of a Benchmark Analysis provide a new (tested) assumption upon which to build an analytical procedure for watershed analysis, then the invalid procedure would be dropped and the valid procedure adopted. Periodic review, say annually, and adjustment of each component of watershed analysis will enable adaptive improvement of the process.

B. Technical Rationale for the Proposed Management Measures and Definitions

Riparian Management.

Vegetation in the aquatic protection zone greatly influences the biological and physical processes that provide freshwater habitat for coho salmon and other salmonids. These processes include shade and cover, water quality and flow routing, the aquatic food web, sediment routing and composition, stream channel bedform and stability, and linkages to the floodplain (Beschta 1991; Gregory et al. 1991; Schlosser 1991; Sullivan et al. 1987). Riparian vegetation produces habitat for coho salmon—depending on the position of the stream reach in the fluvial network (Vannote et al. 1980). Forestry practices have the potential to affect freshwater habitat for salmonids by changing the characteristics of, and inputs from, streamside vegetation (Gregory et al. 1987).

Shade is an important product of riparian vegetation—it moderates water temperatures. Reducing shade increases water temperatures, which can reduce the success or survival rate of coho salmon during adult upstream migration, downstream smolt migration, and juvenile rearing. Increased water temperatures can obstruct adult migration and limit spawning success; trigger early juvenile outmigration—resulting in decreased survival rates (Beschta et al. 1987); change juvenile sheltering behavior (Taylor 1988); reduce disease resistance; and increase metabolic requirements (Beschta et al. 1987). Riparian vegetation also provides the majority of the energy for the food web in heterotrophic systems by providing the allocthonous inputs that support aquatic macroinvertebrates (Cummins et al. 1983) and influencing the rate of nutrient spiraling (Newbold et al. 1982) under stable, persistent conditions (Gregory et al. 1987).

Large woody debris (LWD).

This is an important component of freshwater salmonid habitat. It is provided to stream systems by hillslope processes such as debris flows (McGarry 1994), but it largely comes from adjacent and upstream riparian vegetation. Woody debris regulates sediment and flow routing, influences stream channel bedform and stability, and provides hydraulic refugia and cover within stream systems (Bilby 1984; Gregory et al. 1987; Hogan 1987; Keller and Swanson 1979; Keller et al. 1995; Lisle 1983; Nakamura and Swanson 1993; Sedell and Beschta 1991). It thus influences the formation of the spatial template within which coho salmon exist (Sullivan et al. 1987; Vannote et al. 1980). This template includes pool-riffle bedforms, backwater and edgewater habitats, and cover that provides adult spawning and holding habitat, juvenile summer and overwintering habitat, and refugia habitat from predation and high water velocities (Bisson et al. 1992; Sullivan et al. 1987). Reducing the quantity or quality of any of these habitats may reduce coho salmon survival (Bisson et al. 1992; Hicks et al. 1991; Rhodes et al. 1994). Woody debris also plays a key role in retaining salmon carcasses (Cederholm and Peterson 1985), a major source of nitrogen and carbon in stream ecosystems (Bilby et al. 1996). Forest management activities in the aquatic protection zone have the potential to change the distribution, size, and abundance of LWD in streams (Hicks et al. 1991; Ralph et al. 1994, McHenry et al. in-press) and to simplify stream channels (Bisson et al. 1992).

A riparian area's ability to provide these essential habitat requirements decreases in proportion to increasing distance from the streambank. Air temperature and relative humidity are not significantly altered if buffer strips in old-growth stands exceed 30 meters (100 feet) in width (Chen et al. 1995; Ledwith 1996). Both McDade et al. (1990) and Van Sickle and Gregory (1990), reported that more than 90% of the instream wood identified as coming from adjacent riparian sources came from within 200 feet from the channel, approximately one site-potential tree height for Douglas fir. Streambank stability is maintained within a distance of one-half to one site-potential tree height (Sedell and Beschta 1991). Nutrient input and retention, litter fall (Gregory et al. 1987), and shade functions (Beschta et al. 1987) also occur within 100 to 200 feet of the channel. At distances greater than approximately one site-potential tree height, the ability of riparian vegetation to provide these essential habitat requirements declines sharply. The NMFS believes that within this riparian area, forest management activities may change stream temperatures, increase sediment levels, alter the species composition and abundance of macroinvertebrates, destabilize streambanks, reduce in-stream structural complexity, and alter peak and base flows. Furthermore, the presence and use of roads within this area may contaminate water, create migration barriers, reduce stream shading, reduce large wood recruitment to the stream, and increase sediment levels. These impacts may harm coho salmon.

Timber harvest occurring upstream of coho salmon habitat may also adversely affect the species. Perennial reaches upstream of coho salmon habitat contribute to instream temperatures in the larger reaches downstream (Beschta et al. 1987). The loss of riparian vegetation above coho salmon habitat may increase instream temperatures downstream. Upstream reaches, including intermittent and ephemeral streams, carry sediment, nutrients, and woody debris down to salmonid habitat. The quality of coho salmon habitat is determined, in part, by the timing, speed, and amount of organic and inorganic materials transported downstream from reaches above salmonid habitat (Chamberlin et al. 1991). Management activities that increase sediment inputs upstream of coho salmon habitat may impair important habitat parameters such as deep pools and clean spawning gravels. Woody debris in upstream reaches regulate sediment and organic debris inputs downstream; the loss of LWD in these upstream reaches may increase sediment and debris transport into salmonid habitat. The loss of LWD in these upstream reaches also means there will be less LWD available to move downstream into coho salmon habitat (Bisson et al. 1987).

Studies examining riparian zone wood recruitment have purposely avoided stream reaches recently affected by landslides movement or acknowledged the inability to account for the origin of about half the wood found in small stream channels (VanSickle and Gregory 1990; McDade et al. 1990). Approximately 48% of the wood in mainstem Cummins Creek, a coastal Oregon wilderness stream, came from upstream sources, delivered primarily by debris torrents (McGarry 1994).

Timber management activities in riparian areas above coho salmon habitat that provide for adequate canopy cover, streambank stability, and allocthonous inputs (woody debris, litter, and nutrients) will likely avoid adverse impacts. Streambank stability is maintained by a dense, live root mass, through the contribution of root strength to bank stability declines at distance greater than one-half the crown diameter of a stream-side tree (FEMAT 1993). Activities in the upstream reaches of a watershed that significantly increase the amount of sediment delivered downstream may adversely affect coho salmon in those reaches (Frissell et al., 1997)

<u>Road Management.</u>

Roads can adversely affect coho salmon habitat by increasing sediment loads, altering channel morphology, destabilizing streambanks, modifying the hydrological drainage network, creating barriers to movement, and increasing the potential for chemical contamination (Furniss et al. 1991). Construction of a road network can greatly accelerate erosion rates in a watershed (Beschta 1978; Gardner 1979; Haupt 1959; Reid and Dunne 1984; Swanson and Dyrness 1975; Swanston and Swanson 1976). Cederholm et al. (1981) reported that the percentage of fine sediments in spawning gravels increased above natural levels when more than 2.5% of a basin area was covered by roads. Roads and other areas of surface disturbance continually erode fine sediments—providing a large source of sediment to streams (Swanston 1991). Roads and related ditch networks are often connected to streams, thus providing a direct conduit for the sediment. In steeper terrain, road construction may trigger mass soil movements that deliver large amounts of sediment directly into streams (Furniss et al. 1991). Improperly maintained roads may fail years after construction (Furniss et al, 1991). Roads built near watercourses can deliver sediment to streams, destabilize streambanks, and constrain the natural migration of the stream channel. Road networks can affect hillside drainages by intercepting, diverting, and concentrating surface and subsurface flow, and increasing a watershed drainage network (Hauge et al. 1979; Wemple et al. 1996). This can change peak and base flows and may trigger mass wasting events. Stream crossings can restrict channel geometry and prevent or interfere with adult and juvenile coho salmon migration (Furniss et al. 1991). Crossings can also be a source of sedimentation, especially if they fail or become plugged with debris (Furniss et al. 1991; Murphy 1995).

Forest Chemicals.

Used in forest management activities, these include pesticides, herbicides, insecticides, dust abatement sprays, and fire retardants. They can enter streams directly or be carried by runoff water. All of these chemicals can affect salmonids through their direct toxicity or by altering primary and secondary production and influencing the amount and type of food available (Norris et al. 1991). When chemicals are transported near or across streams, a chemical-spill hazard exists (Furniss et al. 1991).

Potentially unstable areas prone to landslides.

Mass wasting is a part of a watershed's natural disturbance regime and is sometimes beneficial to coho salmon—providing coarse sediment and debris into stream systems (Reeves et al. 1995). Nonetheless, to protect coho salmon, the potential for *increasing* mass failure rates (i.e., landslides) above natural levels should be minimized. Furthermore, if mass movement does result from timber management, the likelihood of soil and debris entering streams should be eliminated. This can be accomplished by carefully delineating and marking potentially unstable areas and limiting or avoiding timber management activities there that could potentially deliver sediment to a stream.

Much of the landscape along the Oregon Coast is characterized by erodible soils and parent material, high precipitation, and steep slopes. This combination leads to a landscape dominated by mass movement processes (Chatwin et al. 1994) and high levels of sediment in many streams. Streams in the Oregon's Coast Range for example, annually export 53-102 metric tonnes of sediment per km^2 (Hawkins et al. 1983). Mass failures are a major source of stream sediment. In sediment-poor streams, mass wasting may bring in needed rubble and woody debris (Everest and Meehan 1981). Usually, mass movements bring sediment into higher-gradient channels which then carry it downstream into deposition zones—potentially impairing rearing and spawning functions (Chamberlin et al. 1991). Depending on the amount of material transported, the velocity, and the channel gradient, mass failures that deliver sediment to streams can increase sediment loads, partially or completely block channels, and scour streambeds (Swanston 1991). These habitat modifications may significantly impair coho salmon migration, spawning, feeding, and sheltering.

Mass movement frequency has been strongly linked to land management type and intensity (Chamberlin et al. 1991; Rood 1984). Timber management activities that undercut hillslopes, increase surface weight, alter surface or subsurface flows, or reduce root strength strongly influence slope and soil stability (Chatwin et al. 1994). Most management-related mass wasting events are associated with roads and their drainage systems, but some occur on open slopes after logging activities (O'Loughlin 1972). Coho may be affected if mass failures deliver fine sediment to their salmon spawning habitat or block or impair migration. In a particular stream segment that currently lacks coarse sediment and LWD, a landslide that delivers these inputs may have a beneficial long-term effect on fish habitat (Gregory et al.1987). Other stream segments that are currently carrying high levels of sediment may not respond favorably, particularly when timber harvest has reduced LWD loading in the landslides.

Definitions—For the purposes of these measures the following definitions should be used:

Bankfull stage: The point on a streambank at which overflow into the active floodplain begins. The active floodplain is a flat area adjacent to the channel constructed by a stream and which is overflowed at a recurrence interval of about 1.5 to two years (Dunne and Leopold 1978). If the floodplain is absent or poorly defined, other indicators may identify bankfull. These include the heights of various depositional features, changes in vegetation or slope, topographic breaks along the bank, a change in the particle size of bank material, undercuts in the bank, stain lines, and the lower extent of lichens on boulders. Deposits of organic debris are seldom good indicators of bankfull. Harrelson et al. (1994) provides a field guide for determining bankfull. Field determination of bankfull should be calibrated to known stream flows to avoid errors.

Bankfull depth: The vertical distance between the channel bed in the thalweg and the water surface at bankfull stage.

Channel migration zone: The area a stream is expected to occupy in the time period it takes to grow a tree of sufficient size to geomorphically function in the channel. Spatially, this area generally corresponds to the modern floodplain, but can also include river terraces subject to significant bank erosion. An acceptable method for delineating the CMZ at a particular site involves delineating either the flood-prone area or the approximate 100-year floodplain, whichever is greater. For larger streams, the 100-year floodplain may already be available on U.S. Army Corps of Engineers or county flood hazard maps. A field method for delineating the flood-prone area can be found in "*Applied Fluvial Morphology*" (Rosgen 1996). The flood-prone area is approximated by the area that would be inundated by stream flows of two times the bankfull depth. The objective of identifying the CMZ is to ensure that the stream has a protective buffer in the future, even if the stream were to move away from its present location.

Inner gorge: These physiographic features that occur along valley side-slopes adjacent to stream channels. In an inner gorge, slopes (generally >65%) that are adjacent to the stream channel are steeper than those further up slope. In most cases, a clearly defined break-in-slope separates the steeper inner gorge slopes from the more moderate, higher hillslopes. In all cases, a recognizable break-in-slope occurs at the upper limit of the inner gorge. Inner gorges therefore occur on segmented hillslopes that have a valley-within-valley cross section (Kelsey 1988).

Site-potential tree: A tree that has attained the average maximum height of the tallest dominant trees within 100 years, given the site conditions where it occurs. For second-growth conifers in riparian areas, these heights range from about 130 feet to over 200 feet. To determine site-potential tree height, NMFS recommends reviewing"*The yield of Douglas fir in the Pacific Northwest*" (McArdle and Meyer 1961).

Wet weather conditions: These occur when two inches of precipitation accumulates within a 24-hour period. Other indicators of wet weather conditions include water flowing in inside ditches, displacement of fines causing a visible increase in turbidity in inside ditches or natural streams, and precipitation generating overland flow off of roads.

Stream type definitions:

Fish-bearing streams—those streams that currently or historically have fish continuously or seasonally present (or have the potential to do so). This includes having the habitat to sustain fish migration, spawning, or rearing. Some small streams with seasonal flow may support fish at times of continuous or discontinuous surface flow.

Perennially flowing non-fish-bearing streams—all streams with generally year-round surface flow. There may be short segments without continuous surface flow in some dry periods. Typically these streams provide aquatic habitat for non-fish aquatic species, including invertebrates. These streams include many streams that enter directly into fish-bearing streams, as well as all wetlands, seeps, and springs connected by perennially flowing surface water to fish-bearing streams.

Seasonally flowing non-fish-bearing streams—waters that flow intermittently throughout the year within a defined channel. During periods without surface flow, generally no aquatic life would be present, although sub-surface flow may support aquatic life. These include any definable channel, including gullies and swales, that are capable of transporting sediment, water, or woody debris to perennially flowing streams, especially during high-water flow conditions.

Table 2. Comparison of riparian and watershed protection afforded by the current Oregon Forest Practice Rules (Rules), plus the voluntary measures of the OCSRI, and the changes proposed by the National Marine Fisheries Service (NMFS).

OREGON FOREST PRACTICE RULES PLUS OCSRI ENHANCEMENTS	PROPOSED CHANGES BY NMFS
Riparian Management Areas (RMA) along all streams. Intended to provide riparian function by mid-rotation (25 years) and allow repeated timber harvest every 50 years, while maintaining a minimum basal area.	**Riparian Management Zones (RMZ)** along all streams. Intended to allow limited timber management aimed at growing properly functioning riparian forests. After the riparian stand attains the desired conditions, then no further timber harvest is allowed.
RMAs are measured from annual high water level of the main channel or connected side-channels.	RMZs are measured from outer edges of a channel migration zone (CMZ), where present, in order to provide floodplain function.
RMAs along all streams are measured along the slope. No correction for steep sideslopes.	RMZs are measured horizontally to correct for steep slopes, and in order to account for greater function of steep sideslopes.
Fish-bearing streams: RMAs are 50 to 100 feet wide, depending on stream size. Widths are based on economic and operational considerations.	RMZs are functionally based and are as wide as the height of a 100-year site-potential tree (approx 150 to 200 feet on OR coast).
Inner RMA is 20 feet, based on shade provisions.	Inner RMZ is 30 feet, based on function of root strength for streambank stability. Other riparian functions such as shade, litter-fall, and LWD recruitment would be partly met within the inner RMZ.
Hardwood conversion allows harvest of existing conifers and durable hardwoods (e.g., myrtle and maple) within an RMA. Where red alder is harvested, these other trees should not be removed.	Hardwood conversion would not include harvest of existing conifers within RMZ, to maintain existing conifer function. Hardwood conversion sites would be selected within context of watershed.
Objectives of 80 to 200-year riparian forest would be partly met by providing RMA widths with 72% to 92% of the potential riparian source conifer trees for LWD recruitment. Small fish-bearing streams have the least number of trees for shade or LWD sources.	Objectives of 80 to 200-year riparian forest would be met by providing RMZ widths with nearly 100% of the potential riparian source trees for LWD recruitment for all fish-bearing streams. Shade goals would be met along all small fish-bearing streams.
The mid-rotation (25 years) target for conifer basal area would be 27% to 73% of potential LWD recruitment for OR Coast. No assurance that retained trees would be allowed to grow and become LWD.	Wider RMZs and conservative management provide high levels of potential LWD recruitment for OR Coast. Outer RMZ managed to grow large trees while maintaining adequate tree stocking. High assurance that retained trees would be allowed to grow and eventually become LWD.

