Northwest Fisheries Science Center Processed Report

Final Economic Analysis of Critical Habitat Designation for the Oregon Coast coho ESU

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
NOAA Fisheries
Northwest Fisheries Science Center
2725 Montlake Blvd. East
Seattle, WA 98112-2097

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FOREWORD

This report is based on the methods developed and data gathered for the 2005 designation of critical habitat for 12 ESUs of West Coast salmon and steelhead (70 FR 52630) as described in NMFS (2005d). When critical habitat for West Coast salmon and steelhead was proposed in 2004 (69 FR 74572), the Oregon Coast coho ESU was included in the proposed rule. For reasons discussed in Section 1.2, the ESU was not included in the final designations published in 2005. The methods and data described in NMFS (2005d), however, are the same as those used for this final designation of critical habitat for the Oregon Coast coho ESU. For that reason, we have adapted NMFS (2005d) for the current designation, using data gathered to support the 2004 proposed designation of critical habitat for the Oregon Coast coho ESU. Where appropriate, we have updated description, methods, and data to reflect the limitation of the analysis to that ESU.

Executive Summary
Draft Final Economic Analysis of Critical Habitat Designation for the Oregon Coast coho ESU

ES.1 Introduction

The National Marine Fisheries Service (NOAA Fisheries) is designating critical habitat for the Oregon Coast coho ESU. Section 4(b)(2) of the ESA requires NOAA Fisheries to consider the economic, national security, and other impacts of designating a particular area as critical habitat. NOAA Fisheries may exclude an area from critical habitat if it determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless it also determines that the failure to designate such area as critical habitat will result in the extinction of the species concerned.

In general, West Coast salmon and steelhead migrate through a broad range of interconnected habitats. For that reason, implementation of section 7 of the ESA has potentially large economic and other impacts. Federal agencies and other parties that are federally funded, have a federal permit, or otherwise have a "nexus"[1] with a federal agency, must modify actions that potentially jeopardize listed salmon and steelhead or adversely modify habitat designated as critical. These modifications have economic costs and other negative impacts, ranging in magnitude from modest to hundreds of millions of dollars. To the extent that the modifications enhance salmon and steelhead habitat, they also have beneficial impacts, to the fish species and possibly to other species and elements of the affected ecosystems.

For reasons discussed later, this report focuses on the economic costs of critical habitat designation. This focus does not mean that the beneficial and non-economic impacts of critical habitat designation have been overlooked and not incorporated into the designation process. NOAA Fisheries has chosen to express the benefits of designation in terms of the conservation value of designating a particular area as critical habitat. These benefits are gauged with a biological metric and are the subject of a separate report (NMFS, 2007a).

ES.2 Background

NOAA Fisheries is responsible for determining whether species, subspecies, or distinct population segments of West Coast salmon and steelhead are threatened or endangered, and which areas constitute critical habitat for them under the ESA (16 U.S.C. 1531 et seq). To be considered for listing under the ESA, a group of organisms must constitute a "species." Section 3 of the ESA defines a species as follows: "any subspecies of fish or wildlife or plants, and any distinct

1. We use the term "federal nexus" or "nexus" to refer to activities or projects that the Federal government carries out or funds, or for which it issues a permit.

population segment of any species of vertebrate fish or wildlife which interbreeds when mature." The agency has determined that a group of Pacific salmon or steelhead populations qualifies as a distinct population segment if it is substantially reproductively isolated and represents an important component in the evolutionary legacy of the biological species. A group of populations meeting these criteria is considered an "evolutionarily significant unit" (ESU) (56 FR 58612, November 20, 1991). In its ESA listing determinations for West Coast salmon and steelhead, NOAA Fisheries has treated an ESU as a distinct population segment and to date has identified six species comprised of 52 ESUs in Washington, Oregon, Idaho, and California.

Section 4(b)(2) of the ESA requires NOAA Fisheries to designate critical habitat for threatened and endangered species "on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security and any other relevant impact, of specifying any particular area as critical habitat." This section grants the Secretary [of Commerce] discretion to exclude any area from critical habitat if he determines "the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat." The Secretary's discretion is limited, as he may not exclude areas if it "will result in the extinction of the species."

The ESA defines critical habitat under section 3(5)(A) as:

> (I) the specific areas within the geographical area occupied by the species, at the time it is listed . . ., on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
> (ii) specific areas outside the geographical area occupied by the species at the time it is listed . . . upon a determination by the Secretary that such areas are essential for the conservation of the species.

Once critical habitat is designated, section 7 of the ESA requires federal agencies to ensure they do not fund, authorize, or carry out any actions that will destroy or adversely modify that habitat. This requirement is in addition to the section 7 requirement that federal agencies ensure their actions do not jeopardize the continued existence of listed species.

In 1995, we completed a comprehensive status review of West Coast coho salmon (Weitkamp et al., 1995) that resulted in proposed listing determinations for three coho ESUs, including a proposal to list the Oregon Coast coho ESU as a threatened species (60 FR 38011; July 25, 1995). On October 31, 1996, we announced a 6-month extension of the final listing determination for the ESU, pursuant to section 4(b)(6)(B)(I) of the ESA, noting substantial disagreement regarding the sufficiency and accuracy of the available data relevant to the assessment of extinction risk and the evaluation of protective efforts (61 FR 56211). On May 6, 1997, we withdrew the proposal to list the Oregon Coast coho ESU as threatened, based in part on conservation measures contained in the Oregon Coastal Salmon Restoration Initiative (later renamed the Oregon Plan for Salmon and Watersheds; hereafter referred to as the Oregon Plan) and an April 23, 1997, Memorandum of Agreement (MOA) between NMFS and the State of Oregon which further defined Oregon's commitment to salmon conservation (62 FR 24588). We concluded that implementation of harvest and hatchery reforms, and habitat protection and restoration efforts under the Oregon Plan and the MOA substantially reduced the risk of extinction faced by the Oregon Coast coho ESU. On June 1, 1998, the Federal District Court for the District of Oregon issued an opinion finding that our May 6, 1997, determination to not list Oregon Coast coho was arbitrary and capricious (Oregon Natural Resources Council v. Daley, 6 F. Supp. 2d 1139 (D. Or. 1998)). The Court vacated our determination to withdraw the proposed rule to list the Oregon Coast coho ESU and remanded the determination to NMFS for further consideration. On August 10, 1998, we issued a final rule listing the Oregon Coast coho ESU as threatened (63 FR 42587), basing the determination solely on the information and data contained in the 1995 status review (Weitkamp et al., 1995) and the 1997 proposed rule (62 FR 24588; May 6, 1997).

In 2001 the U.S. District Court in Eugene, Oregon, set aside the 1998 threatened listing of the Oregon Coast coho ESU (Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154, (D. Or. 2001)) (Alsea decision). In response to the Alsea ruling and several listing and delisting petitions, we announced that we would conduct an updated status review of 27 West Coast salmonid ESUs, including the Oregon Coast coho ESU (67 FR 6215, February 11, 2002; 67 FR 48601, July 25, 2002).

In 2003 we convened the Pacific Salmonid Biological Review Team (BRT) (an expert panel of scientists from several Federal agencies including NMFS, the U.S. Fish and Wildlife Service (FWS), and the U.S. Geological Survey) to review extinction risk of naturally spawning populations in the 27 ESUs under review, including the Oregon Coast coho ESU (Good et al., 2005; NMFS, 2003l). A slight majority of the BRT concluded that the naturally spawning populations in the Oregon Coast coho ESU were likely to become endangered, noting that short-term risks were alleviated by encouragingly high escapements in recent years (2001-2002). The BRT noted considerable uncertainty regarding the future viability of the ESU given the uncertainty in predicting future ocean conditions for coho survival, as well as uncertainty in whether current freshwater habitats are of sufficient quality and quantity to support the recent high abundance levels and sustain populations during future downturns in ocean conditions. Although the BRT couched its conclusion in terms of the statutory definition of a threatened species (that is, not in danger of extinction, but likely to become endangered in the foreseeable future), the BRT's conclusion did not a constitute a recommendation to list species. Our listing determination also considered the risks and benefits from artificial propagation programs included in the ESU, efforts being made to protect the species, and the five factors listed under section 4(a)(1) of the ESA.

On June 14, 2004, we proposed to list the Oregon Coast coho ESU as a threatened species (69 FR 33102). In the proposed rule, we noted that Oregon was initiating a comprehensive assessment of the viability of the Oregon Coast coho ESU and of the adequacy of actions under the Oregon Plan for conserving Oregon Coast coho. As part of that proposed rule we proposed amendments to existing 4(d) protective regulations for all threatened West Coast salmon and steelhead. These amendments were needed to: (1) provide flexibility in fisheries and hatchery management, and (2) simplify and clarify the existing regulations so that they may be more efficiently and effectively accessed and interpreted by all affected parties.

On December 14, 2004, we proposed designations of critical habitat for 13 ESUs of Pacific salmon and steelhead in the Pacific Northwest, including the Oregon Coast coho ESU (69 FR 74572). We proposed critical habitat in 72 of 80 occupied watersheds, contained in 13 subbasins, totaling approximately 6,665 stream miles along the Oregon Coast, south of the Columbia River and north of Cape Blanco (Oregon). The estimated economic impact of the areas proposed for critical habitat was approximately $15.7 million. Eight occupied watersheds were proposed for exclusion because the high benefits of exclusion (due to economic impacts) outweighed the low benefits of inclusion (due to the low inherent conservation value for the listed species). These excluded watersheds included approximately 134 stream miles and represented a 15 percent reduction (approximately $2.75 million) in the economic impact of the proposed designation. In assessing economic impacts, we did not distinguish between the costs associated with the species listing from the costs of separately designating critical habitat.

In January 2005 the State of Oregon released a draft Oregon Coastal Coho Assessment (Oregon's Draft Viability Assessment), which (1) evaluated the current viability of the Oregon Coast coho ESU, and (2) evaluated the certainty of implementation and effectiveness of the Oregon Plan measures in addressing the factors for decline of the Oregon Coast coho ESU. The latter evaluation was intended to satisfy the joint NMFS – FWS Policy on Evaluating Conservation Efforts ("PECE"; 68 FR 15100, March 28, 2003). Oregon's Draft Viability Assessment concluded that the Oregon Coast coho ESU is currently viable and that measures under the Oregon Plan have stopped, if not reversed, the deterioration of Oregon Coast coho habitats. The Draft Viability Assessment also concluded that it is highly likely that existing monitoring efforts will detect any significant future deterioration in the ESU's viability, or degradation of environmental condition, allowing a timely and appropriate response to conserve the ESU. On February 9, 2005, we published a notice of availability of Oregon's Draft Viability Assessment for public review and comment in the Federal Register (70 FR 6840) and noted that information presented in the draft and final assessments would be considered in developing the final listing determination for the Oregon Coast coho ESU.

We forwarded the public comments we received on Oregon's Draft Viability Assessment, as well as our technical reviews, for Oregon's consideration in developing its final assessment. The public comments and our review highlighted areas of uncertainty or disagreement regarding the sufficiency and accuracy of Oregon's Draft Viability Assessment, including: the assumption that Oregon Coast coho populations are inherently resilient at low abundance, and that this compensatory response will prevent extinction during periods of low marine survival; the apparent de-emphasis of abundance as a useful indicator of extinction risk; assumptions regarding the duration and severity of future periods of unfavorable marine and freshwater conditions; the ability of monitoring and adaptive management efforts to detect population declines or habitat degradation, and to identify and implement necessary protective measures; and the ability of Oregon Plan measures to halt or reverse habitat degradation once detected.

On May 13, 2005, Oregon issued its final Oregon Coastal Coho Assessment (Oregon's Final Viability Assessment). Oregon's Final Viability Assessment included several changes intended to address concerns raised regarding the sufficiency and accuracy of the draft assessment. Oregon's Final Viability Assessment concluded that: (1) the Oregon Coast coho ESU is viable under current conditions, and should be sustainable through a future period of adverse environmental conditions (including a prolonged period of poor ocean productivity); (2) given the assessed viability of the ESU, the quality and quantity of habitat is necessarily sufficient to support a viable ESU; and (3) the integration of laws, adaptive management programs, and monitoring efforts under the Oregon Plan will maintain and improve environmental conditions and the viability of the ESU into the foreseeable future.

On June 28, 2005 (70 FR 37217), we announced a 6-month extension of the final listing determination for the Oregon Coast coho ESU, finding that "there is substantial disagreement regarding the sufficiency or accuracy of the available data relevant to the determination . . . for the purposes of soliciting additional data" (section 4(b)(6)(B)(I)). We announced a 30-day public comment period to solicit information regarding the validity of Oregon's Final Viability Assessment, particularly in light of the concerns raised with respect to Oregon's Draft Viability Assessment.

On January 19, 2006, we issued a final determination that listing the Oregon Coast coho ESU under the ESA was "not warranted." As part of this determination, we withdrew the proposed 4(d) protective regulations and critical habitat designation for the ESU. In reaching our determination not to list Oregon Coast coho, we found that the BRT's slight majority opinion that the ESU is "likely to become endangered" and the conclusion of Oregon Final Viability Assessment that the ESU is viable represented competing reasonable inferences from the available scientific information and considerable associated uncertainty. The difference of opinion centered on whether the ESU was at risk because of the "threatened destruction, modification, or curtailment of its habitat or range." We conducted an analysis of current habitat status and likely future habitat trends (NMFS, 2005j) and found that: (1) the sufficiency of current habitat conditions was unknown; and (2) likely future habitat trends were mixed (i.e., some habitat elements were likely to improve, some were likely to decline, others were likely to remain in their current condition). We concluded that there was insufficient evidence to support the conclusion that the ESU was <u>more likely than not</u> to become an endangered species in the foreseeable future throughout all or a significant portion of its range.

Our decision not to list the Oregon Coast coho ESU was challenged in <u>Trout Unlimited III</u> <u>v</u>. <u>Lohn</u>. On October 9, 2007, the U.S. District Court for the District of Oregon invalidated our January 2006 decision not to list Oregon Coast coho. The Court found that Oregon's Viability Assessment does not represent the best available science, and that we improperly considered it in reaching our final listing decision. The Court ordered us to issue a new decision on listing consistent with the ESA. As a result of that order, NOAA Fisheries is listing the Oregon Coast coho ESU as a threatened species and designating critical habitat. This report supports this decision by providing information on the economic impacts of critical habitat designation.

ES.3 Framework for the 4(b)(2) Exclusion Process

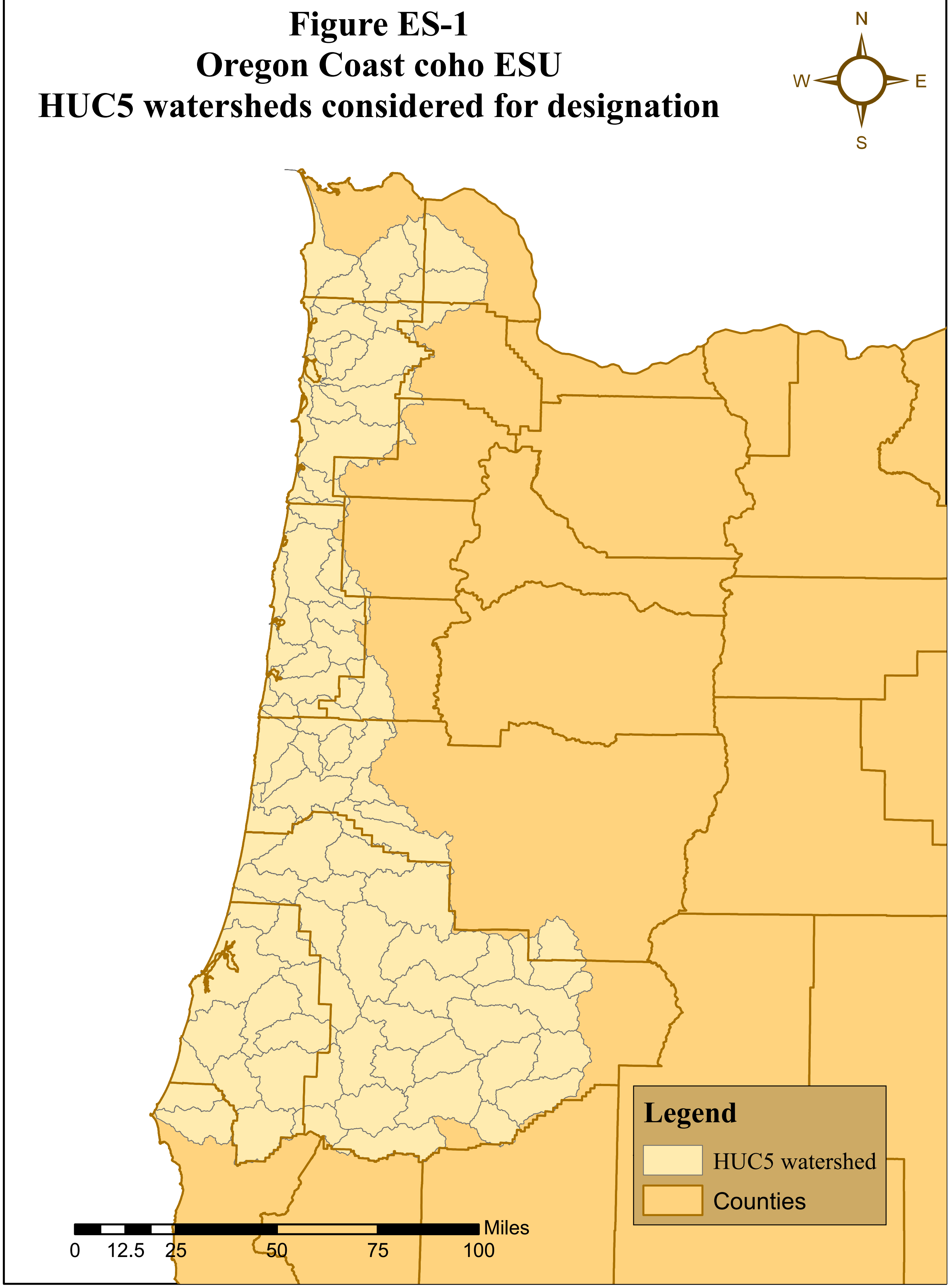
Under section 4(b)(2) of the ESA, the Secretary of Commerce may exclude a "particular area" from critical habitat designation based on a comparison of the benefits of excluding that area and the benefits of including it. The 4(b)(2) exclusion process therefore operates at a geographic scale that (potentially) divides the area(s) under consideration into smaller subareas. The statute does not specify the exact geographic scale of these subareas, nor does it dictate the form of the economic analysis and the nature of the impacts to be included in the analysis.

For the purposes of this report, a "particular area" is defined as a standard watershed unit, as mapped by the U.S. Geological Service and designated by fifth field hydrologic unit codes, or HUC5s, referred to below as "watersheds." Figure ES-1 shows the HUC5 watersheds the Oregon Coast coho ESU. Table ES-1 below lists demographic and economic characteristics of the ESU. This table includes all 80 watersheds considered for critical habitat designation, not just those that are part of the final designation.

Table ES-1
Demographic and Economic Characteristics of Oregon Coast coho ESU

ESU characteristic	Counties	ESU portion of county
Population	1,583,067	266,690
Area (sq. miles)	23,666.00	10,442.30
Population Density	66.9	25.5
Personal Income ($1000)	$42,324,751	$6,135,714
Total Employment	890,001	141,751

Figure ES-1
Oregon Coast coho ESU
HUC5 watersheds considered for designation



Economic analyses of regulatory actions commonly use a standard benefit-cost framework. Conceptually, the "benefits of exclusion," which is essentially the language used in section 4(b)(2) of the ESA, are identical to the "costs of inclusion," and so estimates of these costs could be used in a benefit-cost framework. For reasons discussed here and in NMFS (2007b), NOAA Fisheries has chosen a framework more akin to a cost-effectiveness one for the purpose of conducting a portion of the 4(b)(2) exclusion process. Ideally, a cost-effectiveness analysis would first quantify the benefits of designating a watershed as critical habitat using, for example, a biological metric such as the percent reduction in extinction risk, percent increase in productivity, or increase in numbers of fish. Given the state of the science, it is difficult to quantify the benefits of critical habitat designation reliably. It is possible, however, to differentiate among habitat areas based on their relative contribution to conservation. For example, habitat areas can be rated as having a high, medium, or low conservation value. Such a rating is based on best professional judgment.

The qualitative ordinal evaluations of conservation value can be combined with estimates of the economic costs of including an area in the critical habitat designation in a framework that essentially adopts that of cost-effectiveness. Individual habitat areas can then be assessed for possible exclusion using both their biological evaluation and economic cost, so that areas with high conservation value and low economic cost have a higher priority for designation and areas with a low conservation value and high economic cost have a higher priority for exclusion.

ES.4 Framework for the Economic Analysis

Because the 4(b)(2) process does not utilize monetized estimates of the benefits of critical habitat designation, this analysis focuses on the monetized costs of designation. The analysis follows the standard approach to regulatory analysis: The regulation under consideration changes the state of the world and any resulting changes in economic activity are then attributed to the regulation. This approach has been called the "baseline approach." It does not assume the world will remain unchanged in the absence of regulation. Instead, it projects a future course of the world as a baseline, one which may involve substantial changes in economic and other conditions. It then projects another course in which the regulation has taken effect. The impacts of the regulation are then analyzed in terms of the differences between the two courses. Changes that would exist in the absence of the regulation are included in the baseline, and so do not add to the regulation's benefits or costs.

Applying this approach to the designation of critical habitat takes the following steps:

1. Identify the baseline of economic activity and the statues and regulations that constrain that activity in the absence of the critical habitat designation;
2. Identify the types of activities that are likely to be impacted by critical habitat designation;
3. Estimate the costs of modifications needed to bring the activity into compliance with the ESA's critical habitat provisions;

4. Project over space and time the occurrence of the activities and the likelihood they will in fact need to be modified; and
5. Aggregate the costs up to the watershed level.

The 4(b)(2) process addresses the following question: For the Oregon Coast coho ESU, do the benefits of excluding a particular watershed as critical habitat (which we refer to as the costs of designation) outweigh the benefits of designating that watershed? If the answer is affirmative, the watershed is considered for exclusion.[2] Although the economic analysis laid out in this report is best suited for a regulatory decision at this watershed-level, it is possible to use the results to estimate impacts at the ESU level. We present results below for both of these levels.

In considering the first step of this framework, the first part of identifying the baseline is to document the socioeconomic characteristics of the area covered by a critical habitat designation. Ideally, this part would include a projection of economic activity in this area over the time period under consideration. Adequate data are not available to make such projections for all activities, however, and so we present information on the region's current socioeconomic state.

The second part of the first step is to document existing legal and regulatory constraints on economic activity that are independent of critical habitat designation. In the case of critical habitat designation, the standard approach to regulatory analysis would describe a baseline that includes other forms of habitat protection, including those provided by other elements of the ESA, such as listing. This standard approach has been modified, however, by NMFS's decision to consider the impact of critical habitat designation that are co-extensive with impacts from listing. The rationale for adopting this approach is further explained in NMFS (2007b). As done for the 2005 designations of critical habitat for 12 West Coast salmon and steelhead ESUs, NOAA Fisheries interprets this ruling in the following way:

- Co-extensive impacts, or those that are associated with habitat-modifying actions covered by both the jeopardy and adverse modification standards; and
- Incremental impacts, or those that are solely attributable to critical habitat designation and would not occur without the designation.

The economic impacts considered in this report therefore include activities covered by the adverse modification standard of section 7 of the ESA, whether or not they are also covered by the jeopardy standard. We note that not all elements of the ESA are considered as co-extensive with critical habitat designation. In particular, section 9 of the ESA, which applies to both non-federal and federal parties, is considered a baseline protection. Also, federal actions that do not alter habitat but may instead harm the species directly (*e.g.*, harvest governed by federal regulations) are also not considered as co-extensive.

2. NMFS (2007b) provides the full details on the 4(b)(2) exclusion process.

The laws and regulations that are considered for the baseline include the following:

- ESA protections for the Oregon Coast coho ESU outside section 7;
- ESA protections for other listed species; and
- Other federal and state statutes and regulations.

In many cases, the protections afforded by these laws are intertwined with those of section 7. In cases where we cannot make a clear separation, we have adopted the stance that the impacts of habitat protection are attributable to the designation of critical habitat and the implementation of section 7 for the Oregon Coast coho ESU under consideration. We have also taken care to project these baseline conditions into the future, using a 20-year period as a reasonable span over which to make such a prediction. For some activities, the data enable us to predict with precision when the baseline will change. An example is the relicensing of hydropower facilities by the Federal Energy Regulatory Commission licenses. This occurs at predictable intervals and so we are able to predict with great certainty when the baseline (a license currently exists and therefore no Section 7 ESA impacts will occur) will change. In other cases, we have certainty for shorter periods of time. In these cases, we assume the conditions that prevail during the near future will represent the conditions over the 20-year period.

For the second step, we used the set of activity types developed for the 2005 critical habitat designations (NMFS 2005d):

- Hydropower dams
- Non-hydropower dams and other water supply structures
- Federal lands management, including grazing (considered separately)
- Transportation projects
- Utility line projects
- Instream activities, including dredging (considered separately)
- EPA NPDES-permitted activities
- Sand & gravel mining
- Residential and commercial development
- Agricultural pesticide applications[3]

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3. In January 2004, the Environmental Protection Agency (EPA) was enjoined from authorizing the application of a set of pesticides within certain distances from "salmon-supporting waters" (Washington Toxics Coalition, et al., v. EPA, C01-0132 (W.D. WA), 22 January 2004). The basis for this injunction was the EPA's failure to consult with NOAA Fisheries concerning possible adverse effects of pesticide applications on salmon and steelhead protected under the ESA. Because the injunction is based on section 7 of the ESA, we include agricultural pesticide applications as an activity even though it is largely absent from the consultation record.

This set does not cover all possible activities but covers both the majority of consultations and a high proportion of the impacts.[4]

Fore the third step, we used the estimates from NMFS (2005d), adjusted for inflation[5]:

<u>Hydropower Projects</u>

Projects with installed capacity of less than 5MW: $2.4 million ($26,921 to $4.7 million).

Projects with installed capacity ranging from 5 to 20 MW: $6.4 million ($0 to $12.9 million).

Projects with installed capacity of greater than 20 MW that do not have but may require, fish passage facilities: $82.8 million ($12.9 million to $152.6 million).

Projects with installed capacity of greater than 20 MW that have, or will not require, fish passage facilities: $50.7 million ($12.9 million to $88.7 million).

Costs of dam removal: $26.9 million.

Dams with known/planned modification costs: varies.

<u>Non-Hydropower Dams and Water Supply Structures</u>

Infrastructure costs: $2.4 million ($26,921 to $4.7 million).

Operation of water projects (e.g., flow regime, withdrawal constraints): Not quantified on a per-project basis.

<u>Federal Land Management Activities (excluding grazing)</u>

Land management activities on non-wilderness lands: $0.76 to $9.77 annual costs per acre, depending on region.

Land management activities on wilderness lands: $0.04 to $0.49 annual costs per acre, depending on region.

<u>Livestock Grazing on Federal Land</u>

Livestock grazing: $1,298 per stream mile ($907 to $1,433)

<u>Transportation projects</u>

Bridge and culvert projects: $46,864 to $110,241 per project (depends on project mileage).

Road projects: $41,255 - 95,659 per project (range depends on project mileage).

<u>Utility Line Projects</u>

Outfall structure projects and pipelines: $113,295 ($112,173 to $114,416).

<u>Instream activities (excluding dredging)</u>

Boat dock, boat launch, and bank stabilization projects: $61,134 ($28,043 to $94,225).

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4. The Oregon Coast coho ESU was included in the proposed designations of critical habitat for West Coast salmon and steelhead, and the experience with that ESU was accounted for in the development of the activity types.

5. The activities analyzed in the report are mostly construction and other types of projects that require intermediate materials and labor, and so we used a producer price index (Intermediate Materials: Supplies & Components, Series PPIITM). We chose July 2005 as the base month for the adjustment, and October 2007 as the endpoint. The change in the producer price index for this period was 12.2%.

Dredging projects
Dredging: $920,938 ($372,414 to $1,469,463).
EPA NPDES-permitted Activities
Temperature Management Plan Compliance activities for major projects: $707,212 ($534,484 to $879,947).
Temperature Management Plan Compliance activities for minor projects: $80,808 ($0 to $161,616).
Sand and Gravel Mining
Sand and gravel mining: $758,885 ($0 to $1,516,694).
Residential and Commercial Development
Residential and commercial development: $263,606 ($257,997 to $269,215).
Agricultural Pesticide Applications
Agricultural pesticide applications: $0 to $7,310 per acre, depending on crop type and county.

For the fourth step, we used spatial data from NMFS (2005d) on the location of projects for each activity type and the estimates from that report of the annual level of an activity type in a particular watershed. Where an activity has different sub-types or scales, a separate level was estimated for each.

Appendix A discusses in more detail the important assumptions for each activity, violations of which could introduce error into our estimation; we also list the likely direction(s) of the error(s), should it exist. Table ES-2 lists some of these assumptions.

Finally, the fifth step consisted of calculating the economic impact of critical habitat designation for each watershed, using the following formula:

$$\begin{array}{c}\text{Aggregate Annual}\\\text{Impact for}\\\text{Watershed (\$/yr)}\end{array} = \begin{array}{c}\text{Sum}\\\text{(over all}\\\text{Activity}\\\text{Types)}\end{array}\left[\begin{array}{c}\text{Annual}\\\text{Activity}\\\text{Level}\end{array} \times \begin{array}{c}\text{Per-project Im-}\\\text{pact Cost}\end{array}\right]$$

This watershed-level annual impact then constitutes the potential cost of designating the watershed as critical habitat, recognizing that it includes co-extensive impacts, or those impacts that are associated with habitat-modifying actions covered by both the jeopardy and adverse modification standards. This annual amount is then projected over a 20-year period, a period we believe is a reasonable span over which to project estimated costs.

Table ES-2 Major Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
For most types of activities, we count project modifications recommended in biological opinions as an impact of section 7 implementation, even if they appear to overlap particular baseline elements, such as fish passage provisions.	+
Costs associated with implementing past consultations are the most reasonable predictor of future costs.	+/-
The historic locations of USACE permits, stormwater permits, and other activities in which the Federal government carries out, funds, or issues a permit are reasonable predictors of future locations of projects that will be impacted by section 7 implementation.	+/-
Hydropower and non-hydropower projects may be required to provide additional instream flow for salmon and steelhead and, as a result, may experience economic impacts to the extent that increased flow results in decreased or redistribution of power generation, lost agricultural value, or other impacts. The likelihood of a particular project being required to provide flow for salmon and steelhead will depend on many factors, including biological significance of the dam project to salmon/steelhead survival and recovery, the seasonality of flow, the economic importance of the dam project, whether there is public concern over the project, and other factors. Any flow changes that may be required are also the result of an examination of factors that may span more than one watershed. For these reasons, costs associated with flow requirements are not included in the cost estimates attributed to a particular watershed.	-
For Federal lands management activities, we assume that each acre of Federal land within critical habitat areas is subject to section 7 implementation. In fact, many projects may not affect salmon and steelhead habitat.	+
We assume that Federal land management agencies carry out land management activities consistently within geographical areas. Real variations in geography and management could result in different management activities in each management unit.	+/-

Table ES-2
Major Assumptions and Potential Errors

Assumption	Direction of Potential Error
We assume that per-project costs of modifications to specific land management activities are uniform across geographic areas.	+/-
The long-term effects of modifying transportation projects in critical habitat areas on regional transportation functions (such as congestion and air pollution) are not included in this analysis. If projects occur that are not included in state transportation plans, this analysis may understate costs.	-
We assume that section 7 implementation will not result in any net reduction in utility transmission capability. The same amount of utility lines will be constructed, although potentially at a higher cost and/or in a different location.	-
We assume that substitute sites are unavailable to sand and gravel mining companies who are required to reduce mining efforts in salmon and steelhead critical habitat areas.	+
We assume that the court-ordered injunction barring pesticide spraying represents the likely outcome of section 7 consultations for this activity. Future consultation may find more flexible ways to avoid jeopardy and adverse modification.	+
We assume that no adjustments in cropping or pesticide practices are possible nor are there alternative beneficial uses of land where section 7 implementation constrains agricultural pesticide applications, implying that these constraints will result in the loss of any net revenue earned from the affected land.	+
- : May result in an underestimate of costs + : May result in an overestimate of costs +/- : Has an unknown effect on estimates	

ES.5 Estimated Economic Impacts of Critical Habitat Designation

Below, we present a series of tables that summarize the results of the analysis for the Oregon Coast coho ESU. The results are presented (in 2007 dollars) for six different cases, where we combine three levels of cost estimates (Low, Mid-range, High) and two discount rates (7% and 3%).[6] Table ES-5 gives the annual total potential impact and the present value of the impact over a 20 year period; Table ES-6 gives the annual total impact and the present value of the impact over a 20 year period for each type of activity (for the mid-range cost estimate, 7% discount rate case); and Tables ES-7 and ES-8 list the average, median, maximum, and minimum annual total impact and present value of the impact over 20 years (respectively) for the individual watersheds in the Oregon Coast coho ESU.

Lastly, we emphasize that the impacts listed in these tables and many of the other tables in this report are those that stem from the implementation of section 7 for activities that modify habitat, and are not just the incremental impacts of critical habitat designation alone. As noted above and discussed later in the report, the NMCA decision called for an analysis of "all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes."[7] The estimates of impacts should then be interpreted as the sum of two types of impacts:

- Co-extensive impacts, or those that are associated with habitat-modifying actions covered by both the jeopardy and adverse modification standards; and
- Incremental impacts, or those that are solely attributable to critical habitat designation and would not occur without the designation.

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6. As described in more detail in Appendix A, our cost estimation produced a range of possible per-unit costs (and sometimes a range in the level of an activity). We take the middle of this range (referred to as the mid-range) as the representative cost estimate, but also present results using the low and high end of the range. The 4(b)(2) exclusion process used one of these cases – mid-range cost estimate, 7% discount rate – to weigh the benefits and costs of designation. We express the aggregate cost estimates to the nearest $1000, which represents an approximation of the significance of the aggregate figures. Because many of the unit cost estimates and other data are based on best professional judgment, no formal analysis of the significance level of the cost estimates is possible.