OREGON FOREST PRACTICE RULES PLUS OCSRI ENHANCEMENTS	PROPOSED CHANGES BY NMFS
Perennially-flowing non-fish-bearing streams: RMA widths are 0 to 70 feet, depending on stream size.[6]	RMZs would be the width of two-thirds the height of a 100-year site-potential tree (approx 100 to 135 feet in OR coast).
Inner RMA of retained trees is 0 to 20 feet, depending on stream size.	Inner RMZ is 30 feet, based on function of root strength for streambank stability. Other riparian functions of shade, litter-fall, and LWD recruitment would be partly met within the inner RMZ.
Rules' objective of functioning riparian forest would be partly met by providing RMA widths with 0% to 83% of the potential riparian source trees for LWD recruitment. Small non-fish-bearing streams have negligible potential trees for shade and LWD sources.	Objectives of functioning riparian forest would be met by providing RMZ widths that would provide about 80% of the potential riparian source trees for LWD recruitment for perennial non-fish-bearing streams. Riparian function would be met for small streams, which are by far the most numerous.
The mid-rotation (25 years) target for basal area would be 0% to 30% of potential LWD recruitment for OR Coast. No assurance that retained trees would be allowed to grow and become LWD.	Wider RMZs and conservative management provide moderate to high levels of potential LWD recruitment for OR Coast. Outer RMZ managed to grow large trees while maintaining adequate tree stocking. High assurance that retained trees would be allowed to grow and become LWD.
Seasonally flowing non-fish-bearing streams: "operators are encouraged whenever possible to retain understory vegetation, non-merchantable trees, and leave trees within clearcuts along all other small type N streams within harvest units."	RMZs would be the width of half the height of a 100-year site-potential tree (approx 50 to 100 feet in OR coast). This may be adjusted on a site-basis with site information.
No inner RMA of retained trees.	Inner RMZ is 0 to 30 feet, based on slope and functions of root strength and sediment filtering. Other riparian functions of shade, litter-fall, and LWD recruitment would be partly met.
No commitment to provide riparian trees for shade or LWD recruitment. Rules' objective of functioning riparian forest would likely not be met.	Objectives of functioning riparian forest would be met by providing RMA widths that would provide approx 40% of the potential riparian source trees for LWD recruitment for seasonal non-fish-bearing streams. Outer RMZ managed to grow large trees while maintaining adequate tree stocking.

[6] Protection measures for Type 4 waters in the Washington Dept Natural Resources HCP are close to what should be implemented in Oregon on non-Federal lands. These measures are: A 100-foot riparian management zone with inner 25-foot no-harvest zone, and minimal, selective timber harvest that focusses on restoration in the outer 75 feet. The width of the zone is measured horizontally from the stream, starting at the outer edge of the 100-yr floodplain.

Oregon Forest Practice Rules Plus OCSRI Enhancements	Proposed Changes by NMFS
Landslides: There is no provision under the Rules to prohibit an activity on a high-hazard site. Protocols for identifying potentially unstable slopes are not spelled out. Current management may not meet the Rules' objective of maximum practical protection to maintain water quality and fish habitat.	Use preliminary and site screening of all project areas to identify potentially unstable slopes, runout paths and depositional areas of potential debris flows. A process is suggested to prescribe site-specific measures for protecting potentially unstable slopes. Sites with a high risk of failing and delivering to a stream would have trees retained to maintain root strength and eventually supply LWD to streams when failures occur.
No commitment to protect **potentially unstable slopes** adjacent to streams. These areas are sources of both sediment and LWD to streams.	The inner RMZ would retain trees on potentially unstable slopes next to all streams.
Surface erosion from roads: Rules require adequate maintenance for active roads, but not necessarily for inactive roads. Monitoring by ODF reported in 1996 that 30 to 40% of surveyed forest roads were found to be delivering sediment to streams. Rules direct correction of identified problems but are not easily used to control operations before erosion occurs. Voluntary commitment by industrial forest landowners to inventory and repair surface erosion problems.	Preparing road management plans is strongly encouraged to comprehensively address roads across an ownership or watershed. Also, specific measures address many ways to minimize and avoid sediment delivery from existing and newly constructed roads. Forest managers would be directed to cease operations and take corrective action when the likelihood for sediment delivery exits. User handbooks from other areas are offered as guidance to road managers.
Hydrologic function is not addressed by BMPs for roads or clearcut harvest.	Hydrologic function is addressed by specific road management measures.
Fish passage is not assured for culverts in use before Sept 1994. Voluntary commitment by industrial forest landowners to inventory and upgrade passage problems.	Fish passage is met for all forest road crossings.
The limits of fish distribution are not field surveyed for all small streams. An unknown number of small fish-bearing streams are misidentified and do not receive protection under the Rules. Voluntary commitment by industrial forest landowners to survey forest streams for fish distribution.	All sites potentially affected by ongoing and proposed forest activities would be surveyed for fish presence, and appropriately protected.
Watershed Assessment draft methods are intended to enable watershed councils to select sites to restore or protect. No procedure for watershed analysis (WSA) has been developed. Some landowners would conduct their own WSA.	An expedited WSA is proposed to guide landowners to manage individual sites with an understanding of watershed-scale ecological processes.
Cumulative Watershed Effects are not assessed. Assumption that correctly implemented Rules will avoid adverse cumulative effects.	The expedited WSA will enable proposed projects to be assessed on a watershed scale. Project design and land management based on improved understanding will address and minimize cumulative watershed effects.

C. Other Approaches

Habitat conservation plans (HCPs) that address long-term salmonid survival on industrial forest lands are designed to provide properly functioning habitat conditions—thereby ensuring healthy watersheds and riparian areas. They also give landowners long-term management clarity and certainty.

Specific HCP conservation measures focus on attaining mature forest conditions in riparian areas, minimizing sediment input to streams, protecting and recovering floodplain functions, and protecting water quality during timber management operations. Each HCP has a different blend of conservation measures that reflect landowner operations, geographic limitations, and baseline environmental conditions.

Over the past three years, NMFS approved four HCPs for industrial forest lands in the Pacific Northwest, the approval took into account measures to minimize and mitigate potential impacts on salmonid habitat and monitoring measures for compliance and effectiveness (Murray-Pacific, Plum Creek Timber, Port Blakely Tree Farms, and Washington Department of Natural Resources). It is difficult to directly compare the components of these HCPs with each other and with NMFS' current proposal; this is due to differences in scale, baseline environmental conditions, data availability, and other factors that affected the outcomes of the HCP negotiations.

The specifics of two recently approved HCPs are detailed in the following text. Although the plan area sizes, baseline conditions, geographies, and management strategies differ between the two examples, the approaches to attaining properly functioning habitat condition are the same: the intent is to grow mature riparian trees and minimize adverse forestry impacts.

1. <u>Washington Department of Natural Resources (DNR) Habitat Conservation Plan (HCP)</u>

DNR HCP Objectives

The measures described in the HCP address habitat requirements and minimize, mitigate and monitor the impacts of timber-related and non-timber-related activities on western Washington runs of anadromous salmonids. The HCP proposes to apply a riparian conservation strategy to the five west-side planning units. This strategy proposes to maintain or restore salmonid habitat and to help conserve other riparian and riparian-obligate species. There is a related strategy for the Olympic Experimental Forest that is not prescriptive, but rather, objective-oriented (see section below).

DNR HCP Plan Area

The HCP covers approximately 1,388,000 acres of DNR-managed trust lands. These lands range from scattered, isolated parcels under 40 acres to large contiguous blocks in excess of 110,000 acres. The majority of the forest on these lands is conifer, with less than 10 percent hardwood in upland stands. Most DNR-managed lands have been logged at least once in the last 100 years. Riparian areas in the HCP plan area include 133,500 acres, or about 12% of the westside HCP acres outside the Olympic Experimental Forest. Nearly 20% of the riparian areas are hardwood stands, about 10% are conifer stands older than 100 years, and the remainder consists of conifer stands less than 100 years old.

DNR HCP Environmental Baseline

The environmental baseline for the anadromous salmonid species that inhabit the area covered by the HCP includes the past and present effects of all Federal, State, and private activities in the action area, as well as the anticipated effects of all proposed Federal projects in the action area that have already undergone section 7 consultation, and the effects of State or private actions which are contemporaneous with the consultation in progress (50 C.F.R. 402.02).

Stream Types 1 through 5 are those defined by the Washington Forest Practice Act (RCW 76.09) under WAC 222-16-030. Fish-bearing streams include Types 1, 2, and 3: Type 3 streams are the smallest in size and fish use them less. Type 4 streams are generally perennial (but sometimes have seasonal flow) with channel widths of two to five feet, and water quality factors important for fish-bearing waters. All other streams (or seeps) are Type 5, typically they have only seasonal flow.

Although the HCP presented no information on specific studies of the effects of historic logging practices on the present conditions of riparian and salmonid habitat in the Plan Area, the types and extent of likely effects have been well documented for similar landscapes that were logged in the same period (Murphy 1995). Channels were simplified by channelized landslides and splash damming that removed in-stream structure and pools. Fish passage was inadvertently blocked in some streams by road and railroad fills. Riparian trees that would have contributed shade, bank stability, and a steady supply of LWD to streams were largely removed by extensive logging in the riparian zone.

Thus, for the purposes of this analysis, riparian and aquatic habitats under the environmental baseline will be assumed to be “at risk” or “not properly functioning.”

Olympic Experimental State Forest (OESF)

The DNR's objectives for the riparian conservation strategy in the OESF take a landscape approach to protecting and restoring the area's aquatic, riparian, and wetland systems and maintaining and restoring those factors which affect this system. These factors include the physical integrity of stream channels and floodplains, the natural disturbance regime of the system, the sediment regime, and the development of information about this dynamic system and its maintenance and restoration in commercial forests. Specifically, the riparian conservation strategy in the OESF seeks to meet the following objectives:

1. Maintain or help restore the composition, structure, and function of the aquatic, riparian, and wetland systems that support aquatic species, populations, and communities.

2. Maintain and help restore the physical integrity of stream channels and floodplains.

3. Maintain and help restore the water quantity, quality, and timing in which these stream systems evolved (i.e., the natural disturbance regime of these systems).

4. Maintain and help restore the sediment regime in which these systems evolved.

5. Develop, use, and distribute information about maintaining and restoring aquatic, riparian, and associated wetland ecosystem processes in commercial forests.

To help meet these objectives, the DNR will provide the following protective mechanisms concerning riparian habitats within the OESF:

1. The DNR will use interior-core buffers to minimize disturbance of unstable channel banks and adjacent hillslopes, thus protecting and aiding the natural restoration of riparian processes and functions. Harvesting can occur within the buffers as long as the activities are consistent with the conservation objectives. While buffer widths will be determined on a site-specific basis, using landscape-level field evaluations, the average widths for stream Types 1 and 2 is 150 feet, on stream Types 3 and 4 it is 100 feet, and Type 5 waters will be buffered following a 12-step watershed-assessment procedure described in the HCP. Buffer widths are measured horizontally, outward from the channel migration zone (i.e., 100-year floodplain).

2. The DNR will use exterior buffers to protect the interior-core buffers from winds. Exterior buffers will also help maintain channel-floodplain interactions, moderate the riparian microclimate, shield the inner core from the physical and ecological disturbances of forest practices on upslope sites, and maintain diverse habitat for riparian-dependent species. The average width of the exterior buffers on Types 1, 2, and 3 is 150 feet, on

Types 4 and 5 it is 50 feet. The DNR anticipates that exterior buffers will be applied on approximately 75% to 85% of the riparian areas in the OESF.

3. Potential sediment introductions from management will be minimized by placing harvest restrictions near Type 5 waters flowing on unstable slopes where there is a high risk of mass wasting. Sediment will also be minimized by developing and implementing a comprehensive landscaped-based road network that would minimize active road density, prioritize roads for decommissioning, upgrading, and maintaining, and identify fish blockages caused by stream crossings and prioritize them for retrofitting or removal.

4. The DNR will initiate a 12-step watershed assessment procedure to ensure that the objectives of the OESF riparian conservation strategy and timber management objectives will be met. Results from assessments of physical and biological conditions obtained from the regulatory watershed-analysis process (Washington Forest Practices Board 1994) will be used, where possible, in lieu of those assessments required in the 12-step process.

Elements of the DNR HCP

The DNR's general riparian conservation strategy for the westside planning units is to protect and naturally restore resources with a long-term effort to find management and conservation solutions through experimentation and active management. Specific riparian protection relies on watershed-level assessments of physical and biological conditions to determine the level of protection over long term. Interim management strategies and buffer-width guidelines are provided while assessments are being completed.

In addition to the HCP measures, the DNR will continue to participate in watershed analysis (in accordance with state Forest Practices Rules—Washington Forest Practices Board 1994). If watershed analysis indicates that public resources require a greater level of protection than that specified in the HCP, the measures developed (through watershed analysis) to provide this additional protection shall be implemented.

Proposed Conservation Measures To Avoid, Minimize, And Mitigate Take

Westside Planning Units

1. The DNR will use riparian buffers (RMZ) on both sides of stream Types 1, 2, 3, and 4 to address riparian functions that influence the quality of salmonid freshwater habitat. The RMZ consists of an inner riparian buffer (minimum 100 feet, or one site-potential tree height, whichever is greater, on stream Types 1, 2, and 3; 100 feet, on Type 4 waters); and an outer wind buffer (100 feet on Type 1 and 2 waters; 50 feet on Type 3 waters more than five feet wide) where

needed to protect the inner buffer. For the purposes of this HCP, the height shall be derived from standard site index tables, using 100 years as the age of a mature conifer stand. When determining the width of the buffer, the site productivity used in the derivation will be that occurring in upland portions of the riparian ecosystem for that particular site. The site index table used will be that corresponding to the dominant conifer species in the upland portion of the riparian ecosystem. This measure should result in average buffer widths between 150 and 160 feet.

The RMZs are measured as a horizontal distance from the 100-year floodplain. The 100-year floodplain is the valley-bottom area adjoining the stream channel that is constructed by the stream when it overflows at times of very high discharge (i.e. flooding associated with storms of a 100-year recurrence interval (Dunne and Leopold 1987).

No harvest will be allowed in the first 25 feet, "minimal harvest" will be around in the next 75 feet, and "low harvest" will be allowed in the remaining buffer more than 100 feet from the active channel margin. These measures (and their accompanying rationale) are described in Chapter IV of the HCP. The DNR and the Services will develop specific procedures for managing riparian areas after the HCP and IA have been finalized. The NMFS will use the matrix of pathways and indicators (NMFS, 1996) to help develop the riparian management strategy.

Timber harvest in the riparian management zones and wind buffers before agreement is reached on the long-term agency procedures will be subject to the following limitations:

a. In the 25-foot “no harvest” zone, only commonly accepted restoration activities may occur.

b. In the “minimal harvest zone,” “low harvest zone,” and “wind buffer,” partial harvests may occur that remove no more than 10% of the conifer volume or 20% of the hardwood volume or both per rotation.

The DNR may slightly increase timber harvest within the RMZ and wind buffers under the limits described in Section 4 of the HCP if agreement has not been reached between the agencies within three months of the Services receiving the proposed procedures.

It has been demonstrated that error in Stream Type classifications are quite common (Bahls and Ereth 1994). The DNR recognizes that incorrectly classifying streams as Type 4 or Type 5 (non-fish-bearing) waters could have significant adverse effects on salmonid habitat. In order to avoid such effects, a 100-foot wide riparian buffer was applied on both sides of Type 4 waters. Additionally, stream typing will be examined or verified in the field before harvest.

2. The DNR's Road Management Strategy will be implemented to: (1) Minimize further road-related degradation of riparian, aquatic, and identified species habitat; (2) plan, design,

construct, use, and maintain a road system that serves the DNR's management needs; and (3) remove unnecessary road segments from the road network. This strategy is detailed in Section IV of the HCP (DNR 1996). Comprehensive road maintenance plans will include annual inventories of road conditions; aggressive maintenance, stabilization, and access control to minimize management and environmental problems; and limits on road network expansion. The standards for new road construction and appropriate placement will be consistently applied and updated. The DNR will initially focus on improving roads in the more sensitive areas of a landscape—giving priority to locations on steep slopes with unstable soils and high precipitation, and locations within 100 feet of Type 1, 2, and 3 waters and wetlands. In order to keep new roads to a minimum, log yarding will be allowed through the harvest zone in the RMZ. Specific measures for this yarding (and any other management in the RMZs) will be developed by DNR and reviewed by the Services. Such management would be based on detailed, site-specific conservation objectives; sufficient monitoring would be included to ensure that the RMZs will continue to adequately provide the desired riparian functions.

3. With respect to stream Type 5 protection: (1) Those streams crossing unstable hillslopes will be protected (no timber harvest) to minimize potential for landslides and other mass-wasting activities; (2) those streams crossing stable ground will be protected where necessary to maintain important elements of the aquatic ecosystem; and (3) an aggressive, 10-year research program will study the effects on aquatic resources of forest management along Type 5 waters. At the end of 10 years, a long-term conservation strategy for forest management along Type 5 waters shall be developed and incorporated into the HCP.

4. Potential sediment introductions will be minimized by placing harvest restrictions near Type 5 waters flowing on unstable slopes and in areas with a high risk of mass wasting. Also a comprehensive landscape-based road network will be developed; it will identify fish blockages caused by stream crossings and prioritize their retrofitting or removal.

5. Adverse effects on salmonid habitat caused by rain-on-snow floods will be minimized by maintaining two-thirds of DNR-managed forest lands in a forest condition that is hydrologically mature with respect to rain-on-snow events. In addition, improved road management will decrease adverse effects on natural hydrologic function.

6. The DNR will monitor the HCP to determine whether its conservation strategies are implemented as written and whether that implementation results in anticipated habitat conditions. Implementation monitoring will document the types, amounts, and locations of forest management activities carried out on DNR-managed lands in the five westside and OESF HCP planning units. Research monitoring in riparian habitats will focus on determining how to design wind buffers, evaluating forest practices along Type 5 waters not associated with unstable slopes, designing timber harvest in riparian buffers and mass wasting areas, and developing basic information on the relationship between forest practices, riparian ecosystems, and basin hydrology.

Monitoring reports will be completed and submitted to NMFS and the USFWS by March 30 of each year. Details of this monitoring program appear in Chapter V of the HCP. Details of the monitoring plan will be developed by the interagency science team.

2. Port Blakely Tree Farms HCP

Port Blakely HCP Objectives

The HCP proposes a fully developed management scheme designed to avoid, minimize, and mitigate take of listed species. Furthermore, the HCP addresses all unlisted anadromous salmonid fish species in the Plan Area by taking into account their habitat requirements and minimizing, mitigating, and monitoring the impacts of the HCP on those fish species.

The HCP attempts to address structural attributes important to indigenous fish and wildlife, especially those attributes known to be limiting in managed forests in southwest Washington's Coast Ranges Physiographic Province. Prescriptive measures in the HCP are designed to increase the quantity, quality, and distribution of these habitat structures during the 50-year term of the HCP and permit, thereby conserving the species that use them.

The HCP is a commitment to schedule timber harvest in ways that gradually change the age and size distributions of the upland forests from the current relatively narrow range of older age classes to a wider variety of forest successional stages that will then be maintained by an even-aged clearcut harvest rotation of about 70 years. Riparian areas would be managed to maintain all the older riparian forest in the riparian management zones and eventually grow all the RMZs within the Plan Area to provide properly functioning riparian areas characterized by at least 50 large conifer trees/acre (>24 inches diameter), with a basal area greater than 150 $feet^2$/acre. Some riparian areas now dominated by hardwood trees may be converted to conifers, while it may be appropriate to maintain other sites as hardwoods for the long term.

Port Blakely HCP Plan Description

The 7,486 acre Plan Area — located in Pacific and Grays Harbor Counties, Washington — has been used for commercial timber production since the turn of the century; it will continue to be used as such under the proposed action. The surrounding hills are primarily corporately-owned commercial forest land; floodplains in the larger valley bottoms are smaller, privately-owned tracts, and are used for forestry and agricultural production (hay and pasture land). Streams draining the Plan Area are mostly tributary to the North River, which empties into the north end of Willapa Bay — an enclosed, shallow estuary situated 5-20 miles north of the mouth of the Columbia River.

There are currently no threatened or endangered anadromous salmonids species in the Plan Area, but there are three at-risk species that are known to exist in, or have a high likelihood of occasionally using, the aquatic habitat types existing on the Plan Area. Based on a recently updated field inventory of streams in the Plan Area, there are approximately 25.5 miles of anadromous fish-bearing streams on the Plan Area. These are coho salmon (*Oncorhynchus kisutch*), steelhead (*O. mykiss*), and chinook salmon (*O. tshawytscha*).

Port Blakely HCP Environmental Baseline

An analysis of historic habitat conditions is summarized in the Environmental Assessment (EA), it shows that early forest practices in the Plan Area were conducted largely without regard for salmonids and their habitat. Logging that took place in the early 1900s removed most of the stands of old-growth conifers from the Plan Area. Railroads were constructed throughout the Plan Area to allow log yarding and transport. Although there have been no specific studies of the channel conditions or impacts of early logging for the Plan Area, the types and extent of likely impacts have been well documented for similar landscapes that were logged in the same period (Murphy 1995).

- Channels were simplified by channelized landslides and splash damming that removed in-stream structure and pools.

- Fish passage was inadvertently blocked in some streams by road and railroad fills.

- Riparian trees that would have contributed shade, bank stability, and a steady supply of large woody debris (LWD) to streams were largely removed by extensive logging.

In addition to changes in fish habitats, there have been likely adverse interactions between the wild stocks of anadromous salmonids and hatchery stocks of the same species in the Willapa basin. This information is summarized in the EA and the report by WDFW et al. (1994) which shows that hatcheries have contributed an increasing fraction of the commercial and sport catch. Further, harvesting the mixed stocks of wild and hatchery fish has likely had adverse effects on the wild stocks (EA). To briefly summarize, the primary causes of salmonid population declines in the HCP area are habitat modifications from a variety of activities, possible adverse interactions between hatchery and wild stocks, and mixed-stock harvest impacts.

The Plan Area is not located next to any Federal lands — the nearest national forest is located about 40 miles away and none of those lands drains into Willapa Bay. Thus, none of the components of the Aquatic Conservation Strategy of the Northwest Forest Plan is expected to influence fish habitat management associated with the proposed HCP.

Elements of the Port Blakely HCP

The HCP protects and manages stream and riparian habitats through measures that address mass-wasting (landslides), surface erosion, streambank stability, stream shading, LWD recruitment, and riparian forest composition. The measures are completely described in the HCP, Section 3, and the accompanying rationale is presented in Section 4.

Port Blakely does not own enough land within a sub-basin to initiate Washington State Watershed Analysis, but they did use the modules for mass-wasting and surface erosion derived from that process to develop their own measures.

Port Blakely identified ten types of riparian landforms — based on channel gradient and confinement — that describe the range of perennial stream channels on the Plan Area (Appendix D of the HCP). Each riparian landform describes a stream in terms of unique channel response to inputs of LWD and sediment. When timber is harvested next to a stream, each side of the channel would receive a site-specific prescription, based on the riparian landform, that would define the RMZ within which riparian forest management measures would be applied.

Proposed Conservation Measures To Avoid, Minimize, And Mitigate Take:

1. In a manner similar to Washington State Watershed Analysis, potential management-induced sediment introductions will be minimized by following measures that address these possible sources: Mass wasting, surface erosion, and road construction, maintenance and upgrading. See HCP-3.2, 3.3, 4.3 and Appendices B and C.

2. Port Blakely would use site-specific measures to address riparian functions. These include: bank stability (minimum 25 feet no harvest on all fish-bearing streams); stream shading (following standard forest practices as water temperature does not appear to be a problem on the Plan Area); and soil stability (any streamside area evaluated as high potential for both mass-wasting and delivering that material to a stream would become a no-harvest zone). Recruitment of LWD would be met by placing RMZs along all fish-bearing streams to provide sizes and numbers of large conifers (>24 inch diameter) sufficient to ensure potential LWD contribution. The RMZ width would range between 50 feet (25 feet no-harvest and 25 feet managed) and 122 feet (25 feet no-harvest and 97 feet managed) dependent on stream type, channel type, and geologic landform. The widths would be measured outside of channel migration zones (CMZs) to allow natural channel movements over time and maintain floodplain processes. By the end of the plan term, these RMZ widths would provide 100% of the LWD recruitment potential needed on fish-bearing streams (based on the sizes and numbers of large conifer trees retained within the entire RMZ).

3. Riparian areas along more than 35% of all the perennial non-fish-bearing streams will have either no-harvest or partial harvest buffers as a result of mass wasting measures. For example, more than 50% of all harvest units containing non-fish-bearing streams will have either partial or no-harvest riparian buffers along these streams. All other perennial non-fish-bearing streams would have at least 30 trees per acre (greater than 9"dbh) per 1000 feet of streambank; these will be left in discrete patches (HCP-4.3431).

4. Fish passage barriers caused by roads on the Plan Area will be evaluated in conjunction with state habitat biologists to develop site-specific measures for improving fish passage. See HCP - Appendix C.

5. In order to minimize increases in road densities, logs could be yarded across RMZs with the following provisions: Only full-suspension skyline cable systems could be used, and corridors through the RMZs would be spaced no closer than 150 feet and would be no wider than 20 feet. Yarding corridors would occur on no more than 10% of total length of fish-bearing streams (HCP-3.33).

6. Compliance monitoring, conducted by Port Blakely staff, would be conducted on all enforceable aspects of the HCP; the Services would have an oversight role. See HCP-5.1.

7. The HCP measures would be monitored for effectiveness. Monitoring would entail visiting all 400 stands on the Plan Area every 5 years. Further, stream habitat monitoring would focus on water temperature, substrate quality, LWD recruitment, and channel characteristics across all landforms on the Plan Area. See HCP-5.2.

8. If monitoring indicates that measures are not resulting in desired outcomes, commitments in the IA and HCP ensure that measures would/can be altered to better achieve stated goals.

VI. ROLE OF WATERSHED AND CUMULATIVE EFFECTS ANALYSES

Watershed analysis is a procedure used to characterize the aquatic, riparian, terrestrial, and human features, conditions, processes, and interactions in a watershed. The objective of watershed analysis is to understand ecological conditions and processes and thereby determine the sensitivity of individual watersheds to management activities. This knowledge allows management activities to be tailored to reflect the watershed's current ecological resiliency to human activities. Consequently, watershed analysis is also the key to refining default or interim management measures. Applying of the products of a credible watershed analysis allows managers to more adequately protect and restore public resources including fish, water quality, and related capital improvements. Credible watershed analyses are achieved only through carefully applying the scientific process and thoroughly documenting watershed-specific conditions. Watershed analyses are best viewed in the basin or subbasin contexts.

The conceptual framework of watershed analysis is explicitly related to the issue of cumulative (or multiple) effects. Watershed processes resilient enough to withstand disturbance from a single, site-specific action may be overwhelmed by the cumulative effect of multiple, widespread actions over time. Cumulative effects may impact ecological processes over large scales—resulting in a loss of habitat quality throughout a watershed. Effects assessments that identify potential risks solely for individual actions do not consider the complex interactions between upland, riparian, and aquatic processes which determine and sustain watershed health. They have therefore contributed to many of the current problems with water quality, habitat degradation and species status.

Watershed analysis provides the context for assessing the effect of multiple actions throughout a watershed over time. Identifying site sensitivities and activity distributions within the watershed permits management measures and strategies to be tailored to maintain ecological processes at both the site and watershed scales. Thus, watershed analysis is a valuable tool for developing flexible management practices and minimizing adverse cumulative effects on watershed processes. Consequently, watershed analysis increases management flexibility while increasing the likelihood that management will provide a high probability of protecting and restoring aquatic habitat.

Watershed analysis may be driven by issues such as management programs, priorities, resource problems, and regulatory requirements. These issues may affect the core topics to be considered. With respect to coho habitat protection, watershed analysis should include (but may not be limited to) assessments of the following: (1) Potentially unstable areas and their ability to deliver sediment and wood to fish-bearing channels; (2) conditions of perennial and seasonally flowing streams; (3) riparian vegetation condition (including LWD recruitment potential); (4) major sediment sources; (5) fish distribution, stock status, and distribution of key habitats; and (6) the extent of existing or reasonably likely to occur cumulative effects.

Examples of watershed analysis approaches taken in the Pacific Northwest are the Federal watershed analysis method (employed as part of the Northwest Forest Plan) and the methodology developed in Washington State for non-Federal timber lands. Another approach is being developed in Oregon as part of the Coastal Salmon Restoration Initiative.

A. Federal Watershed Analysis

The Federal approach to watershed analysis was designed to be an intermediate-scale analytical effort to support decision-making and regulatory processes for designing and reviewing management decisions on specific land management and watershed restoration projects. Federal watershed analysis, together with protective land allocations (e.g., riparian and late successional reserves, key watersheds, etc.), standards and guidelines (i.e., default management measures), and a program of watershed restoration, collectively constitute the Northwest Forest Plan's Aquatic Conservation Strategy. The strategy was specifically designed to protect and restore salmon and steelhead habitat by maintaining and restoring ecosystem health at the watershed scale.

The Federal land management agencies have adopted a standardized, interagency analysis process designed to: Characterize the important ecological processes in a watershed, identify key management and resource issues in the watershed, describe current aquatic and terrestrial ecosystem conditions in the watershed, describe ecological reference conditions, synthesize and interpret the information compiled, and develop management recommendations that are responsive to the watershed processes, conditions, and issues identified in the analysis. The analysis is not a decision document yielding site-specific measures but a tool to use in characterizing the aquatic, riparian, and terrestrial features, conditions, processes, and interactions in a watershed to provide the context for subsequent decision-making processes, (e.g., planning, project development, and regulatory compliance). The analysis is interdisciplinary; it uses available watershed-specific data. However, because it is an incremental process, new information from surveys and inventories, monitoring reports, and other analyses can be added at any time. Federal analyses are applied to watersheds roughly 20 mi^2 to 200 mi^2 in size (fifth- to sixth-field hydrologic units).

The watershed analysis process is intended to enhance the ability of land management and regulatory agencies to estimate the direct, indirect, and cumulative effects of management activities and guide the general type, location, and sequence of appropriate management activities within the watershed. Default management measures on Federal lands in the absence of watershed analysis are the standards and guidelines found in the Northwest Forest Plan, which were designed to reverse the declining trend of habitat quality and begin recovering of aquatic ecosystems and habitat.

B. Washington State Watershed Analysis

The Washington Forest Practices Board's approach to watershed analysis was designed to identify site-specific protection and, where necessary, regulate timber harvest beyond standard Washington Forest Practices. A principal intent of the process was to prevent the adverse cumulative effects that forest management has on water quality, fish habitats, and other public resources. The relationships between erosional, hydrological, and riparian functions and processes and the associated inputs of sediment, water, wood, and heat are assessed for their potential effects on fish habitat, water supplies, and public capital improvements. Under the Washington approach, an interdisciplinary team of trained analysts collects new information within a structured format, and then passes this assessment to a separate team to develop the actual forest practice measures. Voluntary restoration measures are also identified. The watersheds analyzed range in size from about 15 mi^2 to 78 mi^2, and are typically 40 mi^2 to 50 mi^2.