7. New Mexico Cattle Growers' Association v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001).

Table ES-3 Annual Total Potential Impact of Section 7 Implementation			
Discount Rate	**Cost Estimate**	**Annual Total Potential Impact**	**Present Value over 20 years**
Oregon Coast coho ESU			
3%	Low	$10,348,000	$117,302,000
	Mid-range	$22,304,000	$252,826,000
	High	$34,260,000	$388,353,000
7%	Low	$10,380,000	$117,666,000
	Mid-range	$22,179,000	$251,414,000
	High	$33,978,000	$385,165,000

Table ES-4 Annual Total Potential Impact by Type of Activity			
Type of Activity	**Annual Total Potential Impact**	**Present Value over 20 years**	**% of total**
Oregon Coast coho ESU			
Hydropower Dams	$95,000	$1,079,000	0.4%
Non-hydropower Dams	$1,439,000	$16,313,000	6.5%
Federal Lands (non-wilderness)	$16,713,000	$189,448,000	75.4%
Federal Lands (wilderness)	$23,000	$258,000	0.1%
Grazing	$0	$0	0.0%
Transportation Projects	$378,000	$4,290,000	1.7%
Utility Line Projects	$265,000	$3,000,000	1.2%
Sand & Gravel Mining	$1,340,000	$15,187,000	6.0%
Instream Activities	$240,000	$2,717,000	1.1%
Dredging	$615,000	$6,968,000	2.8%
Residential & Commercial Development	$467,000	$5,289,000	2.1%
EPA NPDES-permitted Activities	$409,000	$4,641,000	1.8%
Agricultural Pesticide Applications	$196,000	$2,224,000	0.9%

Table ES-5 Annual Total Potential Impacts for Individual Watersheds					
Discount Rate	**Cost Estimate**	**Annual Total Potential Impact**			
		Average	**Median**	**Maximum**	**Minimum**
Oregon Coast coho ESU					
3%	Low	$129,351	$92,951	$426,646	$0
	Mid-range	$278,797	$223,519	$869,861	$0
	High	$428,245	$361,358	$1,320,062	$0
7%	Low	$129,753	$92,951	$426,646	$0
	Mid-range	$277,240	$222,419	$869,861	$0
	High	$424,729	$352,219	$1,320,061	$0

Table ES-6 Present Value of Annual Total Potential Impact over 20 Years for Individual Watersheds					
Discount Rate	**Cost Estimate**	**Present Value over 20 years**			
		Average	**Median**	**Maximum**	**Minimum**
Oregon Coast coho ESU					
3%	Low	$1,466,275	$1,053,657	$4,836,283	$0
	Mid-range	$3,160,329	$2,533,722	$9,860,390	$0
	High	$4,854,410	$4,096,210	$14,963,683	$0
7%	Low	$1,470,826	$1,053,657	$4,836,282	$0
	Mid-range	$3,142,679	$2,521,257	$9,860,389	$0
	High	$4,814,559	$3,992,615	$14,963,683	$0

Section 1
Introduction and Background

1.1 Introduction

The National Marine Fisheries Service (NOAA Fisheries) is designating critical habitat for the Oregon Coast coho ESU. Section 4(b)(2) of the ESA requires NOAA Fisheries to consider the economic, national security, and other impacts of designating a particular area as critical habitat. NOAA Fisheries may exclude an area from critical habitat if it determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless it also determines that the failure to designate such area as critical habitat will result in the extinction of the species concerned.

This report analyzes the economic impacts of designating a particular area as critical habitat, based on the best scientific data available.[1] In this section, we give background information on the critical habitat designation and discuss the biology and habitat use of Pacific salmon and steelhead. The section finishes with an overview of the rest of the report.

1.2 Background

NOAA Fisheries is responsible for determining whether species, subspecies, or distinct population segments of West Coast salmon and steelhead are threatened or endangered, and which areas constitute critical habitat for them under the ESA (16 U.S.C. 1531 et seq). To be considered for listing under the ESA, a group of organisms must constitute a "species." Section 3 of the ESA defines a species as follows: "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." The agency has determined that a group of Pacific salmon or steelhead populations qualifies as a distinct population segment if it is substantially reproductively isolated and represents an important component in the evolutionary legacy of the biological species. A group of populations meeting these criteria is considered an "evolutionarily significant unit" (ESU) (56 FR 58612, November 20, 1991). In its ESA listing determinations for West Coast salmon and steelhead, NOAA Fisheries has treated an ESU as a distinct population segment and to date has identified six species comprised of 52 ESUs in Washington, Oregon, Idaho, and California.

Section 4(b)(2) of the ESA requires NOAA Fisheries to designate critical habitat for threatened and endangered species "on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security and any other relevant impact, of specifying any particular area as critical habitat." This section grants the Secretary [of

1. The primary data for this report are taken from NMFS (2005d) and were originally gathered by Industrial Economics, Inc., which also prepared supplementary material for sections 3, 4, 5, and Appendix A of the report.

Commerce] discretion to exclude any area from critical habitat if he determines "the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat." The Secretary's discretion is limited, as he may not exclude areas if it "will result in the extinction of the species."

The ESA defines critical habitat under section 3(5)(A) as:

> (I) the specific areas within the geographical area occupied by the species, at the time it is listed . . ., on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
> (ii) specific areas outside the geographical area occupied by the species at the time it is listed . . . upon a determination by the Secretary that such areas are essential for the conservation of the species.

Once critical habitat is designated, section 7 of the ESA requires federal agencies to ensure they do not fund, authorize, or carry out any actions that will destroy or adversely modify that habitat. This requirement is in addition to the section 7 requirement that federal agencies ensure their actions do not jeopardize the continued existence of listed species.

In 1995, we completed a comprehensive status review of West Coast coho salmon (Weitkamp et al., 1995) that resulted in proposed listing determinations for three coho ESUs, including a proposal to list the Oregon Coast coho ESU as a threatened species (60 FR 38011; July 25, 1995). On October 31, 1996, we announced a 6-month extension of the final listing determination for the ESU, pursuant to section 4(b)(6)(B)(I) of the ESA, noting substantial disagreement regarding the sufficiency and accuracy of the available data relevant to the assessment of extinction risk and the evaluation of protective efforts (61 FR 56211). On May 6, 1997, we withdrew the proposal to list the Oregon Coast coho ESU as threatened, based in part on conservation measures contained in the Oregon Coastal Salmon Restoration Initiative (later renamed the Oregon Plan for Salmon and Watersheds; hereafter referred to as the Oregon Plan) and an April 23, 1997, Memorandum of Agreement (MOA) between NMFS and the State of Oregon which further defined Oregon's commitment to salmon conservation (62 FR 24588). We concluded that implementation of harvest and hatchery reforms, and habitat protection and restoration efforts under the Oregon Plan and the MOA substantially reduced the risk of extinction faced by the Oregon Coast coho ESU. On June 1, 1998, the Federal District Court for the District of Oregon issued an opinion finding that our May 6, 1997, determination to not list Oregon Coast coho was arbitrary and capricious (Oregon Natural Resources Council v. Daley, 6 F. Supp. 2d 1139 (D. Or. 1998)). The Court vacated our determination to withdraw the proposed rule to list the Oregon Coast coho ESU and remanded the determination to NMFS for further consideration. On August 10, 1998, we issued a final rule listing the Oregon Coast coho ESU as threatened (63 FR 42587), basing the determination solely on the information and data contained in the 1995 status review (Weitkamp et al., 1995) and the 1997 proposed rule (62 FR 24588; May 6, 1997).

In 2001 the U.S. District Court in Eugene, Oregon, set aside the 1998 threatened listing of the Oregon Coast coho ESU (Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154, (D. Or. 2001)) (Alsea decision). In response to the Alsea ruling and several listing and delisting petitions, we announced that we would conduct an updated status review of 27 West Coast salmonid ESUs, including the Oregon Coast coho ESU (67 FR 6215, February 11, 2002; 67 FR 48601, July 25, 2002).

In 2003 we convened the Pacific Salmonid Biological Review Team (BRT) (an expert panel of scientists from several Federal agencies including NMFS, the U.S. Fish and Wildlife Service (FWS), and the U.S. Geological Survey) to review extinction risk of naturally spawning populations in the 27 ESUs under review, including the Oregon Coast coho ESU (Good et al., 2005; NMFS, 2003l). A slight majority of the BRT concluded that the naturally spawning populations in the Oregon Coast coho ESU were likely to become endangered, noting that short-term risks were alleviated by encouragingly high escapements in recent years (2001-2002). The BRT noted considerable uncertainty regarding the future viability of the ESU given the uncertainty in predicting future ocean conditions for coho survival, as well as uncertainty in whether current freshwater habitats are of sufficient quality and quantity to support the recent high abundance levels and sustain populations during future downturns in ocean conditions. Although the BRT couched its conclusion in terms of the statutory definition of a threatened species (that is, not in danger of extinction, but likely to become endangered in the foreseeable future), the BRT's conclusion did not a constitute a recommendation to list species. Our listing determination also considered the risks and benefits from artificial propagation programs included in the ESU, efforts being made to protect the species, and the five factors listed under section 4(a)(1) of the ESA.

On June 14, 2004, we proposed to list the Oregon Coast coho ESU as a threatened species (69 FR 33102). In the proposed rule, we noted that Oregon was initiating a comprehensive assessment of the viability of the Oregon Coast coho ESU and of the adequacy of actions under the Oregon Plan for conserving Oregon Coast coho. As part of that proposed rule we proposed amendments to existing protective regulations issued under ESA section 4(d) ("4(d) regulations") for all threatened West Coast salmon and steelhead. 50 C.F.R. § 223.203. These amendments were needed to: (1) provide flexibility in fisheries and hatchery management, and (2) simplify and clarify the existing regulations so that they may be more efficiently and effectively accessed and interpreted by all affected parties.

On December 14, 2004, we proposed designations of critical habitat for 13 ESUs of Pacific salmon and steelhead in the Pacific Northwest, including the Oregon Coast coho ESU (69 FR 74572). We proposed critical habitat in 72 of 80 occupied watersheds, contained in 13 subbasins, totaling approximately 6,665 stream miles along the Oregon Coast, south of the Columbia River and north of Cape Blanco (Oregon). The estimated economic impact of the areas proposed for critical habitat was approximately $15.7 million. Eight occupied watersheds were proposed for exclusion because the high benefits of exclusion (due to economic impacts) outweighed the low benefits of inclusion (due to the low inherent conservation value for the listed species). These excluded watersheds included approximately 134 stream miles and represented a 15 percent reduction (approximately $2.75 million) in the economic impact of the proposed designation. In assessing economic impacts, we did not distinguish between the costs associated with the species listing from the costs of separately designating critical habitat.

In January 2005 the State of Oregon released a draft Oregon Coastal Coho Assessment (Oregon's Draft Viability Assessment), which (1) evaluated the current viability of the Oregon Coast coho ESU, and (2) evaluated the certainty of implementation and effectiveness of the Oregon Plan measures in addressing the factors for decline of the Oregon Coast coho ESU. The latter evaluation was intended to satisfy the joint NMFS - FWS Policy on Evaluating Conservation Efforts ("PECE"; 68 FR 15100, March 28, 2003). Oregon's Draft Viability Assessment concluded that the Oregon Coast coho ESU is currently viable and that measures under the Oregon Plan have stopped, if not reversed, the deterioration of Oregon Coast coho habitats. The Draft Viability Assessment also concluded that it is highly likely that existing monitoring efforts will detect any significant future deterioration in the ESU's viability, or degradation of environmental condition, allowing a timely and appropriate response to conserve the ESU. On February 9, 2005, we published a notice of availability of Oregon's Draft Viability Assessment for public review and comment in the Federal Register (70 FR 6840) and noted that information presented in the draft and final assessments would be considered in making the final listing determination for the Oregon Coast coho ESU.

We forwarded the public comments we received on Oregon's Draft Viability Assessment, as well as our technical reviews, for Oregon's consideration in developing its final assessment. The public comments and our review highlighted areas of uncertainty or disagreement regarding the sufficiency and accuracy of Oregon's Draft Viability Assessment, including: the assumption that Oregon Coast coho populations are inherently resilient at low abundance, and that this compensatory response will prevent extinction during periods of low marine survival; the apparent de-emphasis of abundance as a useful indicator of extinction risk; assumptions regarding the duration and severity of future periods of unfavorable marine and freshwater conditions; the ability of monitoring and adaptive management efforts to detect population declines or habitat degradation, and to identify and implement necessary protective measures; and the ability of Oregon Plan measures to halt or reverse habitat degradation once detected.

On May 13, 2005, Oregon issued its final Oregon Coastal Coho Assessment (Oregon's Final Viability Assessment). Oregon's Final Viability Assessment included several changes intended to address concerns raised regarding the sufficiency and accuracy of the draft assessment. Oregon's Final Viability Assessment concluded that: (1) the Oregon Coast coho ESU is viable under current conditions, and should be sustainable through a future period of adverse environmental conditions (including a prolonged period of poor ocean productivity); (2) given the assessed viability of the ESU, the quality and quantity of habitat is necessarily sufficient to support a viable ESU; and (3) the integration of laws, adaptive management programs, and monitoring efforts under the Oregon Plan will maintain and improve environmental conditions and the viability of the ESU into the foreseeable future.

On June 28, 2005 (70 FR 37217), we announced a 6-month extension of the final listing determination for the Oregon Coast coho ESU, finding that "there is substantial disagreement regarding the sufficiency or accuracy of the available data relevant to the determination . . . for the purposes of soliciting additional data" (section 4(b)(6)(B)(i)). We announced a 30-day public comment period to solicit information regarding the validity of Oregon's Final Viability Assessment, particularly in light of the concerns raised with respect to Oregon's Draft Viability Assessment.

On January 19, 2006, we issued a final determination that listing the Oregon Coast coho ESU under the ESA was "not warranted" (71 FR 3033). As part of this determination, we withdrew the proposed 4(d) regulations and critical habitat designation for the ESU. In reaching our determination not to list Oregon Coast coho, we found that the BRT's slight majority opinion that the ESU is "likely to become endangered" and the conclusion of Oregon Final Viability Assessment that the ESU is viable represented competing reasonable inferences from the available scientific information and considerable associated uncertainty. The difference of opinion centered on whether the ESU was at risk because of the "threatened destruction, modification, or curtailment of its habitat or range." We conducted an analysis of current habitat status and likely future habitat trends (NMFS, 2005a) and found that: (1) the sufficiency of current habitat conditions was unknown; and (2) likely future habitat trends were mixed (i.e., some habitat elements were likely to improve, some were likely to decline, others were likely to remain in their current condition). We concluded that there was insufficient evidence to support the conclusion that the ESU was more likely than not to become an endangered species in the foreseeable future throughout all or a significant portion of its range.

Our decision not to list the Oregon Coast coho ESU was challenged in Trout Unlimited v. Lohn. On October 9, 2007, the U.S. District Court for the District of Oregon invalidated our January 2006 decision not to list Oregon Coast coho. The Court found that Oregon's Viability Assessment does not represent the best available science, and that we improperly considered it in reaching our final listing decision. The Court ordered us to issue a new decision on listing consistent with the ESA. As a result of that order, NOAA Fisheries is listing the Oregon Coast coho ESU as a threatened species and designating critical habitat. This report supports this decision by providing information on the economic impacts of critical habitat designation.

1.3 Salmon and Steelhead Biology and Habitat Use

Salmon and steelhead are anadromous fish, meaning adults migrate from the ocean to spawn in freshwater lakes and streams where their offspring hatch and rear prior to migrating back to the ocean to forage until maturity. The migration and spawning times vary considerably between and within species and populations (Groot and Margolis 1991). At spawning, adults pair to lay and fertilize thousands of eggs in freshwater gravel nests or "redds" excavated by females. Depending on lake/stream temperatures, eggs incubate for several weeks to months before hatching as "alevins" (a larval life stage dependent on food stored in a yolk sac). Following yolk sac absorption, alevins emerge from the gravel as young juveniles called "fry" and begin actively feeding. Depending on the species and location, juveniles may spend from a few hours to several years in freshwater areas before migrating to the ocean. The physiological and behavioral changes required for the transition to salt water result in a distinct "smolt" stage in most species. On their journey juveniles must migrate downstream through every riverine and estuarine corridor between their natal lake or stream and the ocean. For example, smolts from Idaho will travel as far as 900 miles from their inland spawning grounds. En route to the ocean the juveniles may spend from a few days to several weeks in the estuary, depending on the species. The highly productive estuarine environment is an important feeding and acclimation area for juveniles preparing to enter marine waters.

Juveniles and subadults typically spend from one to five years foraging over thousands of miles in the North Pacific Ocean before returning to spawn. Some species, such as chinook salmon, have precocious life history types (primarily male fish) that mature and spawn after only several months in the ocean. Spawning migrations known as "runs" occur throughout the year, varying by species and location. Most adult fish return or "home" with great fidelity to spawn in their natal stream, although some do stray to non-natal streams. Salmon species die after spawning, while steelhead may return to the ocean and make repeat spawning migrations. This complex life cycle gives rise to complex habitat needs, particularly during the freshwater phase (see review by Spence et al. 1996). Spawning gravels must be of a certain size and free of sediment to allow successful incubation of the eggs. Eggs also require cool, clean, and well-oxygenated waters for proper development. Juveniles need abundant food sources, including insects, crustaceans, and other small fish. They need places to hide from predators (mostly birds and bigger fish), such as under logs, root wads and boulders in the stream, and beneath overhanging vegetation. They also need places to seek refuge from periodic high flows (side channels and off channel areas) and from warm summer water temperatures (coldwater springs and deep pools). Returning adults generally do not feed in fresh water but instead rely on limited energy stores to migrate, mature, and spawn. Like juveniles, they also require cool water and places to rest and hide from predators. During all life stages salmon and steelhead require cool water that is free of contaminants. They also require rearing and migration corridors with adequate passage conditions (water quality and quantity available at specific times) to allow access to the various habitats required to complete their life cycle.

The homing fidelity of salmon and steelhead has created a meta-population structure with distinct populations distributed among watersheds (McElhany et al. 2000). Low levels of straying result in regular genetic exchange among populations, creating genetic similarities among populations in adjacent watersheds. Maintenance of the meta-population structure requires a distribution of populations among watersheds where environmental risks (e.g., from landslides or floods) are likely to vary. It also requires migratory connections among the watersheds to allow for periodic genetic exchange and alternate spawning sites in the case that natal streams are inaccessible due to natural events such as a drought or landslide.

1.4 Overview of Report

In general, West Coast salmon and steelhead migrate through a broad range of interconnected habitats. For that reason, implementation of section 7 of the ESA for salmon and steelhead ESUs has potentially large economic and other impacts. Federal agencies and other parties that are federally funded, have a federal permit, or otherwise have a "nexus" with a federal agency, must modify actions that have the potential to harm listed salmon and steelhead. These modifications have economic costs and other negative impacts, ranging in magnitude from modest to hundreds of millions of dollars. To the extent that the modifications enhance salmon and steelhead habitat, they also have beneficial impacts, to the fish species and possibly to other species and elements of the affected ecosystems.

For reasons discussed later, this report covers some of these impacts, focusing on the economic costs of critical habitat designation. This focus does not mean that the beneficial and non-economic impacts of critical habitat designation have been overlooked and not incorporated into the designation process. As explained in Section 2 below, NOAA Fisheries has chosen to express the benefits of designation in terms of the conservation value of designating a particular area as critical habitat. These benefits are gauged with a biological metric and are the subject of a separate report (NMFS, 2007a).

Section 2 of this report outlines the framework for the economic analysis. In that section, we explain how the economic analysis fits into the process of designating critical habitat and outline the methods used to gauge the economic impacts. Section 3 describes the economic and legal conditions that account for the baseline of the analysis. This section includes socioeconomic descriptions of the areas covered by the critical habitat designations, as well as information on other laws and regulations that afford Oregon Coast coho some level of habitat protection. Section 4 describes the types of activities affected by critical habitat designation and the costs of modifications needed to comply with section 7. Finally, Section 5 summarizes the results of the analysis for the Oregon Coast coho ESU. The report also contains a series of appendices that give the full set of results and greater details on other issues.

In most cases, we present the results of the analysis in two ways. First, the 4(b)(2) process is conducted at the level of a "particular area," which we have defined as a HUC5 watershed. The economic analysis estimates the annual potential impact of section 7 enforcement for each watershed, which is then used as a measure of the benefit of excluding that watershed from critical habitat designation. Second, we also present aggregated results at the ESU-level. Regulatory determinations such as those imposed by the Regulatory Flexibility Act, E.O. 12866, and E.O. 13211 are conducted at the level of the regulation as a whole. The economic analysis supports these determinations by aggregating all the watershed-level impacts to gauge the impacts at the ESU level.

Section 2
Framework for the Economic Analysis

2.1 Introduction

The process of designating critical habitat under the ESA involves an analysis of the economic, national security, and other relevant impacts of the designation. The 4(b)(2) exclusion process is conducted for a "particular area," not for critical habitat as a whole. For that reason, the analysis should be conducted at a geographic scale that divides the area under consideration into smaller subareas, if such a division is undertaken. The statute does not specify the exact geographic scale of these subareas, nor does it dictate the form of the economic analysis and the types of impacts to be included in the analysis.

In this section, we present the framework NOAA Fisheries is using to analyze the economic impacts of critical habitat designation. We begin by discussing this framework in broad terms. Economic analyses of regulatory actions commonly use a standard benefit-cost framework. For reasons discussed here and in NMFS (2007b), NOAA Fisheries has chosen a framework more akin to a cost-effectiveness one, and so we begin with a discussion of this issue from an economic standpoint. We then outline the 4(b)(2) process, which utilizes biological, economic, and other information. Finally, we discuss the framework for this economic analysis, which is designed to support the 4(b)(2) process.

2.2 General Analytical Framework

When an economic activity has biological effects or other consequences for conservation, analyzing those consequences can take a number of approaches. Two possible approaches are benefit-cost analysis and cost-effectiveness analysis. Each of these approaches has strong scientific support as well as support from the Office of Budget and Management through its guidelines on regulatory analysis (OMB 2003). Each also has well known drawbacks, both theoretical and practical. Below, we discuss them in the context of critical habitat designation.

2.2.1 Benefit-cost analysis

Benefit-cost analysis (BCA) is the first choice for analyzing the consequences of a regulatory action such as critical habitat designation (OMB 2003). BCA is a well-established procedure for assessing the "best" course or scale of action, where "best" is that course which maximizes net benefits (Zerbe and Dively 1994). Because BCA assesses the value of an activity in that way, a single metric – most commonly dollars – must be used to gauge both benefits and costs.

Although the data and economic models necessary to estimate costs may be difficult or costly to gather and develop, expressing costs in dollars is straightforward for most regulatory actions. This is the case for critical habitat designation, which has direct impacts on activities carried out, funded, or permitted by the federal government. (Conceptually, the "benefits of exclusion," which is essentially the language used in section 4(b)(2) of the ESA, are identical to the "costs of inclusion," and so estimates of these costs could be used in a benefit-cost framework.) These activities may be those of a federal agency, or those of a non-federal agency or private party that is federally funded, has a federal permit, or otherwise has a federal nexus. In many instances, those activities must be modified to comply with section 7 of the ESA. Assessing the cost of critical habitat designation and section 7 generally, then, is mainly a task of estimating the costs and levels of the modifications.[2]

Assessing the benefits of critical habitat designation in a BCA framework is also straightforward in principle but much more difficult in practice. To the extent that enforcement of section 7 of the ESA increases the protections afforded Oregon Coast coho habitat, it produces real benefits for that ESU. In principle, these benefits can be measured first by a biological metric, and then by a dollar metric. A biological metric could take the form of the expected decrease in extinction risk, increase in number of spawners, increase in the annual population growth rate, and so forth. A BCA would then use this metric to assess the state of the species with and without critical habitat designation. This assessment would reveal the biological impact of designation, quantified in terms of the metric.

Preserving West Coast salmon and steelhead has a well-established economic value.[3] Again, in principle, the quantified biological benefits could be evaluated in terms of willingness-to-pay, the standard economic measure of value for BCA (Zerbe and Dively 1994), and the measure recommended by OMB (OMB 2003). This would produce a dollar estimate of the benefits of critical habitat designation, which could then be compared directly to the costs. Evaluating a number of alternatives in this way would reveal the one with the highest net benefits (among those compared).

Translating biological benefits into dollar estimates of value is difficult and costly, however. NOAA Fisheries has used a variety of measures to gauge the viability of West Coast salmon and steelhead ESUs. No previous study has estimated the monetary value of these species using these measures, and so no economic data are available that would support a BCA of critical habitat designation.

2.2.2 Cost-effectiveness analysis

Recognizing the difficulty of estimating economic values in cases like this one, OMB has recently acknowledged cost-effectiveness analysis (CEA) as an appropriate alternative to BCA:

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2. As noted in the economic analysis of critical habitat designation, there may be other types of costs, such as those generated by what are called "trigger" or "stigma" effects. While identifying and estimating the extent of these costs is difficult, the process is still straightforward. We discuss stigma effects in the context of residential and commercial development in Section 4.3.9 of this report.

3. See, for example, Olsen et al. (1991), Loomis (1996), and Layton et al. (1999).

> Cost-effectiveness analysis can provide a rigorous way to identify options that achieve the most effective use of the resources available without requiring monetization of all of [the] relevant benefits or costs. Generally, cost-effectiveness analysis is designed to compare a set of regulatory actions with the same primary outcome (e.g., an increase in the acres of wetlands protected) or multiple outcomes that can be integrated into a single numerical index (e.g., units of health improvement).[4]

Ideally, CEA quantifies both the benefits and costs of a regulatory action but uses different metrics for each. A common application of this method is to health care strategies, where the benefits of a strategy are quantified in terms of lives saved, additional years of survival, or some other quantitative, health-related measure.[5]

In principle, conducting a CEA of critical habitat designation would proceed along the same lines identified above for BCA, except that the last step of transforming biological benefits into economic (dollar) values would not be taken. Different configurations of critical habitat could be gauged by both metrics, with the cost-effectiveness (units of biological benefits/$ cost) evaluated in each case. If alternatives have the same level of biological benefits, the most cost-effective is the one with the highest ratio of biological benefits/dollar.

2.2.3 The designation of critical habitat: an alternate framework

Standard CEA presumes that benefits can be measured with a cardinal[6] or even continuous measure. For critical habitat designation, however, constructing such a measure for the biological benefits is problematic. Although protecting habitat for Oregon Coast coho has unquestionable benefits, biological and economic, it is not yet possible to quantify the benefits reliably with a single biological metric given the state of the science (Beechie et al. 2003). There are models for estimating numbers of salmon that might be produced from a watershed under different sets of environmental conditions.[7] While such models give quantified results, the accuracy of the quantified projections is unknown because data are not available both on the relationships between environmental conditions and numbers of fish and the actual conditions of habitat in a given area. This produces a heavy reliance on expert opinion for estimating habitat condition and the expected response of fish to changing environmental conditions in a specific location. Moreover, applying

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4. OMB (2003).

5. For a full discussion of CEA in this context, see Gold et al. (1996).

6. A cardinal measure has the important attribute of being susceptible to arithmetic operations. That is, if one object has a cardinal measure of "2", this can be compared directly to another object with a cardinal measure of "4", in that the second has "twice as much" of whatever is being measured as the first. Similarly, two objects with cardinal measure "2" would be equivalent to one object with a cardinal measure of "4".

7. For example, see Mobrand Biometrics, Inc. (1999).

such models at the scale required for Oregon Coast coho would be time-consuming and costly. Thus, applying CEA in its standard form is not possible.

In lieu of a cardinal measure, we developed an ordinal measure of the biological benefits of critical habitat designation (NMFS 2007a). Although it is difficult to monetize or quantify benefits of critical habitat designation, it is possible to differentiate among habitat areas based on their relative contribution to conservation. For example, habitat areas can be rated as having a high, medium, or low conservation value. Like the models discussed above, such a rating is based on best professional judgment. The simpler output (a qualitative ordinal ranking), however, may better reflect the state of the science for the geographic scale considered here than a quantified output, and can be done more easily with available information.

The qualitative, ordinal evaluations can be combined with estimates of the economic costs of critical habitat designation in a framework that resembles cost-effectiveness and arguably moves the designation toward a more efficient outcome (NMFS 2007b; Plummer 2007). For each level of habitat conservation value, the framework uses a threshold economic cost to identify habitat areas (which have costs higher than the threshold) that are then considered for exclusion from critical habitat designation. In essence, areas with high conservation value and lower economic cost have a higher priority for designation and areas with a low conservation value and higher economic cost have a higher priority for exclusion. By proceeding in order of these priorities (either in terms of inclusion or exclusion), a critical habitat designation will be formed in a manner that (in principle) minimizes or at least (in practice) reduces the overall economic cost of achieving any given level of conservation.

This framework has two limitations, one of which it shares with the standard form of CEA. First, all CEAs have an important limitation when the level of benefits varies across alternatives. Because CEA does not evaluate benefits and costs in the same metric, the analysis cannot assess whether a given change has benefits that, in monetary terms, are greater than costs. Thus, while either CEA or the framework described above is a way of minimizing the cost of achieving any given level of benefits, the analysis alone cannot specify which among a set of possible levels of benefits is the "best" choice.

A second limitation of the framework we chose is the inability to discern variation in benefits among those areas that have the same conservation value rank. The likely result is a designation with higher expected costs of achieving any given level of conservation than one produced with standard CEA (with a cardinal benefit measure) or BCA. This limitation should be compared to the greater feasibility of the framework described above, however.

2.3 Framework for the 4(b)(2) process

Specific areas that satisfy the definition of critical habitat are not automatically designated as critical habitat. Section 4(b)(2) (16 U.S.C. 1533(b)(1)(A)) requires the Secretary to first consider the impact of designation and permits the Secretary to exclude areas from designation under certain circumstance. Exclusion is not required for any particular area:

> The Secretary shall designate critical habitat, and make revisions thereto, under subsection (a)(3) of this section on the basis of the best scientific data available and after taking into consideration the economic impact, the impact on national security and any other relevant impact, of specifying any particular area as critical habitat. The Secretary may exclude any area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific and commercial data available, that the failure to designate such area as critical habitat will result in the extinction of the species concerned.

The approach NOAA Fisheries has taken (in part) to implement section 4(b)(2) involves these steps:

1 Identify particular areas for possible exclusion from critical habitat designation
2 Conduct a section 4(b)(2) analysis for each particular area:
  2.1 Determine the benefit of designation;
  2.2 Determine the benefit of exclusion (cost of designation);
  2.3 Determine whether the benefits of exclusion outweigh the benefits of designation
  2.4 Determine whether the exclusions (if any) will result in extinction of the species.

NMFS (2007b) discusses these steps in more detail.

2.4 Framework for analyzing economic impacts of critical habitat designation

The economic analysis of the impacts of critical habitat designation follows the standard approach to regulatory analysis. The regulation under consideration changes the state of the world and any resulting changes in economic activity are then attributed to the regulation. This approach has been called the "baseline approach."[8] It does not assume the world will remain unchanged in the absence of regulation. Instead, it projects a future course of the world as a baseline, one which may involve substantial changes in economic and other conditions. It then projects another course in which the regulation has taken effect. The impacts of the regulation are then analyzed in terms of the differences between the two courses. Changes that would exist in the absence of the regulation are included in the baseline, and so do not add to the regulation's benefits or costs.

Within the framework of the 4(b)(2) process, the analysis of economic impacts is limited to impacts that are not directly related to the conservation value of the particular area (and not among the "other relevant impacts" that are also being considered). This does not mean that the benefits of critical habitat designation are being overlooked or ignored. Expressing these benefits in terms comparable

8. This methodology is fundamental to economic analysis and not peculiar to the analysis of critical habitat designations or other forms of regulations. See EPA (2000).

to the costs of designation was not possible because the full set of data was not available.[9] In principle, the economic analysis would still cover both economic benefits of inclusion as well as economic benefits of exclusion. The designation of critical habitat may have ancillary benefits unrelated to Oregon Coast coho. Data on such ancillary benefits of inclusion, however, are not available at the level of the particular areas that are the focus of the 4(b)(2) process. For that reason, the economic analysis focuses on the economic benefits of a particular area being excluded from critical designation, which we sometimes refer to as the economic costs of designation.

Applying this approach to the designation of critical habitat takes the following steps:

1. Identify the baseline of economic activity and the statues and regulations that constrain that activity in the absence of the critical habitat designation;
2. Identify the types of activities that are likely to be impacted by critical habitat designation;
3. Estimate the costs of modifications needed to bring the activity into compliance with the ESA's critical habitat provisions; and
4. Project over space and time the occurrence of the activities and the likelihood they will in fact need to be modified; and
5. Aggregate the costs up to the watershed level.

As noted above, the 4(b)(2) process is conducted at the level of an individual area, not at the level of the critical habitat designation as a whole. For this reason, the steps outlined above take place for each of these individual areas. For Oregon Coast coho, NOAA Fisheries used standard watershed units, as mapped by the U.S. Geological Service, designated by fifth field hydrologic unit codes, or HUC5s (this report refers to these HUC5s as "watersheds") for the purpose of delineating a "particular" area.

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9. Monetizing the benefits of critical habitat designation requires two types of data: estimates of the monetary value of improvements in salmon and steelhead habitat, and estimates of the likely improvements in that habitat stemming directly from designation. There are numerous estimates of the monetary value of improved salmon populations (see, for example, Alkire 1994; Bell *et al*. 2003; Davis and Radtke 1995; ECONorthwest 1999; Layton *et al.* 1999; Loomis 1996; Olsen *et al*. 1991; Radtke *et al*. 1999; Radtke 1992; and Reading 2005). Relatively little of this literature, however, is conducted at the level of a particular ESU and even less at the watershed level. As documented in Layton *et al*. (1999), the marginal value of protecting salmon populations is not constant, so using an "average value per fish" derived from a "general" study of salmon populations is not appropriate. Moreover, none of this literature quantifies the biological improvements in salmon and steelhead habitat likely to stem from critical habitat designation. Without these estimates, assigning a monetary value to critical habitat designation or section 7 enforcement in general using the existing valuation literature is not possible.

In the remainder of this section, we briefly discuss each step in detail. The subsequent sections of the report provide the details of how the analysis was implemented and present the results of the analysis.

1. Identify the economic and statutory/regulatory baselines
The first part of identifying the baseline is to document the socioeconomic characteristics of the area covered by a critical habitat designation. Ideally, this part would include a projection of economic activity in this area over the time period under consideration. Adequate data are not available to make such projections for all activities, however, and so we present information on the region's current socioeconomic state.

The second part of the first step is to document existing legal and regulatory constraints on economic activity that are independent of critical habitat designation. In the case of critical habitat designation, the standard approach to regulatory analysis would describe a baseline that includes other forms of habitat protection, including those provided by other elements of the ESA, such as listing. This standard approach has been modified, however, by NMFS's decision to consider the impact of critical habitat designation that are co-extensive with impacts from listing. The rationale for adopting this approach is further explained in NMFS (2007b). As done for the 2005 designations of critical habitat for 12 West Coast salmon and steelhead ESUs, NOAA Fisheries interprets this ruling in the following way:

- Co-extensive impacts, or those that are associated with habitat-modifying actions covered by both the jeopardy and adverse modification standards; and
- Incremental impacts, or those that are solely attributable to critical habitat designation and would not occur without the designation.