The default measures in Washington (without State Forest Practices Board watershed analysis) are standard forest practices. These were not designed to protect and restore stocks of at-risk salmonids.

C. Draft Oregon Watershed Assessment Manual

The Governor's Watershed Enhancement Board (GWEB) is developing the Oregon Watershed Assessment manual as a component of the OCSRI. This manual, intended as a coarse screen assessment to be used primarily by non-technical watershed council members, is currently under development and has not yet been finalized or field-tested. The manual's primary objective is to improve watershed health by providing watershed councils with a standardized process for identifying reach-scale sites that need protection and restoration. These assessment products are not intended (or sufficient) to develop site-specific management measures or satisfy applicable regulatory requirements.

The draft manual is being designed around protocols for evaluating specific elements of watershed condition: Channel habitat type (based on channel gradient, confinement, and connection to wetlands or estuaries); fish distribution and relative abundance; extent of modified channels; sediment sources; riparian vegetation (potential to provide shade and LWD recruitment); instream LWD and shade; currently available water quality information; documented water withdrawals; and hydrology and the potential for land management to alter it.

Protocols are being developed to assess the historical conditions and disturbance regimes necessary to begin addressing cumulative impacts. The final synthesis will integrate the results of these individual assessment protocols into a "watershed condition evaluation" that will help determine where there are potential areas for voluntary protection and restoration. Although this assessment process will contribute to watershed council efforts to undertake voluntary restoration activities, the technical review team appointed by the GWEB has recently concluded that the manual is not useful for developing the regulatory or management measures needed for land use activities such as forest management operations.

D. Options for Improved Watershed Assessment

Members of the NMFS Science Discussion Groups raised a number of concerns about current approaches to watershed analysis (they did not review the Draft Oregon Watershed Assessment Manual). Their concerns include: (1) The analytical methods and assumptions of the Washington State Watershed Analysis procedure lack monitoring and validation; (2) the Federal approach (that is also not validated) relies too heavily on information that is already available and also lacks provisions for monitoring; (3) procedures for increasing knowledge of biological communities are weak or missing in both methods; and, (4) the links between physical processes and biological productivity have not been clearly demonstrated for either method.

They discussed several options for more effective watershed analysis (below).

Option 1 - Benchmark Analyses

In order to be accepted and used, it is important that watershed analysis be scientifically credible and based on a testable, theoretical framework. Ecosystem stressors act as either chronic presses or pulses in a given area over broad spatial and temporal scales. Watershed analysis (as currently practiced) relies on generally untested assumptions about the way that these stressors and natural processes interact to create productive fish habitats over spatial scales as small as stream segments and as large as landscapes. Statements of theory with testable hypotheses are typically missing from the analytical procedures. What is needed to understand the ecological processes for the Oregon Coast Range is a process to validate the methods and assumptions of watershed analysis. This could be done by using a series of "Benchmark Analyses"—that is, analyses designed to develop theories, testable hypotheses, field techniques, and conditional conclusions specifically targeting the relationships between forest practices and cumulative watershed effects at specific sites in test watersheds.

The Benchmark Analyses results would be a set of established theories and related hypotheses that could be extrapolated to other basins of similar geology in the Coast Range. Currently used analytical methods, such as the some of the standard methodology of the Washington Forest Practices Board Watershed Assessment Manual, would be validated with the Benchmark Analyses. Validated methods would then be available to assess the effects of the processes of erosion, hydrology, and riparian function and the input variables of sediment, water, wood, and energy upon the habitats for anadromous and resident fish. Methods would also be developed to determine the species composition and distribution of fish and their key habitats (with the focus on salmonids).

Management measures and watershed analysis procedures may both need to be adjusted to reflect the increased understanding of ecological processes resulting from the Benchmark Analyses. Broad variations in geology and topographic relief influence ecological processes, thus Benchmark Analyses may produce management measures and analysis methods that address region-specific risks to sensitive processes. To effectively assess conditions over an entire species' range, watershed analysis would ultimately need to be expanded to address ecological processes throughout watersheds, including valley bottoms and estuaries.

Option 2 - Streamlined Watershed Analysis

A separate, much-simplified method of performing watershed analysis has been sketched by members of the Cumulative Effects Discussion Group. This approach tries to capture a better sense of the levels and range of historical variation and move management actions and practices in the direction of conditions in which species have historically adapted. The approach would be simpler because the analytical procedures would be limited to only a few methods tailored to individual watersheds, where a scoping process would be used to help identify the elements to be analyzed (based on observed impacts and local issues). These priorities may differ in each watershed (i.e., the most important stressors would vary from watershed to watershed and would therefore need to be addressed). This approach would take a watershed-scale look at the current and historic conditions of riparian vegetation; stratify channels by source, transport or response reaches; and simply characterize the upland timber harvest and road histories. Proposed practices would be evaluated against those historical conditions and variations.

Watershed analysis could be used to describe the watershed and generate a sense of whether the watershed, under current and proposed practices, is moving closer to or farther away from the levels and range of historical variability. Areas of greater deviation from historic variability would likely be less productive in terms of coho habitat and should therefore be emphasized for restoration. As land management improves at each site (and generally over each watershed), then areas closer to the historic variability would eventually become widespread and help recover at-risk salmonids.

The key point of the effort is to set the management targets in relation to historical variation and move in that direction, acknowledging that socio-economic conditions and other factors may constrain the extent of the return to historical conditions and limit the extent of any large-scale refugia or "survival areas." The historical conditions would be expressed as a range of values for key attributes, not absolute values, because ranges better reflect the dynamic patterns of ecological processes. Important tasks are to describe the dominant processes within the historical range of conditions and permit some flexibility in the methods used to achieve them. This will require that watershed analysis be performed by qualified individuals and used to inform decisions once it has been conducted. This approach also implies that watershed analysis will include some historical reconstruction of habitat conditions. A process for adaptive management would be an important part of the analytical procedure. It would need to include extensive monitoring and review to ensure that resulting measures were correctly aimed at protecting and restoring coho habitats.

E. Watershed Analysis - Recommended Next Steps

The NMFS believes that the Washington Forest Practices Board approach to watershed analysis, although not without its problems, represents the best starting point for watershed analysis in Oregon. This framework could be augmented with ideas from Options 1 and 2 above, and could be further enhanced by the basin-scale reconnaissance described below.

A potentially important first step in watershed analysis would be to have a highly qualified group of scientists, selected with the cooperation of all interested agencies and parties, conduct basin-scale analyses. Their primary mission would be to:

1. Review available information on current habitat conditions in the basin.

2. Prepare an overview of the likely historical conditions and range of natural variation.

3. Prepare an overview of the major ecological and developmental impacts that have occurred.

4. Give advice concerning the key ecological changes or conditions that should be addressed by watershed-specific measures in order to protect and restore salmon habitat.

This exercise could be very beneficial to forest land owners and others. It would make available preliminary guidance on matters of high priority in the basin and would enable users and councils to focus subsequent phases of watershed analysis and design any early projects to address the identified key factors. The initial insights of the scientists could, of course, be modified based on subsequent analysis.

F. Cumulative Watershed Effects (CWEs)

Although CWEs were not identified as a factor for decline of coho salmon, NMFS believes there is abundant evidence that the cumulative effects of land and water uses over the past century have greatly degraded river basin health in coastal Oregon. In order to adequately protect and restore coho habitats, land management should generally assume that CWEs are present and plan management to reduce existing adverse CWEs and avoid generating more.

The Council of Environmental Quality (CEQ) provided a definition of cumulative impact (or effect) (CEQ Guidelines, 40 CFR 1508.7, issued April 23, 1971) to implement the National Environmental Policy Act of 1969.

> "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

The CEQ has further explained how to assess potential cumulative effects in a recent handbook (CEQ 1997). The handbook lists eight principles of cumulative effects analysis.

1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions.

2. Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions.

3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected.

4. It is not practical to analyze the effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful.

5. Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries.

6. Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects.

7. Cumulative effects may last for many years beyond the life of the action that caused the effects.

8. Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects based on its own time and space parameters.

Cumulative watershed effects (CWEs) have been discussed by a number of researchers (Reid 1993, Bisson et al, 1992, Beschta et al. 1995). The following summary of CWE is from Reid (1993).

Cumulative watershed effects (CWEs) include any changes that involve watershed processes and are influenced by multiple land-use activities. CWEs do not represent a new type of impact, and almost all land-use impacts can be evaluated as CWEs. The CWE concept is important primarily because it identifies an approach to impact evaluation and mitigation that recognizes multiple influences. The significance of a CWE varies with the type of resource or value impacted and is determined on political, economic, and cultural grounds. In contrast, impact magnitude can be assessed objectively by measuring physical and biological changes. Most CWEs are incremental results of multiple controlling factors; rarely can a single threshold value be identified for provoking a response.

Watersheds are topographical forms that concentrate runoff. They are sculpted by production and transport of water and sediment. These media transport other watershed products, such as organic material, chemicals, and heat. If one watershed process or product is altered by land use, others change in compensation. Changes often influence or are influenced by biological communities, and most biological changes have repercussions throughout a biological community. Both physical and biological systems continually undergo change even in an undisturbed state.

CWEs are caused by changes that accumulate in time or space. Land use directly affects only a small number of environmental parameters, including vegetation, soil properties, topography, chemicals and fauna. These parameters, in turn, influence production and transport of water, sediment, organic matter, chemicals, and heat. On-site impacts can occur if the triggering change or the resulting impact is persistent in time. Off-site impacts can occur only if watershed processes or products are altered, because something must be transported for a remote effect to occur.

The manifestation of CWEs is complicated by lags in system response to change, geographic decoupling between cause and effect, site-specific variations in impact expression, accumulation of innocuous changes to the point that a catastrophic change is triggered, the ability of high-magnitude events such as storms or earthquakes to trigger delayed impacts, and interaction between changes that modify their expression.

Any CWE evaluation must be based on the basic understanding of watershed and ecological processes already provided by studies in hydrology, geomorphology, forestry, ecology, and many other fields. These studies have employed a variety of approaches, including qualitative description, statistical comparison, experimentation, and modeling. Each approach has advantages and disadvantages, and methods must often be combined to solve a particular problem. Studies also vary in their selected focus: some concentrate on the mechanics of an isolated process, while others compare multiple sites or watersheds through time. Research that specifically addresses CWEs usually must consider large temporal and spatial scales and often needs to include interdisciplinary work.

> Cumulative effects can be caused by repeated, progressive, sequential, and coexisting land-use activities. They can occur because of a single type of influence on an environmental parameter (for example, many types of land use can compact soils), complementary influences (for example, both increased compaction and altered snow accumulation can affect flood peaks), cascading influences (one type of land use can influence a second to cause an impact, as when urbanization increases recreational pressure, increasing trail erosion), and interdependent influences (for example, two introduced chemicals can react to produce a third). Many studies document the occurrence of such impacts, and a few attempt to predict them at particular sites.
>
> Several methods have been developed to evaluate potential CWEs from particular land-use activities. However, methods rarely address accumulation of effects through time, few are adequately validated, and rarely do they address more than one type of land-use of impact. Approaches fall into three categories: procedures for calculating values or indices, a collection of analytic procedures, and a checklist of issues to consider during evaluation. None is adequate for a complete CWE analysis.
>
> A valid general approach to CWE analysis would be capable of assessing the full variety of impacts and land-use activities at all potentially impacted sites. To remain credible, it would need to incorporate new analytical methods as they become available, and it would require comprehensive validation and monitoring of component methods and results. A useful format might use a California Dept Forestry-style checklist to select relevant analytical methods from a collection of procedures. Enough is already known of most environmental parameters, watershed processes, and impacts to develop preliminary procedures.

The CEQ handbook discusses a number of primary and special methods for analyzing cumulative effects. Many factors are suggested for consideration when selecting an appropriate method for a specific application (e.g., ability to assess temporal or spatial changes, additive or synergistic effects, and delayed effects; and whether the method is validated and repeatable).

Since the likely impacts of present and future actions can extend for many years into the future, it may be necessary to monitor cumulative effects over several decades. If the goal is to reduce adverse cumulative watershed effects, then monitoring should be linked to adaptive management. According to the CEQ handbook:

> Cumulative effects analysis, therefore, should be an iterative process in which consequences are assessed repeatedly following incorporation of avoidance, minimization, and mitigation measures into the alternatives. In this way, monitoring is the last step in determining the cumulative effects that ultimately result from the action. Important components of a monitoring program for assessing cumulative effects include the following:

- measurable indicators of the magnitude and direction of ecological and social change,
- appropriate time-frame,
- appropriate spatial scale,
- means of assessing causality, and,
- provisions for adaptive management.

G. Cumulative Effects Discussion Group

Members of the Cumulative Effects Discussion Group discussed cumulative watershed effects. The members of the group developed an overview of the subject, its key attributes, and its implications for management. The members of the group concluded that cumulative effects is an important topic that must be addressed as part of an effective watershed protection and restoration effort. A synopsis of their discussion follows:[7]

Definition. *Cumulative effects are changes in system behavior due to the increase in the number, intensity, or frequency of system stressors operating over time and through space. Cumulative effects are usually invoked to explain an observed change (effect) resulting from multiple, interwoven causes (stressors). Stressors may be cumulative in several senses, in that they may involve: (1) Physical constituents that are themselves additive or subtractive (i.e., water, wood, sediment, heat, etc.); (2) the interaction, either linear or non-linear, of multiple stressors; or (3) the accumulation of increasing sensitivity to change, expressed as increased variability, volatility, or departure from some prior system state. In considering cumulative effects, it is important to consider past, present and reasonable foreseeable activities in a given system. In this context, "system" is meant to include the ecosystem, landscape, watershed, and habitat unit scales.*

Key attributes. *The following attributes are the key principles of cumulative effects that are revealed by long periods of careful scientific study.*

1. *Cumulative effects are real in that they offer an explanation for large-scale trends. The coastal coho salmon problem is the cumulative result of localized actions of several different kinds (e.g., harvest, logging, hatcheries, agricultural practices, and industrial development). While it is generally possible to observe changes in system behavior that may be cumulative in nature or cause, it is very difficult to define in advance the thresholds beyond which significant effects will occur. Such thresholds, if they exist, may only be recognized in hindsight.*

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[7] These points are summarized from discussion group meeting notes and do not represent the full details of the topics discussed or suggest consensus in areas where it might not exist. They are provided to describe the general content of the discussions.

2. *We typically can not measure the small increments of change. For example, we can not say a particular clear-cut or slide will make a specific contribution to cumulative effects. However, where material and processes are "conserved" (in a mass-balance sense) within a watershed, we can make an estimate of the incremental effect.*

3. *Typically, it is the stressors that are cumulative The effects occur when stressors cumulate sufficiently. Oregon forest practices have caused and modified these stressors. Not all stressors are equal. We can generally identify and distinguish between stressors that have large effects and those that have small effects.*

4. *The ability to assign cause and effect diminishes with time, distance, and intervening process linkages.*

5. *In general, the consequence of a stressor (or the intensity of the cumulative effect) is inversely proportional to the distance between the stressor and the point of measurement. Stressors may be expressed at multiple scales. In addition, because of the interactive nature of some stressors, some effects can show up in areas far removed in time and space from the stressor itself and may in fact be intensified.*

6. *An external event may be necessary to expose a given cumulative effect by triggering an effect from the accumulated stressors (e.g., a five-year increase in temperature or mass wasting following a major storm event).*

7. *While there is some uncertainty about the concept of cumulative effects and there may be no single agreed-upon method to evaluate and address them, they are an important consideration in effective watershed protection and restoration.*

8. *Cumulative effects may be addressed in the short-term through precautionary management — i.e., the application of conservative measures to avoid individually small effects that may add to an already adverse circumstance or cumulate over time and eventually reduce salmon survival. In the longer-term, cumulative effects should be addressed as part of effective watershed analysis along the lines outlined above.*

The Discussion Group noted that there are three conceptual approaches for CWE analysis that can be used in resource management:

1. *The best management practices approach. This approach suggests that taking the correct action in individual cases will preclude cumulative effects. Under this approach, watershed analysis is used primarily to define where to apply best management practices.*

2. *The species conservation or focal species approach. This approach defines a target species and all actions are assessed based on the target species.*

3. *The range of historical variation approach. Conceptually, this approach attempts to capture a sense of the levels of historical variation and move management actions and practices in the direction of conditions in which species have historically adapted. Typically, data are available for a portion of the variables.*

In general, the Discussion Group members indicated that the preferred framework is the range of historical variation approach. They noted that aspects of the species conservation approach would provide the basis for evaluating the effectiveness of individual actions and that the best management practices could be used in part to enumerate the actions needed to implement the framework. Coupling this with a sound scientific approach, the best management practices would necessarily be adaptive in order to ensure practices can be changed depending on new information and insights.

H. Conclusion

At present, there is no routinely approved method for assessing cumulative effects in Oregon's coastal watersheds. Given the importance of this issue, NMFS will work with the Advisory Committee and expert scientists to develop an appropriate methodology.

VII. ADDITIONAL MATERIALS SUBMITTED BY U.S. FISH AND WILDLIFE SERVICE ON OTHER SPECIES AFFECTED BY THE PROPOSAL

See materials attached.

VIII. ADDITIONAL MATERIALS TO BE SUBMITTED BY THE ENVIRONMENTAL PROTECTION AGENCY ON THE CLEAN WATER ACT AND APPLICABLE COASTAL ZONE STATUTES

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Appendix I. Members of NMFS' Riparian, Landslide and Cumulative Effects Science Discussion Groups

<u>Riparian Science Discussion Group</u>

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Appendix II. List of Riparian Ranking Objectives, with statements of context and additional considerations, developed by members of the Riparian Discussion Group.

1. Reduce human-induced inputs of sediment into streams e.g., from roads and harvest units in forest-lands.

2. Increase delivery and volume of large wood into streams.

3. Diversity of riparian vegetation is an important characteristic from the landscape to stand level, including diversity of species and age. Accordingly, ensure terrestrial habitat diversity of riparian areas, recognizing several features of plant communities e.g., complex mosaics not simply seeking large trees in all locations.

4. Diversity of riparian vegetation is related to diversity in the alluvial surfaces of channels. Restore and maintain the processes and, where appropriate, implement active management to create the diversity of vegetation conditions.

5. Improve understanding of floodplains and vegetation; develop strategies for restoring associated vegetation; and then restore connectivity/floodplain topography. The relative coho response may be higher in the upland/lowland transition zone; however, a long-term restoration strategy requires restoration throughout a watershed.

6. In general, temperatures are elevated in many streams in the Coast Range, particularly in the lowland streams. Increase shading in open stream reaches, particularly in lowlands, to reduce elevated stream temperatures. It will be important to recognize the patchy character of shade for mature and late-successional stands.

7. Given the importance of beaver ponds as coho rearing habitat and sediment traps, at the watershed scale, improve riparian conditions and beaver management to provide for long-term maintenance and increase in population and distribution of beavers.

8. Institutional change is needed to coordinate the policies and practices of agencies, e.g., addressing contradictions in the enforcement provisions between Oregon Department of Forestry's regulatory approach and Oregon Department of Agriculture's voluntary approach in the current OCSRI.

9. Develop integrated, whole system approaches to analyzing landscape patterns that would result from achieving the objectives.

10. In addition to watershed-level refugia, increase the size and number of refugia to buffer the effects and reduce risks of future development activities/disturbances e.g., floodplains, off-channel ponds, tributary junctions and other widespread areas of intact systems

throughout the watersheds. Where key watersheds are unavailable, utilize blocks of stateland as needed to create watershed-scale refugia for short-term habitat protection or until improved conditions have occurred elsewhere.

11. Improve understanding of the role of disturbance (including fire, flood, debris flows, etc.) in riparian processes at local and landscape scales in order to develop more effective management practices.

12. Definition of riparian area needs to be more variable for wood, encompassing landslide-prone areas, and not just fish-bearing streams.

13. Reduce the number of streams that are water quality limited (temperature, sediment, dissolved O2, nutrients, wetlands).

14. Provide more explicit protection of wetlands.

15. Restore the connection and function of lowland waterways, especially during disturbance events, including those zoned agricultural and urban.

16. At the watershed scale, achieve sustainable cycles (reproduction, growth, etc.) of riparian vegetation types and wood sources to ensure long-term productivity and diversity of systems. Grow trees for riparian and terrestrial functions and provide age classes. Continually provide these trees long-term.

17. Increase late successional forests along streamsides.

Additional Considerations

1. The time perspective in setting priorities is very important. Priorities could be set to encourage short-term, relatively quick results or could focus on the longer-term sustainability of fish resources. The implications of both need to be explored further.

2. Given the status of existing knowledge and experience with past rehabilitation efforts, actions, whether active management or a more passive allowance of natural process restoration, should be pursued on an experimental basis as demonstration projects with careful monitoring and evaluation to promote learning and the ability to make mid-course corrections.

3. The above biological objectives can be achieved in a variety of ways. Landowners will need to be constructively involved in the restoration effort. Given the extensive and diverse land ownership in coho habitat, a variety of approaches may be needed to produce effective landowner action. To accomplish that, objectives and the means to achieve them

will need to be flexible, coupled with incentives and related voluntary efforts to encourage positive action. These approaches may also need to include educational programs. Ways to measure the effectiveness of incentive-based approaches also need to be developed.

3. Watershed analysis is an important step in the right direction, but it is not a panacea. It will take a substantial amount of time to complete in all watersheds along the coast. The analysis needs to be defined correctly and needs to be simplified to be more useful in protection and restoration of aquatic habitat. It should not attempt a complete catalog of adverse developments. Default standards or guidelines are a useful starting point for the watershed analysis and subsequent evaluation of changes proposed in specific watersheds.

4. On a coastwide basis, the OCSRI whole system analytical approach can be used, with emphasis on consistencies, inconsistencies and linkages between various agency policies and practices. On a basin or ecoregion basis, the state should facilitate the conduct of basin analyses to examine basin-scale conditions and trends and the implications of varied policies and programs. These analyses should be helpful in efforts to identify high priority actions.

Appendix III. List of Ranking Objectives and additional considerations developed by members of the Landslide Discussion Group.

1. Manage the risk of landslides (which will affect the rate, magnitude, composition and thereby the consequences of slides) such that forest practices will not alter the rate, magnitude or composition in a manner that adversely affects coho habitat.

2. Manage the risk of landslides (which will affect the rate, magnitude, composition and thereby the consequences of slides) such that forest practices will not alter the frequency, magnitude or composition from background levels.

Additional considerations by members of the Landslide Discussion Group:

1. There is a need to reduce the risk of slides in general. There is a significant burden of proof problem in many of these landslide-related issues. For example, it will be difficult, if not impossible, for science to prove a site-specific cause of failure at a landslide, even after considerable research is undertaken.

2. The existing ODF rules do not take a landscape or watershed view and are vague in the definition of concepts such as high risk , which is left to the State Forester. The CSRI measures are viewed as generally unspecific and include a large number of studies and seemingly unrelated actions. This lack of clarity could open the door to inappropriate actions on risky sites.

3. A coarse screen may be applicable in the effort to identify risky sites. (An approach was discussed and will be provided to NMFS).

4. A conservative approach is needed given the inability to predict slide potential with precision. There is a need to address potentially unstable areas in defining high risk sites. Slope stability specialists should review activity plans. The buffer width will vary depending on local conditions. Studies are needed on both in-unit failures and road-related failures.

5. Road maintenance plans, upgrading structures to 100 year events and managing toward background slide levels will be important. Road corridor guidelines may be useful to help relate road needs to harvest plans. Existing roads, not just new roads, need to be addressed in specific measures. While it is hard to measure the 100 year flood, 100 year drainage structures may be advisable on biological and economic grounds. Water should not be concentrated in potentially unstable areas. The specific prevention method--outsloping or collection--will depend on the circumstances.

6. It is important to recognize the projected extent (i.e., runout) of slides, not just the initiation site of the slide. Having wood available in the riparian areas below the slides is important. Wood is needed to help mitigate the effects of slides at the site of the slide and below. Wood in small streams is important.

7. There may be a need for active management under some circumstances to prevent undesirable takeover by shrubs in the riparian area.

8. The schedule for adaptive management review and mid-course corrections should be specified. Given the scientific uncertainties, re-openers to consider new information should be provided. A clear mechanism for monitoring is needed. Compliance monitoring is an important feature of any measure set. Unified reporting and consistent data collection will be important across the watersheds. Technical assistance programs for small landowners would be helpful.

Appendix IV. Additional Evidence and Expert Scientific Observations.

A. The Botkin Report, as commissioned by the State of Oregon, states:

> "The proposal (new rules) would preserve or allow rapid re-establishment of all riparian functions except that of supplying LWD. This is particularly disturbing since the channels in the region are already strongly depleted in this vital resource. It is not clear how trees with a dbh ["diameter at breast height"] of only 8-11 inches could supply LWD [Large Woody Debris] to the stream before the next logging cycle in which they would be susceptible to harvest that would once again leave only small trees in the RMA [Riparian Management Area]. It is quite likely that the various limits on tree sizes to be left in the RMAs were based on some economic and political calculations as well as on scientific judgements about fish biology." p. 82

> "It is the opinion of the panel that these rules may not provide sufficient loading of LWD to the stream channel, especially in the short term in secondary forests." p. 159

> "Steelhead and coho, which spawn and rear in the smaller streams, are very much affected by forest cover. This analysis suggests that for these two species, relatively speaking, forest cover is an important factor in past local extinctions." pp. 120-121

> "A riparian timber harvest every 40 years [allowed under the revised Rules] would cause salmon habitat to be relatively unproductive most of the time . . ." p. 166

B. The NRC Report, titled Upstream: Salmon and Society in the Pacific Northwest (NRC 1996) states:

[re: Long-term LWD]

> "Perhaps no other structural component of the environment is as important to salmon habitat as is large woody debris, particularly in coastal watersheds . . . Loss of large woody debris from streams usually diminishes habitat quality and reduces carrying capacity for rearing salmon during all or part of the year (Hicks et al. 1991)" (p. 194)

> "Attempts at improving habitats by adding in-channel roughness elements without eliminating management practices that are causing habitat degradation are likely to fail. For example, some short-term habitat benefits might be achieved by adding

large woody debris to streams, but the benefit can be only temporary from an ecological perspective unless riparian management practices ensure the long-term recruitment of large woody debris from the riparian zone." (p. 219)

[Note: The Rules currently allow these practices (LWD placement, boulder placement) without adequately addressing the cause of the problem. The Rules allow continued reduction in potential LWD recruitment from riparian areas]

[re: Small Stream Protection]

"The distribution and abundance of large woody debris have been extensively altered in most river systems. Headwater streams have lost woody debris through several processes, most related to logging activity." (p. 195)

[re: Cumulative Effects, Riparian Protection]

"Rotational harvest ages of forests on many industrial forestlands (40-60 years) have been short enough to preclude reestablishment of dominant conifers in riparian zones (Andrus et al. 1988)." (p. 195)

[re: Riparian Protection, Core Area Protection]]

"Recommendation. Riverine-riparian ecosystems and biophysical watershed processes that support aquatic productivity should have increased protection. Riparian zones are important for the maintenance of aquatic productivity, but insufficient protection has been given to these critical areas in the past. The width of riparian zones requiring protection from harmful human disturbances is usually not known with any degree of certainty, but all possible ecological functions should be considered when attempting to define riverine-riparian boundaries." (p. 365)

[Note: During riparian Rule revision, ODF primarily considered the role of riparian vegetation in providing temperature regulation to streams, and (to a lesser extent) to provide LWD recruitment]

"Forestry, agricultural, and grazing practices should allow riparian zones to maintain a full range of natural vegetative characteristics, i.e. characteristics occurring in watersheds with natural disturbance regimes. Riparian zones should ideally be wide enough to fulfill all functions necessary for maintaining aquatic productivity. (p. 365)

C. The Beschta et al. 1995 Cumulative Effects Report, as commissioned by the ODF, states:

[re: Long-term LWD]

> "Though instream loadings of large woody debris present prior to harvest were not affected by current harvesting practices, future supplies of large wood are significantly reduced by current practices in western Oregon. This reduction in large wood recruitment has the potential to continue a state of diminished fish habitat quality and quantity." (Chapter 7, page 40)

> "the legacy of active removal of large wood from stream systems and the diminishment of future sources of large wood from riparian areas and hillslopes represents a major change in the ecological characteristics and functions of forested stream systems in Oregon. If pre-harvesting levels of large wood are not maintained, channel morphology is not likely to return to pre-harvest conditions . . . without the long-term growth of forest trees along streams for root strength and for potential sources of large woody debris, the ecological functioning and complexity of stream channels is expected to be greatly reduced. (Chapter 7, page 85)

> "When riparian harvesting removes large proportions of the coniferous species along a stream and occurs over relatively short rotations (less than 100 years) the potential for large woody debris recruitment for conifers is effectively curtailed. Such is the situation that apparently exists for many riparian areas associated with state and private forestlands, particularly in western Oregon." (Chapter 7, page 126)

[re: Cumulative Effects]

> "If the rotation age for the site is 50 years, the full functioning of all the riparian components of this system may not recover prior to the next harvest entry." (Chapter 7, page 88-89)

> "On private commercial forestlands, roading and cutover areas are more extensive [than on Federal lands]; entire drainage basins may be harvested within a few years. (Chapter 7, page 89)

> "By the time a cumulative effect is actually demonstrated, the system may have been significantly altered due to the accumulation of small-scale perturbations." (Chapter 7, page 94)

[Note: this point is critical; ODF routinely pushes the cumulative effects issue into the category of "monitoring" which forces an undue burden of proof upon the resource. ODF currently requires that monitoring results should be completed and should demonstrate an effect before any actual improvements in forest practices are considered. By the time cumulative effects of the new (revised) forest practices are demonstrated, these effects will have occurred (across the landscape) and may result in long-term changes that are essentially irreversible.

> "Whereas silvicultural practices on National Forests have typically involved 20- to 60- acre clearcuts staggered throughout a basin, harvest units on private lands tend to be significantly larger. Furthermore, rotation ages for private forestlands tend to be shorter than for Federal ownerships indicating a relatively larger portion of a basin is likely to experience forestry at any given time. Primarily because of these differences in the rate of harvest, forest practices on National Forest lands may directly affect a zero to 1st-order basin while on private lands 3rd- to 4th- order basins may be entirely affected (Haar 1989.) In 1991, Oregon's Forest Practices Rules addressed the issue of clearcut size and limited them to 120 acres on commercial forestlands. However, there remains a legacy of large continuous tracts of harvested state and private lands in Oregon." (Chapter 7, page 96)

[re: Riparian Protection]

[Note: It is not clear that side channels of fish-bearing waters are adequately identified and included within the RMAs. The relevant section of the Rules, section 629-635-310, (1) (b,c), states: “operators should measure the RMA width as a slope distance from the high water level of main channels . . . where wetlands or side channels extend beyond the designated RMA widths, operators shall expand the RMA as necessary to entirely include any stream-associated wetland or side channel plus at least 25 additional feet. This provision does not apply to small Type N streams.” Since there is no assurance that RMAs would be extended more than 25 feet beyond a side channel that is fish-bearing, these channels would likely receive narrower buffers than any other type of fish-bearing stream.]

> "Because of the potential for channel changes to occur at high flows, maintaining some level of riparian protection for off-channel areas is likely important for maintaining the integrity of riparian/aquatic systems and for protecting a variety of functions and riparian-dependent species." (Chapter 7, page 43)

[re: Road Related Problems]

> "[Forest] roads often occupy a significant component of the original riparian area or floodplain and in many instances have caused a generally straightening [sic] or other simplifications of the channel systems (e.g. filling of old side channels or hydraulically "disconnecting" them from the mainchannel)." (Chapter 7, page 43)

"The construction and use of roads in forested watersheds can often cause significant increases in the availability of erodable [sic] sediments to streams . . ."(Chapter 7, page 46)

"In another Oregon Coast Range study, road failures were a principal factor contributing to episodic debris flow inputs to streams" (Chapter 7, page 46)

"Road density and usage can be important in affecting the extent and magnitude of road-related sediment impacts (Chapter 7, page 49)

[re: Mass Wasting/Unstable Areas]]

". . . areas with slopes greater than 35% are most likely to show an increase in sediment production due to forest management activities. (Chapter 7, page 45)

"Studies in Oregon and Washington generally indicate that the harvesting of trees increases the rate of mass failures by 2 to 4 times over that experienced on uncut areas. (Chapter 7, page 51)

"A wide range of studies has shown that clearcutting in steep terrain has the potential to alter the amount and rate of sediment to streams" (Chapter 7, page 52).