The economic impacts considered therefore include activities covered by the adverse modification standard of section 7 of the ESA, whether or not they are also covered by the jeopardy standard. We note that not all elements of the ESA are considered as co-extensive with critical habitat designation. In particular, section 9 of the ESA, which applies to both non-federal and federal parties, is considered a baseline protection. Also, federal actions that do not alter habitat but may instead harm the species directly (*e.g.*, harvest governed by federal regulations) are also not considered as co-extensive.

The laws and regulations that are considered for the baseline include the following:

- ESA protections for the Oregon Coast coho ESU outside section 7;
- ESA protections for other listed species; and
- Other federal and state statutes and regulations.

In many cases, the protections afforded by these laws are intertwined with those of section 7. In cases where we cannot make a clear separation, we have adopted the stance that the impacts of habitat protection are attributable to the designation of critical habitat and the implementation of section 7 for the Oregon Coast coho ESU under consideration. We have also taken care to project these baseline conditions into the future, using a 20-year period as a reasonable span over which to make such a prediction. For some activities, the data enable us to predict with precision when the baseline will change. An example is the relicensing of hydropower facilities by the Federal Energy Regulatory Commission licenses. This occurs at predictable intervals and so we are able to predict with great certainty when the baseline (a license currently exists and therefore no Section 7 ESA impacts will occur) will change. In other cases, we have certainty for shorter periods of time. In these cases, we assume the conditions that prevail during the near future will represent the conditions over the 20-year period.

2. Identify the types of activities likely impacted by critical habitat designation

Having specified the baseline economic conditions and legal/regulatory constraints, the next step is to identify the economic activity likely affected by critical habitat designation. Because section 7 directly applies only to federal actions, the majority of impacts will be borne by federal agencies, non-federal parties whose federally permitted activities are altered to avoid adverse modification, and those parties that are otherwise affected by the alteration of these activities. NOAA Fisheries maintains a substantial database covering consultations under section 7, and this database was used to derive a set of activity types for the analysis.

The designation of critical habitat may also trigger other impacts on non-federal activity, however. For example, state environmental laws may contain provisions that are triggered if a state-regulated activity occurs in federally-designated critical habitat. Another possibility is that critical habitat designation could have "stigma" effects, or impacts on the economic value of private land not attributable to any direct restrictions on the use of the land. All of these types of impacts are considered in the analysis, although quantitative estimates are not presented in every case.[10]

3. Estimate the costs of the necessary activity modifications

The next step in the analysis is to estimate the cost of modifying each type of activity to bring it into compliance with section 7. Where the federal agency's own project is the source of the potentially harmful effect, we assume sufficient expenditures are made to make the necessary modifications. Similarly, if the activity is one that is permitted or funded by a federal agency, we assume the non-federal party does the same. This assumption is strong, in that there are alternatives to modifying the project and incurring those costs. The party responsible could pursue the activity in a location that does not potentially harm the species or choose not to pursue the activity at all.

Estimating costs also involves discounting. Modifications to activities that affect Oregon Coast coho habitat may involve costs that are spread out over time. These costs must be discounted, using standard guidance in guides such as that from the Office of Management and Budget (OMB 2003).

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10. We discuss stigma effects in the context of residential and commercial development in Section 4.3.9 of this report.

In accordance with the latest guidelines, we evaluate costs using both a 7% and a 3% discount rate. The 4(b)(2) exclusion process uses the estimates based on a 7% discount rate.

As noted above, NOAA Fisheries is analyzing both the incremental and co-extensive impacts of critical habitat designation, in accord with the NMCA decision. It is still desirable, however, to separate the two types of costs. If an impact is co-extensive and not incremental, it will occur whether or not critical habitat is designated for a particular area. Weighing the benefits of inclusion against the benefits of exclusion, then, is most easily accomplished if the focus is on incremental impacts.

The simplest case for distinguishing incremental from non-incremental impacts is when incremental impacts are (approximately) a constant proportion of the total section 7 impacts. This was the approach taken , for example, in the Fish and Wildlife Service's economic analysis of critical habitat designation for the northern spotted owl, which focused on the effects of section 7 implementation on federal timber sales:

> It was further assumed, based on [Fish and Wildlife] Service consultative experience, that of the total reduction in [timber] sales, 70 percent would be due to listing impacts through application of the jeopardy standard and take prohibitions and the remaining 30 percent would be due to application of the adverse modification standard.[11]

The FWS made similar assumptions in the economic analyses for two other critical habitat designations (Brookshire et al. 1993 and Brookshire et al. 1995).

In the case at hand, however, examination of the consultation record for all West Coast salmon and steelhead ESUs provides no obvious way to distinguish incremental from co-extensive impacts in this way. Consultations that produce an outcome declaring adverse modification are exceptionally rare for these species (NOAA, 2005d).

Nevertheless, the consultation record for all West Coast salmon and steelhead ESUs does support, at least qualitatively, an assumption that the jeopardy standard and the adverse modification standard are applied for similar actions and in similar places. If critical habitat designation supplements the application of the jeopardy standard, then the concomitance in when and where they are applied is not inconsistent with an assumption that the incremental impacts are roughly proportional to the total (adverse modification + jeopardy) impacts.

If that is the case, providing information on total impacts provides useful information for the 4(b)(2) process, as long as the benefits of inclusion are judged in the same manner (that is, in terms of the total benefits of section 7, not just the incremental benefits of critical habitat protection). Both are

11. Schamberger et al. (1992), at 34.

biased upward, in that the true benefits of inclusion and of exclusion are less than the total benefits in each case. But if the incremental benefits and costs are roughly proportional to the total benefits and costs, respectively, it is still possible to ascertain, with a high likelihood, whether the benefits of inclusion are greater than the benefits of exclusion, even without knowledge of what that proportion may be.[12]

4. Project the occurrence of projects and likelihood of modification
The fourth step begins by projecting the occurrence over space and time of activities that are likely to be impacted by section 7 and critical habitat designation. Projecting the occurrence of projects is not the same as projecting the occurrence of consultations and concomitant modifications, however. We also consider the likelihood of a project triggering a consultation and requiring modifications. In some cases, we had relevant information on this likelihood for a specific project, while in most other cases we made assumptions about the distribution of that likelihood based on historical information or using best professional judgment.

5. Aggregate the costs for each watershed
Ideally, the estimation of the aggregate costs at the watershed level would focus on changes in consumer and producer surplus, the standard measure of regulatory impacts (EPA 2000, OMB 2003).[13] This is in keeping with the guidance of the Office of Management and Budget and in accord with E.O. 12866 (OMB 2003).

Data to support such an analysis are not available, however, and the geographic scope of the designations also makes this approach unfeasible. A simpler approach provides an acceptable alternative under a robust set of circumstances. In cases where the scale of the activity being impacted in a watershed is "small," the aggregate costs of modifications approximates the change in economic surplus. A "small" scale is one that does not (significantly) affect the market for the goods and services associated with the type of project or action. With few exceptions, the projects and actions covered in this analysis appear to meet this standard.

Our basic approach, then, is to estimate aggregate costs by using the per-project modification cost and the forecasted level of projects in a watershed to calculate a total cost for that activity and watershed. This method does not allow for more dynamic responses to section 7 (for example, relocating activities or changing their frequency or timing) but is a good approximation of the true

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12. Simply put, if $X > Y$, then $X/P > Y/P$ ($P>0$). Information on the relative sizes of total impacts thus provides useful information about the relative sizes of the incremental impacts even without information on the factor of proportionality (that is, P).

13. Consumer surplus is the amount one would pay for a “good” over what one does pay, or over what cost one bears, rather than do without the good. Producer surplus is the amount that can be taken away from a producer or supplier without diminishing the amount produced or supplied. Zerbe and Dively (1994).

impacts under most circumstances. This annual amount is then projected over a 20-year period, a period we believe is a reasonable span over which to project estimated costs.

Our framework assumes that the per-project costs are not affected by the amount of critical habitat designated for an ESU. This is in accord with the focus of the analysis on a single unit (a watershed), implicitly assuming that no other units have been designated. Yet as areas are in fact designated, it is possible that economic impacts could accumulate to the level at which market-level effects are significant. This could then affect the costs (and benefits) of additional inclusions. For example, if critical habitat designation restricts the supply of a good in more than one area, the magnitude of the restriction's impact on a particular area may depend on the amount of critical habitat designated overall.

Another complication concerns the attribution of the impacts of critical habitat designation to an individual watershed. A large project may have biological effects that extend downstream, beyond the boundaries of the watershed within which it is located. If this is the case, the designation of a watershed other than the project's home watershed can nevertheless have impacts on that project. For example, a major hydropower project can have biological effects tens or even hundreds of miles downstream. Designating any one of the downstream watersheds would be sufficient to force at least some modifications on the project. The incremental impact of designating more than one downstream watershed would be significantly less than the incremental impact of designating the "first " watershed. This makes it difficult conceptually to attribute the impacts of designation to a particular area, as there is no basis for identifying one watershed among many as the "first" to be designated.

2.5 Summary

The economic framework we use in this report is a straightforward one, summing project-level impacts to estimate the total impact of designating a watershed as critical habitat. We have noted limitations in this framework, and more are considered for each activity in Section 4 below and in Appendix A. Even with the limitations, the framework produces information that will allow the 4(b)(2) process to distinguish between areas that have a "high" benefit of exclusion and those that have a "low" benefit of exclusion. This information will support a cost-effectiveness approach to designating critical habitat.

Section 3
Baseline Information

3.1 Introduction

This section provides information on the economic, legal, and regulatory baselines for the economic analysis. As is the case for all West Coast salmon and steelhead, the Oregon Coast coho ESU occupies a substantial geographic area and is protected by a complex web of other federal, state, and local laws and regulations. We begin with a brief overview of the geographic scope of the designation, and then discuss first the economic baseline and then the legal and regulatory baseline.

3.2 Geographic Scope and Economic Baseline

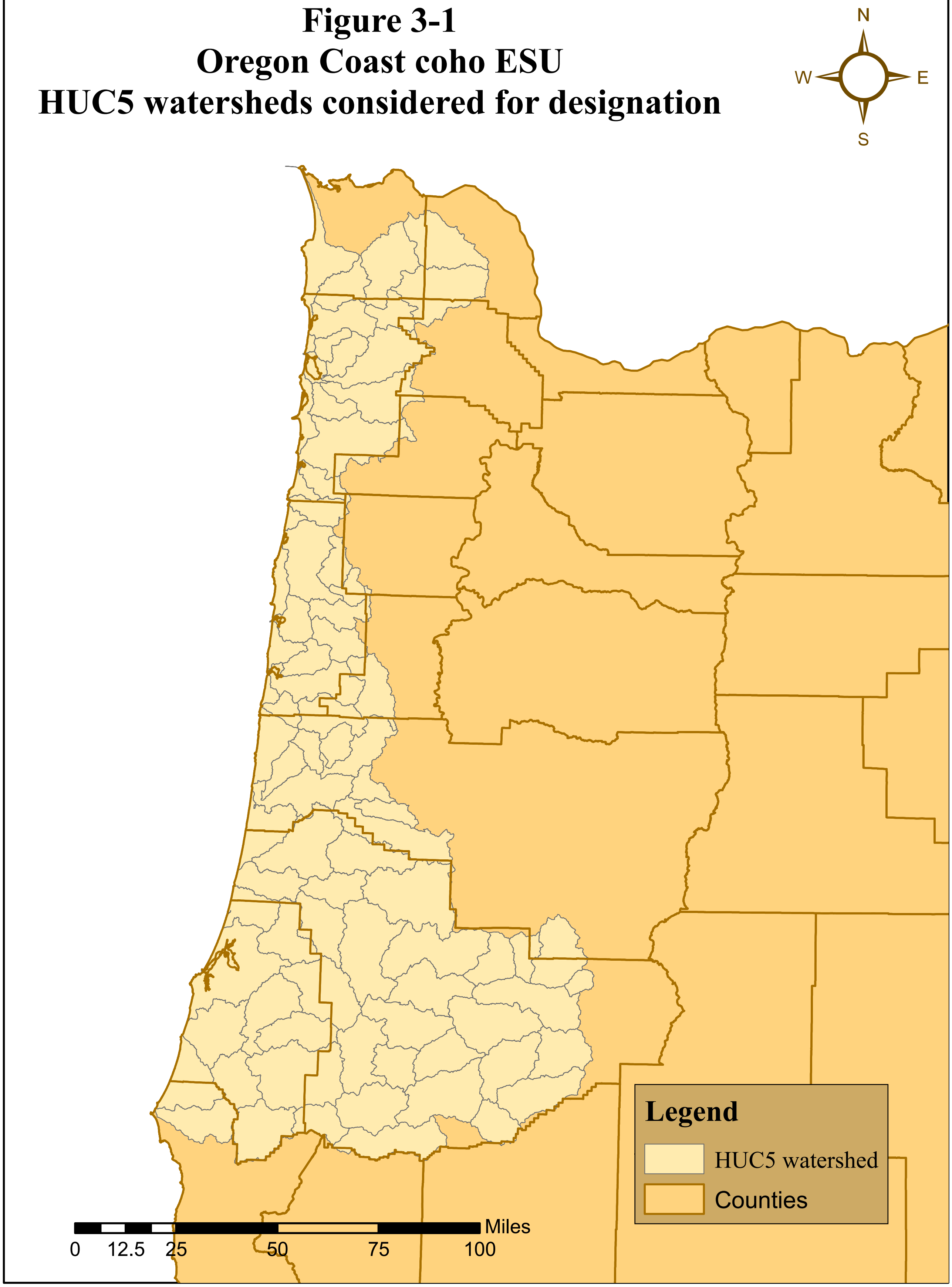
The critical habitat areas under consideration for the Oregon Coast coho ESU covers 80 watersheds, averaging 130.5 square miles in size and ranging from 16.7 to 308.2 square miles. Figure 3-1 shows the location of the watersheds under consideration.

In presenting baseline information on the economic characteristics of the watersheds in the Oregon Coast coho ESU, we face a classic problem: Ecological and economic boundaries do not coincide. Census information is available at the county (or metropolitan area) level, but a county may be covered by several watersheds, and this coverage varies widely. Describing economic activity at the level of the entire county may be misleading, however, as the watersheds considered for critical habitat designation may only cover a small part of the county. Describing a baseline in terms of the socioeconomic characteristics of these counties would not be representative of the true baseline.

One way to present a more accurate economic picture of the ESU and its constituent watersheds is to apportion a county's economic activity between the part of the county that intersects the area being considered for an ESU's critical habitat designation and the part of the county that is not being considered. Using geographic area as the basis for this apportionment would necessarily assume that the density of economic activity is uniform throughout a county, an assumption that is untenable. A strong but more palatable assumption is that economic activity is constant throughout a county on a per-capita basis. Estimating the population within a watershed then provides the basis for estimating economic activity at the watershed level. If the watersheds under consideration cover only part of a county, this approach also produces a more accurate picture of the potential impacts on that county.

Using spatial data on county and watershed boundaries and 2000 U.S. Census block data, we estimated the population of each watershed and of the part of each county covered by one or more watersheds in an ESU. Using the assumption of constant per-capita economic activity, we then estimated economic activity at the watershed level and for each county-ESU intersection. This was done by multiplying the value of per-capita economic activity by the estimated population in the watershed and in the county-ESU intersection.

Figure 3-1
Oregon Coast coho ESU
HUC5 watersheds considered for designation



Below, we present demographic and economic information in two ways: for the county as a whole and for the part of the county that intersects the watersheds in an ESU. Table 3-1 summarizes this information for the Oregon Coast coho ESU. For each characteristic, we present a figure that sums over all the counties covered by the ESU by including the entire county, and then one that sums over all the counties in an ESU by including only that portion covered by the ESU.

Table 3-1
Demographic and Economic Characteristics of Oregon Coast coho ESU

ESU characteristic	Counties	ESU portion of county
Population	1,583,067	266,690
Area (sq. miles)	23,666.00	10,442.30
Population Density	66.9	25.5
Personal Income ($1000)	$42,324,751	$6,135,714
Total Employment	890,001	141,751

3.3 Statutory and Regulatory Baseline

There are two broad types of legal and regulatory restrictions that can protect habitat even in the absence of critical habitat designation. The first is other parts of the ESA, while the second is a law or regulation that protects habitat, whether or not that is its intent, and operates independently of the ESA. Both of these are discussed below.

3.3.1 ESA habitat protections other than Section 7

In the current state of the world, where critical habitat is not designated for the Oregon Coast coho ESU, the ESA can still protect habitat through ESA sections other than section 7. Absent section 7 protections, habitat may still be protected by other parts of the ESA. For example, section 9's prohibition against "take" can curtail economic activity in an area occupied by a listed species. If there is no federal nexus – the federal government does not carry out, fund, or issue a permit for the activity – section 7 does not apply but the species and its habitat are still protected. The impacts engendered by section 9 and sections of the ESA other than section 7 are therefore included in the baseline and not considered in the analysis.

Similarly, restrictions on federal activities that jeopardize a listed species in ways that avoid modifying habitat are also embedded in the baseline. For example, NOAA Fisheries has conducted consultations for activities such as harvest and hatchery operations, which may harm the species but not by modifying its habitat. Although the ESA may have substantial impacts on these activities, they are not related to section 7's constraints on habitat modification, and so are included in the baseline and not considered in the analysis.

A more challenging example is hydropower operations. The operation of hydropower dams can adversely modify spawning, rearing, and migratory habitat, but it can also directly harm Oregon Coast coho by increasing mortality as the fish pass through a dam's turbines. Modifications that address the first set of effects properly fall within the scope of the economic analysis, while modifications that address the second set of effects belong, in principal at least, in the baseline. Distinguishing the effects of hydropower operations in this way, however, is not possible with the data available, and so all hydropower modifications are included in the analysis. This may result in an overestimate of the impacts of critical habitat.

Finally, other species listed under the ESA may occupy the same geographic area as Oregon Coast coho, and thereby afford some protection to the latter's habitat. The ranges of the northern spotted owl and marbled murrelet, for example, overlap with the habitat of Oregon Coast coho. To the extent that the ESA protections for these species provide ancillary benefits to Oregon Coast coho, those benefits should be included in the baseline. In at least one case (the Northwest Forest Plan, discussed below), these benefits may be significant.

A fundamental problem in incorporating these benefits into the baseline, however, is that they depend on the status of a species other than the Oregon Coast coho. If the status of that species improves, their critical habitat could be revised but not based on any consideration of the status of Oregon Coast coho. For that reason, we do not consider these benefits generally to be part of the baseline.

3.3.2 Other laws and regulations that protect habitat

Federal laws other than the ESA, and state and local laws and regulations can protect Oregon Coast coho habitat in the absence of critical habitat designation. While these protections may not be as strong as those under section 7, they should still be included in the baseline. In many cases, a law or regulation directly affects an activity that also has the potential to adversely modify Oregon Coast coho habitat. In those cases, we incorporate the economic impacts of these other measures into the baseline, in that we do not consider them even if section 7 also covers them. In other cases where the link is less clear or direct, we adopt a conservative stance and assume that the effects of the law or regulations and those of critical habitat designation do not overlap.

Below, we discuss the major sources of legal and regulatory baseline protection and note how we incorporated their effects into the analytical baseline. The "baseline status" notation is as follows:

- **Baseline status: No** – We explicitly considered this regulation in terms of its potential to offer baseline protection to the species, and determined that the regulation should not be assigned baseline status because: (1) its provisions for the protection of listed salmon and steelhead habitat were historically reinforced through section 7 consultation, and therefore considered to be coextensive with section 7; or (2) while the regulation encouraged behavior to protect listed salmon and steelhead habitat, it did not explicitly require these protections by law.

- **Baseline status: Partial** Certain protections for the species and habitat provided by this regulation are considered baseline; other protections are not. Using the Clean Water Act as an example, compliance with current water quality standards are considered to be baseline protections for the species and habitat. In contrast, explicit consideration of listed salmon and steelhead associated with section 404 permitting, which requires a section 7 consultation, is considered to be a protection associated with the designation of critical habitat.
- **Baseline status: Yes** – The protections provided by this regulation to listed salmon and steelhead habitat are incorporated into the baseline, as the impacts would occur without section 7 consultation and therefore not included in our cost assessment.

We also list other laws and regulations that may constrain habitat-modifying federal actions but are unlikely to provide significant protection.

Clean Water Act **(33 U.S.C. 1251 et seq. 1987)**
Baseline status: Partial
The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States. It gives the Environmental Protection Agency (EPA) the authority to implement pollution control programs such as setting wastewater standards for industry. The CWA also continued requirements to set water quality standards for all contaminants in surface waters.

According to the CWA, it is unlawful for any person to discharge a pollutant from a point source into navigable waters, unless a permit is obtained under its provisions; this requires issuance of Section 404 permits from the USACE. As part of pollution prevention activities, the USACE may limit activities in waterways through its 404 permitting process, independent of salmon concerns. These reductions in pollution may benefit Oregon Coast coho.

Under the National Pollutant Discharge Elimination System (NPDES) program, EPA sets pollutant-specific limits on the point source discharges for major industries and provides permits to individual point sources that apply to these limits.

Under the water quality standards program, EPA, in collaboration with States, establishes water quality criteria to regulate ambient concentrations of pollutants in surface waters. Under section 401 of the CWA, all applicants for a Federal license or permit to conduct activity that may result in discharge to navigable waters are required to submit a State certification to the licensing or permitting agency.

This analysis considers NOAA Fisheries's recommended modifications (as described in biological opinions) to USACE permit applications to be a section 7 impact. To the extent that NOAA Fisheries recommendations overlap with USACE's planned actions under the CWA, then this analysis may overstate the impact of section 7 impacts. In addition, it includes impacts related to water temperature control requirements implemented through the NPDES program. Other potential CWA protections that are not reinforced through section 7 (e.g., as project modifications in biological opinions) are considered baseline protections (which is the basis for the partial baseline status of this law).

National Forest Management Act (16 USC §§ 1600-1614 1976)
Baseline status: Partial
This Act requires assessment of forest lands, development of a management program based on multiple-use, sustained-yield principles, and implementation of a resource management plan for each unit of the National Forest System. The Act may provide protection to Oregon Coast coho within National Forests, primarily through its authorization of the Northwest Forest Plan (NWFP). NWFP provides numerous protections for salmon species related to Federal lands management activities (The NWFP is discussed in more detail below).

As stated below, this analysis considers NOAA Fisheries recommended alterations (as described in biological opinions) to planned USFS and BLM actions in these areas to be a section 7 impact. To the extent that NOAA Fisheries recommendations overlap NWFP provisions, this analysis may overstate the impact of section 7 implementation for Oregon Coast coho. NWFP-dictated protections that are not reinforced through section 7 are considered baseline protections (which is the basis for the partial baseline status of this law).

Northwest Forest Plan (1994)[1]
Baseline status: Partial
The Northwest Forest Plan (NWFP) defines Standards and Guidelines (S&Gs) for forest use throughout the 24 million acres of Federal lands in its planning area (the range of the Northern spotted owl). Specifically, the NWFP provides S&Gs for management of timber, roads, grazing, recreation, minerals, fire/fuels management, fish and wildlife management, general land management, riparian area management, watershed and habitat restoration, and research activities on USFS and BLM lands. To accomplish its goals, the NWFP defines seven land allocation categories, including "matrix lands," which are areas where the majority of timber is to be taken, and Riparian Reserves and Key Watersheds, where distances from rivers are set within which many activities are restricted. The Aquatic Conservation Strategy (ACS) component of the plan specifically provides for fishery habitat, protection, and restoration.

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1. NOAA Fisheries and the Fish and Wildlife Service recently clarified their application of section 7 to the Northwest Forest Plan. See USFS and BLM (2004).

All Federal lands management activities in the NWFP planning area are affected by the Northwest Forest Plan. As a result, some projects that would have affected salmon habitat will not be proposed, and therefore will not be subject to section 7 implementation. These changes in projects are considered baseline and are not included as an impact of section 7 in this analysis (which is the basis for the partial baseline status of this law). For section 7 consultations that do occur, they may include project modifications that would already have occurred under the NWFP. These modifications are nevertheless included in this analysis as section 7 impacts. As a result, this analysis may overstate the costs of section 7 implementation for Oregon Coast coho.

Federal Power Act (16 U.S.C. § 800 1920, as amended)

Baseline status: No

The purpose of the Federal Power Act (FPA) was to establish a regulatory agency to oversee non-federal hydropower generation. The resulting Federal Energy Regulatory Commission (FERC), an independent Federal agency governing approximately 2,500 licenses for non-Federal hydropower facilities, has responsibility for national energy regulatory issues.

This Act may provide protection to Oregon Coast coho habitat from hydropower activities. Section 10(j) of the Federal Power Act (FPA) was promulgated to ensure that FERC considers both power and non-power resources during the licensing process. More specifically, section 18 of the FPA states that FERC shall require the construction, operation, and maintenance by a licensee at its own expense of a fishway if prescribed by the Secretaries of Interior (delegated to the Fish and Wildlife Service) and Commerce (NOAA Fisheries).

The recommendation to install or improve a fish ladder may be brought about through consultation under section 7 of the ESA or through the FPA. In the absence of information on which regulation may serve as the causative factor, this analysis considers the cost of these modifications as section 7 impacts.

Fish and Wildlife Coordination Act (16 U.S.C.§§ 661-666 1934, as amended)

Baseline status: No

This regulation provides that, whenever the waters or channels of a body of water are modified by a department or agency of the U.S., the department or agency first shall consult with the U.S. Fish and Wildlife Service and with the head of the agency exercising administration over the wildlife resources of the State where modification will occur with a view to the conservation of wildlife resources.

The purpose of this Act is to ensure that fish and wildlife resources are equally considered with other resources during the planning of water resources development projects by authorizing NOAA Fisheries to provide assistance to Federal and State agencies in protecting game species and studying the effects of pollution on wildlife. This Act may offer protection to Oregon Coast coho habitat by requiring consultation concerning the species with NOAA Fisheries for all instream activities with a federal nexus.

This analysis assumes that NOAA Fisheries's recommendations to Federal agencies through consultation under the FWCA are the same, or similar, to those provided through section 7 for Oregon Coast coho. As a result, recommendations generated from FWCA are considered to be coextensive with section 7, and these costs are included in this analysis.

<u>Rivers and Harbors Act (33 USC §§ 401 et seq. 1938)</u>
Baseline status: Partial
The Rivers and Harbors Act (RHA) places Federal investigations and improvements of rivers, harbors and other waterways under the jurisdiction of the Department of the Army (USACE) and requires that all investigations and improvements include due regard for wildlife conservation.

This Act may provide protection to Oregon Coast coho from instream construction activities. Under sections 9 and 10 of the RHA, the USACE is authorized to regulate the construction of any structure or work within navigable water. This includes, for example, bridges and docks.

To the extent that NOAA Fisheries's recommendations through section 7 overlap USACE regulated provisions for Oregon Coast coho according to the RHS, this analysis overstates the impact of section 7 implementation for Oregon Coast coho. RHA protections that are not reinforced through section 7 (e.g., as project modifications in biological opinions) are considered baseline protections.

<u>National Environmental Policy Act (42 USC §§ 4321-4345 1969)</u>
Baseline status: No
The National Environmental Policy Act (NEPA) requires that all Federal agencies conduct a detailed environmental impact statement (EIS) in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment.

The NEPA process may provide protection to Oregon Coast coho for all activities that have Federal involvement, if alternatives are considered and selected that are less harmful to salmon and its habitat than others. For this analysis, however, NEPA provisions are not considered as a baseline element.

<u>Wilderness Act (16 USC §§ 1131-1136 1964)</u>
Baseline status: Yes
The Wilderness Act established the National Wilderness Preservation System. With a few exceptions, no commercial enterprise or permanent road is allowed within a wilderness area. Temporary roads, motor vehicles, motorized equipment, landing of aircraft, structures and installations are only allowed for administration of the area. Measures may be taken to control fire, insects and disease. Prospecting for mineral or other resources, if carried on in a manner compatible with the preservation of wilderness, is allowed.

The Wilderness Act may offer protections to Oregon Coast coho by limiting land-disturbing activities in Wilderness Areas in National Forests. Human activity in wilderness areas is likely to be greatly reduced when compared to non-wilderness areas, which is likely to benefit salmon. As explained in the next section, we used Schedules of Planned Actions (SOPAs) from National Forests to determine expected activity levels in the future. To the extent that Wilderness Area designations have precluded human activity and plans for activity in critical habitat, then Wilderness Area impacts are incorporated into the baseline. Where activities may still take place, we have accounted for the likely reduction in the level of those activities.

<u>Washington Department of Ecology Minimum Requirements for Stormwater Management Impact on Land Use Activities Within Salmon and steelhead Critical Habitat</u>
Baseline status: No
This guidance document's implementation is not required except in the case of municipal stormwater systems that require a NPDES permit. Implementation may also be required by local zoning laws or as other permit requirements. The analysis examines requirements under this guidance plan to estimate the types of costs likely to be borne for section 7 consultation stormwater consultation requirements.

<u>Other statutes and regulations that apply to land use activities</u>
While the following statutes and regulations may apply to the land within an ESU, they are unlikely to provide significant baseline protection and are not considered in the analysis.

Fish and Wildlife Conservation Act (16 USC §§ 2901-2911 1980, as amended) – The FWCA encourages States to develop, revise and implement, in consultation with Federal, State, local and regional agencies, a plan for the conservation of fish and wildlife, particularly species indigenous to the state.

Magnuson-Stevens Fishery Conservation and Management Act (16 USC §§ 1801-1882 1976, as amended) – This regulation requires identification of essential fish habitat in fishery management plans and consideration of actions to ensure the conservation and enhancement of habitat.

Fisheries Restoration and Irrigation Mitigation Act (16 USC § 777 2000) - The FRIMA directs the Secretary of Interior, in consultation with the heads of other appropriate agencies, to develop and implement projects to mitigate impacts to fisheries resulting from the construction and operation of water diversions by local government entities (including soil and water conservation districts) in the Pacific Ocean drainage area.

Water Resources Development Act (33 USC §§ 2201-2330 1986, as amended) - WRDA authorizes the construction or study of USACE projects and outlines environmental assessment and mitigation requirements.

Anadromous Fish Conservation Act (16 USC §§ 757 et seq. 1965) - The AFCA authorizes the Secretary of the Interior to enter into agreements with States and other non-Federal interests to conserve, develop and enhance the anadromous fish resources of the U.S.

Wild and Scenic Rivers Act (16 USC §§ 1271-1287 2001) - WSRA authorizes the creation of the National Wilderness Preservation System and prohibits extractive activities on specific lands.

North American Wetland Conservation Act (16 USC § 4401 et seq. 1989) - NAWCA encourages partnerships among public agencies and other interests to protect, enhance, restore and manage an appropriate distribution and diversity of wetland ecosystems and other habitats for migratory birds and other fish and wildlife.

Federal Land Policy and Management Act (43 USC §§ 1701-1782 1976) – This Act requires the Bureau of Land Management to employ a land planning process that is based on multiple use and sustained yield principles

Executive Order 11988 and 11990 (1977) – These Executive Orders require, to the extent possible, prevention of long and short term adverse impacts associated with the occupancy and modification of floodplains and prevention of direct or indirect support of floodplain development wherever there is a practicable alternative.

Coastal Zone Management Act (16 USC §§ 1451 et seq. 1972) - CZMA establishes an extensive Federal grant program to encourage coastal States to develop and implement coastal zone management programs to provide for protection of natural resources, including wetlands, flood plains, estuaries, beaches, dunes, barrier islands, coral reefs, and fish and wildlife and their habitat.

Section 4
The Impacts of Section 7 on Habitat-Modifying Activities

4.1 Introduction

In this section we present the estimated impacts of section 7 on activities that may affect Oregon Coast coho by modifying their habitat. Below, we first discuss types of activities included in the analysis and the modifications typically needed to comply with section 7. We then discuss the potential costs of making these modifications, including costs generated by the Section 7 consultations covering the activities. Appendix A gives a more detailed discussion of our methods for estimating impacts.

4.2 Types of Activities

Because section 7 directly applies only to federal actions, the majority of impacts will be borne by federal agencies, non-federal parties whose federally permitted activities are altered to avoid adverse modification, and those parties that are otherwise affected by the alteration of these activities. NOAA Fisheries maintains a substantial database covering consultations under section 7, and this database was used to derive the following set of activity types for the analysis (NMFS 2005d):

- Hydropower dams
- Non-hydropower dams and other water supply structures
- Federal lands management, including grazing (considered separately)
- Transportation projects
- Utility line projects
- Instream activities, including dredging (considered separately)
- EPA NPDES-permitted activities
- Sand & gravel mining
- Residential and commercial development
- Agricultural pesticide applications[1]

This set does not cover all possible activities but covers both the majority of consultations and a high proportion of the impacts. We discuss each of these types below.

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1. The Environmental Protection Agency (EPA) was recently enjoined from authorizing the application of a set of pesticides within a certain distance from "salmon supporting waters" (Washington Toxics Coalition, et al., v. EPA, C01-0132 (W.D. WA), 22 January 2004). The basis for this injunction was the EPA's failure to consult with NOAA Fisheries concerning possible adverse effects of pesticide application on ESA-protected salmon and steelhead. The effect of this injunction is to create an additional set of activities to be considered in the analysis, in that the restrictions on pesticide use can be viewed as a habitat-related impact of section 7.

4.2.1 Hydropower Dams

Hydropower activities account for a very small percentage of past section 7 consultations regarding Oregon Coast coho. The consultations that have occurred for West Coast salmon and steelhead ESUs in general, however, have at times been controversial and costly. A number of hydropower actions have been covered in West Coast salmon and steelhead consultations, including licensing/relicensing of projects; review of operations plans; construction of new projects; modifications to structures of dams (e.g., installation of fish passage facilities); changes in operations (e.g., change in flow regime); and removal of dams. The major Federal agency responsible for hydropower activities in the area covered by the Oregon Coast coho ESU is the Federal Energy Regulatory Commission (FERC). FERC issues licenses for privately owned hydropower projects. These licenses are valid for between 30 and 50 years depending on the extent of proposed new development or environmental mitigation and enhancement measures.

Multiple hydropower-related Federal and State regulations provide protection to Oregon Coast coho. Specifically, section 10(j) of the Federal Power Act (FPA) was promulgated to ensure that FERC considers both power and non-power resources during the licensing process.[2] Further, section 18 of the FPA states that FERC shall require the construction, operation, and maintenance by a licensee at its own expense of a fishway if prescribed by the Secretaries of Interior (delegated to the FWS) and Commerce (NOAA Fisheries).