[re: Riparian Protection, Small Stream Protection]

". . . bufferstrips approximately 60 feet wide in the Oregon Coast Range (Brazier and Brown, 1973) and 120 feet wide in the western Cascades (Steinblums et al. 1984) would be expected to provide shading levels approximately equivalent to that of old-growth forest conditions." (Chapter 7, page 56) [Note: ODF Riparian Protection Rules provide no-cut buffers of only 20', far narrower than these distances]

"Research results have generally indicated the effects of timber harvest upon water temperatures are most pronounced for relatively small order streams." (Chapter 7, page 59)

[This point is critical; ODF Riparian rules do not provide adequate buffers for small non-fish perennial and intermittent streams to provide even basic water temperature protection, let alone allow for adequate LWD recruitment to small streams for sediment storage, channel roughness and pool formation (moderates flows during peak events and during late season low flows). Riparian areas of small, steep, intermittent streams (especially those associated with unstable areas or "high risk sites") may also require standing large wood to slow the runout of channelized landslides.]

[re: Potential Hydrologic Changes]

> "Research studies in Oregon, the Pacific Northwest, and elsewhere throughout the United States, have shown that forest practices often influence the magnitude (water yields) and timing of runoff from mountain watersheds. In some instances, peakflows and lowflows are also affected . . . (Chapter 7, page 106)
>
> "The greatest water yield increases following clearcut harvesting in Oregon occur in the rain-dominated Coast Range Region . . . the shorter the [harvest] rotation, the greater is the expected cumulative effect on water yields [sic] increases at the mouth of the basin." (Chapter 7, page 108)
>
> "The potential for cumulative peakflow effects in areas of rainfall dominated hydrology is apparently associated with both roading and harvesting effects." (Chapter 7, page 117)

D. Review of Oregon Department of Forestry Riparian Rule Administrative Record and Information Indicating that Existing Forest Practice Rules may be Inadequate to Protect Water Quality and Beneficial Uses:

The administrative record shows considerable controversy over the Rules' adequacy. An analysis of the administrative record by NMFS staff follows.

NMFS reviewed the administrative record supporting the adoption of the 1994 forest practices rules for riparian areas by the Oregon Board of Forestry (BOF). The administrative record was initiated in the Fall of 1991. The BOF adopted the Rules in April, 1994, and the Rules became effective in September, 1994.

It is important to note that the Riparian Rules went through a drafting process in which several draft versions of rule language were distributed for public and peer review. Comments received by ODF refer to many different draft versions.

1. Mass Wasting:

This issue received very little attention in the rule process, as the 1991 statutory amendments focused rule promulgation on the riparian area. The relationship between uplands and riparian areas was discussed generally by a few commentators. No scientific evidence or information was presented on this critical topic.

State statutes and ODF administrative rules adopted prior to 1991 mention "high risk sites" and require the State Forester to identify these areas. However, in practice, high risk sites are addressed at the operations stage by local ODF district offices. Some high risk sites have been mapped and photographed, and these maps are located at local state ODF offices so that forest owners and district foresters can identify the sites while planning for a harvest operation. It is unclear what guidance local district ODF staff give to prevent or reduce problems in high risk site areas.

[Note: the Aquatic Conservation Strategy of the Northwest Forest Plan requires that "unstable areas" and "potentially unstable areas" adjacent to riparian reserves be included in interim riparian reserve delineations. These connected unstable areas (including steep headwalls) can not be operated on without the prior benefit of a comprehensive watershed analysis.]

2. Small, Non-fish Stream Protection:

Numerous commentators recognized inadequacies in the protection provided for small, non-fish bearing streams by the riparian rules. This issue was addressed from the beginning of the rule process in technical workshops held by ODF. See ODF Sediment Workshop Report (January 16, 1992), and Large Woody Debris Workshop Report (January 23, 1992).

ODF convened a series of technical workshops on various aspects of ecosystem and forest management with invited participation from numerous agency, private and academic experts. The participants shared scientific literature and their best professional judgment on the significance of various issues to riparian health and "efficient" forestry.

These technical workshops discussed the importance of small streams for trapping sediments and providing cooling for waters for downstream reaches. They also noted the importance of large wood to achieve those characteristics (Letter and attachments from B. Beschta to C. Andrus, April 3, 1992).

Protection for small, non-fish stream protection were called for by the American Fisheries Society Executive Committee, A Consortium of Conservation Organizations (September 25, 1992), the ODF Waters of the State Workshop (May 6, 1992), and the ODFW Riparian Classification and Protection Goals to Maintain Fish and Wildlife Populations on State and Private Forest Lands in Oregon (April 6, 1992).

ODFW recommended that larger diameter debris be provided to maintain stability in small aquatic systems during extreme flood events, even though small diameter trees (8-inch minimum) may provide stable instream woody debris for small streams during normal flow periods. Including these streams into the rule requiring that trees be retained in proportion to pre-operation size classes will assure that stability during flood events, natural functions, and wildlife habitat (snags) will be maintained.

3. Potential Hydrologic Changes:

This issue was not a major topic for technical or policy evaluators during the riparian rule process. Water quality was the principle issue, while flows, delivery and general hydrographic changes received little, if any, consideration. However, the Oregon Water Resources Department did recommend that ODF's rules allow for increased protection standards for specific watersheds to increase the ability for certain watersheds to store and release water at natural rates. WRD Comments, 1994. It is quite possible that if cumulative effects had become a more central discussion point, the potential hydrologic changes in a watershed from multiple harvest activities would have been a central issue in the riparian rule process.

4. Cumulative Effects:

This issue was not addressed comprehensively in the rule adoption for riparian areas because the 1991 Legislative changes called for the completion of a study to address cumulative impacts prior to the development and adoption of rules addressing them (ORS 527.710(8)). A report addressing this topic (but apparently not the report specifically required by the Legislature) has been completed (Beschta et al. 1995) however, the BOF appears reluctant to begin a cumulative impacts rule process for two reasons. First, ODF has stated that due to the reduced impacts to riparian areas from the 1994 rules, the individual impacts of each operation have been reduced, thus reducing the cumulative effects of unconnected operations. This is false. Second, Legislative amendments in 1995 may have set a higher standard for the BOF to meet before it develops any rules that may result in stricter regulations. This legislative change was signed by Governor Kitzhaber in February, 1996 as part of a Special Legislative Session. (See ORS 527.713(5)). This is a serious legal hurdle for the BOF.

One issue which was not addressed in the riparian rule process was the continued effects of past actions on riparian area condition as the new rules are implemented. Some commentators noted that the forest and stream areas would be exhibiting adverse effects for decades to come from past actions despite any positive impact from new rules, yet no provisions in the new rules addressed this concern. (<u>See</u> American Fishery Society, Letter from Phil Howell to Ted Lorensen (October 1, 1992)), (USFS, Letter from Gordon Grant to Ted Lorensen (February 27, 1994)), (Environmental Defense Fund Letter from Rod Fujita to Ted Lorensen (February 28, 1994)).

5. Inadequate Long-term Wood into Streams:

This is the most controversial aspect of the riparian rule process, as it relates most directly to leaving woody along streams or along mill ponds. The amount of credible scientific information submitted to ODF related to this issue is voluminous. For example, both Bob Bilby and Peter Bisson presented materials to ODF on recruitment of woody debris that supported larger leave requirements. <u>See</u> Bilby, RMA Management to provide Large Woody Debris (undated memo)(4 pages), Bilby, Alternatives to OFIC RMA Proposal for large woody debris,(undated memo)(3 pages) with calculations attached) and Bisson, Managing Riparian Zones in Class 2 Streams for Continued Inputs of Large Woody Debris. (January 22, 1992)(6 pages)).

A group of 12 academic and research scientists recommended a 100 foot no-cut buffer as well as other riparian management changes in a letter to ODF. (See "Gang of 12 Letter, March 23, 1992). Conservation groups also suggested alternate "minimum" RMAs of 100 feet for protection categories I, II, and III, and of 60 and 30 feet for categories IV and V. The widths they proposed were based on the recommendations of 12 researchers and faculty of OSU and the Forest Service's Laboratory in Corvallis. They are also consistent with the recommendations of the Columbia River Intertribal Fish Commission, U.S. Fish and Wildlife Service (USFWS) and the Northwest Power Planning Council. (See Recommendations of the Columbia River Inter-tribal Fish Commission, November 26, 1991, and May 13, 1992). However, neither USFWS nor the Northwest Power Planning Council submitted any technical justification for their recommendations to adopt a "no-cut buffer." (See USFWS, Letter from Bill Shake to Janet McLennan (September 24, 1992)).

The ODF RMA distances are considerably less than those employed by Federal land managers. The standards described in the Aquatic Conservation Strategy (ACS) for the Northwest Forest Plan provide for minimum buffer widths from 100 to 300 feet along all streams. (See USFS Record of Decision: Standards and Guidelines (April 13, 1994). The development of the Northwest Forest Plan took place concurrently with the drafting and adoption of the state riparian rules, and many of the technical basis for those standards were submitted as the basis for increasing protection within the state riparian rule process (See 'Gang of Four' Report: Alternatives for Management of Late Successional Forests of the Pacific Northwest, 1991), (Willamette National Forest Riparian Management Guide, 1992),(B. J. Hicks, et al., Responses of Salmonids to Habitat Changes, In: Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats, AFS Special Publication, 1991).

An important issue for retention of LWD is how the RMA and riparian-associated floodplain is measured.

ODF proposed that in areas where a stream channel was steep exposed soil, rock bluff, or talus slope, the RMA be measured horizontally until top of exposed bank, bluff, or slope was reached, and then from that point the remaining portion be measured as a slope distance. ODFW proposed that the RMA be measured as horizontal distance from high water level or outermost edge of stream-associated wetlands if the slope immediately adjacent to the stream is greater than 65%. ODFW contended that its proposal was simpler and more concise for administering riparian management areas on steep slopes, and assuring that these RMA's include the physical components needed to meet the protection standards. Adopting horizontally measured RMA distances at these sites allows for an 'automatic' adjustment of riparian widths as slopes increase. Increased widths may be necessary on these steep slopes due to greater erosion potential, and to assure that adequate numbers of trees are present to meet the live tree retention requirements. These recommendations were ignored.

6. Road-related Problems:

Roads were only marginally addressed in the riparian rule process. Most issues raised involved whether roads were considered within or outside of the RMA when roads bordered riparian areas for use in determining RMA width and retention targets for LWD. Some commented that the rules did not address the ongoing problems caused by old roads not maintained at current standards. (See Environmental Defense Fund Letter (Feb 28, 1994)).

E. NMFS' Science Center Comments, provided by Phil Roni and Steve Grabowski on October 4, 1995.

The Oregon Rules were reviewed by Phil Roni and Steve Grabowski of NMFS' Science Center. Their comments were transmitted to Jacqueline Wyland from Michael H. Schiewe on October 4, 1995. Their comments state:

[re: Long-term LWD]

> "The Oregon Rules require retention of adequate vegetation along fish bearing streams to maintain shade and water temperature. However these rules do not stipulate adequate riparian vegetation for long-term recruitment of woody debris to stream channels, and, therefore do not protect and maintain fish habitat and stream processes. By allowing the harvester or landowner to determine which vegetation to retain in the riparian zone, the Oregon Rules allow for inconsistencies in compliance and possible unintended negative impacts." [note that these comments do not imply that shade and temperature will be adequately protected for non-fish-bearing streams to prevent downstream temperature impacts.]
>
> "Rule 629-640-110 allows an operator to remove additional trees from the RMA in exchange for placing large woody debris in Type F streams to enhance fish habitat. Many streams on nonfederal lands in Oregon have a chronic shortage of LWD due to past management practices. However, removing trees from the riparian zone to enhance fish habitat reduces the natural long-term supply of woody debris for the stream channel and fish habitat. It is inappropriate to remove trees from the riparian zone to provide a short-term solution for low levels of instream woody debris."

[re: Small Stream Protection]

> "The water classification system used to determine the extent of riparian buffer strips oversimplifies stream classification and will not result in adequate riparian buffers along most fish-bearing streams . . . waters degraded by past land use practices may no longer support fish and therefore, will not receive adequate protection . . . Finally, ephemeral streams, which often support fish seasonally, do not receive any protection under the Oregon Rules. Therefore, the Oregon Rules may allow hundreds of miles of streams inhabited by anadromous salmonids, resident salmonids, and other resident stream fishes receiving inadequate protection or none whatsoever."

[re: Mass Wasting/Unstable Areas]

> "Finally, the Oregon Rules contain no provisions for logging on steep slopes or other sensitive areas. The majority of the sediment in coastal Washington and Oregon is delivered to stream channels from debris flows, which is [sic] greatly exacerbated by logging and road building activities."

F. Mike Murphy's Model Results Using ODF's Data and Assumptions

[re: Long-term LWD]

Mike Murphy of NMFS' Science Center has modeled the LWD inputs over time that are provided by the Oregon Rules for small, medium, and large fish-bearing streams. The model results show that large fish bearing streams, with 100-ft RMAs, may have wide enough buffers to eventually allow adequate amounts of large woody debris recruitment to support stream habitats for salmon characteristic of mature conifer forest, depending on current riparian conditions and how the riparian protection rules are implemented. Small and medium sized fish bearing streams do not have wide enough RMAs to receive adequate long-term LWD recruitment, and will be relatively unproductive most of the time (see also Beschta et al. 1995 cumulative effects report, and Botkin Report comments on riparian protection and LWD recruitment).

G. Jones and Grant Paper (1996).

[re: Potential Hydrologic Changes]

A key article done by Jones and Grant (1996) supports NMFS position that excessive clearcut harvesting and roading together can result in altered hydrology of forested watersheds. Jones and Grant (1996) provide paired-basin analyses with data for 34-55 years. Their analysis indicates peak flow increases due to roading and clearcut harvesting are as much as 50% in small basins and 100% in large basins, over control basins. These studies were conducted on watersheds on Federal forestlands, and included flood events of lesser magnitude than previous studies. The changes were attributable to flow routing due to roads and to altered water balance due to clearcut treatment effects and vegetation succession. Their studies were done for watersheds affected by Federal forest practices. Non-Federal forestlands historically had and currently have significantly greater rates of clearcutting and amounts of roading (specifically higher road densities, larger clearcut sizes, and shorter rotation times) than Federal forestlands.

The potential of forest roads to change local hydrology, although not well understood, is discussed in detail by Jones and Grant (1996). This is a key point that is not addressed by the Oregon Forest Practice Rules. The Rules should set goals for road design, construction, and maintenance that minimize the disruption of natural hydrologic flow patterns, and disconnect the existing road drainage system from the stream network.

Appendix V. CSRI Objectives related to forest practices are listed verbatim below:

<u>Water Quality</u>

1) Temperature. To meet DEQ's water quality standard for temperature in coastal waterbodies that support salmonids, or have historically supported salmonids, according to the following milestones (% of stream miles meeting numeric criteria for temperature):

1997 - unknown (18.4% of stream miles assessed)
2007 - 35%
2012 - 45%
2017 - 65%
2027 - 90%

In coastal waterbodies that support or have historically supported salmonids, where water quality currently is equal to or better than DEQ's water quality standard for temperature, manage activities such that water quality is not degraded.

2) Substrate Sediment. To meet DEQ's water quality standard for inter-gravel dissolved oxygen in spawning gravel beds for coastal waterbodies according to the following milestones (% of streams that meet numeric criteria for inter-gravel dissolved oxygen):

1997 - unknown
2007 - 15%
2012 - 40%
2017 - 70%
2027 - 90%

To identify stream reaches with excessive sediment loads and mitigate the major sources of increased sediment by 2007.

3) Dissolved Oxygen. To meet DEQ's water quality standard for water column dissolved oxygen in coastal waterbodies that support, or have historically supported salmonids, according to the following milestones (% of streams meeting the numeric criteria for dissolved oxygen):

1997 - unknown (73.2% of stream miles assessed)
2007 - 35%
2012 - 70%
2017 - 90%
2027 - 95%

In coastal waterbodies that support or have historically supported salmonids, where water quality currently is equal to or better than DEQ's water quality standard for dissolved oxygen, manage activities such that water quality is not degraded.

4) Biological Criteria. Support and maintain a balanced, integrated, adaptive community of organisms, in coastal streams that support salmonids, which have a species composition, diversity, and functional organization comparable to that of the natural habitat of the sub-basin as determined by accepted biomonitoring techniques provided under DEQ's biological criteria water quality standard. Based on the evaluation of randomly selected sites the percent of coastal streams not meeting the biological criteria will be calculated. The goal will be to reduce the percent of biologically impaired streams according to the following milestones.

1997 - 35% impaired
2007 - 30% impaired
2014 - 15% impaired

In coastal waterbodies that support or have historically supported salmonids, where resident biological communities currently have a species composition, diversity, and functional organization comparable to that of the natural habitat of the sub-basin, manage activities such that water quality is not degraded.

5) Toxic Substances. To meet DEQ's water quality standards for toxic substances contained in Table 20 of OAR Chapter 340, Division 41 for all coastal streams that support or have historically supported salmonids, according to the following milestones (% of streams meeting the numeric criteria for toxics):

1997 - unknown (10.9% of stream miles assessed)
2007 - 35%
2012 - 70%
2017 - 90%
2027 - 95%

In coastal waterbodies that support or have historically supported salmonids, where water quality currently is equal to or better than DEQ's water quality standards for toxic substances, manage activities such that water quality is not degraded.

6) pH. To meet DEQ's water quality standard for pH in coastal waterbodies that support, or have historically supported salmonids, according to the following milestones (% of streams meeting the numeric criteria for pH):

1997 - unknown (79.5% of stream miles assessed)
2007 - 35%

2012 - 70%
2017 - 90%
2027 - 95%

In coastal waterbodies that support or have historically supported salmonids, where water quality currently is equal to or better than DEQ's water quality standard for pH, manage activities such that water quality is not degraded.

Physical Habitat

1. Loss/degradation of riparian areas

    i.) The interim habitat objective for trees in riparian areas capable of growing trees is to provide 200 trees of functional size per 1000 feet of stream along 60% of the fish-bearing stream length. Functional size means trees with an adequate diameter and length to provide stable key pieces.

    ii.) In cooperation with local groups and federal agencies, refine, by reach or stream type, all the riparian conditions needed to support healthy stocks of salmonids in all coastal streams by 2002.

    iii.) Inventory existing riparian conditions in 20% of coastal salmonid streams per biennium. Re-inventory at a rate of 5% per biennium.

    iv.) Ensure that existing programs prevent, minimize or mitigate the effects of human activities that would adversely affect riparian functions important to salmonids beyond present (1997) conditions.

    v.) Restore riparian conditions so that 75% of all coastal streams have riparian areas capable of supporting healthy stocks of salmonids over the next two decades.

2. Channel morphology:

    i.) The interim stream channel habitat objectives are:
    For 60% of the stream channel length (stream orders 2 -5), 35% of the total stream area is pool; and for 60% of the stream length (orders 2-5) there will be no more than 5-8 channel widths between pools. (Note: while not quantified, improvement in residual pool depth should also occur over time.)

ii.) In cooperation with local groups and federal agencies, refine, by reach or stream type, all the channel morphology parameters needed to support healthy stocks of salmonids in all coastal streams by 2002.

iii.) Inventory existing channel morphology elements in 20% of coastal salmonid streams per biennium. Re-inventory 5% per biennium.

iv.) In coastal streams, ensure that existing programs prevent, minimize or mitigate the effects of human activities that would modify channel morphology, or the upstream and upland processes that generate various morphological features and morphological diversity, to the detriment of salmonids beyond present (1997) conditions.

v.) Where channel morphology in coastal streams has been altered by human activities to the detriment of salmonids, actively restore those channel morphology elements necessary to support healthy salmonid populations, and/or the upstream and upland conditions that will restore those elements naturally, in 5% of altered stream miles per biennium.

3. Substrate changes in streams:

i.) The interim habitat objectives for substrate condition are to provide:
Greater than 35% gravel availability in 70% of the stream length;
In volcanic parent material, less than 8% fines (% area); and
In sedimentary parent material, less than 10% fines (% area).

ii.) In cooperation with local groups and federal agencies, refine, by reach or stream type, all the substrate elements needed to support healthy salmonid stocks in all coastal streams by 2002.

iii.) Inventory existing substrate conditions in 20% of coastal streams per biennium. Re-inventory 5% of the coastal streams per biennium.

iv.) Ensure that existing programs prevent, minimize, or mitigate the effects of human activities that would modify substrate composition in coastal streams, or the upstream and upland processes that generate instream substrate diversity, to the detriment of salmonids beyond present (1997) conditions.

v.) Restore substrate abundance and distribution elements necessary for healthy salmonid stocks, and/or the upstream and upland processes that would replenish them naturally, in 2 to 5% of altered stream miles per biennium.

4. Loss of instream roughness:

   i.) The interim habitat objectives for instream roughness are 50% of the stream length (orders 2-5) will have more than 3 functional key pieces/100 meters of stream length. A functional key piece is woody debris that has adequate length and diameter to be "stable" within a channel.

   ii.) In cooperation with local groups and federal agencies, refine, by reach or stream type, the amount of instream roughness necessary to support healthy salmonid stocks in all coastal streams by 2002.

   iii.) Ensure that existing programs prevent, minimize or mitigate the effects of human activities on present (1997) instream roughness elements important to salmonids.

   iv.) Ensure that instream roughness elements important to salmonids created during floods and other natural events remain in place to the extent consistent with public health and safety.

   v.) In coastal streams deficient in instream roughness elements important to salmonids, actively restore those elements and/or the upstream and upland processes that will restore them naturally, in 5% of deficient stream miles per biennium.

5. Passage impediments:

   i.) Identify all human-created passage impediments to coastal stream segments usable or potentially usable by salmonids, and categorize those segments according to the amount and/or quality of potential habitat, by 2010. Establish and maintain a list of "significant" barriers for restoration priority. "Significant" barriers are barriers that block access to overwintering habitat or that block access to more than 600 feet of stream.

   ii.) Ensure that human activities in coastal streams currently accessible to salmonids do not block or otherwise segment those streams so as to limit accessibility.

   iii.) Remediate 15% of the significant human-created impediments to fish passage in coastal streams per biennium.

6. Loss of wetlands:

   i.) Support healthy stocks of coastal salmonids on all coastal streams by 2001.

ii.) Complete 5% of the remaining coastal wetland inventories per biennium, including the identification of those wetlands that contribute to healthy salmonid populations (all inventories complete by 2014).

iii.) Ensure that existing (1997) coastal wetlands are not filled or otherwise altered by human activities to the detriment of salmonids, or that compensatory mitigation for such filling or alteration is adequate to replace the lost wetland resources.

iv.) Actively restore, enhance or create 100 acres of wetlands that contribute to healthy stocks of salmonids in coastal streams per biennium until there are sufficient wetlands of various types (based on Habitat Objective 5(a)) to support healthy stocks of salmonids.

Appendix VI. Culvert Passage Guidelines developed by National Marine Fisheries Service Environmental & Technical Services Division, Portland, Oregon, March 1, 1996.

GENERAL DESIGN CONSIDERATIONS

Improperly installed culverts restrict or eliminate the passage of anadromous fish, thereby removing large areas of available habitat from use by anadromous fish. In areas where stream crossings must be made, bridges are the alternative preferred by the National Marine Fisheries Service (NMFS) for preserving fish passage, rearing, spawning and holding conditions. If necessary, culverts should only be installed in fish passage corridors, and not in areas known to be used by anadromous fish for spawning, holding or rearing. Exceptions may be made in cases where suitable mitigation can be provided that is acceptable to NMFS. If a project must be constructed in spawning and rearing areas, bridges should be used instead of culverts.

Most Federal, state and tribal fish and wildlife agencies have their own culvert passage criteria. In addition, resident fish may require more stringent criteria than is listed here for anadromous fish. Because of the criteria required to pass resident fish, the appropriate Federal, state and tribal fisheries biologists should be an integral part of the design process when a culvert is proposed in areas under their jurisdiction.

Culverts designs intended for fish passage should include the ability to access the culvert barrel for regular inspection and maintenance. This involves allowance for the capability to walk the entire length of the culvert barrel. Design should allow for debris accumulations to be easily removed from the culvert barrel and at the culvert inlet. The culvert design should limit scouring at the culvert outlet, and allow for correction of scouring when it occurs.

In some streams, upstream juvenile fish migration is an important component of the species life cycle. NMFS will confer with local fisheries biologists to determine if upstream juvenile fish passage occurs. When upstream juvenile fish migration occurs in a basin, culvert designs must include considerations for juvenile fish passage. These designs should be developed jointly with NMFS fish passage experts on a site specific basis.

DEFINITIONS

The passage flow range is defined to include all stream flows between and including the low and high stream flow levels, as defined below.

The passage season should encompass the entire time period when fish are migrating through the proposed project area.

The low design culvert passage flow is defined as the average daily stream flow that is exceeded by 95% of all average daily stream flows expected during the passage season.

The high design culvert passage flow is defined as the average daily stream flow that is exceeded by 10% of all average daily stream flows expected during the passage season.

A culvert operating under outlet control means that the culvert flow is controlled by the downstream water surface elevation, and culvert flow is always independent of the hydraulic conditions at the culvert inlet.

DATA REQUIREMENTS

In order to evaluate a culvert installation for fish passage, the following information is needed:

- Time periods corresponding to migration periods for species and life stages expected at the site.
- 10% and 95% percent exceedence stream flow levels, or
    1) basin drainage area,
    2) average drainage basin slope,
    3) percent vegetation in drainage basin,
    4) percent impervious area in drainage basin (roof structure, parking lot, roads etc.).
- 50 year flood stream flow.
- Culvert diameter, barrel shape, material, length, entrance and exit configuration.
- Stream bed profile and topographic contours (2 foot maximum) above and below the culvert for a distance equal to one culvert length.
- Fish species present in the drainage basin.
- Available right-of-way for culvert installation.
- Stream bedload size.
- Headwater elevation immediately upstream of the culvert.
- Tailwater elevation immediately downstream of the culvert.
- Area maps including contour lines

HYDRAULIC CONDITIONS REQUIRED FOR ADULT FISH PASSAGE

The preferred maximum culvert slope is 1%, with flow velocity between 2 and 4 feet per second (FPS). The minimum flow depth in the culvert occurring during the low design flow should exceed one foot. This can be achieved by back-watering the culvert outlet by placing weirs downstream as necessary to break the water surface profile into one foot drops until the downstream water surface elevation is met. Weirs can be constructed out of anchored logs, timber, concrete or wedged rock. Weirs should concentrate the minimum stream flow by providing a low point, notch or chevron located in the weir at the stream thalweg.

The upstream weir should be installed at least 30 feet downstream from the culvert outlet, to maintain the design hydraulic gradient throughout the project area. The weir immediately below the culvert should be placed with the crest at least one foot above the upstream culvert invert elevation in order to provide a minimum depth of one foot throughout the culvert. Flow must pass over the weirs at a depth of at least 6 inches and a width of at least one foot for the 95% exceedence stream flow.

Jump pools should be excavated below each weirs point of flow concentration. Jump pools should be a minimum of three feet deep during low design flow, and should be about two to three culvert diameters long by one culvert diameter wide.

Many times the preferred culvert slope can not be obtained for a particular culvert installation because of site constraints. In certain cases, Table 1 can be used to determine the maximum allowable water velocity in the culvert. Using the velocity from Table 1, Mannings equation or other hydraulic formulae can be used to calculate the allowable culvert slope.

Table 1: Maximum allowable velocity at maximum design flow

If culvert length is more than	and culvert length is less than or equal to	then, the passage flow velocity should be less than
300 feet		2 FPS
200 feet	300 feet	3 FPS
150 feet	200 feet	4 FPS
100 feet	150 feet	5 FPS
50 feet	100 feet	6 FPS
20 feet	50 feet	8 FPS
	20 feet	11 FPS

Where culvert lengths exceed 150 feet, a bridge installation should be strongly considered. Generally, culverts smaller than six feet in diameter are not adequate for fish passage and should not be used. Culverts less than ten feet in diameter require lighting within the culvert barrel, provided by a vertical riser (above the road surface), or by artificial lighting at least every 75 feet. In some cases, increasing the culvert roughness will allow steeper culvert slopes in order to meet the velocity criteria outlined in Table 1. Roughness can be increased by using techniques such as grouted cobble placement in the culvert bottom, or by installing low profile baffles for the purpose of maintaining the bed load at the design grade and sizing in the culvert. Any method used to increase roughness should be structurally stable during the hydraulic conditions in the culvert during a 100 year flood event.

Baffles or weirs in the culvert barrel should be used only as a last resort. Debris accumulating on these features often compromise fish passage hydraulic conditions, and increase the potential for fish injury during culvert passage. Debris accumulations at the culvert inlet or in the culvert barrel can also lead to catastrophic culvert failure.

Some extreme cases will entail the use of a formal fish ladder to meet the stream gradient at a culvert installation site. These designs are site specific, and NMFS fish passage experts should be consulted.

CULVERT DESIGN REQUIREMENTS

Culverts should be installed using necessary precaution to prevent scouring of fill material used in construction in and around the culvert. All fill material should be able to withstand a 100-year flood event. In some cases, mechanical structure will be required to retain bed material within the culvert.

Trashracks should not be used at the culvert inlet, because debris accumulations will restrict or eliminate fish passage, and potentially injure fish.

The type of culvert preferred for fish passage is an open-bottom or arch culvert. In cases where an unstable stream bed is present at the culvert installation site, the use of an open bottom culvert may be required to allow stream bed grade changes within the culvert. However, due to foundation limitations at some sites, installing open bottom culverts may not be feasible. Round, square or elliptical culverts can also be used providing they are countersunk at least 20% of the culvert height. Culvert design should pass the 50-year flood event without filling the culvert barrel entirely, using only the area above the countersunk portion.

At low design flow, head loss at a culvert inlet should be small, on the order of 0.1 feet. This can be accomplished by suitably designing the entrance (for example, designs using flared and mitered wing walls) or by grossly over-sizing the culvert.

No perched outlet is allowable at the culvert exit. At normal passage flows, the water surface elevation in the culvert barrel should equal the water surface immediately downstream of the culvert exit. Culvert design should guarantee that flow will always be under outlet control, at least for stream flows up to the maximum fish passage flow.

Where sub-surface flow may occur, cut-off walls shall be included in the culvert and in the downstream weir designs.

The culvert design shall include protection of the culvert from scour, using materials that will withstand a 100 year flood.

CONSTRUCTION REQUIREMENTS

Culverts shall only be installed in a de-watered site, with a sediment control and flow routing plan acceptable to NMFS.

Culverts shall not be placed when construction activities will adversely impact fish migration or spawning. Acceptable in-stream work windows will be negotiated with local Federal, state and tribal fisheries biologists and will be included in the culvert installation contract.

Culvert installation sites shall be re-vegetated with native vegetation, upon completion of construction.

Appendix VII. Juvenile Fish Screen Criteria

Developed by
National Marine Fisheries Service
Environmental & Technical Services Division
Portland, Oregon
Revised February 16, 1995

I. General Considerations:

This document provides guidelines and criteria to be utilized in the development of functional designs of downstream migrant fish passage facilities for hydroelectric, irrigation, and other water withdrawal projects. This material has been prepared by the National Marine Fisheries Service (NMFS) as a direct result of responsibilities for prescribing fishways (including fish screen and bypass systems) under Section 18 of the Federal Power Act, administered by the Federal Energy Regulatory Commission (FERC). This material is also applicable for projects that are undergoing consultation with the NMFS, pursuant to responsibilities for protecting fish under the Endangered Species Act (ESA).