Through the consultation process, NOAA Fisheries may recommend reasonable and prudent alternatives (RPAs) regarding hydropower projects. These RPAs, which we take to be representative of the modifications needed to comply with section 7, may be broadly divided into three major categories: capital, programmatic, and operational. Capital modifications involve direct investment in new or improved infrastructure, and require additional investment for regular operation and maintenance.[3] Programmatic changes include all other types of modification including monitoring of fish passage efficiency and water quality, data collection and research, operation of fish hatcheries, predator control, habitat improvements or restoration, and purchase of land and water

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2. Federal Power Act, 16 U.S.C. § 803(j) (1986).

3. From a review of historical section 7 consultations regarding hydropower activities, capital modifications include: constructing and maintaining fish passage facilities (including ladders and screens where applicable); collection and transport of fish at particular sites; installing improved juvenile sampling facilities, surface bypass collectors, and/or spillway weirs.

rights.[4] Operational changes are changes in hydropower production level or method, and may be engendered by modification to the flow regime.[5]

Individual hydropower dams vary substantially in their potential for harming salmon and steelhead, and so the type and extent of necessary modifications varies accordingly. Characteristics such as size and location, as well as the presence or absence of previous modifications, help determine what the most likely range of modification will be. To reflect some of this variability, we divide hydropower dams into several categories, based on generating capacity and the nature of the impacts (modification *v.* removal). We then estimate capital and programmatic modification costs for each category.

Recommendations to augment flow or change the timing of flow through a project to facilitate fish passage can have significant economic impacts on a hydropower dam. Demand for power varies seasonally, thus the value of power changes throughout the year. To the extent that flow augmentation requires water to be passed at times of the year when it is less valuable, there may be an associated economic cost. Also, where fish passage through the dam is an issue, seasonal spill over the dam may be required to reduce the risk of fatality associated with passage through the turbines. In this case, the spilled water no longer passes through the turbines and therefore cannot be used to generate electricity. The costs of more expensive electricity may be passed on to the power consumers in the form of rate changes (Peters 2003).

The necessity, level, and method of flow regime changes to accommodate the biological needs of salmon and steelhead at a particular project are determined on a case by case basis. Further, the economic impact associated with a flow regime change is dependent upon the type of project. For example, replacing power generated by peaking projects (i.e., projects that produce hydropower during periods of highest demand) is more expensive than replacing base power production. Until a hydropower project operation is reviewed, the type and level of flow changes necessary and feasible for species and habitat protection is speculative, and so the data needed to estimate these impacts for all projects are not available. Moreover, changes in one project's flow regime may result in changes to other projects' flow regime, if multiple projects are linked and managed

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4. Programmatic changes from a review of a number of historical section 7 consultations include: implementing or improving capture and release programs (e.g., enlarging transport barge exits); monitoring, evaluation, and research programs; gas abatement programs; participation in research initiatives (e.g., investigating bypass improvement methods); managing riparian vegetation; controlling erosion and sediment; implementing timing constraints on instream construction; and increased pollution control standards.

5. From a review of historical section 7 consultations regarding hydropower activities, operational changes include recommendations to: improve and manage flows through additional flow augmentation; reduce flow diversions; provide spill to increase fish passage efficiency; operate pools within a specified range; operate turbines within a specified range of efficiency; shut down turbines seasonally; draw down reservoirs; and implement restrictions on ramping rates.

together. For this reason, flow regime impacts may span multiple watersheds. For these reasons, we do not estimate impacts of flow regime changes for the full set of hydropower projects within the area under consideration.

4.2.2 Non-hydropower Dams and Other Water Supply Structures

Projects covered by this type of activity include water diversions dams and structures, water intake structures, flood control activities, pumping plants, and fish screen projects. Generally, Federal agencies, State agencies, regional public agencies, and regional private agencies supply water to end users by means of highly developed water systems consisting of dams and reservoirs, pumping plants, power plants and aqueducts. Agriculture relies on water diversion for irrigation of crops. Municipal suppliers provide water for both commercial and residential use.

Operation of Federal water projects is subject to section 7 consultation under the ESA. Any water supplier providing water via contract with U.S. Bureau of Reclamation (USBR) or using infrastructure owned or maintained by the USBR is subject to section 7 consultation under the ESA. Projects associated with privately owned diversions may require a Federal permit from USACE under sections 401 or 404 of the Clean Water Act.

As is the case for hydropower dams, potential modifications to non-hydropower dams and water supply structures can be broadly divided into three major categories: capital, programmatic, and operational. The most common modifications are capital (or maintenance to capital) and programmatic, including construction or improvement of dams, diversions, and intakes. Construction projects have been modified in their design, scope, maintenance requirements, or monitoring requirements in order to comply with section 7 for Oregon Coast coho. NOAA Fisheries has also recommended adding additional components to a project. For example, to improve habitat in the area surrounding a project, the agency has required rock or woody debris be added to the site. NOAA Fisheries has requested monitoring devices be installed or additional data be collected by the Federal agency or permit applicant. As well, NOAA Fisheries has requested a suite of other minor facility operation and maintenance requirements.

Again as in the case for hydropower dams, the necessity, level, and method of operation or flow regime changes to accommodate the biological needs of salmon and steelhead at a non-hydropower or water supply structure are determined on a case by case basis. While historical data exist to inform our understanding of the value of forgone water or agricultural production, we lack data on water quantity changes attributable to section 7 consultations for all but a few cases. Currently, there is no apparent consensus concerning how varying flow requirements will be implemented throughout the designation (Huppert et al. 2004). For this reason, we cannot attribute estimates for flow regime changes to specific projects and therefore to specific watersheds.

4.2.3 Federal Lands Management and Grazing Permits

A federal nexus exists for all management activities occurring on Federal lands. The U.S. Forest Service (USFS) and the Bureau of Land Management (BLM) have many similar land management goals and regulations, and frequently consult together. For these reasons, we have grouped the activities of the two agencies into one activity category. Activities conducted by the USFS and BLM are wide-ranging, but include fuel reduction activities, road construction, road obliteration, and road maintenance, maintenance of recreation facilities, fisheries programs, timber sales[6], permitting of livestock grazing[7], and permitting of various use permits. We have divided these activities into three activity types: General land management activities in non-wilderness areas, general land management activities in wilderness areas, and livestock grazing on Federal lands.

The consultation history for the Oregon Coast coho ESU during the period 2001-2006 shows that 33% of section 7 consultations for Oregon Coast coho were conducted with the USFS or the BLM on various land management activities. The outcomes of consultations such as these are likely influenced by several important baseline regulations. In particular, the Northwest Forest Plan provides numerous baseline protections to Oregon Coast coho. As noted in section 3 of this report, the Northwest Forest Plan defines Standards and Guidelines (S&Gs) for forest use throughout the 24 million acres of Federal lands in its planning area. Specifically, the NWFP provides S&Gs for management of timber, roads, grazing, recreation, minerals, fire/fuels management, fish and wildlife management, general land management, riparian area management, watershed and habitat restoration, and research activities on USFS and BLM lands. To accomplish its goals, the NWFP defines seven land allocation categories, including “matrix lands,” areas where the majority of timber is to be taken, and Riparian Reserves and Key Watersheds, where distances from rivers are set within which many activities are restricted.

4.2.4 Transportation Projects

Transportation projects that affect Oregon Coast coho habitat are wide ranging. They may include the widening of a road, the reconstruction of a bridge, or the restoration of a ferry terminal. These projects can produce environmental impacts that may directly kill or injure salmon, or may disturb habitat. The impacts can be direct (i.e., riparian destruction during a bridge replacement) or more ancillary (i.e., storm water run-off disturbance following a road widening.

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6. The consultation history indicates that NOAA consults on timber sales on Federal lands, but not on similar sales on private or other non-Federal lands.

7. The consultation history indicates that NOAA consults on livestock grazing on Federal lands, but does not consult on similar activities on private or other non-Federal lands. The reason for this is that grazing on non-Federal lands rarely needs a federal permit, and thus does not have a federal nexus.

The federal nexus for a transportation project may be through the permitting or funding provided by the Army Corps of Engineers (USACE), Federal Highways Administration (FHWA) and/or the Federal Aviation Administration (FAA). The USACE permits bridgework, roadwork, and railroad restoration projects that need Clean Water Act permits. FHWA funds bridgework, roadwork, railroad restoration projects, and ferry terminal maintenance, and the FAA permits aircraft/airport repair and maintenance. Roadwork, bridgework, and culvert projects encompass nearly 90 percent of all transportation projects that have been consulted upon.

Examination of biological opinions, case studies, and other data indicate that NOAA Fisheries requires similar project modifications for road, bridge, and culvert projects. Project modifications typically required for transportation projects include pre-construction surveys; the development and implementation of a site-specific spill prevention, containment, and control plan and removal of toxicants as they are released; water quality monitoring; use of boulders. rock, and woody materials from outside of the riparian area; monitoring and evaluation both during and following construction; and a variety of other measures.

4.2.5 Utility Line Projects

Activities classified as utility lines projects typically install or repair pipes or pipelines utilized to transport gas or liquids; cables, lines, or wires used to transmit electricity or communication; and outfall structures of utilities such as waste water treatment plants or powerplants. The projects associated with utility line activities that could impact salmon and steelhead include excavation, temporary sidecasting of excavated materials, backfilling of the trench, and restoration of the work site to pre-construction contours and vegetation.

The most common federal nexuses for utility lines include the Army Corps of Engineers (USACE) and FERC. USACE consults with NOAA regarding 404 Clean Water Act and/or Section 10 River and Harbors Act permits, while FERC consults on pipeline projects that have the potential to impact threatened and endangered species and their habitat.[8] For projects that may impact wetlands or cross water bodies, FERC maintains a list of construction and mitigation procedures. These mitigation procedures include the use of directional drilling, rather than open cut construction, and suggest mitigation activities during the proposal stage (FERC 2003). Therefore, some of the project modification costs estimated to be attributable to Oregon Coast coho critical habitat may be overestimated as these measures may already be required.

4.2.6 Instream Activities, including Dredging

Actions associated with instream activities that could impact Oregon Coast coho include construction or repair of breakwaters, docks, piers, pilings, bulkheads, boat ramp, and docks, and

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8. Robert Arvedlund, Federal Energy Regulatory Commission, personal communication, February 25, 2003

dredging. Although the projects are commonly undertaken by private or non-federal parties, in most cases they must obtain a USACE permit. That agency must then consult with NOAA Fisheries under section 7.

Turbidity associated with instream activities may interfere with the species' visual foraging, increase susceptibility for predation, and interfere with migratory behavior. Chemicals and waste materials including toxic organic and inorganic chemicals that accumulate in sediment may be directly toxic to aquatic life or a source of contaminants for bioaccumulation in the food chain. The release of ammonia, a common by-product produced in anaerobic sediments, may affect aquatic species as it is re-suspended in the water column. Instream activity impacts on invertebrate colonies may result in some loss of salmonid prey. Finally, entrainment of Oregon Coast coho can occur during dredging when the fish are unable to overcome the water velocities near the draghead and are pulled into the hold of the ship.

For projects that cover boat docks and ramps, bank stabilization projects, and breakwater and bulkhead projects, the modifications typically needed to comply with the ESA include shoreline planting, construction materials restrictions, use of bubble curtains, habitat improvement, spill prevention contaminant control plan, erosion control, and timing restrictions. For dredging, the necessary modifications include work window constraints, extension of the prescribed work window, additional survey work, and mobilization costs.

4.2.7 National Pollutant Discharge Elimination System (NPDES) Permitted Activities

The EPA and NOAA Fisheries have authored guidance to States and tribes on the development of temperature criteria deemed protective of salmon and steelhead. As a result, facilities in the Pacific Northwest that require permits under the National Pollutant Discharge Elimination System (NPDES) must now ensure that effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards. (EPA 2003). The two agencies have consulted under Section 7 on various aspects of the EPA's approval of State Water Quality Standards. Activities for which NOAA has consulted with EPA in the past include development of Total Maximum Daily Loads (TMDLs), review of non-temperature related Water Quality Standards, clean up of Superfund sites, and review of pesticide applications. With the exception of pesticide applications, the majority of these activities do not represent a significant portion of the consultation record nor are they expected to increase in the future.

The only identified incremental standard motivated explicitly by concern for Oregon Coast coho involves temperature controls. While NPDES-permitted facilities have always been required to adhere to certain temperature criteria associated with effluent discharge, the 2003 guidance has led to stricter standards where Oregon Coast coho are known to spawn or rear. As a result, NPDES-permitted facilities in the Pacific Northwest are required to ensure that their effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards (EPA 2003). To comply with the salmon temperature criteria, NPDES-permitted facilities identify and employ a host of temperature control procedures through Temperature Management Plans (TMPs). Controls include process optimization, pollution prevention, land application, and cooling towers.

4.2.8 Sand and Gravel Mining

Mining activities that affect Oregon Coast coho generally include the removal of sand and gravel from active river channels and floodplains for industrial purposes, such as for road construction material, concrete aggregate, fill, and landscaping (NMFS 2005i). Gravel mining is an activity permitted by USACE under sections 401 and 404 of the Clean Water Act, or under section 10 of the Rivers and Harbors Act of 1899.

There are three basic types of gravel mining in salmon habitat: dry-pit mining, wet-pit mining, and bar skimming or scalping. Wet-pit mining involves the use of a dragline or hydraulic excavator to remove gravel from below the water table and can directly destroy spawning habitat, increase turbidity, increase suspended sediment, and increase gravel siltation in salmon habitat areas. Gravel bar skimming typically occurs above the water table, but is also considered to significantly impact aquatic habitat by destabilizing the banks and increasing suspended sediment (NMFS 2005i). Dry-pit mining occurs outside the active stream channel, and typically is considered by NOAA Fisheries to have fewer direct effects on salmon, though degrading the morphology of the channel is still a concern.[9]

Gravel mining may include impacts such as the loss or degradation of spawning beds and juvenile rearing habitat; migration blockages; channel widening, shallowing, and ponding; loss of hydrologic and channel stability; loss of pool/riffle structure; increased turbidity and sediment transport; increased bank erosion and/or stream bed downcutting; and loss or degradation of riparian habitat (NMFS 2005i).

4.2.9 Residential and Commercial Development

The potential for adverse economic impacts arising from constrained residential and related development is a frequent concern to communities in which critical habitat has been proposed for designation. The nature and magnitude of any economic impact attributable to critical habitat designation will depend upon baseline land and housing market conditions and the extent to which a designation distorts these initial conditions. A common concern is that the designation of critical habitat may reduce the overall amount of land available to the market, and increase the price of developed land and housing.

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9. Email communication with Erin Strange, NOAA Fisheries, Sacramento Office, December 9, 2003.

If critical habitat designation inhibits the development potential of some parcels, the supply of land available for development will be reduced. In areas that are already highly developed, or where developable land is scarce for other reasons (i.e., non-critical habitat-related regulations), this reduction in available land and the corresponding increase in price could be significant, and ultimately translate into fewer housing units being built within the affected market, affecting both producers and consumers. In areas where developable land is relatively plentiful, however, developers and builders will be able to identify substitute sites for projects, thereby limiting economic impacts to the owners of specific parcels that suffer a diminishment in their land's value.

Critical habitat designation may also have offsetting, beneficial impacts as well. If the designation creates open space as part of its impacts on residential and commercial development, the remaining property's value may be affected positively. There are no available data to estimate the magnitude or even existence of this link, however.

In addition to the primary economic impacts identified above, commenters on previous economic analyses of critical habitat designation have described additional categories of economic and financial effects in residential and commercial development markets, generally falling into the category of regional economic impacts.[10] Regional economic impacts reflect changes in local output, employment and taxes. The principal category of potential regional impacts associated with critical habitat designation in areas of residential development involves changes in revenues and employment in construction-related firms and other industries that support builders and developers. Specifically, commenters have suggested that if development activity decreases in a given area, these secondary industries are likely to suffer severe economic consequences.

A second category of regional impacts identified by commenters to past critical habitat analyses concerns the potential for forgone tax revenues associated with reduced residential development. That is, reduced development potential in an area may lead to lower real estate and other tax revenues. It is important to note, however, that in many cases any reduction in revenue may be offset by a reduction in municipal expenses. Thus, it is important that any estimated impacts in this category are net of these service expenditures.

Finally, in more extreme cases, concern has been expressed regarding the broader impact of critical habitat designation on regional economies. Specifically, some individuals have questioned whether designation will delay and/or impair an area's ability to realize economic growth by influencing development patterns. Whether further development of a region is, on net, desirable is a point of contention in many markets. Nonetheless, with the exception of cases in which critical habitat designation precludes a large proportion of available land from development, designation is unlikely to substantially affect the course of regional economic development. (Meyer 1998).

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10. For example, see Elliott D. Pollack and Company (1999).

In some cases, the public may believe that critical habitat designation will depress private property values below the levels associated with anticipated project modifications described above. That is, the public may perceive that, all else being equal, a property that is designated as critical habitat will be stigmatized and have lower market value than an identical property that is not within the boundaries of critical habitat. Public attitudes about the limits and costs that critical habitat may impose can cause real economic effects to the owners of property, regardless of whether such limits are actually imposed.

The designation of critical habitat for the Oregon Coast coho ESUs under consideration is unlikely to increase costs to developers, reduce revenues, impose mitigation costs, or result in project delays, at least in significant amounts. There are two reasons significant impacts are not anticipated. First, unlike terrestrial species, habitat for Oregon Coast coho is not itself part of the supply of developable land. For this reason, protection of the aquatic habitat need not take the form of supplanting development if the impacts of the development (whatever they might be) can be mitigated. As a result, section 7 consultations regarding the ESUs for real estate developments are usually limited to specific components of the development and are expected to have no direct impact on the supply of land or housing. Second, as seen in the next part of this section, project modification costs are expected to be modest (anticipated to range from \$230,000 to \$240,000 per project) and, according to NOAA Fisheries personnel, consultations regarding development projects are rare.[11]

This assessment is supported by the consultation history for all West Coast salmond and steelhead ESUs. Consultations regarding residential and related development are rare. More importantly, none of the formal consultations on development in recent years have evaluated the entire project. Past consultations have addressed only the specific activities with a federal nexus that have the potential to affect salmon and steelhead, such as stormwater outfall structures. Project modifications have included timing restrictions for instream work, BMPs, vegetation replacement, filtration systems, and water quality monitoring.

For this reason, the available data also do not support an expectation of significant stigma effects. Section 7 has no strong historical connection to restrictions on private property, and there is no expectation that this lack of a connection will change in the future. If such stigmatization does occur, it seems likely that experience with the actual strictures of critical habitat designation will remove any (negative) premium that might be characterized as a stigma effect.

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11. Personal communication with DeeAnn Kirkpatrick, NOAA Puget Sound Habitat Conservation Division, Fishery Biologist Southern Puget Sound Region, October 31, 2003. Personal communication with Eric Shott, NOAA Fisheries Santa Rosa Field Office Section 7 Coordinator, November 5, 2003

4.2.10 Agricultural Pesticide Applications

Under the Endangered Species Act, the Environmental Protection Agency (EPA) must consult with the Fish and Wildlife Service and NOAA Fisheries to ensure that the registration of products under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) complies with section 7 of the ESA. Because of the complexity of examining the effects of pest-control products on West Coast salmon and steelhead, there have been almost no consultations completed in the past decade.

In January 2004, the Environmental Protection Agency (EPA) was enjoined from authorizing the application of a set of pesticides within certain distances from "salmon-supporting waters".[12] The basis for this injunction was the EPA's failure to consult with NOAA Fisheries concerning possible adverse effects of pesticide applications on salmon and steelhead protected under the ESA. Because of this past failure to consult, the impact of section 7 on this activity, unlike the others described in this report, cannot be discerned from the consultation record.

The court in Washington Toxics v. EPA imposed two types of restrictions on applications of pesticides covered in the lawsuit. For aerial applications, no pesticides can be applied within 100 yards of "salmon-supporting waters"; for ground applications, the distance is 20 yards. We use these restrictions as a proxy for the types of modifications section 7 is likely to have.

4.3 The Costs of Section 7 Impacts

Enforcing section 7 can have two types of impacts. First, the consultation process itself imposes costs both on NOAA Fisheries and on the Federal agency or other party (or both) responsible for the activity. As explained below, our framework's focus on individual projects and watersheds makes an estimate of these costs at the watershed level problematic. Second, modifying a project to bring it into compliance with section 7 can be costly. These costs can occur following consultation, if the party responsible for the activity adopts whatever measures NOAA Fisheries specifies, or they can occur prior to consultation, if the responsible party modifies the activity (either routinely or on a case-by-case basis) in anticipation of the consultation. We account for both cases by assuming that a project located in a critical habitat area will bear these costs, without specifying whether they are incurred prior to or subsequent to consultation.

Because the necessary data are not available, particularly at the geographic scale of the critical habitat designations, we do not consider two other possible avenues for impacts to occur. We assume that activities located in critical habitat will incur the modification costs identified (with the probabilities we have estimated). Alternatively, the project could be 1) moved (if possible) to a location that does not affect Oregon Coast coho, or 2) cancelled. A basic assumption underlying any

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12. Washington Toxics Coalition, et al., v. EPA, C01-0132 (W.D. WA), 22 January 2004; Washington Toxics Coalition, et al., v. EPA, CV-01- 00132 (9th Cir.) June 29, 2005 413 F3d 1024 (2005).

economic analysis, including this one, is that economic actors choose the least costly avenue for their actions. If relocation or cancellation is less costly (accounting for potentially fewer project benefits as well), one of those alternatives would likely be chosen. Therefore, our assumption that projects will not be relocated or cancelled means that our approach likely overstates the cost of section 7 impacts.

4.3.1 Consultation Costs

In 2005, we estimated aggregate consultation costs for 12 West Coast salmon and steelhead ESUs covered by the critical habitat designations of that year (NMFS, 2005d). To illustrate the potential magnitude of consultation costs for the Oregon Coast coho ESU, we present the estimates of the costs per consultation from NMFS (2005d), but do not translate there into estimates for the ESU as a whole for reasons given below.

To estimate costs per consultation, NOAA biologists in the Northwest regional office estimated time in weeks spent on individual salmon and steelhead consultations during 2004. These estimates were then sorted by activity type and translated them into typical dollar amounts per consultation for all types of activity. To estimate per-consultation costs borne by other Federal agencies that participate in consultations, we contacted relevant staff at agency offices across the region that are involved in salmon consultations. Agencies that provided data for this effort include:

- U.S. Army Corps of Engineers, Seattle District and Walla Walla Districts
- Bureau of Land Management, Salem District
- U.S. Bureau of Reclamation, Mid-Pacific Region Division of Environmental Affairs
- Federal Energy Regulatory Commission, Hydropower Compliance Division
- Federal Aviation Administration, Office of Environment
- U.S. Forest Service, Pacific NW Region
- Washington Department of Transportation, Threatened and Endangered Species Department

Table 4-2 presents estimates of these per-consultation costs (updated to 2007[13]) that resulted from the interviews with NOAA Fisheries and other federal and state agency personnel. We note that agencies have learning curves, which may affect consultation costs over time. If an agency repeatedly engages in consultations with NOAA Fisheries for West Coast salmon and steelhead, they are likely to become more familiar with the process and to incorporate salmon concerns earlier in the project planning process, thereby streamlining future administrative costs. Thus, these estimates are likely to overstate future administrative costs to these agencies.

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13. To update the 2005 figures, we used the annual percentage pay increase for General Schedule federal employees: 2.1% for calendar year 2006 (Executive Order 13393, December 22, 2005), and 1.7% for calendar year 2007 (Executive Order 13420, December 21, 2006). The cumulative increase is then 3.84%.

Table 4-2 Costs per consultation, by activity and consultation type, for West Coast salmon and steelhead				
		Formal Consultations		
Activity	Cost range	NOAA Costs	Action Agency Costs	Total
Hydropower dams	Minimum	$19,106	$3,323	$22,429
	Maximum	$57,213	$2,284,385	$2,341,599
	Median	$38,108	$6,542	$44,649
Non-hydropower dams and water supply projects	Minimum	$7,165	$3,323	$10,487
	Maximum	$71,543	$2,284,385	$2,355,928
	Median	$39,354	$6,542	$45,895
Federal Lands Management	Minimum	$14,329	$1,038	$15,368
	Maximum	$21,494	$6,022	$27,516
	Median	$17,860	$3,946	$21,805
Transportation	Minimum	$2,388	$16,925	$19,313
	Maximum	$11,941	$36,239	$48,180
	Median	$7,165	$20,975	$28,139
Utility Lines	Minimum	$3,530	$2,907	$6,438
	Maximum	$19,106	$31,462	$50,568
	Median	$11,318	$12,668	$23,986
Instream Projects	Minimum	$1,454	$2,907	$4,361
	Maximum	$4,776	$12,668	$17,444
	Median	$3,115	$3,842	$6,957
Mining	Minimum	$27,413	$2,907	$30,320
	Maximum	$82,238	$249,206	$331,444
	Median	$54,825	$85,249	$140,074
Development	Minimum	$9,553	$2,907	$12,460
	Maximum	$9,553	$73,204	$82,757
	Median	$9,553	$26,582	$36,135
Other	Minimum	$0	$0	$0
	Maximum	$9,553	$9,553	$19,106
	Median	$4,776	$4,776	$9,553

Table 4-2 **Costs per consultation, by activity and consultation type,** **for West Coast salmon and steelhead**				
		Informal Consultations		
Activity	**Cost range**	**NOAA Costs**	**Action Agency Costs**	**Total**
Hydropower dams	Minimum	$623	$3,323	$3,946
	Maximum	$623	$31,151	$31,774
	Median	$623	$17,237	$17,860
Non-hydropower dams and water supply projects	Minimum	$1,142	$3,323	$4,465
	Maximum	$7,165	$31,151	$38,315
	Median	$4,153	$17,237	$21,390
Federal Lands Management	Minimum	$2,388	$1,038	$3,427
	Maximum	$4,776	$2,596	$7,372
	Median	$3,530	$1,869	$5,399
Transportation	Minimum	$727	$16,925	$17,652
	Maximum	$9,553	$16,925	$26,478
	Median	$5,088	$16,925	$22,013
Utility Lines	Minimum	$519	$2,907	$3,427
	Maximum	$7,165	$2,907	$10,072
	Median	$3,842	$2,907	$6,749
Instream Projects	Minimum	$1,142	$2,907	$4,050
	Maximum	$3,011	$2,907	$5,919
	Median	$2,077	$2,907	$4,984
Mining	Minimum	$1,142	$2,907	$4,050
	Maximum	$1,142	$2,907	$4,050
	Median	$1,142	$2,907	$4,050
Development	Minimum	$1,454	$2,907	$4,361
	Maximum	$1,454	$2,907	$4,361
	Median	$1,454	$2,907	$4,361
Other	Minimum	$0	$0	$0
	Maximum	$4,776	$4,776	$9,553
	Median	$2,388	$2,388	$4,776

Table 4-2
Costs per consultation, by activity and consultation type, for West Coast salmon and steelhead

Activity	Cost range	Programmatic Consultations: NOAA Costs	Programmatic Consultations: Action Agency Costs	Programmatic Consultations: Total
Hydropower dams	Minimum	$19,106	$2,284,385	$2,303,491
	Maximum	$57,213	$2,284,385	$2,341,599
	Median	$38,108	$2,284,385	$2,322,493
Non-hydropower dams and water supply projects	Minimum	$7,165	$2,284,385	$2,291,550
	Maximum	$71,543	$2,284,385	$2,355,928
	Median	$39,354	$2,284,385	$2,323,739
Federal Lands Management	Minimum	$14,329	$32,189	$46,518
	Maximum	$21,494	$56,071	$77,565
	Median	$17,860	$21,286	$39,146
Transportation	Minimum	$2,388	$36,239	$38,627
	Maximum	$11,941	$36,239	$48,180
	Median	$7,165	$36,239	$43,403
Utility Lines	Minimum	$3,530	$31,462	$34,993
	Maximum	$19,106	$31,462	$50,568
	Median	$11,318	$31,462	$42,780
Instream Projects	Minimum	$1,454	$12,668	$14,122
	Maximum	$4,776	$12,668	$17,444
	Median	$3,115	$12,668	$15,783
Mining	Minimum	$27,413	$249,206	$276,618
	Maximum	$82,238	$249,206	$331,444
	Median	$54,825	$249,206	$304,031
Development	Minimum	$9,553	$73,204	$82,757
	Maximum	$9,553	$73,204	$82,757
	Median	$9,553	$73,204	$82,757
Other	Minimum	$0	$0	$0
	Maximum	$9,553	$0	$9,553
	Median	$4,776	$0	$4,776

Table 4-2
Costs per consultation, by activity and consultation type, for West Coast salmon and steelhead

Activity	Cost range	Technical Advice/Pre-Consultation		
		NOAA Costs	Action Agency Costs	Total
Hydropower dams	Minimum	$623	--	$623
	Maximum	$623	--	$623
	Median	$623	--	$623
Non-hydropower dams and water supply projects	Minimum	$0	--	$0
	Maximum	$7,165	--	$7,165
	Median	$3,530	--	$3,530
Federal Lands Management	Minimum	$2,388	--	$2,388
	Maximum	$19,106	--	$19,106
	Median	$10,695	--	$10,695
Transportation	Minimum	$519	--	$519
	Maximum	$9,553	--	$9,553
	Median	$4,984	--	$4,984
Utility Lines	Minimum	$208	--	$208
	Maximum	$208	--	$208
	Median	$208	--	$208
Instream Projects	Minimum	$1,142	--	$1,142
	Maximum	$21,494	--	$21,494
	Median	$11,318	--	$11,318
Mining	Minimum	$1,142	--	$1,142
	Maximum	$1,142	--	$1,142
	Median	$1,142	--	$1,142
Development	Minimum	$208	--	$208
	Maximum	$208	--	$208
	Median	$208	--	$208
Other	Minimum	$4,776	--	$4,776
	Maximum	$4,776	--	$4,776
	Median	$4,776	--	$4,776

In 2005, we used the aggregate consultation record for all West Coast salmon and steelhead ESUs to predict consultation frequencies by type of activity. Breaking down consultations by type of activity is important because the cost per consultation varies widely across those types. For the Oregon Coast coho ESU, the consultation history is not rich enough to support such a detailed forecast of future consultations. Moreover, the nature of the ESU, both in terms of its salmon species (coho) and its location (coastal Oregon) make it distinct from the ESUs covered in the 2005 economic analysis. For those reasons, we do not attempt to estimate annual consultation costs for the Oregon Coast coho ESU.

4.3.2 Per-project Costs and the Occurrence of Impacts

For the 2005 designations, we developed estimates of the costs for modifying a project to comply with section 7, and of the level of the activity in each watershed. These two sets of estimates are the basic elements of the approach used in this analysis, where we have updated the costs estimates to account for inflationary changes since 2005.[14] The method for making these estimates took the following steps:

> 1) Estimate the cost of typical project modifications. For most activity types, modification costs are borne in one year and so no discounting is needed (for this step). For others, expenditures on modifications are likely to take place over a number of years. In these cases, we discounted the stream of expenditures using both a 3% and 7% discount rate. For the purposes of the discussion in this report, we sometimes give only the results for the 7% discount rate.[15]
>
> 2) Determine a forecast period. Traditionally, an economic analysis uses a single time frame over which all impacts and costs are estimated. The data sources we used, however, vary widely in the length of time covered. For that reason, we used individual time periods over which to forecast an activity type's occurrence. In some cases, we used a period of one year, as we have estimates of the annual level of an activity. In other cases, the period is longer, sometimes set by the periodicity of permits or other considerations.

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14. The activities analyzed in the report are mostly construction and other types of projects that require intermediate materials and labor, and so we used a producer price index (Intermediate Materials: Supplies & Components, Series PPIITM). We chose July 2005 as the base month for the adjustment, and October 2007 as the endpoint. The change in the producer price index for this period was 12.2%.

15. In many instances, changing the discount rate does not change the cost estimate because we report annualized costs and the cost stream is uniform. For many activities, modification costs are assumed borne in one year and the probability the costs will be borne in a given year is assumed to be distributed uniformly over the forecast period. Under these assumptions, the annual expected value is constant, and is therefore equal to the annualized expected cost regardless of the discount rate.

3) Estimate the probability that a project will be modified during the forecast period. In some cases, we assumed modifications are certain to take place in a particular year (e.g., the year of a FERC license renewal). In other cases, we used the consultation record to estimate a probability distribution over the forecast period. In still others, where no information on the probability distribution is available, we assumed it is uniformly distributed through the forecast period.

4) Calculate the annual expected cost of project modifications. The cost estimate obtained in the first step is the certain cost of modifying the project. In the third step, however, we recognize that the need to modify a project is uncertain, and so this last step incorporates the probabilities estimated in that step. We first calculated the expected cost of modifications for a particular year (the probability that the modification will take place in a given year × the cost of modification) for each year in the forecast period. We then discounted each year's expected cost (again, we used both a 3% and 7% discount rate) and took their sum to obtain the present value of the expected modification costs. Because the forecast period varies across activity types, however, using the present value will give relatively high costs for those activities with longer forecast periods. For that reason, we annualized this present value to obtain an annual expected modification cost.[16]

In almost all cases, we present a range of possible modification costs. Because our data sources for the cost estimates do not constitute a random sample, we chose not to use an average over the set of estimated costs in our data as the "representative" estimate. Instead, we assumed that the endpoints of the range represent the minimum and maximum values of a symmetric cost distribution, and used the mid-range as the representative cost estimate.

Table 4-3 below summarizes the cost estimates (in 2007 dollars) for the different types of activities, using the mid-range cost estimate and a 7% discount rate. Appendix A, which is reproduced from NMFS (2005d), describes the methods for estimating costs and forecasting volumes of activities in greater detail.

16. Taking the expected cost over time produces an estimate of the *average* cost over the forecast period. The actual level of costs, however, may be zero for all years but one, and very high in that one year. Because the one year of the actual costs is uncertain, expressing costs as an expectation enables us to compare levels of costs across activities with different probability distributions.

Table 4-3
Summary of Activity Cost Estimation[1]

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Consultation and Modifications	Annual Expected Cost
Hydropower Dams[2]	Small (0-5 MW)	per dam	$2,378,624	$2,378,624	20 years	10% over 20 years	$11,893
	Medium (5-20 MW)		$6,449,935	$6,449,935	50 years	100% over 50 years	$128,999
	Large (>20 MW), requires fish passage		$82,839,594	$82,839,594	50 years	100% over 50 years	$1,656,792
	Large (>20 MW), does not require fish passage		$50,735,746	$50,735,746	50 years	100% over 50 years	$1,014,715
	Dam removal		$26,921,466	$26,921,466	Applied to known cases of future removals		
Non-hydropower Dams	Federal and large non-hydropower dams	per dam	$2,378,624	$2,378,624	20 years	100% over 20 years	$106,025
	Small non-Federal Non-hydropower dams					10% over 20 years	$10,603

Table 4-3
Summary of Activity Cost Estimation[1]

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Consultation and Modifications	Annual Expected Cost
Federal Land Management Activities (non-wilderness)	Idaho	per acre	$1.41	$1.41	Annual	100%	$1.41
	Western Oregon & Western Washington		$6.61	$6.61			$6.61
	Eastern Oregon & Eastern Washington		$3.70	$3.70			$3.70
Federal Land Management Activities (wilderness)	Idaho	per acre	$0.08	$0.08	Annual	100%	$0.08
	Western Oregon & Western Washington		$0.33	$0.33			$0.33
	Eastern Oregon & Eastern Washington		$0.17	$0.17			$0.17
Livestock Grazing on Federal Land	Grazing	Stream miles	$12,900 + 2% annual maintenance for 30 years	$16,101	Immediate	100%	$1,298

Table 4-3
Summary of Activity Cost Estimation[1]

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Consultation and Modifications	Annual Expected Cost
Transportation[3]	Bridges & culverts (small)	per project & mile	$31,184 + variable costs	$48,165	5 years	100% over 5 years	$9,633
	Bridges & culverts (medium)		$62,255 + variable costs	$79,237			$15,847
	Bridges & culverts (large)		$94,562 + variable costs	$111,542			$22,308
	Roads (small)	per project & mile	$25,575 + variable costs	$42,556	5 years		$8,511
	Roads (medium)		$52,721 + variable costs	$69,702			$13,940
	Roads (large)		$79,979 + variable costs	$96,960			$19,392
Utility Lines	Outfall structures and pipelines	per project	$113,295	$113,295	Annual	100%	$113,295
Instream Activities	Dredging	per project	$920,938	$920,938	Annual	100%	$920,938
	Boat dock, boat ramps, bank stabilization	per project	$61,134	$61,134	Annual	100%	$61,134

Table 4-3
Summary of Activity Cost Estimation[1]

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Consultation and Modifications	Annual Expected Cost
EPA NPDES-permitted facilities	Minor facility	per facility	O&M: $7,628 for 20 years	$80,808	Immediate	20%	$1,526
	Major facility	per facility	Capital: $472,808 O&M: $22,126 for 20 years	$707,212	Immediate	25%	$16,689
Sand and Gravel Mining	Mining on non-Federal lands	per site	$370,170 for 5 years	$1,516,694	30 years	50% over 30 years	$25,278
Residential and Commercial Development	New development	per project	$263,606	$263,606	Annual	100%	$15,553
Agricultural Pesticide Applications	Agricultural cropping	per acre	$0 - 7,310, depending on crop type and county		Annual	100%	$0 - 7,310, depending on crop type and county

Source: NMFS (2005d), updated to 2007 dollars (see note 14).
[1]Cost estimates in this table are for the case of mid-range costs and a 7% discount rate.
[2]Data for hydropower dams do not allow us to allocate all costs over an expenditure period. The cost stream presented is the present value of costs.
[3]Transportation costs are presented for a project of average mileage (3.2 miles).

Section 5
The Economic Impacts of Critical Habitat Designation

5.1 Introduction

In this section, we present a summary of the economic impacts of critical habitat designation for the Oregon Coast coho ESU. We first discuss the aggregation of individual activity impacts into a total impact for each area, and some qualifications on the results. We then examine two different ways of grouping types of impacts that provide useful economic information to the exclusion process. We then present a summary of the results, with the full set of results given in Appendix B.

5.2 Aggregating Impacts Up to the Watershed Level

As noted in Section 2 of the report, the ideal measure of the economic impact of a regulatory action is the change in economic surplus that occurs as the result of the action. Using this measure is not feasible in this case, as the economic models and data to use in those models are not available. Instead, we use a straightforward "unit-cost" approach to estimate the aggregate impacts for each watershed. Using the spatial data described in Section 4 above, we estimated the annual level of an activity type in a particular area. Where an activity has different sub-types or scales, a separate level was estimated for each. We then used the annual expected modification cost to calculate the economic impact of critical habitat designation for a particular area, using the following formula:

$$\begin{array}{c}\text{Aggregate Annual}\\\text{Impact for}\\\text{Watershed (\$/yr)}\end{array} = \begin{array}{c}\text{Sum}\\\text{(over all}\\\text{Activity}\\\text{Types)}\end{array}\left[\begin{array}{c}\text{Level of}\\\text{Activity Type}\end{array} \times \begin{array}{c}\text{Annual}\\\text{Expected}\\\text{Modification}\\\text{Cost}\\\text{per-project}\end{array}\right]$$

This annual amount is then projected over a 20-year period, a period we believe is a reasonable span over which to project estimated costs.

Two important elements of this estimation warrant closer examination: the discount rate and per-project modification costs. We considered both of these in the following ways. First, using the guidance from OMB (OMB 2003), we substituted a 3% discount rate for the 7% discount rate used in the base case calculations. Second, using the ranges of nominal modification costs (where available) presented in Section 4 and discussed in more detail in Appendix A, we estimated a Low and High case for the annualized expected per-unit costs. For both cases, we substituted the estimate into the equation above. This produced six cases, using the two discount rates (7% and 3%) and three nominal cost estimates (Mid-range, High, and Low).

Although we use the high and low ends of the nominal cost range to produce an upper and lower bound for the aggregate costs, the probability that these bounds will be reached is vanishingly small. The range is not produced by true, uniform uncertainty over the cost estimate. If the cost estimate was distributed in this way, the probability of the true cost being equal to the high or low end of the range would be equal to the probability of it being equal to the midpoint of the range, which we use for the base case. Instead, the range is produced by variation in the underlying determinants of modification costs, such as project location, scale, history, and so forth. The cost of an individual project's modifications may in fact reach the upper or lower bound, but only where all of these determinants are “low” or “high” simultaneously, which is likely to happen in only a small fraction of the cases. For the upper and lower bounds of the aggregate impact costs to be reached, it would have to be that every individual project has the characteristics necessary to reach the upper or lower bound, which we know is not the case. Nevertheless, we present this information to illustrate how variation in the underlying nominal costs produces variation in the estimates of aggregate impacts for a particular area.

Another aspect of the aggregation method that warrants comment is the implicit assumption that there are no cumulative or regional effects. We do not provide alternative estimations in this case, however, because adequate data are not available to support the models and analysis needed to examine such effects. Nevertheless, it is important to discuss the possible limitations this assumption places on the analysis.

The use of a constant per-unit cost is best suited to a situation in which the impacts of a regulation are "small": that is, one in which the accumulation of areas or entities that fall under the regulation do not change either the aggregate level of activity or the per-unit cost itself. At first glance, looking ahead to the results presented later in this section, this would not seem to be the case for the impacts of critical habitat designation for Oregon Coast coho. Yet the magnitudes of the impacts alone do not necessarily imply that the simpler per-unit approach is inappropriate. Two other factors are more determinative: the concentration of the impacts in terms of the industries and markets affected, and the practicality of using more sophisticated models to gauge the cumulative impacts at a regional scale. We have noted previously that the second factor works against examining cumulative impacts. The first factor reinforces this conclusion.

Using sophisticated models such as input-output models or estimations of changes in economic surplus requires a clear, quantifiable link between the regulation and a change in the availability or cost of economic goods and services. In some previous analyses of critical habitat designation, such a link existed (or at least was assumed to exist). In the case of the northern spotted owl, for example, the economic analysis attributed a precise percentage reduction in federal timber harvest in certain areas to critical habitat designation (Schamberger et al. 1992). This assumption allowed the analysis to estimate the impacts of the designation on regional levels of employment and county tax revenues.

Specifying the link between critical habitat designation and a change in an economic good or service so precisely is not possible for the Oregon Coast coho designation, however. In some cases, the link between a type of activity and a particular industry is direct and quantifiable. For example, the link between hydropower dams and power markets is one that could be incorporated into a broader regional study. The data needed to support such an effort are not available even in this case, and this particular type of impact is a minor one for the Oregon Coast coho ESU.

In other cases, the links are less direct and harder to quantify. Modifications to transportation, utility lines, and instream activities, for example, affect firms that either own the affected assets or are hired to build, maintain, or modify them, but the modifications do not directly affect the flow of a given input or output. In cases like these, data to identify and quantify the links from the impacted activities to market inputs or outputs are not available, and so assessing the impacts at a regional level would be tantamount to a simulation exercise.

This leaves us with uncertainty over the presence of any potential error from the decision not to consider cumulative impacts at the regional level. On the one hand, if these impacts in fact exist, the direction of the error in our results is downward, in that we have underestimated the costs of critical habitat designation at the level of the ESU. On the other hand, there are other potential sources of error that would produce an overestimate of the impact costs, as we have discussed in several instances above and in greater detail in Appendix A. The aggregate direction of these potential errors is therefore unknown.

There is no evidence, of course, that cumulative impacts are present in significant amounts. This absence of evidence is not evidence that they do not exist, but it does suggest that attempting to document these effects, given the analytical barriers, is of questionable value. We note, then, that the absence of this analysis possibly biases the results downward, although there is no way to gauge the likelihood or magnitude of this potential error.

5.3 Differentiating Types of Impacts

In addition to estimating the total impact of critical habitat designation for each watershed, we also used two different methods for grouping activity types. The first differentiates activity types by the degree to which the modification costs will be borne locally or in a broader area. This grouping is useful for discerning the possibility that critical habitat designation may impose an inequitable burden on individual watersheds. The second grouping differentiates activity types by their probable location within certain watersheds that serve as major migratory corridors. In these cases, NOAA Fisheries is considering the migratory and non-migratory (that is, tributary) areas separately, and the second grouping is intended to support that consideration.

When analyzing the costs of designating a particular area as critical habitat, the standard approach is to consider the impacts from a national perspective, in that the location and concentration of the impacts does not routinely influence economic efficiency.[1] The location and concentration of impacts may in part determine the equity of the regulation, however. To support consideration of this issue, we divided the set of activity types into two types: those likely to have economic impacts locally and those likely to have economic impacts at a broader geographic scale.[2] For each activity, we judged the extent to which employment would be drawn from local labor markets and output would be consumed locally, and the extent to which the entity affected was local or non-local in nature. This division is presented in Table 5-1.

Table 5-1
Activity Types with Local and Non-Local Impact

Local Impact Activity Types	Non-local Impact Activity Types
Non-hydropower dams	Hydropower dams
Utility lines	Federal lands management
Instream activities	(non-wilderness and wilderness areas)
Dredging	Grazing
NPDES-permitted activities	Transportation
Sand & gravel mining	
Development	
Agricultural pesticide applications	

The most logical candidates for non-local impacts are hydropower dams (for which the impact may be absorbed in the broader market for electricity), transportation projects (which are most often funded at the federal or state level), and all types of federal lands management (which are funded at the federal level). We do not assume that the impacts of all projects within these categories are felt non-locally, only that as a category they are more likely to produce that result.

The second type of grouping categorized activity types by the location of the activity within the watershed. NOAA Fisheries considered the possibility of designating only the migratory corridor within a watershed and excluding the tributary areas. To support this decision-making process, we identified types of activities that were more likely to be located along migratory corridors.[3] Again, the division is categorical, which presumes a higher likelihood of being present in one area or another, but not a certainty. Table 5-2 presents the migratory and tributary grouping of activities.

1. This approach is recommended by OMB (2003) and EPA (2000).

2. This division was made using best professional judgment.

3. This division was made using best professional judgment. We also drew on discussions with NOAA Fisheries biologists familiar with section 7 consultations.

Table 5-2 Location and Activity Types	
Tributary areas	**Migratory corridors**
Non-hydropower dams	Hydropower dams
Federal lands management (non-wilderness and wilderness areas)	Instream activities
Grazing	Dredging
Transportation	Utility lines
Mining	NPDES-permitted activities
Development	
Agricultural pesticide applications	

5.4 Summary of the Results for the Oregon Coast coho ESU

Below, we present a brief summary covering the results for the Oregon Coast coho ESU. Our emphasis is on illustrating the variation in the impact of section 7 and critical habitat designation for individual watersheds in each ESU. Appendices B-1 to B-14 contain the full set of results for all watersheds. This set includes total potential annual impacts for each of the six cases (3 per-project cost estimates and 2 discount rates), as well as the individual activity cost estimates presented in the same way. Our summary includes several important aspects of the results, including

1) The total impact of the designation for the ESU;
2) The distribution across activity types of the total impact for the ESU;
3) The average, median, maximum, and minimum total impact for the individual watersheds in an ESU, both annually and as a present value over a 20-year period; and
4) The sensitivity of the total impacts to variation in cost estimates and discount rates

For most of these, we list the results for each of the six cases we have described above, with Low/Mid/High referring to the three per-project cost estimates, and 3%/7% referring to the two discount rates.

Lastly, we emphasize that the impacts listed in these tables stem from the implementation of section 7 for activities that modify habitat, not just the incremental impacts of critical habitat designation alone. As noted above, the <u>NMCA</u> decision called for an analysis of "all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes."[4] The estimates of impacts should then be interpreted as the sum of two types of impacts:

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4. <u>New Mexico Cattle Growers' Association v. U.S. Fish and Wildlife Service</u>, 248 F.3d 1277 (10^{th} Cir. 2001).

- Co-extensive impacts, or those that are associated with habitat-modifying actions covered by both the jeopardy and adverse modification standards; and
- Incremental impacts, or those that are solely attributable to critical habitat designation and would not occur without the designation.

For this ESU, the analysis covered 80 watersheds, averaging 130.5 square miles in size and ranging from 16.7 to 308.2 square miles. The estimated total population for all watersheds in this ESU is 266,690 and the estimated total personal income is $6,135,714,000.

The next four tables summarize the results of the analysis for the economic impacts of critical habitat designation for the Oregon Coast coho ESU. Table 5-3 lists the annual total and 20-year present value potential impact for the ESU, for each of the six cases. Table 5-4 lists the annual total and 20-year present value potential impact for each type of activity, based on the mid-range cost estimate and a 7% discount rate.[5] Table 5-5 and 5-6 then present average, median, maximum, and minimum annual total and 20-year present value potential impacts across all watersheds in the Oregon Coast coho ESU.

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5. We express the aggregate cost estimates to the nearest $1000, which represents an approximation of the significance of the aggregate figures. Because many of the unit cost estimates and other data are based on best professional judgment, no formal analysis of the significance level of the cost estimates is possible.

Table 5-3 Annual Total Potential Impact of Section 7 Implementation			
Discount Rate	**Cost Estimate**	**Annual Total Potential Impact**	**Present Value over 20 years**
3%	Low	$10,348,000	$117,302,000
	Mid-range	$22,304,000	$252,826,000
	High	$34,260,000	$388,353,000
7%	Low	$10,380,000	$117,666,000
	Mid-range	$22,179,000	$251,414,000
	High	$33,978,000	$385,165,000

Table 5-4 Annual Total Potential Impact by Type of Activity			
Type of Activity	**Annual Total Potential Impact**	**Present Value over 20 years**	**% of total**
Hydropower Dams	$95,000	$1,079,000	0.4%
Non-hydropower Dams	$1,439,000	$16,313,000	6.5%
Federal Lands (non-wilderness)	$16,713,000	$189,448,000	75.4%
Federal Lands (wilderness)	$23,000	$258,000	0.1%
Grazing	$0	$0	0.0%
Transportation Projects	$378,000	$4,290,000	1.7%
Utility Line Projects	$265,000	$3,000,000	1.2%
Sand & Gravel Mining	$1,340,000	$15,187,000	6.0%
Instream Activities	$240,000	$2,717,000	1.1%
Dredging	$615,000	$6,968,000	2.8%
Residential & Commercial Development	$467,000	$5,289,000	2.1%
EPA NPDES-permitted Activities	$409,000	$4,641,000	1.8%
Agricultural Pesticide Applications	$196,000	$2,224,000	0.9%

Table 5-5 Annual Total Potential Impacts for Individual Watersheds					
Discount Rate	**Cost Estimate**	**Annual Total Potential Impact**			
		Average	**Median**	**Maximum**	**Minimum**
3%	Low	$129,351	$92,951	$426,646	$0
	Mid-range	$278,797	$223,519	$869,861	$0
	High	$428,245	$361,358	$1,320,062	$0
7%	Low	$129,753	$92,951	$426,646	$0
	Mid-range	$277,240	$222,419	$869,861	$0
	High	$424,729	$352,219	$1,320,061	$0

Table 5-6 Present Value of Annual Total Potential Impact over 20 Years for Individual Watersheds					
Discount Rate	**Cost Estimate**	**Present Value over 20 years**			
		Average	**Median**	**Maximum**	**Minimum**
3%	Low	$1,466,275	$1,053,657	$4,836,283	$0
	Mid-range	$3,160,329	$2,533,722	$9,860,390	$0
	High	$4,854,410	$4,096,210	$14,963,683	$0
7%	Low	$1,470,826	$1,053,657	$4,836,282	$0
	Mid-range	$3,142,679	$2,521,257	$9,860,389	$0
	High	$4,814,559	$3,992,615	$14,963,683	$0

Section 6
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Appendix A
Estimating Section 7 Impacts and Costs

A 1. Foreword

This appendix describes the methods and data used to estimate the potential economic impacts of implementing Section 7 associated with the designation of critical habitat for the Oregon Coast coho ESU. The appendix was originally published as Appendix A of NMFS (2005d), which was prepared pursuant to the designation of critical habitat for 12 West Coast salmon and steelhead ESUs (70 FR 52630). When critical habitat was proposed in 2004 for West Coast salmon and steelhead, the Oregon Coast coho ESU was included in the proposed rule (69 FR 74572). For reasons discussed in Section 1.2 above, the ESU was dropped from the final designations published in 2005. The methods and data described in Appendix A of NMFS (2005d), however, are the same as those used for this final designation of critical habitat for the Oregon Coast coho ESU.

Appendix A of NMFS (2005d) therefore accurately reflects the methods used and data gathered to support the current designation. For that reason, we reproduce Appendix A of NMFS (2005d) below. The cost figures in Appendix A reflect price levels in 2005. For the current designation, we updated the 2005 cost estimates to reflect inflationary changes.[1] These changes are reflected in the main body of the report, Table 4-3 in particular, but are not reflected in Appendix A as reproduced below.

1. The activities analyzed in the report are mostly construction and other types of projects that require intermediate materials and labor, and so we used a producer price index (Intermediate Materials: Supplies & Components, Series PPIITM). We chose July 2005 as the base month for the adjustment, and October 2007 as the endpoint. The change in the producer price index for this period was 12.2%.

A 2. Introduction

In this appendix we describe in detail each type of activity (and sub-activity, where applicable) included in the analysis:

- Hydropower dams[2]
- Non-hydropower dams and other water supply structures
- Federal lands management, including grazing (considered separately)
- Transportation projects
- Utility line projects
- Instream activities, including dredging (considered separately)
- EPA NPDES-permitted activities
- Sand & gravel mining
- Residential and commercial development
- Agricultural pesticide applications

In each case, we describe the following:

- The nature of the activity;
- Any potential modifications necessary to comply with section 7 for the protection of West Coast salmon and steelhead;
- The range of costs associated with those modifications;
- The methods for estimating the occurrence of the activity over space and time; and
- the likelihood that an activity will require modification.

We also consider the assumptions and possible errors for our analysis for each type of activity.

Because our data sources for the cost estimates do not constitute a random sample, we do not use an average over the range of estimated costs. Instead, we assume that the endpoints of the range represent the minimum and maximum values of a symmetric cost distribution, and use the midpoint of the range (the mid-range) as the representative cost estimate.

Below, we first discuss the method used for obtaining estimates of the annual expected modification cost. We then discuss the application of this method to each activity type. Finally, we present a summary table for all activity types.

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2. The Federal Columbia River Power System (FCRPS) is a system of 31 federally-owned hydropower projects in the Columbia and Snake River basins. The impacts of critical habitat designation and implementation of section 7 of the ESA on the FCRPS are included in this analysis but treated as a separate type of hydropower activity.

A 3. Method for estimating annual expected modification costs

The cost of modifying an activity can be viewed in one of two ways, depending on the nature of the activity. Some activities take the form of a flow, in that a certain level of the activity takes place every year. The activities analyzed in this report that fall into this category are hydropower dam operations, non-hydropower dam and water supply structure operations, federal lands (non-wilderness and wilderness) management, transportation projects, utility line projects, instream projects, dredging, and agricultural pesticide applications. Because we do not have year-specific estimates of the levels of these activities, we assume our level estimates are representative of the uniform annual level for the near-term future. We also assume in most cases that the costs of modifying these types of activities are borne in one year (exceptions are noted in the individual sections below). These assumptions produce a straightforward formula for estimating the annual expected modification cost, namely, the per-project modification cost weighted by the probabilities of modification and consultation.[3]

The other activities – hydropower dam capital and programmatic modifications, non-hydropower dam and water supply structure capital and programmatic modifications, grazing, NPDES-permitted activities, and mining – take the form of a stock, in that a certain number of activity sites are estimated to exist in a particular watershed. Modifications that are the likely result of a section 7 consultation are then viewed as a capital improvement to the site. Capital expenditures are either amortized over an appropriate period or staged over a number of years, and other costs such as maintenance are included where appropriate. For these activities, the estimated modification cost involves a present value calculation. Transforming this cost into an annual expected modification cost then involves two steps. First, the cost is either weighted by the probabilities of consultation and modification in a certain year for an appropriate forecast period, or assigned a certain cost for a particular year if the activity is tied to a date as in the case of FERC relicensing. The expected cost is then discounted and annualized.

The following sections discusses these calculations in more formal detail.

1) **Modification cost stream**

If a project undergoes a consultation and consequently needs to be modified to comply with section 7, we assume that the expenditures on those modifications begin in the year of the consultation, t_c, and continue for τ additional years. This gives a stream of expenditures or costs, $\{C_0, \ldots, C_\tau\}$. In most cases, we assume $\tau = 0$ – that is, the costs are incurred in a single year. In other cases, costs may consist of capital costs that occur in the first year and O&M costs that occur in subsequent years. In still others, the costs may be capital costs that are spread out over a number of years.

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3. As derived more formally below, a change in the discount rate therefore has no effect on the expected annual modification costs for these activities.

2) **Forecast period for consultation**
This is the period over which we specify probability distributions for the possibility that a consultation will take place and the possibility that a project will subsequently need to be modified to comply with section 7. The length of the forecast period, T, is determined by one or both of two factors: the nature of the activity (e.g., FERC-licensed dams) and the nature of the data. In some cases, we used judgment to set this period.

3) **Probability of project modifications during the forecast period**
This probability has two components:

1) The probability, p_t, that consultation will occur in year t, where $0 \leq t \leq T$.
2) The probability, p_M, that consultation will result in a requirement to modify the project.

We assume that p_M is independent of t, and so the probability of project modifications beginning in year t is $p_M p_t$.

Using these three components, our calculation of the annual expected modification cost proceeds as follows:

Step 1: Calculate the present value of the cost stream
We take the stream of costs, $\{C_i\}$, and calculate its present value, using the discount rate, r :

(1) $$PV_C = \sum_{i=0}^{\tau} \frac{C_i}{(1+r)^i}$$

PV_C is the estimated present value of costs incurred if modifications are required.

Step 2: Calculate the expected value of costs over the forecast period
We apply the probabilities of consultation and modification in year t to the present value of costs to get the expected value of costs for year t, $EC_t = p_t p_M PV_C$. We then calculate the present value of this expected cost, PV_{EC}, over the forecast period, using the discount rate, r :

(2) $$\begin{aligned} PV_{EC} &= \sum_{t=0}^{T} \frac{EC_t}{(1+r)^t} \\ &= \sum_{t=0}^{T} \frac{p_t p_M PV_E}{(1+r)^t} \end{aligned}$$

Step 3: Annualization of PV_{EC}

Because T varies across activities, we express modification costs as an annual expected value, AEV_C, using the standard formula for annualization:

(3) $$AEV_C = PV_{EC}\left[\frac{r}{1-(1+r)^{-T}}\right]$$

In general, AEV_C depends on the discount rate, r, in a complex way, as r affects both the annualization and the embedded present value of costs, PV_C.

If p_t is uniformly distributed throughout the forecast period, however, p_t = 1/T. In that case, $p_t\, p_M\, PV_C = (p_M\, PV_C)/\mathrm{T}$, which is constant over time. For this special case, we therefore have

(4) $$AEV_C = \frac{p_M PV_C}{T}$$

Moreover, if expenditures occur in a single year, then $PV_C = C_0$, which is independent of the discount rate. In this case, $AEV_C = p_M\, C_0$ will also be independent of the discount rate.

We use AEV_C to express the cost of section 7 impacts. In Section 5 of the report, we project this annual value over a 20-year period to give a picture of the present value of the costs, but the annual value is the most accurate estimate, given the wide range in forecast periods.

An important assumption embedded in this method is that AEV_C is independent of the area or extent of the critical habitat designation. This is equivalent to assuming that the cumulative impacts of critical habitat designation do not affect the per-unit costs of modifying an activity. If this assumption is violated, the number (and order) of watersheds designated will affect the assessment of a given watershed's impacts.[4]

This possibility raises a difficult analytical issue. If cumulative impacts are present, the analysis should then be conducted either as a series of individual watershed designations with a fixed order, or more generally as a combination of watersheds, ranging over all possibility combinations. Even

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4. If n watersheds have been designated, using a given set of per-unit costs, and the designation of the $n+1$ watershed raises the per-unit costs, the costs used to evaluate the n^{th} and previous watersheds are not accurate. Evaluating the cost of designating the $n+1^{\text{th}}$ watershed, then, depends on and how many and which watersheds have been designated previously.

if data exists on cumulative effects, the possible combinations become intractable for ESUs with more than a small number of watersheds .[5]

Although there is no evidence that cumulative impacts are present and significant, we note that the assumption they are absent introduces a potential error in the results. If the assumption is violated, the estimates we use are biased downward, in that the cumulative impacts would likely increase the cost of critical habitat designation above the levels we estimate.

A 4. Hydropower Dams

A 4.1 Overview

- This analysis assesses impacts to hydropower projects that may result from future section 7 implementation for West Coast salmon and steelhead within a watershed. Hydropower-related activities include operations, maintenance, construction and deconstruction of hydropower facilities including licensing/relicensing, modifications to infrastructure, changes in operation, and removal of dams. A review of recent consultation history shows that approximately five percent of section 7 consultations in the Northwest Region for West Coast salmon and steelhead are conducted on various hydropower-related activities.

- This analysis assigns a per-project cost estimate based on the likely suite of capital modifications and programmatic expenses that may be required in order to comply with the Endangered Species Act (ESA) for West Coast salmon and steelhead. The primary modifications we analyzed are construction or improvements to fish passage facilities and programs; research and monitoring of water quality and fish passage efficiency; and offsite mitigation, such as land purchases for the purpose of conservation. While data regarding anticipated costs stemming from changes in flow regime for particular projects are presented, this category of costs is not integrated with the impact assessment due to the uncertainty surrounding the potential magnitude of costs and the difficulty of attributing these costs to the designation of a particular watershed as critical habitat.

- Where information is available on the likely project modifications recommended for a particular project, the anticipated costs are assigned to that dam. For all other projects, annualized expected costs of project modification are assigned according to two project attributes: (1) size of project based on level of installed capacity; and (2) status of fish passage provisions. The following are the per-project costs of modifications associated with the various types of hydropower projects:

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5. The number of possible designations, where each individual watershed cycles between included and excluded, increases exponentially as the number of watersheds increases. For example, the Hood Canal summer-run chum salmon ESU has 17 individual areas under consideration, which produces over 130,000 possible combinations; the Puget Sound chinook salmon ESU, with 80 watersheds, has 1.2×10^{24} possible combinations; and the Snake River Basin steelhead ESU, with 287 watersheds, has 2.5×10^{86} possible combinations.

- Installed capacity of less than five megawatts (MW): $2.1 million[6] ($24,000 - $4.2 million)
- Installed capacity between five and 20 MW: $5.76 million ($0 - $11.5 million)
- Installed capacity of greater than 20 MW; Fish passage provisions may be required: $73.85 million ($11.5 to $136.0 million)
- Installed capacity of greater than 20 MW; Fish passage provisions are already present: $45.23 million ($11.5 to $79.1 million)
- Installed capacity unknown: $7.53 million ($0 to $136.0 million)[7]
- Dam removal costs: $24,000,000[8]

• While costs were estimated for FCRPS projects, cost estimates were not assigned to individual watersheds.

• For FERC-licensed dams, section 7 consultation and subsequent project modification are anticipated to begin concurrent with the expiration of the current FERC license, or, in the absence of that information, we assume consultation will be initiated within the next 30 years based on the fact that FERC licenses typically last 30 to 50 years. This analysis assumes that consultation for each Federal project will occur sometime within the next 10 years. For small projects, we assume consultation has a ten percent chance of occurring at some point over the next 20 years. For the majority of hydropower projects, the costs of project modifications are assumed to be incurred uniformly over a ten year time period beginning in the year of section 7 consultation.

A 4.2 Background

Hydropower activities account for a relatively small percentage of section 7 consultations regarding West Coast salmon and steelhead in the past. The consultations that have occurred, however, have at times been controversial and costly. For example, consultation regarding review of the Federal Columbia River Power System (FCRPS) operations occurs on a five year schedule. The 2000 Biological Opinion on the FCRPS has been the subject of litigation challenging the adequacy of the project modification recommendations to provide for West Coast salmon and steelhead.[9]

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6. We assume these projects have a ten percent likelihood of bearing these costs due to consultation.

7. The mid-range estimate is estimated by summing the product of the estimated probability that a dam with an unknown capacity could belong to one of the known capacity categories and the mid-range cost estimate for the appropriate capacity category.

8. We do not have a range of costs for dam removals.

9. National Wildlife Fed'n, et al. v. Nat'l Marine Fisheries Serv., et al., 254 F. Supp.2d 1196 (W.D.Wa. 2003) (finding the no-jeopardy conclusion in the 2000 biological opinion to be arbitrary and capricious); National Wildlife Federation, et al., and Oregon v. National Marine Fisheries Service, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation, CV 01-640-RE (Lead

Hydropower activities that generate consultation regarding West Coast salmon and steelhead include licensing or relicensing of projects, review of operations plans, construction of new projects, modifications to structures of dams (e.g., installation of fish passage facilities), changes in operations (e.g., change in flow regime), and removal of dams. The major Federal agencies responsible for hydropower activities in the areas under consideration are the Federal Energy Regulatory Commission (FERC), U.S. Army Corps of Engineers (USACE), the U.S. Bureau of Reclamation (USBR) and the Bonneville Power Administration (BPA). FERC issues licenses for privately owned hydropower projects and these licenses are valid for between 30 and 50 years depending on the extent of proposed new development or environmental mitigation and enhancement measures. The USACE and USBR also own and/or operate hydropower projects within the watersheds covered in this proceeding. A collaborative group comprised of the BPA, USACE, and USBR oversees operations of the 31 multipurpose dams of the FCRPS. While there is no formal procedure for regular review of Federally-operated projects, any change in operations or existing infrastructure may generate consultation regarding the impact to West Coast salmon and steelhead.

Multiple hydropower-related Federal and State regulations provide protection to West Coast salmon and steelhead. Specifically, section 10(j) of the Federal Power Act (FPA) was promulgated to ensure that FERC considers both power and non-power resources during the licensing process.[10] Further, section 18 of the FPA states that FERC shall require the construction, operation, and maintenance by a licensee at its own expense of a fishway if prescribed by the Secretaries of Interior (delegated to the FWS) and Commerce (NOAA Fisheries). The Pacific Northwest Electric Power Planning and Conservation Act (Northwest Power Act) also incorporates a Fish and Wildlife Program directing the Northwest Power and Conservation Council to adopt programs to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River system. BPA resources are utilized through this plan to mitigate and enhance fish and wildlife and habitat affected by the development and operation of hydroelectric projects in the Columbia River and it tributaries.[11]

Reasonable and prudent alternatives (RPAs) recommended through consultation regarding hydropower projects may be broadly divided into three major categories: capital, programmatic, and operational. Capital modifications involve direct investment in new or improved infrastructure, and require additional investment for regular operation and maintenance.[12] Programmatic changes

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Case), and Columbia Snake River Irrigators Association and Eastern Oregon Irrigators Association v.Gutierrez, NOAA Fisheries and Lohn, CV 05-23-RE (Consolidated Cases) (finding the no-jeopardy conclusion in the 2004 biological opinion to be arbitrary and capricious).

10. Federal Power Act, 16 U.S.C. § 803(j) (1986).

11. Pacific Northwest Electric Power Planning and Conservation Act, 16 U.S.C. §§ 839-839h.

12. From a review of historical section 7 consultations regarding hydropower activities, capital modifications include: constructing and maintaining fish passage facilities (including ladders and screens where applicable); collection and transport of fish at particular sites; installing improved

include all other types of modification including monitoring of fish passage efficiency and water quality, data collection and research, operation of fish hatcheries, predator control, habitat improvements or restoration, and purchase of land and water rights.[13] Operational changes include changes in hydropower production level or method, and may be engendered by modification to flow regime.[14] For the purposes of the remainder of our discussion, we group the first two categories together.

A 4.3 Cost Assessment

We use the current operations and existing structures of projects as a baseline for assessing the costs of modifications. Costs of RPAs for specific dams that have been recommended and implemented through past consultations are therefore not included as costs of section 7 implementation. This base case establishes the level of modification to existing operations and facilities that may be recommended through section 7 consultation in the future. Cost estimates for RPAs likely to be imposed in the future are based on a review of past economic studies, surveys of hydropower project operators, and available industry expenditure data.

<u>Capital and programmatic costs</u>
We estimated the potential costs of project modifications for almost 300 hydropower projects in California, Idaho, Oregon, and Washington. As part of this effort, utility companies and Public Utility Districts (PUDs) were contacted regarding the costs of anticipated project modifications to comply with the ESA for West Coast salmon and steelhead. Where project-specific costs were available from these contacts (17 projects in the Northwest Region), we used these figures in the analysis. Total per-project costs for these projects range from approximately $162 thousand to $136 million. As discussed below (separately), the FCRPS also has ample information on project modifications but these modifications are a mixture of section 7 implementation and other, major conservation measures.

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juvenile sampling facilities, surface bypass collectors, and/or spillway weirs.