Since these guidelines and criteria are general in nature, there may be cases where site constraints or extenuating circumstances dictate that certain criteria be waived or modified. Conversely, where there is a need to provide additional protection for fish, site-specific criteria may be added. These circumstances will be considered by NMFS on a project-by-project basis.

In designing an effective fish screen facility, the swimming ability of the fish is a primary consideration. Research has shown that swimming ability of fish varies and may depend upon a number of factors relating to the physiology of the fish, including species, size, duration of swimming time required, behavioral aspects, migrational stage, physical condition and others, in addition to water quality parameters such as dissolved oxygen concentrations, water temperature, lighting conditions, and others. For this reason, screen criteria must be expressed in general terms.

To minimize risks to anadromous fish at some locations, the NMFS may require investigation (by the project sponsors) of important and poorly defined site-specific variables that are deemed critical to development of the screen and bypass design. This investigation may include factors such as fish behavioral response to hydraulic conditions, weather conditions (ice, wind, flooding, etc.), river stage-discharge relationships, seasonal operational variability, potential for sediment and debris problems, resident fish populations, potential for creating predation opportunity, and other information. The size of salmonids present at a potential screen site usually is not known, and can change from year to year based on flow and temperature conditions. Thus, adequate data to describe the size-time relationship requires substantial sampling efforts over a number of years. The NMFS will assume that fry-sized salmonids and low water temperatures are present at all sites and apply the appropriate criteria listed below, unless adequate biological investigation proves otherwise. The burden-of-proof is the responsibility of the owner of the screen facility.

Proposed facilities which could have particularly significant impacts on fish, and new unproven juvenile fish protection designs, frequently require: 1) development of a biological basis for the concept; 2) demonstration of favorable fish behavioral response in a laboratory setting; 3) an acceptable plan for evaluating the prototype installation; and 4) an acceptable alternate plan developed concurrently for a screen and bypass system satisfying these criteria, should the prototype not adequately protect fish. Additional information on unproven juvenile fish protection devices can be found in "Experimental Fish Guidance Devices," Position Statement of the National Marine Fisheries Service, Northwest Region, January 6, 1995.

Screen and bypass criteria for juvenile salmonids are provided below. Specific exceptions to these criteria occur in the design of small screen and bypass systems (less than 25 cubic feet per second). These are listed in Section K, Modified Criteria for Small Screens.

Striped bass, herring, shad, and other anadromous fish species may have eggs and/or very small fry which are moved with any water current (tides, streamflows, etc.). Installations where these species are present may require special screen and/or bypass facilities, including micro-screens and require individual evaluation of the proposed project. In instances where local regulatory agencies require more stringent screening requirements for species of resident or anadromous fish, the NMFS will generally defer to the more conservative criteria.

II. General Procedural Guidelines

A functional design should be developed that defines type, location, size, hydraulic capacity, method of operation, and other pertinent juvenile fish screen facility characteristics. In the case of applications to be submitted to the FERC and consultations under the ESA, a functional design for juvenile (and adult) fish passage facilities must be developed and submitted as part of the application. It must reflect the NMFS input and design criteria and be acceptable to the NMFS. Functional design drawings must show all pertinent hydraulic information, including water surface elevations and flows through various areas of the structures. Functional design drawings must show general structural sizes, cross-sectional shapes, and elevations. Types of materials must be identified where they will directly affect fish. The final detailed design shall be based on the functional design, unless changes are agreed to by the NMFS.

All juvenile passage facilities shall be designed to function properly through the full range of hydraulic conditions in the lake, tidal area, or stream and in the diversion, and shall account for debris and sedimentation conditions which may occur.

III. Screen Criteria For Juvenile Salmonids

A. Structure Placement

1. Streams and Rivers:

a. **Where physically practical and biologically desirable, the screen shall be constructed at the diversion entrance** with the screen face generally parallel to river flow. Physical factors that may preclude screen construction at the diversion entrance include excess river gradient, potential for damage by large debris, and potential for heavy sedimentation. For screens constructed at the bankline, the screen face shall be aligned with the adjacent bankline and the bankline shall be shaped to smoothly match the face of the screen structure to prevent eddies in front, upstream, and downstream of the screen. If trash racks are used, sufficient hydraulic gradient is required to route juvenile fish from between the trash rack and screens to safety.

b. **Where installation of fish screens at the diversion entrance is not desirable or impractical**, the screens may be installed in the canal downstream of the entrance at a suitable location. All screens installed downstream from the diversion entrance shall be provided with an effective bypass system approved by NMFS, designed to collect juvenile fish and safely transport them back to the river with minimum delay. The angle of the screen to flow should be adequate to effectively guide fish to the bypass (see Section F, Bypass Layout).

2. Lakes, Reservoirs and Tidal areas:

a. **Intakes shall be located offshore** where feasible to minimize fish contact with the facility. Water velocity from any direction toward the screen shall not exceed allowable approach velocities (see Section B, Approach Velocity). When possible, intakes shall be located in areas with sufficient sweeping velocity to minimize sediment accumulation in or around the screen and to facilitate debris removal and fish movement away from the screen face (see Section C, Sweeping Velocity).

b. If a **screened intake is used to route fish past a dam**, the intake shall be designed to withdraw water from the most appropriate elevation based on providing the best juvenile fish attraction and appropriate water temperature control downstream of the project. The entire range of forebay fluctuation shall be accommodated in design, unless otherwise approved by the NMFS.

B. Approach Velocity - Definition: Approach velocity is the water velocity component perpendicular to and approximately three inches in front of the screen face.

1. **Salmonid fry** [less than 2.36 inches {60.0 millimeters (mm)} in length]: The approach velocity shall not exceed 0.40 feet per second (fps) {0.12 meters per second (mps)}.

2. **Salmonid fingerling** {2.36 inches (60.0 mm) and longer}: The approach velocity shall not exceed 0.80 fps (0.24 mps).

3. The **total submerged screen area required** (excluding area affected by structural components) is calculated by dividing the maximum diverted flow by the allowable approach velocity (also see Section K, Modified Criteria for Small Screens).

4. The screen design must provide for **uniform flow distribution** over the screen surface, thereby minimizing approach velocity. This may be accomplished by providing **adjustable porosity control** on the downstream side of screens, unless it can be shown unequivocally (such as with a physical hydraulic model study) that localized areas of high velocity can be avoided at all flows.

C. Sweeping Velocity - Definition: Sweeping velocity is the water velocity component parallel and adjacent to the screen face.

1. Sweeping velocity shall be **greater than the approach velocity**. This is accomplished by angling the screen face at less than 45° relative to flow (also see Section K, Modified Criteria for Small Screens). This angle may be dictated by site specific canal geometry, hydraulic, and sediment conditions.

D. Screen Face Material

1. **Fry criteria** - If biological justification can not be provided to demonstrate the absence of fry-sized salmonids {less than 2.36 inches (60.0 mm)} in the vicinity of the diversion intake leading to the screen, fry will be assumed present and the following criteria apply for screen material:

    a. **Perforated plate:** Screen openings shall not exceed **3/32 or 0.0938 inches** (2.38 mm).

    b. **Profile bar screen:** The narrowest dimension in the screen openings shall not exceed **0.0689 inches** (1.75 mm) in the narrow direction.

    c. **Woven wire screen:** Screen openings shall not exceed **3/32 or 0.0938 inches** (2.38 mm) in the narrow direction (example: 6-14 mesh).

    d. Screen material shall provide a minimum of **27% open area**.

2. **Fingerling criteria** - If biological justification can be provided to demonstrate the absence of fry-sized salmonids {less than 2.36 inches (60.0 mm)} in the vicinity of the diversion intake leading to the screen, the following criteria apply for screen material:

a. **Perforated plate:** Screen openings shall not exceed **1/4 or 0.25 inches** (6.35 mm).

b. **Profile bar screen:** The narrowest dimension in the screen openings shall not exceed **1/4 or 0.25 inches** (6.35 mm) in the narrow direction.

c. **Woven wire screen:** Screen openings shall not exceed **1/4 or 0.25 inches** (6.35 mm) in the narrow direction.

d. Screen material shall provide a minimum of **40% open area**.

3. The screen material shall be **corrosion resistant** and sufficiently durable to maintain a smooth uniform surface with long term use.

E. Civil Works and Structural Features

1. The face of all **screen surfaces shall be placed flush** (to the extent possible) with any adjacent screen bay, pier noses, and walls to allow fish unimpeded movement parallel to the screen face and ready access to bypass routes.

2. Structural features shall be provided to **protect the integrity of the fish screens** from large debris. Provision of a **trash rack, log boom, sediment sluice**, and other measures may be needed. A reliable, ongoing **preventative maintenance and repair program** is necessary to assure facilities are kept free of debris and that screen mesh, seals, drive units, and other components are functioning correctly.

3. Screen surfaces shall be constructed at an angle to the approaching flow, with the downstream end of the **screen terminating at the entrance to the bypass system**.

4. The civil works shall be designed in a manner that **eliminates undesirable hydraulic effects** (such as eddies and stagnant flow zones) that may delay or injure fish or provide predator habitat or predator access. **Upstream training wall(s)**, or some acceptable variation thereof, shall be utilized to control hydraulic conditions and define the angle of flow to the screen face. Large facilities **may require hydraulic modeling** to identify and correct areas of concern.

F. Bypass Layout

1. The **screen and bypass shall work in tandem** to move out-migrating salmonids (including adults) to the bypass outfall with a minimum of injury or delay. The bypass entrance shall be located so that it can easily be located by out-migrants. Screens placed in diversions shall be constructed with the downstream end of the **screen terminating at a bypass entrance**.

Multiple bypass entrances (intermediate bypasses) shall be employed if the sweeping velocity will not move fish to the bypass within 60 seconds, assuming fish are transported at this velocity.

2. The bypass entrance and all components of the bypass system shall be of **sufficient size and hydraulic capacity to minimize the potential for debris blockage**.

3. In order to improve bypass collection efficiency for a single bank of vertically-oriented screens, a **bypass training wall** shall be located at an angle to the screens, with the bypass entrance at the apex and downstream-most point. This will aid fish movement into the bypass by creating hydraulic conditions that conform to observed fish behavior. For single or multiple vee screen configurations, training walls are not required, unless a intermediate bypass is used (see Section F, Bypass Layout, Part 1).

4. In cases where there is insufficient flow available to satisfy hydraulic requirements at the bypass entrance (entrances) for the main screens, a **secondary screen** may be required. This is a screen located in the main screen bypass which allows the prescribed bypass flow to be used to effectively attract fish into the bypass entrance(s) and then allow for all but a reduced residual bypass flow to be routed back (by pump or gravity) for the primary diversion use. The residual bypass flow (not passing through the secondary screen) would then convey fish to the bypass outfall location or other destination.

5. **Access is required** at locations in the bypass system where debris accumulations may occur.

6. The **screen civil works floor** shall be designed to allow fish to be routed back to the river safely, if the canal is dewatered. This may entail a sumped drain with a small gate and drain pipe, or similar provisions.

G. Bypass Entrance

1. Each bypass entrance shall be provided with **independent flow-control capability**, acceptable to NMFS.

2. The **minimum bypass entrance flow velocity** must be greater than or equal to the maximum flow velocity vector resultant upstream of the screens. A gradual and efficient acceleration of flow into the bypass entrance is required to minimize delay by out-migrants.

3. **Ambient lighting conditions** are required at, and inside of, the bypass entrance and should extend downstream to the bypass flow control.

4. The **bypass entrance** must extend from the floor to the canal water surface.

H. Bypass Conduit Design

1. Bypass pipes shall have **smooth surfaces** and be designed to provide conditions that minimize turbulence. Bypass conduits shall have a **smooth joint design** to minimize turbulence and the potential for fish injury and shall be satisfactory to the NMFS.

2. Fish shall **not be pumped** within the bypass system.

3. Fish shall **not be allowed to free-fall within a confined shaft** in a bypass system.

4. **Pressures in the bypass pipe** shall be equal to or above atmospheric pressures.

5. **Bends shall be avoided** in the layout of bypass pipes due to the potential for debris clogging. **Bypass pipe center-line radius of curvature** (R/D) shall be greater than or equal to 5. Greater R/D may be required for super-critical velocities.

6. Bypass pipes or open channels shall be designed to **minimize debris clogging and sediment deposition** and to facilitate cleaning as necessary. Therefore, the required pipe diameter shall be greater than or equal to 24 inches {0.610 meters (m)}, and pipe velocity shall be greater than 2.0 fps (0.610 mps), unless otherwise approved by the NMFS, for the entire operational range (also see Section K, Modified Criteria for Small Screens, Part 4).

7. **Closure valves** of any type are not allowed within the bypass pipe, unless approved by NMFS.

8. The **minimum depth** of open-channel flow in a bypass conduit shall be greater than or equal to 0.75 feet (0.23 m), unless otherwise approved by the NMFS (also see Section K, Modified Criteria for Small Screens, Part 5).

9. **Sampling facilities** installed in the bypass conduit shall not impair normal operation of the facility.

10. The bypass pipe hydraulics should not produce a **hydraulic jump** within the pipe.

I. Bypass Outfall

1. Bypass outfalls should be located such that **ambient river velocities** are greater than 4.0 fps (1.2 mps).

2. Bypass outfalls shall be **located to minimize avian and aquatic predation** in areas free of eddies, reverse flow, or known predator habitat.

3. Bypass outfalls shall be **located where the receiving water is of sufficient depth** (depending on the impact velocity and quantity of bypass flow) to ensure that fish injuries are avoided at all river and bypass flows.

4. Maximum bypass outfall **impact velocity** (including vertical and horizontal velocity components) shall be less than 25.0 fps (7.6 mps).

5. The bypass outfall discharge into tailrace shall be designed to **avoid adult attraction or jumping injuries**.

J. Operations and Maintenance

1. Fish screens shall be **automatically cleaned** as frequently as necessary to prevent accumulation of debris. The cleaning system and protocol must be effective, reliable, and satisfactory to the NMFS. Proven cleaning technologies are preferred.

2. Open channel intakes shall include a trash rack in the screen facility design which shall be kept free of debris. In certain cases, a satisfactory profile bar screen design can substitute for a trash rack.

3. The head differential to trigger screen cleaning for intermittent type cleaning systems shall be a maximum of 0.1 feet (0.03 m) or as agreed to by the NMFS.

4. The completed screen and bypass facility shall be made available for inspection by NMFS, to verify compliance with the design and operational criteria.

5. Screen and bypass facilities shall be evaluated for biological effectiveness and to verify that hydraulic design objectives are achieved.

K. Modified Criteria for Small Screens (Diversion flow less than 25 cfs)

The following criteria vary from the criteria listed above and apply to smaller screens. Twenty-five cfs is an approximate cutoff; however, some smaller diversions may be required to apply more universal criteria listed above, while some larger diversions may be allowed to use the "small screen" criteria listed below. This will depend on site constraints.

1. The **screen area required** is shown in Section B, Approach Velocity, Parts 1, 2 and 3. Note that "maximum" applies to the greatest flow diverted, not necessarily the water right.

2. **Screen orientation**:

a. For **screen lengths less than or equal to 4 feet**, screen orientation may be angled or perpendicular relative to flow.

b. For **screen lengths greater than 4 feet**, screen-to-flow angles must be **less than or equal to 45 degrees** (see Section C, Sweeping Velocity, Part 1).

c. For drum screens, the **design submergence shall be 75%** of drum diameter. Submergence shall not exceed 85%, nor be less than 65% of drum diameter.

3. The **minimum bypass pipe diameter shall be 10 inches**, unless otherwise approved by NMFS.

4. The **minimum allowable pipe depth is 0.15 feet** (1.8 inches or 4.6 cm) and is controlled by designing the pipe gradient for minimum bypass flow.

Questions concerning this document can be directed to NMFS Hydropower Division Engineering staff, at 503-230-5400.