13. Programmatic changes from a review of a number of historical section 7 consultations include: implementing or improving capture and release programs (e.g., enlarging transport barge exits); monitoring, evaluation, and research programs; gas abatement programs; participation in research initiatives (e.g., investigating bypass improvement methods); managing riparian vegetation; controlling erosion and sediment; implementing timing constraints on instream construction; and increased pollution control standards.

14. From a review of historical section 7 consultations regarding hydropower activities, recommended operational changes include: improve and manage flows through additional flow augmentation; reduce flow diversions; provide spill to increase fish passage efficiency; operate pools within a specified range; operate turbines within a specified range of efficiency; shut down turbines seasonally; draw down reservoirs; and implement restrictions on ramping rates.

Five hydropower projects within the watersheds covered by this proceeding are currently slated for removal. These projects are anticipated to bear a one time cost of $24 million in capital costs of deconstruction ($18 million) and land donation ($6 million).[15]

For other projects, where we do not have information on the specific per-project costs associated with section 7 implementation, we determined the likely suite of project modifications that may be recommended based on review of historical consultations. We aggregated the costs associated with these project modifications to determine potential ranges in total cost associated with section 7 implementation. To refine these estimates, we divided hydropower projects into six cost categories based on their relative level of power generation, and status of fish passage provisions.

For the majority of projects, we assume the costs of project modifications are incurred uniformly over a ten year time period beginning in the year of potential section 7 consultation. There are four exceptions: (1) dam removal costs are anticipated to occur in a single year, the year of decommissioning and deconstruction; (2) costs associated with small projects are assumed to occur in one year to be consistent with the treatment of non-hydropower dams; and (3) project modification costs associated with 11 of the projects employ a specific cost allocation formula provided by the project owners.[16] The present value of the cost estimates for each category is described in Table A-1.

Operational costs

Whether or not flow regime changes are necessary for West Coast salmon and steelhead at a particular project, and the level and method of change required, is determined on a case-by-case basis. Historically, while economic impacts associated with changes to flow regimes to accommodate West Coast salmon and steelhead (or their habitat) have been substantial, these impacts may vary by orders of magnitude depending upon the particular hydropower project and specific flow regime recommendation. If direct spill is requested, spilled water no longer passes through the turbines and therefore cannot be used to generate electricity. This may result in losses in profits to producers and/or welfare impacts to power consumers resulting from replacing lost electricity production with more expensive energy sources (for example, coal or gas turbine generation). Alternatively, seasonal changes to flow through turbines may be requested. While this water may still pass through the turbines, demand for power varies seasonally, thus the value of power changes throughout the year. To the extent that flow change recommendations require water to be passed at times of the year when it is less valuable, there may be an associated economic cost.

15. Based on anticipated costs of dam decommissioning and removal of the Sandy River Project from an interview with Portland General Electric (2003).

16. For these projects, four percent of costs occur each year for 2004 through 2018, two percent of costs occur each year from 2019 through 2033, and 0.5 percent of costs each year from 2034 through 2053, survey of Portland General Electric, December 2003.

Estimating impacts prospectively at a specific project is possible if the following key pieces of information are available:

- **Site-specific instream minimum flow requirements for West Coast salmon and steelhead**. Minimum instream flow requirements for West Coast salmon and steelhead are needed to identify sites that are likely to lack sufficient stream flow for conservation. This information is also helpful in determining the incremental amount of water needed from upstream dams to increase flows downstream.
- **Method of augmenting or changing flows at specific projects**. The type and method of implementation for specified flow augmentation levels depends on the causative factor of the recommendation and the adaptability of the project. To determine how a hydropower project may be affected, specific information is needed on the type of operation changes being requested, for example, whether additional flow needed downstream or fish passage through the turbines is the primary concern. In the case of the former, additional cubic feet per second (cfs) of flow may be requested; in the case of the latter, direct spill over of the dam may be requested to reduce the risk of fatality associated with passage through the turbines.
- **Project-specific operational models**. The marginal impact of implementing changes in flow regime varies by project; that is, the unit change in power generation resulting from a unit change in flow is not uniform across projects. Further, replacement costs of lost or displaced power production depends on the operations of each project subject to modification. For example, replacing power generated by peaking projects (i.e., projects that produce hydropower during periods of highest demand) is more expensive than replacing base power production. Hydropower project operators typically develop an operations model that may calculate the change in power generation associated with a particular change in flow. These models may estimate both energy generation and dependable capacity impacts of the flow restrictions, by computing both annual energy and peak capacity availability for the facility both "without" and "with" West Coast salmon and steelhead conservation activities.

Power generation is a function of multiple parameters related to the specific infrastructure characteristics of the dam and the hydrology of the river system. In the case that these data were available for all projects within the region, the modeling of impacts would be possible, though massive and complex. For hydraulically-coupled dam systems like the FCRPS, however, the estimation of impacts is possible only by developing a dynamic, regional hydrological model. Flow changes implemented at upstream dams will affect the level of flow change necessary for salmon and steelhead conservation at downstream projects. Importantly, this means that even impoundments located outside of the proposed critical habitat may affect flow within the designation and therefore may require modification to operations. Because the same water flows through each of these projects, attributing the impacts of changes in operation of any one critical habitat area is complicated, if not impossible.

Until a hydropower project operation is reviewed, then, the type and level of flow changes necessary and feasible for species and habitat protection is speculative, and so the data needed to estimate these impacts are not available. For this reason, we cannot attribute estimates for flow regime changes to specific projects and therefore to specific watersheds. Data are available for a few, larger hydropower projects, however, and present them in Table 2. We use these data to illustrate the potential magnitude of these costs at the aggregate level of all 12 ESUs.

Table A-1 Estimated Costs of Project Modifications for Hydropower Dams			
Project Category (# of dams)	**Installed Capacity of Project (MW)**	**Status of Fish Passage**	**Estimated Per-Project Costs of Modifications**
1 (231 dams)	less than 5	N/A	**Present Value of Cost: $2.1 million ($24,000 - $4.2 million)** According to FERC guidelines, hydroelectric projects with an installed capacity of less than five megawatts (MW) may be exempted from the licensing process.[c] Because these projects are not currently generating power, or are generating power in small amounts, estimated costs are based on the project modification costs of non-hydropower dams, which are anticipated to range between from $24,000 to approximately $4.2 million. Each of these projects is assigned a ten percent probability of incurring these costs sometime during the next twenty years.
2 (24 dams)	between 5 and 20	N/A	**Present Value of Cost: $5.75 million ($0 to $11.5 million)** The high-end of this estimate comprises: - capital costs, such as facilities improvements, of $8 million; - species surveys at $2,600 per year for ten years; - research on species survival and passage efficiency at $150,000 per year for ten years; and - water quality monitoring at $200,000 per year for ten years. The low end is for a project where no modifications are required.

Table A-1
Estimated Costs of Project Modifications for Hydropower Dams

Project Category (# of dams)	Installed Capacity of Project (MW)	Status of Fish Passage	Estimated Per-Project Costs of Modifications
3 (10 dams)	greater than 20	none	**Present Value of Cost: $73.75 million ($11.5 - $136.0 million)** The low end of the range includes: - Species surveys at $2,600 per year for ten years (BPA 1992); - Capital costs, such as facilities improvements, of $8 million, from a survey of 17 hydropower projects in the Northwest United States; - Research on species survival and passage efficiency at $150,000 per year for ten years (Huppert et. al. 1996); and - Water quality monitoring at $200,000 per year for ten years (Huppert et. al. 1996). The high-end of the cost range is the high-end for project modifications to a hydropower project from a December 2003 survey of utility companies and Public Utility Districts in the Pacific Northwest. The estimate includes annual costs of fish-related operations (hatchery and spawning operations, predator control studies, fish ladders and operations, fish survival studies, etc.), fish-related maintenance (fish ladder and bypass maintenance), and associated debt services (surface collector, diversion screens juvenile fish bypass system, etc.) projected over ten years. Not included is the market value of lost power generation as a result of modifications to project operation.
4 (8 dams)	greater than 20	present or not needed	**Present Value of Cost: $45.3 million ($11.5 - $79.1 million)** Where passage facilities were determined to be present or not required, the average costs of related operations and maintenance of these facilities was removed from the high-end estimate in the cost range (i.e., high-end estimate of $136 million less approximately $57 million over ten years of fish passage-related costs) These costs originate from a December 2003 survey of utility companies and Public Utility Districts in the Pacific Northwest.[b]

Table A-1 Estimated Costs of Project Modifications for Hydropower Dams			
Project Category (# of dams)	**Installed Capacity of Project (MW)**	**Status of Fish Passage**	**Estimated Per-Project Costs of Modifications**
5 (16 dams)	greater than 20	unknown	**Present Value of Cost: $56.4 million ($11.5 - $136 million)** In the absence of information regarding the presence of fish passage (as is common for the California hydro projects), this estimate reflects the probability of the presence of fish passage based on data from the Northwest Region. In the Northwest, approximately 61 percent of projects with installed capacities greater than 20 MW currently have or do not require fish passage facilities, and 39 percent either do not have facilities or the status is unknown.
6 (35 dams)	unknown	unknown	**Present Value of Cost: $7.53 million ($0 to $136.0 million)** Where installed capacity is unknown, the cost estimate reflects the likelihood of the project having various levels of installed capacity, based on the data from the Northwest, as well as the likelihood that the project will need modifications (10% for projects with installed capacity less than 5MW). In the Northwest region, 81.2% of dams have i.c. of less than 5MW, 6.4% have i.c. between 5 and 20, and 12.4% have i.c. greater than 20MW. These probabilities were applied to the mid-range estimates above to arrive at this cost estimate.

[a] Data on installed capacity of projects and status of fish passage is from the Pacific Northwest Hydropower Database and Analysis System.
[b] The recommendation to install or improve a fish ladder may be brought about through consultation under section 7 of the ESA or through the Federal Power Act. This analysis quantifies the cost of this modification as coextensive with the designation of critical habitat, although in the absence of the designation, the FPA may obligate construction of an adequate fishway.
[c] FERC (2001).

Table A-2 Costs of Fish & Wildlife Modifications to Major (non-FCRPS) Hydropower Dams			
		Annual Fish & Wildlife Costs	
Dam	**River**	**Capital and Programmatic**	**Forgone Power Revenues**
1. Ariel Dam (Lake Merwin)	Lewis River	$7,729	$0
2. Baker River	Baker River	$11,749,000	$1,925,900
3. Faraday Dam	Clackamas River	$339,046	$0
4. Oak Grove (Timothy Lake)	Clackamas River, Oak Grove Fork	$339,046	Unknown
5. Priest Rapids	Columbia River	Unknown	$31,550,547
6. Oregon City (Smurfit)	Willamette River	$101,714	Unknown
7. Pelton Dam	Deschutes River	$1,281,593	Unknown
8. Pelton Reregulating Dam	Deschutes River	$244,113	Unknown
9. River Mill	Clackamas River	$339,046	Unknown
10. Rock Island	Columbia River	$427,668	$9,069,365
11. Rocky Reach	Columbia River	$6,476,778	$7,601,885
12. Round Butte Dam	Deschutes River	$1,525,706	Unknown
13. Swift No 1	Lewis River	$7,729	$0
14. Swift No 2	Lewis River	$7,729	$0
15. T W Sullivan (PGE)	Willamette River	$101,714	$0
16. West Linn (Simpson)	Willamette River	$101,714	$0
17. Yale Dam	Lewis River	$7,729	
Total for 17 Dams (known costs)		$23,058,054	$50,147,697

Sources

1. Communication with Pacificorps, November & December 2003. Estimate includes cost of fish collection and transport over 10 years
2. Puget Sound Energy, 2004. Baker River Hydroelectric Project, FERC No. 2150, Application for New License, Major Project—Existing Dam, Volume I, Part 1 of 2, Exhibits A, B, C, D and H, 18 CFR, Part 4, Subpart F, Section 4.51.
3. Communication with Portland General Electric (PGE), November & December, 2003. Costs include changes to facilities and mitigation costs, 4% of costs each year for 2004-2018, 2% of costs each year from 2019-2033, and 0.5% of costs each year from 2034-2053. Through a phone interview, PGE assumed that there would be no lost energy production at Faraday

Table A-2 **Costs of Fish & Wildlife Modifications to Major (non-FCRPS) Hydropower Dams**
associated with salmon conservation. 4. Same as 3. Through a phone interview, PGE offered that to estimate energy losses, one could "assume that the ESA will force" a 15% reduction in energy reduction at Oak Grove Dam. Average annual generation is 29 aMW. This was also assumed to be an underestimate as it does not consider any lost capacity at the project. 5. FERC Reports from Grant County PUD received through communication with Grant County PUD, November 2003. 6. Same as 3. 7. Same as 3. 8. Same as 3. 9. Same as 3. 10. Communication with Chelan County PUD, February 2004. Power revenue cost estimate is average annual market value of lost power generation due to fish spill implementation from 1998 through 2002 ($2004). 11. Communication with Chelan County PUD, February 2004. Cost impact estimate is average annual market value of lost power generation due to fish spill implementation from 1998 through 2002 ($2004). 12. Same as 3. 13. Cost estimate from communication with Pacificorps in December 2003. Estimate includes cost of fish collection and transport over 10 years. Swift No1, Swift No 2, Yale Dam and Ariel Dam are four hydropower dams of Pacificorps' Lewis River hydro projects. In a November 2003 phone interview, Pacificorps noted that ESA compliance associated with these projects was about $4.8 million and included purchase of lands to protect anadromous salmon, and fish collection and transport (annual costs through license period). Pacificorps specifically stated that there were no operational impacts, e.g., lost generation. 14. Same as 13. 15. Same as 3. 16. Same as 3. 17. Same as 13.

<u>The Federal Columbia River Power System (FCRPS)</u>

Projects belonging to the FCRPS comprise a unique type of hydropower activity, both in scale and in the extent to which the projects are hydraulically-coupled. Of the 31 FCRPS hydropower projects, 22 fall within the boundaries of the potential critical habitat for West Coast salmon and steelhead, but all projects may adversely affect that habitat through their operations (USBR et al. 2003). The implementation of section 7 for the 12 West Coast salmon and steelhead ESUs under consideration has had significant impacts on the FCRPS, both in terms of capital structures and operations.[17] Attributing these impacts to the designation of critical habitat for a particular watershed, however, is problematic for at least three reasons. Table A-3 presents these expenses over the period 1995-2004; Table A-4 gives projections for the period 2007-2009.

Table A-3
Bonneville Power Administration (BPA) Fish & Wildlife Costs for the FCRPS, 1995 - 2004[1]

Cost Element	Fiscal Year					
	1995	1996	1997	1998	1999	2000
Capital Investments[2]						
BPA Fish and Wildlife	$38.2	$30.0	$32.0	$24.8	$16.3	$15.1
Associated Projects (Federal Hydro)	$46.2	$52.1	($48.5)	$0.0	$15.6	$50.9
Total Capital Investments	$84.5	$82.1	($16.5)	$24.8	$31.9	$66.0
Program Expenses						
BPA Direct Fish & Wildlife Program	$84.0	$79.1	$93.6	$118.1	$119.9	$117.3
Supplemental Mitigation Program Expenses[3]	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0
Lower Snake River Hatcheries (O&M)	$14.9	$13.3	$13.4	$12.8	$14.4	$13.4
Corps of Engineers (O&M)	$20.9	$21.0	$21.5	$20.8	$22.1	$21.4
Bureau of Reclamation (O&M)	$1.5	$1.7	$1.7	$3.0	$2.9	$2.0
Other (NW Power and Conservation Council)	$5.1	$4.9	$4.2	$4.2	$3.8	$4.0
Program Related Fixed Expenses[4]	$74.8	$84.4	$86.9	$83.4	$84.3	$82.7
Total Program Expenses	$201.3	$204.5	$221.3	$242.4	$247.4	$240.7
Forgone Revenues and Power Purchases						
Foregone Revenues	$8.4	$94.4	$122.7	$131.1	$219.2	$209.3
Power Purchases For Fish Enhancement	$74.7			$6.1	$52.8	$70.2
Total Foregone Revenues and Power Purchases	$83.1	$94.4	$122.7	$137.2	$272.0	$279.5
Total Program Expenses, Foregone Revenues, & Power Purchases[5]	$284.4	$298.8	$344.0	$379.6	$519.4	$520.2

17. Section 7 of the ESA was first applied to the FCRPS in 1995, which predates the listing of the 12 ESUs under consideration. The ESUs covered in that biological opinion were Snake River sockeye salmon, Snake River spring/summer chinook salmon, and Snake River fall chinook salmon.

Table A-3, continued
Bonneville Power Administration (BPA) Fish & Wildlife Costs for the FCRPS, 1995 - 2004

Cost Element	Fiscal Year costs ($millions)[1]				10-year Ave-rage
	2001	2002	2003	2004	
Capital Investments[2]					
BPA Fish and Wildlife	$17.4	$6.4	$11.9	$8.5	$20.1
Associated Projects (Federal Hydro)	$6.6	$9.2	$70.1	$75.9	$27.8
Total Capital Investments	$24.0	$15.5	$81.9	$84.4	$47.9
Program Expenses					
BPA Direct Fish & Wildlife Program	$106.9	$142.8	$144.1	$137.9	$114.4
Supplemental Mitigation Program Expenses[3]	$3.1	$7.4	$6.7	$7.8	$6.2
Lower Snake River Hatcheries (O&M)	$13.4	$15.5	$15.5	$17.3	$14.4
Corps of Engineers (O&M)	$24.4	$29.4	$31.0	$32.3	$24.5
Bureau of Reclamation (O&M)	$3.2	$4.0	$3.2	$3.9	$2.7
Other (NW Power and Conservation Council)	$3.9	$4.2	$4.1	$3.7	$4.2
Program Related Fixed Expenses[4]	$82.7	$58.9	$58.1	$85.4	$78.2
Total Program Expenses	$237.6	$262.1	$262.7	$288.3	$240.8
Forgone Revenues and Power Purchases					
Foregone Revenues	$122.5	$13.1	$81.1	$21.7	$102.4
Power Purchases For Fish Enhancement	$1,469.2	$153.9	$175.2	$191.0	$219.3
Total Foregone Revenues and Power Purchases	$1,591.7	$167.1	$256.4	$212.7	$321.7
Total Program Expenses, Foregone Revenues, & Power Purchases[5]	$1,829.3	$429.2	$519.1	$501.0	$562.5

[1]Costs are in 2004 dollars.
[2]Capital Investments include both BPA's direct Fish and Wildlife Program capital investments, funded by BPA's Treasury borrowing, and "Associated Projects", which include capital investments at Corps of Engineers' and Bureau of Reclamation projects, funded by appropriations and repaid by BPA. The negative amount in FY 1997 reflects a decision to reverse "plant-in-service" investment that was never actually placed into service. The annual expenses associated with these investments are included in "Program-Related Fixed Expenses", below.
[3]Includes High Priority and Action Plan Expenses and other supplemental programs including the BPA Power Business Line's contribution to Pikeminnow reward program.
[4]"Fixed Expenses" include depreciation and interest on investment for Corps of Engineers' projects, and amortization and interest on the investments associated with BPA's direct Fish and Wildlife Program.
[5]Capital investments are not added to this total because their annual cost is more accurately reflected as an amortization, not an expenditure in a particular fiscal year.
Source: Roger Schiewe, Bonneville Power Administration, personal communication, June 27, 2005.

Table A-4 BPA Fish & Wildlife Projected Costs for the FCRPS, 2007-2009	
Category	**FY2007-2009 Projection ($millions/year)**
Annual Average Hydropower Operations Effects	$356.9
Integrated Fish & Wildlife Program	$139.0
Northwest Power and Conservation Council	$4.6
Lower Snake River Hatcheries (O & M)	$19.8
Corps of Engineers (O & M)	$37.5
Bureau of Reclamation (O & M)	$4.2
Total repayment obligations for current & past F&W investments	$129.6
Total	$691.6
Source: BPA (2005)	

First, NOAA Fisheries implements section 7 for the FCRPS at the system level, in that the agency applies the jeopardy and adverse modification standards to the system as a whole, not to the operation of individual constituent projects within a particular watershed. Because the system spans dozens of watersheds, it is not possible to assign section 7 impacts on a watershed-by-watershed basis.

Second, the FCRPS is operated as an optimized system subject to constraints, where the optimization involves multiple objectives. The impact of section 7 of the ESA is to add a set of constraints on the system's operation. Because the scale of the FCRPS is so large, this constraint cannot be viewed as one imposed on an individual project within a particular watershed. Changing the amount or timing of flow at one dam, for example, will produce changes at other dams as the system is adjusted in light of a new constraint.

Finally, while there is a rich historical record for the FCRPS covering expenditures on conservation projects and the cost of power generation lost or replaced due to conservation measures, this record does not clearly distinguish impacts attributable to the implementation of section 7 from impacts attributable to other conservation measures such as the Northwest Power Act . Moreover, NOAA Fisheries has issued a revised biological opinion covering the FCRPS that is the subject of ongoing litigation.[18] Thus, identifying past and future modifications for the FCRPS attributable to section 7 implementation is particularly problematic.

For these reasons, we have included historic record of section 7 impacts and other conservation measures on the FCRPS in this analysis, as well as current estimates of near-term future impacts, but we do not apportion these impacts on a watershed-by-watershed basis nor attribute a subset of them to section 7 implementation. Tables A-3 and A-4 present estimates of these impacts (for both types of modifications), giving historical and projected costs borne by the Bonneville Power Administration (BPA).[19]

In many cases, the costs reported in these tables stem from actions taken to support the conservation of fish and wildlife species other than the 12 West Coast salmon and steelhead ESUs under consideration. It is not possible to apportion many of these costs among the various species covered, however. Therefore, the costs in these tables must be viewed as an overestimate of the costs attributable to the conservation of the 12 West Coast salmon and steelhead ESUs. As a result, these impacts are treated as an extreme upper bound for the impacts of section 7 for the designation of critical habitat, but not as an impact of designating a *particular* watershed as critical habitat.

A 4.4 Spatial and Temporal Distribution of Activity

We used latitude and longitude data from the Pacific Northwest Hydrosite Database (Bonneville Power Association) to locate hydropower dams in the Northwest region, augmenting those data with geospatial data from USACE National Inventory of Dams.[20] Although these databases include the FCRPS dams, we did not include them in the analysis of impacts at the watershed level, for the reasons given above.

In order to determine the likely date of consultation for a dam, we made a series of assumptions based on the nature of the federal nexus. For FERC-licensed dams, section 7 consultation and

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18. National Wildlife Federation, et al., and Oregon v. National Marine Fisheries Service, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation, CV 01-640-RE, and Columbia Snake River Irrigators Association and Eastern Oregon Irrigators Association v.Gutierrez, NOAA Fisheries and Lohn, CV 05-23-RE (FCRPS Biological Opinion Cases).

19. Not included in these estimates is the operational cost of additional spill ordered by the district court in FCRPS Biological Opinion Cases, Order and Opinion, June 10, 2005. The estimated annual cost of this spill ranges between $57 and 81 million (Roger Schiewe, Bonneville Power Administration, personal communication, June 30, 2005). This cost cannot be added to the other estimated costs in Table 4, however, because those estimates are predicated on no such spill taking place.

20. Bonneville Power Administration, The Pacific Northwest Hydropower Database and Analysis System (NWHS); USACE, National Inventory of Dams, accessed at http://crunch.tec.army.mil/nid/webpages/nid.cfm.

subsequent project modification are anticipated to begin concurrent with the expiration of the current FERC license as part of the relicensing process. Federal dams are not subject to FERC relicensing and, as such, operations may not be reviewed on a standard schedule. This analysis assumes that consultation for each non-FCRPS Federal project will occur sometime within the next 10 years. We assumed the probability that the consultation will occur in a given year is uniformly distributed through this period (i.e, a consultation has a ten percent probability of occurring in any given year). For small projects (that is, less than 5MW installed capacity), we assumed that consultation has a ten percent chance of occurring at all over the next 20 years (consistent with the treatment of non-hydropower dams), with the annual probability uniformly distributed through this period.

A 4.5 Annual Expected Modification Cost Estimates

Unlike most other activity types, the cost estimates for hydropower dams are a mix of specific cost information for some dams and general estimates for others. Table A-5 illustrates the annual expected modification costs[21] for the general estimates associated with each cost category as described in Table A-1.

Table A-5
Estimated Annual Expected Per-Project Costs for Hydropower Dams

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost
Hydropower Dams	Installed capacity is less than 5MW	$2,120,500	$10,603
	Installed capacity between 5 and 20 MW	$5,750,000	$115,000
	Installed capacity is greater than 20MW; fish passage may be required	$73,850,000	$1,477,000
	Installed capacity is greater than 20MW; fish passage already present or unnecessary	$45,230,000	$904,600
	Installed capacity is greater than 20 MW; fish passage status is unknown	$56,390,000	$1,127,800
	Installed capacity unknown	$7,400,000	$246,667

21. Because 17 projects were assigned project-specific modification cost estimates, those specific estimates are not included in this table, in that they are excluded from the estimation of the typical present value and annual expected costs. Also, the dams slated for removal are also not included in this table, as the date for removal is known in each case. In both cases, the costs are included in the estimated impacts for the corresponding watershed.

A 4.6 Assumptions and Potential Errors

Table A-6 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-6
Hydropower Dams: Assumptions and Potential Errors

Assumption	Direction of Potential Error
To estimate the expected start date for future consultation, we employ a combination of methods based upon FERC relicensing schedules, operating review schedules for certain Federal dams, and a 30 year uniform probabilistic distribution of consultation for the remaining dams. In addition, it is assumed that once consultation and modifications commence, related expenditures will occur uniformly over a ten year time frame following consultation. In reality, start dates, duration, and distribution of consultations and modifications across all dams may vary from these assumptions.	+/-
We assume that the level of installed capacity is a key determinant of the level of project modification that may be required in order to meet the requirements of section 7.	+/-
Project modifications recommended in biological opinions are included in this analysis, even if they appear to overlap particular baseline elements, such as fish passage provisions.	+
We assume that each hydropower project will experience an individual consultation. In reality, a consultation may cover more than one project. To the extent that costs of particular project modifications associated with a single consultation may be jointly borne by the project owners, this analysis may overstate its costs.	+

Table A-6 Hydropower Dams: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
Hydropower projects may be required to provide additional flow for salmon and steelhead and, as a result, may experience economic impacts to the extent that increased flow results in decreased or redistribution of power generation. The likelihood of a particular project being required to provide flow for salmon and steelhead will depend on many factors, including biological significance of the dam project to salmon/steelhead survival and recovery, the seasonality of flow, the economic importance of the dam project, whether there is public concern over the project, and other factors. As a result, costs associated with flow requirements are not included in the estimates of section 7 implementation costs assigned to a particular watershed.	*
To the extent possible, this analysis uses the location of dam infrastructure for the spatial analysis. Certain instances have been identified where dam locations vary across different data sources. The location of every dam in the data layers has not been independently corroborated.	+/-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates * : These costs are not attributable to an individual watershed.	

A 5. Non-hydropower Dams and other Water Supply Activities

A 5.1 Overview

- The analysis examines the impact of section 7 implementation for West Coast salmon and steelhead on both construction and improvement of water supply infrastructure for agricultural and municipal/industrial uses as well as the operation, or flow regime, of non-hydropower dams.

- Approximately three percent of the consultations on West Coast salmon and steelhead over the past four years were associated with water supply activities (not including consultations pertaining to dams with hydropower operations). These water supply activities include flood control activities, pumping plants, water diversions, water intake structures, and fish screen projects.

- Construction and infrastructure improvement projects have been modified in design, scope, maintenance requirements, and/or monitoring requirements as a result of section 7 consultation for West Coast salmon and steelhead. Water project operations have also been modified to make available minimum (sometimes maximum) instream flows for aquatic species.

- Costs of non-hydropower dam capital and programmatic modifications to comply with section 7 requirements are estimated to cost \$2.1 million (\$24,000 to \$4.2 million).

- We assume that all federally regulated non-hydropower dams and dams with large reservoirs (defined as dams in the 90th percentile or higher of reservoir storage capacity) are certain to bear modification costs at some point over the next 20 years. Other non-hydropower dams are assumed to have a ten percent probability of bearing consultation costs over the next 20 years.

- Costs to provide additional water flow or change the flow regime for salmon and/or steelhead are difficult to estimate reliably. Data on water quantity changes attributable to section 7 implementation are too sparse to support an estimation of potential section 7 impacts for the nonhydropower and water supply projects in the area under consideration for critical habitat. There also is no consensus on the flow requirements likely to be recommended in the future. Further, attributing costs to provide flow to a specific watershed is difficult because water supply constraints in one watershed often have effects that are realized throughout the water system. As a result, this analysis does not integrate costs associated with providing additional flow for salmon into the assessment of section 7 impacts at the watershed level.

A 5.2 Background

Water supply activities captured in this section include actions related to flood control activities, pumping plants, water diversions, water intake structures, and fish screen projects. Generally, Federal agencies, State agencies, regional public agencies, and regional private agencies supply water to end users by means of highly developed water systems consisting of dams and reservoirs, pumping plants, power plants and aqueducts. Agriculture relies on water diversion for irrigation of crops. Municipal suppliers provide water for both commercial and residential use.

Operation of the Federal water projects is subject to section 7 consultation under the ESA. Any water supplier providing water via contract with U.S. Bureau of Reclamation (USBR) or using USBR owned or maintained infrastructure is subject to section 7 consultation under ESA. Projects associated with privately owned diversions may require a Federal permit from USACE under sections 401 or 404 of the Clean Water Act.

Consultations on non-hydropower dams and other water supply activities involved Federal agencies such as the Bureau of Reclamation, U.S. Army Corps of Engineers, Bonneville Power Administration and Natural Resources Conservation Service. Other agencies involved in water supply consultations included the Department of Housing and Urban Development, Bureau of Indian Affairs, National Parks Service, and U.S. Forest Service.

As is the case for hydropower dams, we divide the potential impacts into two categories: capital and programmatic impacts, and operational impacts. The recent historical West Coast salmon and steelhead consultation record suggests that the most common modifications stemming from section 7 implementation are construction or improvement of dams, diversions, and intakes. Infrastructure construction projects have been modified in their design, scope, maintenance requirements, or monitoring requirements in order to comply with section 7 for West Coast salmon and steelhead. In the past, NOAA Fisheries has stipulated that alternative project designs be developed if the proposed design is believed to jeopardize listed species or adversely modify critical habitat. Design changes may require additional engineering and planning. NOAA Fisheries has also recommended adding additional components to a project. For example, to improve habitat in the area surrounding a project, NOAA Fisheries has required rock or woody debris be added to the site. The agency has requested monitoring devices be installed or additional data be collected by the Action agency or permit applicant. NOAA Fisheries has also requested a suite of other minor facility operation and maintenance requirements.

USBR water project operations, State operations, and regional water agency operations have been modified to make available minimum (sometimes maximum) instream flows for salmon, steelhead, and other aquatic species. In addition, NOAA Fisheries has recommended that flow fluctuations associated with reservoir operations be minimized. The agency also has stipulated that water project gate and pump operations be altered. Sometimes, NOAA Fisheries stipulates temperature objectives be pursued, or it may recommend research and monitoring of project operations.

A 5.3 Cost Assessment

Capital and programmatic modifications. We considered a variety of sources to document typical costs for these types of modifications. An analysis of the PNHD database showed that costs to install fish passage and fish screens can range from $92,000 to $4.2 million. Costs potentially attributable to section 7 implementation also are imposed on municipal water intake construction projects. For the latter case, we researched specific municipal water intake construction case studies by contacting project managers. Table A-7 presents the case studies, cost categories, and specific costs identified. Because non-hydropower dam projects may bear any combination of the modifications we have identified, costs are estimated to range from $24,000 to $4.2 million. We use the midpoint of this range, $2.1 million, as our cost estimate, which we assume will be borne over one year.

Table A-7
Case Studies of Operational Modification Costs for Nonhydropower Dams

Case Study	Cost Categories	Per-Project Costs
Lincoln City Municipal Water Intake Project on Schooner Creek, Siletz River Basin, Oregon	Engineering costs	$100,000
	Construction costs	$150,000-$220,000
	Monitoring costs	$25,000
	Habitat enhancement costs	$25,000
	Legal fees	$30,000
	Delay costs	$10,000
	Annual data collection & monitoring costs	$130,000-$260,000
City of Pendleton Water Intake and Pump Station Project, Oregon	Engineering costs	$20,000
	Construction costs	$4,000
Taylor Water Treatment Intake Project, Upper Willamette River Basin, City of Corvallis, Oregon	Construction costs	~$500,000
City of Boardman Collector Well No. 2 Project, Columbia River, Oregon	Flow replacement costs (One-time cost)	$100,000-$2,500,000
PNHD database	Fish screen and fish passage installation	$92,000 to $4.2 million
Range		$24,000 to $4.2 million

Operational (flow regime) modifications. Requirements for changes to flow regimes at dams and other water supply structures can affect water uses other than hydropower, such as agricultural and municipal water use. Almost 900 impoundments exist within the proposed critical habitat designation that serve functions of water supply, irrigation, and flood control. Flow regime changes at structures with these purposes are most likely to result in impacts to agricultural and municipal water uses. Impacts on these users could occur if the amount of water stored behind a dam is decreased, making it unavailable for its planned use at the time it is required. Impacts could also occur if the timing of water releases are altered so that water deliveries do not occur as scheduled. Impacts on flood control activities could occur if, conversely, more water is required to be held behind a dam for a later release, when it would have been released in preparation for a flood event.

The imposition of flow changes through section 7, however, requires a federal nexus to the operation of the dam or water supply structure, not just to the structure itself. For federal, non-hydropower dams, a federal nexus potentially exists for structural modifications through a U.S. Army Corps of Engineers permit for instream work. This nexus typically does not reach into the operational aspects of the structure, and therefore flow considerations are rarely covered in these types of consultations. If a non-hydropower dam or water supply structure is owned by a federal government agency, such as the Bureau of Reclamation (BOR), a federal nexus exists that can result in flow regime changes.

Water supply constraints can produce substantial economic impacts. Unfortunately, it is difficult to quantify and spatially distribute these impacts with any predictable degree of accuracy. As with calculating the impacts of flow change on hydropower operations, calculating the impacts of flow regime change on agriculture and other water uses requires site-specific minimum flow requirements and knowledge of the method (i.e. timing) of changing the flows at these sites. In addition, knowledge of the following attributes are necessary to fully understand the implications of changes to flow for municipal and agricultural uses:

- **Affected water users.** The key element to understanding the impact of flow changes on water users is understanding who will be affected. This exercise requires determining the location of water users that draw water from intakes/diversions both behind and downstream of each affected dam. Note that merely understanding the existence of farms or municipalities that are in proximity to the dams is not likely to provide a full understanding of all of the users of that water, as water users may be located remotely from the rivers providing the water. Another complicating factor is identifying the appropriate boundary where flow changes can be assumed to cease to affect downstream users. This is particularly true in dams that are managed as part of a river system, and thus where flow changes at one may be felt beyond the location of the next dam downstream.

- **The priority of the water right.** To understand the implications of a reduced water supply, it should be known what priority water right is held by each water user. While one could assume that all users would be affected by a flow change, in many cases, only the lowest priority users are likely to be affected. The priority of the water right held by users will determine which users may not receive water in the even that water supply is reduced due to flow changes. The lowest priority users will be the most likely to lost their water in the event of a shortage.

- **Purpose of water**. The purpose of the water used must be determined for affected users, either for the low-priority users, or for all users. To understand impacts on agricultural uses, this should include information on the specific crops grown, the acreage used, and the typical return flow. For municipal users, the points of withdrawal and the volume of water used should also be understood.

- **Value of the water**. A valuation tool must be used to determine the value of the lost water used as a result of flow changes. Methods are described in more detail below, but include the value of the agricultural production (on a per acre or crop basis), the market value of water, and land valuation.

For most dams and water supply structures that fall withing the salmon and steelhead critical habitat areas, the minimum flow requirements are not yet specified. Data are also not widely available on the water rights, uses, purposes, and values. As a result, the extent of flow regime changes for nonhydropower and water supply projects are the most difficult to forecast. Recommended modifications are location-specific and vary according to multiple factors, including the type of facility, the purpose of the facility, the regional importance of the facility, the presence of salmon and steelhead, the season of use, and other factors. There also does not appear to be a consensus within NOAA Fisheries on the flow requirements likely to be recommended for individual projects in future consultations. Nevertheless, it is possible to look at past consultations to gauge at least the potential magnitude of the impacts of section 7 implementation.

An example comes from the Bureau of Reclamation's (BOR) operations in the Snake River Basin above Brownlee Reservoir, including 12 BOR irrigation projects (Minidoka, Palisades, Ririe, Michaud Flats, Little Wood River, Boise, Lucky Peak, Mann Creek, Owyhee, Vale, Burnt River, and Baker), collectively referred to as the upper Snake River projects. These projects store and release water from Federal storage facilities, divert or pump water from the projects, and generate energy at Federal hydropower plants.

The projects were first brought into a section 7 consultation through the 1995 biological opinion on the FCRPS.[22] NOAA Fisheries recommended that the BOR provide up to 427,000 acre-feet of water from willing sellers and in accordance with state water law for the upper Snake River from these projects to augment flows in the Snake and Columbia rivers. This amount increased to 487,000 acre-feet through the 2004 Nez Perce water rights settlement, the terms of which have been incorporated into the 2005 Biological Opinion for the BOR's Snake River projects.

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22. NOAA Fisheries, 1995. Biological Opinion, Reinitiation of Consultation on 1994-1998, Operation of the Federal Columbia River Power System and Juvenile Transportation Program in 1995 and Future Years, March 2, 1995.

The BOR has provided water to satisfy this recommendation from the following sources:

- Uncontracted space in BOR water storage reservoirs;
- Water obtained from Idaho water rental pools;
- Buyout of existing contracts for water delivery from the upper Snake River projects; and
- Acquisition of water rights for instream flows.

Table A-8 presents the amounts, costs, and average cost per acre-foot for several water sources from which the BOR has rented or contracted for water on an annual basis. Table A-9 presents the same information for other cases where the BOR has purchased water either on a long-term contract or permanently.[23]

Table A-8
Snake River Flow Augmentation from Annual Contracts, 1995-2004

Water Source and Year of Rental	Amount of Water (acre-ft)	Cost of Water Rental	Cost/acre-foot
Upper Snake (reservoir storage)			
1995	232,839	$2,314,744	$9.94
1996	194,667	$2,361,046	$12.13
1997	202,104	$2,415,544	$11.95
1998	200,325	$2,367,408	$11.82
1999	148,397	$1,727,042	$11.64
2000	162,325	$1,847,212	$11.38
2004	46,420	$675,411	$14.55
Payette Water District 65 (reservoir storage)			
1995	50,758	$322,470	$6.35
1996	56,000	$349,305	$6.24
1997	60,000	$368,804	$6.15
1998	50,000	$303,887	$6.08
1999	65,000	$389,041	$5.99
2000	50,000	$306,168	$6.12
2002	60,000	$353,071	$5.88

23. Not included in these tables are transactions the BOR makes with local rental pools that account for water purchased through contractual buy-backs. Gail McGarry, Bureau of Reclamation, provided the data for these tables. The dollar values have been adjusted to 2004 dollars.

Table A-8 Snake River Flow Augmentation from Annual Contracts, 1995-2004			
Water Source and Year of Rental	**Amount of Water (acre-ft)**	**Cost of Water Rental**	**Cost/acre-foot**
2003	64,500	$561,513	$8.71
2004	50,000	$425,000	$8.50
Boise River Water District 63 (reservoir storage)			
1995	2,000	$16,306	$8.15
1997	2,000	$15,777	$7.89
Lemhi River (natural flow)			
2001	1,000	$230,483	$230.48
2002	1,000	$255,674	$255.67
2003	1,000	$251,424	$251.42
2004	1,000	$211,000	$211.00
Idaho high lift pumpers (natural flow)			
2002	37,889	$2,062,586	$54.44
2003	43,137	$2,071,044	$48.01
2004	83,473	$3,683,420	$44.13
Grande Ronde River (natural flow)			
1996	64	$1,848	$28.88
1997	132	$3,751	$28.41
1998	198	$3,709	$18.73
1999	198	$3,652	$18.45
2000	198	$3,571	$18.04
2001	198	$3,484	$17.59
2002	198	$3,432	$17.33
2003	198	$3,375	$17.04

Table A-8 Snake River Flow Augmentation from Annual Contracts, 1995-2004			
Water Source and Year of Rental	**Amount of Water (acre-ft)**	**Cost of Water Rental**	**Cost/acre-foot**
All Water Sources			
1995	285,597	$2,653,519	$9.29
1996	250,667	$3,014,537	$10.81
1997	264,104	$2,800,125	$10.60
1998	250,325	$2,671,295	$10.67
1999	213,397	$2,116,083	$9.92
2000	212,325	$2,153,380	$10.14
2001	1,198	$221,295	$184.72
2002	108,687	$2,998,331	$27.59
2003	108,637	$2,829,220	$26.04
2004	180,893	$4,994,831	$27.61

Table A-9 Snake River Flow Augmentation from Long Term Contracts and Permanent Purchases, 1995-2004			
Water Source and Year of Contract	**Amount of Water (acre-ft)**	**Cost of Water Transfer**	**Cost/acre-foot[1]**
Permanent buyback of Snake River projects storage space			
1996	35000	$2,629,489	$75.13
1995	6518	$1,150,278	$176.48
1995	15878	$2,592,565	$163.28
Shoshone Bannock tribal water			
1998	38,000	$1,924,619	$50.65
Ontario, Oregon farm (natural flow)			
1997	17,649	$1,493,258	$84.61
[1]These costs are "one-time" costs, not annual amounts.			

In this example, the consultation record established a desired quantity of additional flow: 427,000 acre-feet, increasing to 487,000 acre-feet. A more common outcome of a section 7 consultation is a recommendation to maintain certain minimum instream flows during certain time periods. For example, in a consultation with the BOR on the Umatilla River Basin water supply projects, NOAA Fisheries, recommended that the BOR "avoid or minimize incidental take from dewatering McKay Creek from November through April by maintaining a minimum flow in McKay Creek."[24]; and in a consultation on the Deschutes River Basin water supply projects, NOAA Fisheries recommended that the BOR minimize incidental take by providing irrigation and flood control releases from upstream projects which will ensure streamflows on a weekly basis5 of 1,700 cfs into Lake Billy Chinook in October and November."[25]

Estimating actual impacts of section 7 for these other examples would require the types of information noted above for each project site, as well as projections of water conditions and water values over the near future. Moreover, the record from the upper Snake River projects is unique to their history, and so provides no reasonable basis for making projections to other regions.[26] Indeed, the wide variance in the per-unit costs illustrated in these tables demonstrates the difficulty of making any generalizations about likely per-unit costs and therefore likely impacts of section 7 implementation. For these reasons, we do not provide estimates of the impacts of operational (flow regime) changes to non-hydropower dam and other water supply structures at the level of a particular watershed.

A 5.4 Spatial and Temporal Distribution of Activity

We used latitude and longitude data from the USACE National Inventory of Dams to locate dams other than hydropower projects. Dams in the Pacific Northwest Hydrosite Database that are not currently producing hydropower and have a purpose in addition to hydropower (e.g. flood control or recreation) were also included.

Limited data exist regarding maintenance schedules for non-hydropower projects. Unlike FERC-licensed hydropower dams, nearly all non-hydropower dams lack a specific event similar to FERC licensing that would enable us to identify a likely date for consultation. Instead, we assumed that for most types of non-hydropower dams, a consultation will occur sometime over the next 20 years. We chose this period based on the historic frequency of consultation for these project types. For all Federally-regulated dams and dams with large reservoirs, we assume that they will incur

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24. NOAA Fisheries, Ongoing Operation of the Umatilla Project and the Umatilla Basin Project, April 23, 2004.

25. NOAA Fisheries, Ongoing Operation and Maintenance of the Deschutes River Basin Projects, February 17, 2005.

26. The Snake River augmentation program is focused on surplus water, not water that is actively being used for agriculture. If flow regime changes had the effect of significantly reducing agricultural production, the per-acre-foot costs likely would be higher.

modification costs with certainty sometime during that period. We assumed a uniform distribution for the probability that the modifications would occur in a given year. All other non-hydropower projects are assigned a ten percent probability of incurring modification costs during this period.

A 5.5 Annual Expected Modification Cost Estimates

As noted above, we assume that modification costs are borne in one year; Federal and large non-hydropower dams are certain to bear these costs during a 20 year period; and smaller non-hydropower dams have a 10% chance of bearing these costs during the 20 year period. Using the cost estimates derived above, the annual expected modification cost estimates are given in Table A-10.

Table A-10
Estimated Annual Expected Per-Project Costs for Non-hydropower Dams

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost
Non-hydropower dams	Federal and large dams	$2,120,500	$106,025
	Small non-Federal dams	$2,120,500	$10,603

A 5.6 Assumptions and Potential Errors

Table A-11 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-11
Nonhydropower Dams: Assumptions and Potential Errors

Assumption	Direction of Potential Error
Impacts related to flow regime are difficult to model, because information concerning specific anticipated changes to flow across the designation at each relevant dam are unattainable. In addition, the specific critical habitat areas engendering changes in operations at a particular dam may be located distantly from the affected dam, and areas affected by changes in flow may be, in turn, distantly located from the dam. Thus, because impacts from changes in flow result from broad and interrelated system changes across large areas, and changes are not easily predicted, these potential impacts are not estimated in our analysis.	-

Table A-11 Nonhydropower Dams: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
Each non-hydropower dam within critical habitat areas is assumed to be subject to some level of modification costs over the next 20 years (though in most cases, a low probability of bearing these costs is assumed). In fact, many projects may not be subject to section 7 consultations.	+
Project modifications included in biological opinions for non-hydropower dams are included in this analysis, even if they appear to overlap baseline elements. As a result, the impact of section 7 implementation over and above the baseline may be overstated.	+
Specific infrastructure costs and impacts attributable to critical habitat designation for most non-hydropower dams are not available. As a result, the cost and impacts identified are based on a relatively small sample of projects, and may not precisely capture impacts incrementally attributable to critical habitat or Section 7 of the ESA.	+/-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

A 6. Federal Lands Management (including grazing)

A 6.1 Overview

- A review of recent consultation history shows that nearly 18 percent of section 7 consultations for West Coast salmon and steelhead are conducted with the U.S. Forest Service (USFS) and Bureau of Land Management (BLM) on various land management activities. The analysis assesses impacts on Federal land management activities that will result from section 7 enforcement for West Coast salmon and steelhead on USFS and BLM lands within areas of potential critical habitat.
- Since the mid-1990's, the Northwest Forest Plan and PACFISH have altered the priorities of the Federal land management agencies, and provided a strong management baseline for anadromous species protection. As a result, future impacts of section 7 implementation of the ESA, particularly in areas where the Northwest Forest Plan and PACFISH exist, are likely reduced from what they would have been absent these other protections. Nevertheless, this analysis

includes types of project modifications that appear in biological opinions, some of which may overlap with these baseline protections. As a result, this analysis may overstate the additional costs of section 7 implementation for West Coast salmon and steelhead.

- We consider three types of Federal land management activities: Programmatic land management in non-wilderness areas; programmatic land management in wilderness areas; and grazing land management.
- We distinguish the first two types by geographic region. This produces the following cost estimates for Federal land management modifications:
  - Idaho: $1.26 ($0.68 to $1.84) per non-wilderness acre and $0.07 ($0.04 to $0.10) per wilderness acre;
  - Eastern Oregon/Washington: $3.30 ($1.62 to $4.98) per non-wilderness acre and $0.15 ($0.07 to $0.24) per wilderness acre
  - Western Oregon/Washington: $5.89 ($3.08 to $8.71) per non-wilderness acre and $0.029 ($0.15 to $0.44) per wilderness acre
- Impacts on livestock grazing estimated to result from future section 7 implementation for West Coast salmon and steelhead are estimated to be $1,157 ($1,006 to $1,308) per stream mile on Federal land impacted by grazing.

A 6.2 Background

A federal nexus exists for all management activities occurring on Federal lands. We have grouped the activities of the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) together because the agencies have many similar land management goals and regulations, and because they frequently consult together. Activities conducted by the USFS and BLM are wide-ranging, but include fuel reduction activities, road construction, road obliteration, and road maintenance, maintenance of recreation facilities, fisheries programs, timber sales[27], permitting of livestock grazing[28], and permitting of various use permits. We have grouped these activities into two general activity types: General land management activities (classified into 10 sub-activities) and permitting of livestock grazing.

Our review of the recent consultation history (2001-2004) shows that about 17% of section 7 consultations for West Coast salmon and steelhead are conducted with the USFS and the BLM on various land management activities. The outcomes of these consultations are likely influenced by

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27. The consultation history indicates that NOAA Fisheries consults on timber sales on Federal lands, but not on similar sales on private or other non-Federal lands. Timber sales on non-Federal lands rarely need a federal permit, and thus do not have a federal nexus.

28. The consultation history indicates that NOAA Fisheries consults on livestock grazing on Federal lands, but does not consult on similar activities on private or other non-Federal lands. The reason for this is that grazing on non-Federal lands rarely needs a federal permit, and thus does not have a federal nexus.

several important baseline regulations. In particular, the Northwest Forest Plan (NWFP) and PACFISH guidelines provide numerous baseline protections to West Coast salmon and steelhead.

The NWFP defines Standards and Guidelines (S&Gs) for forest use throughout the 24 million acres of Federal lands in its planning area. Specifically, the NWFP provides S&Gs for management of timber, roads, grazing, recreation, minerals, fire/fuels management, fish and wildlife management, general land management, riparian area management, watershed and habitat restoration, and research activities on USFS and BLM lands. To accomplish its goals, the NWFP defines seven land allocation categories, including "matrix lands," areas where the majority of timber is to be taken, and Riparian Reserves and Key Watersheds, where distances from rivers are set within which many activities are restricted.

For Federal lands in eastern Oregon, Washington, and Idaho not covered by the NWFP, USFS and BLM have adopted a management strategy specifically for anadromous fish protection.[29] Like the NWFP, PACFISH provides guidelines for timber, roads, grazing, recreation, minerals, fire/fuels management, lands, riparian area, watershed and habitat restoration, and fisheries and wildlife restoration. Standards and guidelines under PACFISH are nearly identical to those in the NWFP.

A 6.3 Cost Assessment

A 6.3.1 Federal land management activities

We first classified the (non-grazing) activities typically conducted by Federal agencies or permittees on Federal lands into ten categories using Schedule of Proposed Actions (SOPAs) and past programmatic consultations. Because wilderness areas typically have different compositions and levels of activities than non-wilderness areas, we distinguish between the two types of areas. We then characterized"typical" project modifications by examining the Reasonable and Prudent Measures and Terms and Conditions from past salmon and steelhead biological opinions on these ten activities. Finally, we estimated costs of each identified project modification for each of the ten activities and then combined them into a per-acre estimate of modification costs.

Data sources of cost information for Federal lands management activities include more than 20 approved project proposals for Bonneville Power Administration's Fish and Wildlife Grants Program and the Wyden Amendment Watershed Restoration program as well as transportation costs from the State of Washington. Table A-12 presents a list of the typical project modifications characterized for each activity, and a range of costs associated with each category of Federal land management activity. Generally, where multiple cost values were available for a single project modification, we identified a low and a high cost to provide a range of potential costs for each modification. A composite low and high range for each activity was developed using the sum of the ranges for each type of modification. Because wilderness areas have a higher level of baseline

29. This strategy was intended to be in place for 18-months, beginning in February of 1995, but continues to be implemented.

protections, we modified these cost estimates for activities occurring on those lands. Consulting with USFS and BLM personnel, we attached a likelihood of occurrence to each specific sub-activity. We also adjusted the frequency of occurrence of each category of project for wilderness lands.[30]

Table A-12
Estimated Costs of Project Modifications for Federal Land Management Activities (excluding Grazing)

Sub-activity	Typical Project Modifications* (per-project)	Project Modification Costs
Road maintenance, aquatic habitat projects, instream work, riparian protection	- Develop an approved spill containment plan - Conduct erosion control measures - Minimize vegetation disturbance - Revegetate stream-side area - Gather/obtain materials needed to complete the project and implement bank stabilization - Minimize brushing in riparian areas by leaving a minimum 10 foot buffer along intermittent and ephemeral streams, and a minimum 20 foot buffer along perennial streams	\$48,100 to \$211,500
Recreation, site, trail, and administrative structure maintenance and associated public use	- Provide an annual monitoring report - Prevent and minimize erosion from trails	\$19,400 to \$30,000
Fisheries, wildlife, botany and cultural programs	- Minimize disturbance to fish by training personnel in survey method - Coordinate with other local agencies to prevent redundant surveys	\$4,200 to \$5,400

30. Interviews with Bob Ruediger, BLM Salem District, March 7, 2005; Data from Wade Sims, USFS Willamette and Siuslaw National Forests, March 7, 2005; Diane Cross, Fire Management specialist, Los Padres National Forest on March 21, 2005; Bruce Smith, Fisheries Bioligist, Salmon-Challis National Forest March 21, 2005; Ken Stauffer, Recreation Coordinator, Salmon-Challis National Forest March 21, 2005.

Table A-12 Estimated Costs of Project Modifications for Federal Land Management Activities (excluding Grazing)		
Sub-activity	**Typical Project Modifications* (per-project)**	**Project Modification Costs**
Pump change/helipond maintenance and use	- Dispose of waste on stable site. - Minimize soil disturbance using filter materials such as straw bales or silt fencing - Work with engineering/fire personnel to review proposed activities to minimize potential effects to stream channel conditions and water quality - Water withdrawal with fish prevent must have a fish screen installed, operated and maintained in accordance with NMFS fish screen criteria	$12,000 to $17,600
Rock quarry operations and ornamental rock collecting	- Include erosion control plans for quarries to protect fish	$5,000 to $10,000
Road decommissioning, obliterating, storm-proofing and inactivation	- Develop an approved spill containment plan - Maximize activities during late summer and early fall during dry conditions - A biologist should participate in the design and implementation of the project - Dispose of waste on stable site. Nearby is acceptable if approved by a geotechnical engineer or other qualified personnel	$8,400 to $16,600
Telephone line and power line renewal	- Directionally fell hazard trees toward streams and riparian areas where it is safe and feasible to do so - Conduct erosion control measures - Minimize soil disturbance using filter materials such as straw bales or silt fencing - Rehabilitate and stabilize all disturbed areas by seeding & planting	$4,300 to $22,500

Table A-12 Estimated Costs of Project Modifications for Federal Land Management Activities (excluding Grazing)		
Sub-activity	**Typical Project Modifications* (per-project)**	**Project Modification Costs**
Special use permits	- Prior to issuance of a special use permit, a fisheries biologist shall make a written evaluation of the proposed action and any interrelated and interdependent effects of the action to determine if an individual consultation is necessary - Conduct erosion control measures - Minimize soil disturbance using filter materials such as straw bales or silt fencing - Rehabilitate and stabilize all disturbed areas by seeding & planting	$1,200 to $2,400
Timber sales	- Suspend timber hauling when road conditions become degraded - Install sediment traps along roads - Inspect and monitor roads frequently - Culverts shall be constructed to withstand 100-year floods (as in PACFISH) - No-cut riparian protection zones (RPZ) are defined and are site-specific depending on slope (but seem to follow NWFP).	$17,600
Fuel reduction, timber salvage (non-commercial), logging, thinning	- Minimize take from construction activities by ensuring that an effective spill prevention, containment and control plan is developed, implemented and maintained - Minimize take from vegetation management including salvage harvest and commercial thinning by minimizing adverse effects of key components of steelhead habitat - Complete annual comprehensive monitoring report	$40,300 to $115,500

To account for regional variation in the modification costs for Federal land management activities, we first classified all National Forests and BLM districts based on geography into three regions:

Idaho, Western Oregon and Washington, and Eastern Oregon and Washington. These classifications are summarized in Table A-13.

Table A-13
Assessment Regions for National Forests and BLM Districts

Region	BLM District(s)	National Forests*
Idaho	Idaho Falls District, Coeur d'Alene District	**Nez Perce National Forest, Payette National Forest, Salmon-Challis National Forest, Sawtooth National Forest**, St. Joe National Forest
Western Oregon and Washington	Coos Bay District, Eugene District, Medford District, Prineville District, Roseburg District, Salem District	**Columbia River Gorge National Forest**, **Mount Baker Snoqualmie National Forest**, **Olympic National Forest**, **Siskiyou National Forest, Siuslaw National Forest**, **Wenatchee-Okanogon National Forest, Willamette National Forest**, Rogue River National Forest, Mount Hood National Forest, Umpqua National Forest, Gifford Pinochet National Forest
Eastern Oregon and Washington	Burns District, Lakeview District, Spokane District, Vale District	**Malheur National Forest**, **Umatilla National Forest**, Ochoco National Forest, Wallowa-Whitman National Forest, Crooked River NG, Deschutes National Forest
*Bold indicates that a SOPA for this forest was used to derive estimates of activity level.		

We next used quarterly SOPA's from National Forests to determine the number of each of the 10 categories of projects that typically occur in each forest on an annual basis.[31] SOPA's include the same types of activities that are usually included in programmatic consultations on West Coast salmon and steelhead.

We estimated the annual total land management costs for forests that had available SOPAs by multiplying the number of annual activities of each type by the costs associated with each activity, adjusting this process for the different composition and levels of activities expected to occur on wilderness lands. We then calculated a per-acre cost for each forest that had data available by adding together the estimated costs for each activity and dividing by that forest's total forest acres.

31. Carol Brown, Sawtooth National Forest, March 10, 2004, suggested that the SOPA's are a good representation of typical activities that occur within forests in a "typical" year.

Finally, we calculated a regional per-acre cost estimate by averaging the per-acre costs created in the previous step for each forest within the three regions. This enabled us to project costs to USFS forests and BLM land that did not have SOPA information available.[32] Table A-14 lists the regional cost estimates and their ranges.

Table A-14
Estimated Modification Costs for Federal Lands Management Projects

Type of Land	Region	Cost Estimate (per acre)
Non-wilderness	Idaho	$1.26 ($0.68 to $1.84)
	Western Oregon or Western Washington	$5.90 ($3.08 to $8.71)
	Eastern Oregon or Eastern Washington	$3.30 ($1.62 to $4.98)
Wilderness	Idaho	$0.07 ($0.04 to $0.10)
	Western Oregon or Western Washington	$0.029 ($0.15 to $0.44)
	Eastern Oregon or Eastern Washington	$0.15 ($0.07 to $0.24)

This method assumes that every National Forest or BLM District acre within critical habitat areas will bear a cost associated with section 7 implementation for West Coast salmon and steelhead. Indeed, several forests have programmatic agreements with NOAA Fisheries that compel them to place certain restrictions on activities within critical habitat areas. Even within critical habitat areas, however, it is possible that some projects will not need to be altered to accommodate salmon needs due to specific geography or specific attributes of the projects.

In addition, project modifications described in biological opinions for land management activities are included in this analysis, even if they appear to overlap baseline elements such as NWFP or PACFISH. As a result, the impact of section 7 implementation over and above the baseline elements may be overstated in areas where those baseline elements are in place. For these reasons, this analysis likely presents a high-end estimate of the costs likely to be incurred associated with Federal lands management activities.

32. Because BLM does not produce SOPA documents, we assume that BLM lands carry out the same mix of activities within a region as the USFS lands.

A 6.3.2 Livestock Grazing

Project modifications for livestock grazing activities in salmon and steelhead habitat include fencing riparian areas, placing salt or mineral supplements to draw cattle away from rivers, total rest of allotments when possible, and frequent monitoring. Many consultations consider impacts on salmon and steelhead from more than one allotment, and include general instructions to the land management agency to develop general policies (e.g., establish a utilization standard of at least 4 inches of stubble height).

To determine costs of section 7 implementation for West Coast salmon and ,steelhead associated with Federal lands grazing modifications, we first characterized "typical" modifications and estimated their costs by examining Reasonable and Prudent Measures and Terms and Conditions from past salmon and steelhead biological opinions on grazing activities on a per-allotment basis. These measures typically include

- Grazing management plans
- Stream and spawning surveys
- Project monitoring
- Riparian fencing
- Off-channel water developments
- Rangeland Best Management Practices

While these measures are associated with section 7 consultations on grazing, most are impacts that are not triggered by the ESA. Activities like grazing management plans and surveys may be modified slightly by section 7 enforcement but are rarely brought into being in that way. The possible exceptions are riparian fencing and off-channel water developments. We focus on these measures to describe the activity modifications to grazing land management.

We treated riparian fencing as a capital investment in the grazing land, and so the cost is amortized over the expected life of the fence (30 years). We also include an estimate of maintenance costs, which are borne annually. The capital and maintenance costs are presented in Table A-15.

Table A-15
Estimated Modification Costs for Grazing Land Management (Fencing)

Activity	Sub-activity	Cost Estimate
Grazing Land Management	Fencing	$14,354 (12,481 - 16,226) per mile*
*The High case includes the cost (per mile) of off-channel water developments.		

A 6.4 Spatial and Temporal Distribution of Activity

A 6.4.1 Federal land management activities

We used land ownership spatial data to determine USFS and BLM acreage in each watershed based on data collected from the Interior Columbia Basin Ecosystem Management Project (1995). Data include BLM Administrative Unit Boundaries and National Forest boundaries in Oregon, Washington and Idaho. We identified wilderness areas using spatial data (National Special Designated Areas) from the USFS, including both National Wilderness areas and Wilderness Study areas.

SOPAs that were used to develop the cost estimates generally have a forecast period of two years or shorter. Forest managers report that these activities are fairly constant, however, and are likely to continue indefinitely at similar rates.[33] We therefore used the annual level of SOPA activity as an estimate of the typical annual level. We also assumed that activities that take place on Federal lands are certain to bear modification costs and that these costs are borne in a single year.

A 6.4.2 Livestock Grazing

We identified grazing activity on Federal lands by intersecting spatial coverages for statewide grazing allotments with a USFS and BLM ownership coverage in the area under consideration. We employed the Interior Columbia Basin Ecosystem Management Project (ICBEMP) spatial data for grazing. Based on discussions with NOAA Fisheries biologists, we excluded allotments identified as having only sheep or horses. We then identified and measured (in miles) stream reaches on these Federal grazing lands that are likely to trigger section 7 consultation. We identified these stream reaches by using the "branch" stream reach concept developed by the Interior Columbia Basin Technical Recovery Team (TRT). The TRT developed a biological framework for gauging recovery of Interior Columbia Basin salmon and steelhead ESUs. They describe the "branch" concept in the following way:

> In our approach to describing spatial structure, we designated the basic building block for a salmonid population as a branch. In our definition, a branch component can be any reach organization containing suitable spawning habitat within a subwatershed. The quantity and interrelatedness of branches within a watershed contribute to a population's risk level in regard to sustainable production.[34]

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33. Carol Brown, Sawtooth National Forest, March 10, 2004, suggested that projects listed in quarterly SOPAs are likely to continue indefinitely at the present annual rate

34. TRT (2004), at 34.

Based on an analysis of actual stream mileage with fencing in several Snake River watersheds,[35] we assume that a proportion (20%) of the stream miles on Federal grazing lands (as identified above) will bear modification costs for section 7 consultations related to West Coast salmon or steelhead. Based on the same analysis, we assume that this proportion can range between 10% and 50%, and we use this figures for the Low and High cost-estimates cases, respectively. Finally, we assumed that 50% of the affected stream mileage would require fencing on one side, and 50% would require fencing on both sides.

A 6.5 Annual Expected Modification Cost Estimates

For land management activities, we assume all costs are certain and borne in one year and the level of activity per acre is constant. Thus, the regional per-acre cost estimate equals the annual expected modification cost for these activities. For grazing, the annual expected modification cost incorporates the capital costs of fencing (amortized over 30 years) and annual maintenance costs. These estimates are presented below in Table A-16.

Table A-16
Estimated Annual Expected Costs for Federal Lands Management and Grazing

Activity	Sub-activity	Present Value of Costs (per-acre/stream-mile)	Annual Expected Cost (per-acre/stream-mile)
Federal land management, non-wilderness areas	Idaho	$1.26	$1.26
	Western Oregon or Western Washington	$5.90	$5.90
	Eastern Oregon or Eastern Washington	$3.30	$3.30
Federal land management, wilderness areas	Idaho	$0.07	$0.07
	Western Oregon or Western Washington	$0.029	$0.029
	Eastern Oregon or Eastern Washington	$0.15	$0.15

35. The analysis used data gathered on 12 HUC5 Snake River Basin watersheds, from Garry Seloske, Dave Mays, Wayne Paradis, and Steve Hiebert, Nez Perce National Forest; Craig Johnson, Cottonwood District, BLM; and Pat Murphy, Clearwater National Forest.

Table A-16 Estimated Annual Expected Costs for Federal Lands Management and Grazing			
Activity	**Sub-activity**	**Present Value of Costs (per-acre/stream-mile)**	**Annual Expected Cost (per-acre/stream-mile)**
Livestock Grazing on Federal Land	Fencing	$14,354 per stream-mile	$1,157 per stream-mile

A 6.6 Assumptions and Potential Errors

Table A-17 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-17 Federal Lands Management: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
Each acre of Federal land within critical habitat areas is assumed to be subject to section 7 implementation. In fact, many projects may not affect salmon and steelhead habitat.	+
Project modifications included in biological opinions for Federal land management activities are included in this analysis, even if they appear to overlap baseline elements. As a result, the impact of section 7 implementation over and above the baseline elements may be overstated.	+
Land management agencies are assumed to carry out the list of land management activities consistently within geographical areas. Real variations in geography and management could result in different management activities in each management unit.	+/-
Per-project costs of modifications to specific land management activities are assumed to be uniform across geographic areas (e.g. costs of a fuels management project are assumed to be consistent across all regions).	+/-

Table A-17
Federal Lands Management: Assumptions and Potential Errors

Assumption	Direction of Potential Error
On December 8, 2003, NOAA Fisheries and USFWS issued "Joint Counterpart Endangered Species Act Section 7 Regulations" whose purpose is "to streamline projects that fit under the National Fire Plan." These new regulations may alter the future consultation behavior of NOAA Fisheries regarding fuel reduction/fire management activities on Federal lands. If executed as planned, future informal consultations will be streamlined. As a result, our estimated costs of fuel reduction activities would be overstated.	+/-
For grazing impacts, we assume that the ratio of one-sided to two-sided (1:1) was the same across all watersheds. Similarly, we also assume that the proportion of identified stream miles that require fencing was the same. These parameters may actually vary across watersheds, and so the actual impacts at the watershed level may be higher or lower than our estimated impacts.	+/-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

A 7. Transportation Projects

A 7.1 Overview

- Transportation projects that affect West Coast salmon and steelhead habitat are wide ranging, but may include the widening of a road, the reconstruction of a bridge, or the restoration of a ferry terminal. Examination of the consultation history reveals that roadwork, bridgework, and culvert projects encompass nearly 90 percent of all transportation projects that are in the consultation record.

- Transportation projects can produce environmental impacts that may directly kill or injure salmon and steelhead, or may disturb habitat. The impacts can be direct (i.e., riparian destruction during a bridge replacement) or more ancillary (i.e., storm water run-off disturbance following a road widening).

- Our method for estimating section 7 impacts on transportation projects is to measure the direct costs associated with section 7 implementation. We first reviewed the consultation history and spatial data to identify the types and sizes of transportation projects planned to occur. We then combined spatial data with typical project modification costs (fixed and variable) to estimate a cost for each project type and a total cost for transportation activities in each watershed.

- Secondary economic impacts resulting from changes to regional transportation mobility as a result of Section 7 implementation are expected to be minor. The consultation record indicates that transportation agencies can comply with section 7 project modifications without precluding any projects within critical habitat.

- On a per-project basis, project modification costs associated with transportation activities are small relative to other activity types. Because of the high level of these projects, however, they may prove significant in specific geographical regions. These costs are likely to be borne or passed on to the Federal government, which accordingly will ultimately bear the majority of the costs.

A 7.2 Background

Nearly a quarter of all Section 7 consultations conducted by NOAA Fisheries during 2001-2003 involved transportation projects. These projects may entail the widening of a road, the reconstruction of a bridge, or the restoration of a ferry terminal. The federal nexus for a transportation project may be through permitting or funding provided by the Army Corps of Engineers (USACE), Federal Highways Administration (FHWA) and/or the Federal Aviation Administration (FAA). The USACE permits bridgework, roadwork, and railroad restoration projects that need Clean Water Act permits. FHWA funds bridgework, roadwork, railroad restoration projects, and ferry terminal maintenance, and the FAA permits aircraft/airport repair and maintenance.

Transportation projects can produce environmental impacts that may directly jeopardize the existence of salmon and steelhead, or may disturb habitat. The impacts can be direct (for example, riparian destruction during a bridge replacement) or more ancillary (for example, storm water run-off disturbance following a road widening). Federal agencies involved in transportation projects are required by NOAA Fisheries to modify their activities to avoid both direct and indirect take of salmon. Table A-18 lists both the effects from and the modifications typically required of transportation projects.

Table A-18 Typical Project Modifications for Transportation Projects		
Project Types	**Effect on Salmon**	**Typical Project Modifications**
Roadwork, Bridgework, Culvert Projects	- In-water work during critical salmon life stages that may disturb spawning and development ability - Pollution of chemicals/waste into stream water by construction or repair machinery - Direct handling of salmon during transportation activities (i.e culvert installation) - Discharge of construction water - Stormwater run-off disturbance to habitat - Stream bank damage during construction activities (erosion and pollution)	- Limit time of in-water work to avoid take during vulnerable salmon life stages - Ensure isolation of in-water work area and proper fish handling methods - Develop effective erosion and pollution control measures - Stormwater management measures - Restoration of construction site through contouring, mulching, seeding and planting with native vegetation - Monitoring and evaluation both during and following construction
Other Transportation Projects	- Sound disturbance to salmon habitat due to piling installation - In-water work during critical salmon life stages that may disturb spawning and development ability - Pollution of chemicals/waste into stream water by construction/repair machinery	- Use of bubble curtain to maintain low sounds during ferry restoration - Obtaining hydraulic permit approval from State. - Monitoring and evaluation both during and following railroad restoration project - Construction time limits - Captive breeding, re-establishment and habitat restoration program

Examination of the consultation history reveals that roadwork, bridgework, and culvert projects encompass nearly 90 percent of all transportation projects that have been the subject of a consultation, and so we focus on these categories in our analysis.

A 7.3 Cost Assessment

To determine the costs of section 7 implementation for West Coast salmon and steelhead associated with transportation projects, we first examined spatial data and recent consultation history to identify the typical characteristics of transportation projects in the areas under consideration. We then developed typical project modifications by examining Reasonable and Prudent Measures and Terms and Conditions from past salmon and steelhead biological opinions on transportation projects.

Finally, we estimated the costs of each identified project modification. Some costs vary continuously with project scale (usually measured by miles of roadway or feet of stream affected), and so we categorized costs as either fixed or variable depending on the nature of the modification. Data sources for cost information for transportation projects include the *Integrated Streambank Protection Guidelines* (Washington Department of Transportation), published economic analyses, and various other cost studies. Table A-19 lists the estimated costs associated with typical project modifications identified for road, bridge and culvert projects.

Modification costs classified as fixed are incurred once in the course of a project, and do not vary continuously with project scale (e.g. costs of spill prevention plan development, costs of water quality monitoring). A low, medium, and high cost level for each fixed project modification cost is presented in Table A-19 to provide a range of potential costs for each modification.

Table A-19
Estimated Costs of Project Modifications for Transportation Projects

Project Modifications	Fixed Costs (per-project)*			Variable Costs (per linear foot of stream im-pacted)
	Low	Medium	High	
Pre-construction Surveys	$4,900	$5,950	$7,000	N/A
Develop and implement a site-specific spill prevention, containment and control plan and remove toxicants as they are released	$5,000	$7,500	$10,000	N/A
Water quality monitoring	$5,000	$17,500	$30,000	N/A
Excavation and relocation of materials dur-ing a project where they cannot enter wetlands.	$1,000	$3,000	$5,000	N/A
Bank stabilization	N/A	N/A	N/A	$25.00-65.00
Maintain supply of emergency erosion con-trol materials (slit fence and straw bales)	N/A	N/A	N/A	$2.50-$5.50
Use of boulders, rock, woody materials from outside of the riparian area.	$500	$2,750	$5,000	N/A
Stormwater management measures	$2,000	$2,650	$3,300	N/A
Restoration of construction site through con-touring, mulching, seeding and planting with native vegetation	N/A	N/A	N/A	$10-$60

Table A-19 Estimated Costs of Project Modifications for Transportation Projects				
	Fixed Costs (per-project)*			Variable Costs (per linear foot of stream im-pacted)
Project Modifications	**Low**	**Medium**	**High**	
Monitoring and evaluation both during and following construction	$4,400	$7,700	11000	N/A
Construction and implementation of coffer dam (a temporary structure to exclude water during instream work)**	$4,000	$6,000	$8,000	N/A
Ensure isolation of in-water work area and proper fish handling methods (hoop net sampling, electro-fishing)**	$1,000	$2,500	$5,000	N/A
TOTALS	**$27,800**	**$55,550**	**$84,300**	**$130.50**
*Scale classes for fixed costs: Low = <1 mile, Medium = 1-10 miles, High = >10 miles **These project modifications only apply to bridge and road projects				

In contrast to fixed costs, some costs are highly dependent on the scale of a transportation project and can be calculated on that basis. These variable costs may include restoration efforts, bank stabilization, and emergency erosion control, and are a function of the length of the waterway affected by the project (or for which mitigation efforts are required). Because data are more widely available for project length than for stream length impacted, we explored the relation between the two using data on both from biological opinions. Unfortunately, instances where data on both road length and stream length impacted are available are rare, and so we used two cases to develop the following relationship:

$$\textit{Stream Length Impacted (SLI) (ft)} = 100 + 5 \times \textit{Road Length (miles)}$$

Using this relation, the variable cost for a project that impacts *N* feet of stream would be

$$\textit{Total variable cost} = N \times \textit{modification cost estimate (per-foot)}$$

The estimated total modification cost is then the sum of the fixed cost for the project's particular scale and the variable costs as computed above.[36]

36. In this case, we used the high end of the variable cost range as the representative cost estimate. Although the review of the data sources found projects with variable costs at the lower end of the

A 7.4 Spatial and Temporal Distribution of Activity

Idaho, Washington, and Oregon have produced future transportation plans, which we used to forecast the locations of transportation projects. These plans include spatial information, budget allocation, and road mileage for projected road, bridge, culvert, and transit activities in each state. The plans vary in scope as well as time frame, and thus, the nature of the data varies considerably across regions. Table A-20 summarizes all projected, federally funded transportation projects within the critical habitat designation. Because exact start and completion dates are often difficult to anticipate, this analysis assumes that the projects included in the state transportation plans represent an estimation of the number and types of projects that are completed within a given 5 year period.

Table A-20
Summary of Transportation Projects Affected by Critical Habitat

State	Data Source	Time Frame for Planned Projects (years)*	Total Number of Projects within Areas under Consideration
Idaho	State Improvement Plans (STIP) 2002- 2005	3	28
Oregon	State Improvement Plans (STIP) 2002-2005	3	198
Washington	6-Year Capital Improvements Plan	6	379

*Although transportation plans differ in time frame, this analysis assumes that all projects listed in each state's transportation plan are completed within 5 years

A 7.5 Annual Expected Modification Cost Estimates

Using the data in the state transportation plans, we applied the formula given above to each project in the plan. We assumed all modification costs are certain and borne in one year, and that the probability of bearing the costs is uniform through the 5 year period for transportation projects. As a result, the annual expected modification cost for a project is equal to the estimated project cost derived from the formula above multiplied by the probability of occurrence (0.20). Because projects vary in road mileage, the estimated project costs vary as well. Below in Table A-21, we give estimated and annual expected costs for a project that involves the average mileage (3.2 miles).

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range, the higher end is applicable in instances that are far more typical. This was not the case for other activities where we found a range of costs for typical projects.

Table A-21 Estimated Annual Expected Per-Project Costs for Transportation Projects			
Activity	**Sub-activity**	**Present Value of Costs**	**Annual Expected Cost**
Transportation*	Bridges & culverts (small)	$41,778	$8,356
	Bridges & culverts (medium)	$69,478	$13,896
	Bridges & culverts (large)	$98,278	$19,656
	Roads (small)	$36,778	$7,356
	Roads (medium)	$60,978	$12,196
	Roads (large)	$85,278	$17,056
*Transportation costs are presented for a project of average mileage (3.2 miles).			

A 7.6 Assumptions and Potential Errors

Table A-22 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-22 Transportation Projects: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
We assume that all project modifications included in section 7 consultations for transportation projects are implemented specifically for salmon and steelhead protection and are not part of the baseline (e.g., these measures would not already be conducted as part of Best Management Practices).	+
Best Management Practices are followed strictly as outlined in state legislation, and do not overlap with recommended project modifications.	+/-
Future methods of compliance with specific project modifications will mirror past methods (i.e., pollution/erosion control plans do not change significantly over time).	+/-
All streams containing salmon and steelhead in the area under consideration are assumed to have similar ecological sensitivity with regards to pollution and chemical contamination.	+/-

Table A-22 Transportation Projects: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
Transportation projects may include sub-projects within them (e.g., road projects w/ bank stabilization efforts). If sub-projects are constructed as part of a transportation project, project modification costs could be understated. Available data do not allow us to reasonably forecast projects that would include sub-projects, however.	-
Long-term effects of modifying transportation projects in critical habitat areas on regional transportation functions (such as congestion and air pollution) are not included in this analysis. If projects occur that are not included in state transportation plans, this analysis may understate costs.	-
State transportation plans are assumed to include all major federally-funded transportation projects planned to occur over the designated the time period.	-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

A 8. Utility Line Projects

A 8.1 Overview

- The analysis separates the category of "utility lines" into two subcategories: pipelines and outfall structures. Overall, utility lines account for approximately two percent of the total consultation activity for the salmon in our consultation record. Most of these consultations are associated with pipeline projects.
- The most common federal nexuses for utility lines are through the actions of the Army Corps of Engineers (USACE), and the Federal Energy Regulatory Commission (FERC). USACE consults with NOAA Fisheries regarding permits issued under Section 404 of the Clean Water Act and/or Section 10 of the River and Harbors Act. FERC consults on pipeline projects that have the potential to affect threatened and endangered species and their habitat.[37] For projects that may impact wetlands or cross water bodies, FERC maintains a list of construction and mitigation procedures. These mitigation procedures include the use of directional drilling, rather than open cut construction, and suggest mitigation activities during the proposal stage (FERC

37. Robert Arvedlund, Federal Energy Regulatory Commission, personal communication, February 25, 2003.

2003). Therefore, some of the project modification costs estimated to be attributable to salmon critical habitat may be overestimated as these measures may be already required.

- We estimate the per-project costs of section 7 implementation on pipeline and outfall structure projects to be \$101,000 (\$100,000 to \$102,000), using historical project modification costs.

A 8.2 Background

Activities classified as utility lines projects include the installation or repair of pipes or pipelines utilized in gas or liquids; cables, lines or wires used to transmit electricity or communication; and outfall structures of utilities such as waste water treatment plants or powerplants. These activities can impact salmon and steelhead habitat through actions such as excavation, temporary sidecasting of excavated materials, backfilling of the trench, and restoration of the work site to pre-construction contours and vegetation.

Table A-23 describes the common project modifications recommended by NOAA Fisheries for each type of utility line activity based on a review of the consultation history. These descriptions illustrate how projects may be impacted by section 7 implementation.

Table A-23
Typical Project Modifications for Utility Line Projects

Sub-activity	Typical Project Modifications
Pipeline Projects	- Use directional drilling - No change in the pre-construction contours - Stockpile soil from the excavation and replace in trench - Minimize roads and other encroachments to the maximum extent possible - Return banklines to original slopes and revegetated with native vegetation - Erosion control
Outfall Structure Projects	- Construction access via a barge from the waterway - Effluent restrictions - Backfill trench with clean sand - Complete site restoration and cleanup - In water work period restrictions - All blasting occurs in the dewatered area of the coffer dams - Provide fish salvage and/or fish passage - Isolate in-water work area
Sources: NMFS (2001), NMFS (2003f), NMFS (2003g), NMFS (2003e).	

A 8.3 Cost Assessment

We used data from local municipalities that have experience with utility line project modifications through consultations with NOAA Fisheries and the USACE to estimate modification costs. Table A-24 lists the typical project modifications associated with each sub-activity and presents a range of costs associated with the corresponding modifications. We assumed that the costs are certain and will be borne in a single year.

Given the available data, we were not able to distinguish between types of utility projects (pipeline projects *v.* outfall structure projects). As a result, we assigned an equal probability to the two types of sub-activities and their estimated modifications costs ($102,000, the midpoint of the range for pipeline projects, and $100,00 for outfall structure projects). The annual expected modification cost for a project is then equal to the mid-range of these two figures, or $101,000 per-project.

Table A-24
Estimated Per-Project Costs of Project Modifications for Utility Line Projects

Sub-activity	Typical Project Modifications	Estimated Costs
Pipeline Projects	- Erosion control (rock lining) - Bypass stream corridor - Riparian planning - Directional drilling ($800 to $1,000 per foot)	$5,000 to $199,000
Outfall Structure Projects	- Flag boundaries - Complete site restoration and clean up - Pollution and erosion control plan - Timing restrictions - Construction monitoring by an on-site biologist - Store and replace native soil upon project completion - Implement construction techniques to avoid sedimentation and conduct a sediment survey.	$100,000

A 8.4 Spatial and Temporal Distribution of Activity

We identified the location of utility line projects using data on the latitude and longitude of historic USACE permits on utility lines. We assumed that the historic patterns of these permits are likely to predict the general location of potential future projects, which will then engage in consultations.[38] We assume the annual level and locations of USACE permits for utility lines are representative of the annual level and locations of projects that need to be modified to comply with section 7 for salmon and steelhead.

We recognize there are limitations associated with using historic data to predict future permitted projects. The main concern is that past location is not a good predictor of future location. Although historic consultations are not a perfect indicator of future consultations, areas of concentrated activity in the past are likely to be areas of concentrated activity in the future and therefore our method produces a reasonable geographic distribution of activity given available data.

A 8.5 Annual Expected Modification Cost Estimates

Given the assumptions that all modification costs are certain and borne in one year, and that the annual level and locations of USACE permits for utility lines are representative of the annual level and locations of projects that need to be modified to comply with section 7 for salmon and steelhead, the annual expected modifications costs are equal to the estimated modifications costs, as shown in Table 25.[39]

Table A-25
Estimated Annual Expected Per-Project Costs for Utility Line Projects

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost
Utility Lines	Outfall structures and pipelines	$101,000	$101,000

A 8.6 Assumptions and Potential Errors

Table A-26 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

38. Future consultations may also cover pipeline projects permitted by FERC. We attempted to account for these by mapping pipeline right-of-ways in each watershed. We did not estimate modification costs for these right-of-way projects, however, as it was not possible to estimate the likelihood that a future pipeline project will in fact utilize a current right-of-way, and will also be involved in a consultation for salmon and steelhead. We therefore limited our analysis to known pipeline and outfall structures.

39. We adjusted USACE permit data from different districts to account for temporal differences in the data. For example, the data set from the Seattle USACE district covered 4 years, while the Portland USACE district's data set covers 3 years. We estimated the annual level of projects requiring modifications by dividing the level we obtained from each district's data by the number of years covered by that district's data set.

Table A-26 Utility Line Projects: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
Historic location of USACE permits for utilities and location of right-of-ways are the most reasonable predictors of future locations available.	+/-
Costs associated with implementing past consultations are the most reasonable predictor of future costs.	+/-
Project modification recommendations do not overlap with Federal, state, or local laws.	+
Because there is no way to differentiate between pipelines with FERC and USACE nexuses, half of all pipelines are assigned directional drilling costs.	+/-
Section 7 consultation will not result in any net reduction in utility transmission capability. The same amount of utility lines will be constructed, although potentially at a higher cost and/or in a different location.	+/-
+ : This assumption is likely to bias our results upward. - : This assumption is likely to bias our results downward. +/- : This assumption could bias our results upward or downward.	

A 9. Instream Activities (including Dredging)

A 9.1 Overview

- The analysis assesses impacts on instream activities that are likely to result from section 7 implementation within critical habitat. Instream activities account for approximately 16 percent of the total consultation activity for the salmon in our consultation record. The majority of dredging consultations are encompassed by programmatic consultation with NOAA Fisheries. Some instream projects are addressed in an independent consultation but many are part of larger projects (e.g., pile driving may also be associated with large bridge projects, or an airport expansion has the potential to include dredging).[40]

- Actions associated with instream activities that may affect salmon and steelhead include dredging, construction or repair of breakwaters, docks, piers, pilings, bulkheads, boat ramp, and

40. Wes Silverthorne, NOAA Fisheries, personal communication, January 9, 2004.

docks. For the purpose of our analysis, we divide instream activities into the following sub-activities: boat dock and boat ramp projects; bank stabilization projects; breakwaters and bulkhead projects; and dredging.

- Consultations on boat dock, boat launch, and bank stabilization projects typically involve USACE permits. Modification to these projects required to comply with section 7 for salmon and steelhead include shoreline planting, construction materials restrictions, use of bubble curtains, habitat improvement, spill prevention contaminant control plan, erosion control, and timing restrictions.

- Consultations on dredging projects typically involve a USACE permit. Modifications to dredging include work window constraints, extension of the prescribed work window, additional survey work, and mobilization costs.

A 9.2 Background

Instream activities include two broad types of projects: construction, maintenance, repair, or other work that is conducted instream, and dredging. Actions associated with the first type may involve structure removal, excavation, filling, and driving pilings. Most of the consultations on this type of project are associated with dock, pier, and breakwater projects.

Instream activity can affect salmon and steelhead in a number of ways. Turbidity associated with instream activities may interfere with salmon and steelhead visual foraging, increase susceptibility for predation, and interfere with migratory behavior. Chemicals and waste materials including toxic organic and inorganic chemicals that accumulate in sediment may be directly toxic to aquatic life or a source of contaminants for bioaccumulation in the food chain. The release of ammonia, a common by-product produced in anaerobic sediments, may affect aquatic species as it is re-suspended in the water column. Instream activity may adversely affect invertebrate colonies, which may result in some loss of salmon and steelhead prey. For dredging, entrainment can occur when the fish are unable to overcome the water velocities near the draghead and are pulled into the hold of the ship during dredging activities.

Table A-27 describes the common project modifications recommended by NOAA Fisheries for each type of instream sub-activity based on a review of the consultation history. These descriptions illustrate how projects may be modified by section 7 implementation.

Table A-27 Typical Project Modifications for Instream Activities (including Dredging)	
Sub-activity	**Typical Project Modifications**
Boat Dock	- Date restrictions - Temporary silt fences and floating silt barriers to limit sediment entry into river and reduce turbidity effects - Disposal of excavated material at upland disposal site - Assurance of clean, inert material making contact with water - Maintenance of all heavy equipment to insure cleanliness and devoid of external oil, fuel or other pollutants - Strict following of permit and contract requirements - Use of bubble curtain to minimize effects of sound waves from pile driving on listed fish - Minimize creation of predator habitat by minimizing incidental take from heavy equipment use - Minimization of incidental take from use of heavy equipment that may disturb riparian and aquatic systems - Minimization of incidental take from erosion control activities by using best available technology - Removal of one piling and its associated dock
Boat Launch	- Date restrictions - Insure isolation from flowing water to minimize take - Development and implementation of erosion and pollution control measures through area of disturbance - Implementation of measures to minmize impacts to riparian and instream habitat - Implementation of measures to treat water and limit fill within the 100-year floodplain - Ensure temporary/permanent impacts to riparian instream habitat are restored and mitigated

Table A-27
Typical Project Modifications for Instream Activities (including Dredging)

Sub-activity	Typical Project Modifications
Bank Stabili-zation	- Limit the extent of rock placement in the channel - Spill Prevention Contaminant Control Plan - Erosion Control - Submit a monitoring and evaluation to USACE and NMFS - Replant disturbed areas with native plants with 80 percent survival after three years - Ensure that the in-water work activities (toe trench excavation and scour protection placement) are isolated from flowing water - Use fish screens on all water intakes - Fisheries biologist oversee capture and release program - Move excavated materials to upland areas - Restore all damaged areas to pre-work conditions - Install fencing as necessary to protect revegetated sites
Breakwater	- Minimize incidental take from general construction by excluding authorized permit actions and applying permit conditions - Comprehensive monitoring and reporting program to make sure objectives are met - Equipment will be fueled and lubricated in designated refueling areas at least 150 feet away from stream
Bulkhead	- In-water work restrictions - Fish passage - Removal of treated wood - Restricted use of heavy equipment - Isolation of in-water work area - Compensatory mitigation - Water intake screening - Pollution/erosion control - Capture and release - Conservation of native materials - Earthwork - Site restoration - Date restrictions - Minimize disturbance to riparian habitat - Minimize disturbance due to construction barges - Minimized contamination of riverine habitat - Monitoring

Table A-27 Typical Project Modifications for Instream Activities (including Dredging)	
Sub-activity	**Typical Project Modifications**
Dredging	- Work windows - Dredge-material disposal requirements
Sources: NMFS (2003a), NMFS (2003b), NMFS (2003c), NMFS (2003d), Peter Losavita, U.S. Army Corps of Engineers, personal communication, December 4, 2003.	

A 9.3 Cost Assessment

We used data from local municipalities that have experience with instream project modifications through consultations with NOAA Fisheries and the USACE to estimate modification costs. Due to data limitations, we were not able to estimate costs separately for bulkhead and breakwater projects, but assume they are included as part of other sub-activity projects. Table A-28 lists the different sub-activities with the typical project modifications and cost estimates.

Table A-28
Estimated Per-Project Costs of Modifications for Instream Activities (including Dredging)

Sub-activity	Typical Project Modifications	Estimated Costs
Boat Dock	- Shore line planting. - Paint pilings white. - Bubble curtain. - Planks and floats graded for 60 percent light passage.	$25,000
Boat Launch	- Habitat improvements, including native plant installation and replacement of failed plantings - Redesign dock to meet NOAA Fisheries performance standards. - Professional fish biologist to monitor construction.	$28,400

Table A-28
Estimated Per-Project Costs of Modifications for Instream Activities (including Dredging)

Sub-activity	Typical Project Modifications	Estimated Costs
Bank Stabilization	- Spill Prevention Contaminant Control Plan - Erosion Control - Monitoring and evaluation - Replant disturbed areas with native plants with 80 percent survival after three years - Ensure that the in-water work activities are isolated from flowing water - Fisheries biologist oversee capture and release program - Move excavated materials to upland areas - Restore all damaged areas to pre-work conditions - Install fencing as necessary to protect revegetated sites	\$34,050 to \$84,000
Dredging Projects	- Work window constraint - Extension of the prescribed work window[1] - additional survey work if safety is an issue - Mobilization cost[2] (occurs 14 percent of the time)	\$332,000 to \$1,310,000[3]

[1]Requires between 40 and 120 man-hours.
[2] If a work window extension is not granted, USACE must complete the project during the next work window. Restarting the project results in additional mobilization costs. Mobilization costs are approximately one third of total project costs.

Because of limitations in the spatial data, we collapsed the first three sub-activities – boat dock construction, boat launch construction, and bank stabilization projects – into one sub-activity. We used the midpoint of the associated range of costs as the cost estimate for each sub-activity: \$54,500 (\$25,000 - \$84,000) for the combined instream project sub-activity, and \$821,000 (\$332,000 - \$1,310,000) for dredging.

A 9.4 Spatial and Temporal Distribution of Activity

We used latitude and longitude location data from historic USACE permits to predict the location of future instream activities. We assume that historic patterns of instream projects are likely to predict the general location of potential future projects over the next eight years (the longest period in the USACE data). We also assume that the annual level and locations of USACE permits for instream activities and dredging projects are representative of the annual level and locations of projects that need to be modified to comply with section 7 for West Coast salmon and steelhead. Finally, we assume that costs are certain and will be borne in a single year.

We recognize there are limitations associated with using historic data to predict future permitted projects. The main concern is that past location is not a good predictor of future location. Although historic consultations are not a perfect indicator of future consultations, areas of concentrated activity in the past are likely to be areas of concentrated activity in the future and therefore our method produces a reasonable geographic distribution of activity given available data.

A 9.5 Annual Expected Modification Cost Estimates

As noted above, we assumed all modification costs are certain and borne in one year, and that the annual level and locations of USACE permits for instream activities and dredging projects are representative of the annual level and locations of projects that need to be modified to comply with section 7 for salmon and steelhead.[41] These assumptions produce the annual expected modification costs for instream projects and dredging shown in Table A-29.

Table A-29
Estimated Annual Expected Per-Project Costs for Instream Activity Projects (including Dredging)

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost
Instream Activities	Boat dock, boat ramps, bank stabilization	$54,500	$54,500
Dredging	Dredging	$821,000	$821,000

A 9.6 Assumptions and Potential Errors

Table A-30 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

41. We adjusted USACE permit data from different districts to account for temporal differences in the data. We estimated the annual level of projects requiring modifications by dividing the level we obtained from each district's data by the number of years covered by that district's data set.

Table A-30
Instream Activities and Dredging: Assumptions and Potential Errors

Assumption	Direction of Potential Error
Historic location of USACE permits for instream activities including dredging are the most reasonable predictors of future locations available.	+/-
Costs associated with implementing past consultations are the most reasonable predictor of future costs.	+/-
Project modification recommendations do not overlap with Federal, state, or local laws or best management practices.	+
Range of costs for case studies are representative of all instream activities.	+/-

- : May result in an underestimate of real costs
+ : May result in an overestimate of real costs
+/- : Has an unknown effect on estimates

A 10. National Pollutant Discharge Elimination System Permitted Facilities

A 10.1 Overview

- This analysis examines the potential economic impact to facilities that are required to obtain National Pollutant Discharge Elimination System (NPDES) permits. The EPA and NOAA Fisheries recently authored guidance to States and tribes on the development of temperature criteria deemed protective of salmon and steelhead. As a result, NPDES-permitted facilities in the Pacific Northwest are required to ensure effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards (EPA 2003). Facilities employ a range of temperature control strategies to meet these standards.

- The federal nexus for this activity is EPA's approval of State Water Quality Standards. NOAA Fisheries has consulted with EPA regarding the review and approval of the temperature component of water quality standards. Although a federal nexus does not apply directly to each NPDES-permitted facility (due to EPA's delegation of permitting to state water quality agencies), this analysis includes the project modifications and costs resulting from future compliance with the new standards by NPDES-permitted facilities.

- To comply with the temperature criteria, NPDES-permitted facilities identify and employ a host of temperature control procedures through Temperature Management Plans (TMPs). Controls include process optimization, pollution prevention, land application, and cooling towers.

- The analysis estimates the operations and maintenance (O&M) costs and capital expenditures necessary to comply with the temperature criteria. These compliance costs are based on a sample of major and minor NPDES-permitted facilities considered in EPA's Economic Analysis of the Proposed Water Quality Standards Rule for the State of Oregon (Science Applications International Cooperation 2003). The estimated modifications costs are $630,467 ($476,483 - $784,451) for a major facility and $72,039 ($0 - $144,078) for a minor facility.

- Impacts of section 7 implementation resulting from NOAA's consultation on the temperature criteria will vary depending on a facility's compliance with existing temperature standards, and whether it is subject to these requirements at all. To reflect this uncertainty, this analysis assumes that any major NPDES-permitted facility has a 25 percent probability of requiring compliance-related expenditures, and any minor NPDES-permitted facility has a 20 percent chance of incurring related costs.

A 10.2 Background

NOAA Fisheries has consulted with EPA on various aspects of its approval of State Water Quality Standards. Since the species were listed, 14 informal and one formal consultation have been completed, including development of Total Maximum Daily Loads (TMDLs), review of non-temperature related Water Quality Standards, clean up of Superfund sites, and review of pesticide applications. With the exception of pesticide applications, the majority of these activities do not represent a significant portion of the consultation record nor are they expected to increase in the future.[42]

In general, the only incremental standard that has been affected explicitly by concern for salmon and steelhead involves water temperature controls. While NPDES-permitted facilities have always been required to adhere to certain temperature criteria associated with effluent discharge, the 2003 guidance has led to stricter standards where salmon and steelhead are known to spawn or rear. As a result, this analysis focuses on costs associated with the temperature criteria.

A 10.3 Cost Assessment

We used EPA's economic impact assessment to estimate modifications costs for NPDES-permitted facilities. The EPA analysis provides cost estimates to meet the spawning and rearing temperature criteria of 18 degrees Celsius for salmon and steelhead rearing, 16 degrees Celsius for core juvenile rearing, and 13 degrees Celsius for spawning. Temperature control procedures commonly employed at NPDES-permitted facilities include:

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42. Pesticide applications are covered as a separate activity in section D-11.

• Process optimization (identifying management procedures that could be altered to reduce thermal loads to waste streams);
• Reduced volume of discharge by reusing effluent;
• Storing heated wastewater;
• Off stream cooling/evaporation ponds; and
• Installing treatment technology to reduce temperatures.

The EPA analysis assumes that facilities first employ low cost controls and then consider more costly controls, if necessary.

Based on EPA's sample of facilities, we assume capital costs are incurred in the first year, and operations and maintenance (O&M) costs are incurred uniformly over a 20 year period. We divided facilities into two categories, also based on the EPA study. Major facilities are those that may require significant capital expenses to comply with the temperature criteria, while minor facilities need only incur O&M expenditures.

Table A-31 provides a summary of the cost estimates and their ranges, based on the EPA analysis.

Table A-31
Estimated Per-Project Costs of Modifications for NPDES-permitted Facilities

Facility Type	O & M	Capital Cost	Present Value of Cost
Minor	\$6,800 (\$0 - \$13,600)	\$0	\$72,039
Major	\$19,725 (\$5,190 - \$34,260)	\$421,500	\$630,467

A 10.4 Spatial and Temporal Distribution of Activity

We identified the location and type (major or minor) of facilities potentially affected by the temperature requirements using latitude and longitude data from the Washington Department of Ecology, the Oregon Department of Environmental Quality, EPA Region 10, and EPA Region EPA Region 9. The data represent the location of facilities as of 2003 or 2004. We assume that if a facility is required to comply with the temperature criteria, it will do so immediately.

A 10.5 Annual Expected Modification Cost Estimates

Based on the EPA's analysis, it is not certain that a facility will in fact incur modification costs. Their analysis focused on a relatively small sample of potentially affected facilities, specifically four major facilities and five minor facilities. The analysis reviewed site-specific monthly effluent and receiving water temperature data from these facilities to evaluate the effect of discharge on receiving waters. Based on this review, EPA concluded that one of the four major facilities would require significant capital expenditures along with incurring incremental O&M costs to comply. Of the five minor facilities, only one would incur incremental O&M costs, while the remaining four would experience no incremental costs.

We employ these ratios as the probabilities that a major and minor facility, respectively, will incur modification costs. Specifically, the analysis assumes that a major facility has a 0.25 probability of bearing modification costs (capital and O&M), and a minor facility has a 0.20 probability (O&M). The resulting annual expected modification costs are shown in Table A-32.

Table A-32
Estimated Annual Expected Per-Project Costs for NPDES-permitted activities

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost
NPDES-permitted activities	Minor facility	$72,039	$1,360
	Major facility	$630,467	$14,878

A 10.6 Assumptions and Potential Errors

Table A-33 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-33
NPDES-permitted Facilities: Assumptions and Potential Errors

Assumption	Direction of Potential Error
All states and related facilities are assumed to begin compliance with more stringent temperature requirements in the near term.	+
The sample of major and minor facilities (located in Oregon) considered in the EPA analysis is representative of facilities throughout the designation	+/-
The compliance costs estimated for the sample of facilities considered in the EPA analysis are representative for all facilities	+/-
The ratio of facilities affected by the new standard to facilities not affected in the EPA sample is representative of the ratio in the entire population of facilities.	+/-

Table A-33 NPDES-permitted Facilities: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
All NPDES permit holders within the same class (major or minor) have a similar probability of incurring temperature control compliance costs.	+/-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

A 11. Sand and Gravel Mining

A 11.1 Overview

- Sand and gravel mining activities that affect West Coast salmon and steelhead generally include the removal of gravel for industrial purposes, such as for road construction material, concrete aggregate, fill, and landscaping (NMFS 2005i).

- Sand and gravel mining is an activity permitted by USACE under sections 401 and 404 of the Clean Water Act, or under section 10 of the Rivers and Harbors Act of 1899.

- Section 7 consultations on sand and gravel mining have produced numerous recommended modifications, but one that is frequently recommended is a limitation that reduces the total amount of gravel that can be removed from salmon and steelhead habitat areas.

- Our approach is to apply an average per-mile cost of the net revenue forgone from sand and gravel mining due to section 7 restrictions in areas where sand and gravel mining affects critical habitat. This is likely to overstate the real costs of reducing sand and gravel mining within critical habitat, as alternative mining sites are likely to exist that would allow for substitution to sites outside of critical habitat.

- Impacts of section 7 implementation may be significant to the companies conducting activities within the riparian areas of this designation, though the overall impact of this activity on regional economies is likely to be smaller than other activities. We do not expect that this impact will result in a reduction in the overall market supply of gravel to the impacted regions.

A 11.2 Background

Sand and gravel is commonly mined from active river channels and floodplains for construction aggregate that can be made into concrete, asphalt, road base, and drain rock. Three basic types of sand and gravel mining can take place in salmon and steelhead habitat: wet-pit mining, bar skimming or scalping, and dry-pit mining. Wet-pit mining involves the use of a dragline or hydraulic excavator to remove gravel from below the water table and can directly destroy spawning habitat, increase turbidity, increase suspended sediment, and increase gravel siltation in salmon habitat areas. Gravel bar skimming typically occurs above the water table, but is also considered to significantly impact aquatic habitat by destabilizing the banks and increasing suspended sediment (NMFS 2005i). Dry-pit mining occurs outside the active stream channel, and typically is considered by NOAA Fisheries to have fewer direct effects on salmon and steelhead, although adverse impacts on the stream channel are still a concern.

Sand and gravel mining is an activity permitted by USACE under sections 401 and 404 of the Clean Water Act, or under section 10 of the Rivers and Harbors Act of 1899, and this is the typical federal nexus for consultation. This activity accounts for less than one percent of consultation on salmon and steelhead during 2001-2003. Several formal consultations are reported to be underway at present.

A 11.3 Cost Assessment

The sand and gravel mining extraction policy for NOAA Fisheries states that "instream gravel removal quantities be strictly limited so that gravel recruitment and accumulation rates are sufficient to avoid prolonged impacts on channel morphology and anadromous fish habitat."[43] Following this guidance, most NOAA Fisheries formal consultations on sand and gravel mining include strict gravel removal restrictions. The consultation record typically does not record the original quantities of gravel intended for a permit, however, so it is not possible generally to account for the opportunity cost of these restrictions. Instead, we use information from one case that has sufficient information to estimate this cost.

The case concerned a site mined for 32 years by Joe Bernert Towing (NMFS 2003i). The average annual gravel extraction for this area before the consultation was 281,000 cubic yards (cy). Under the terms of the biological opinion and resulting five-year USACE permit, the average annual removal allowed was 150,000 cy, a 47% reduction. This restriction imposed a loss of approximately 6,600 tons/mile on average for the site. At a value of $6.70/ton (Kohler 2002), the gross value of the forgone production is about $44,500 per mile annually.[44] If net revenue for this industry is

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43. NMFS (2005i) at 11.

44. It is possible that the age and history of the mine could preclude future mining at the same levels as previously, but this is not known.

assumed to be 25 percent of gross revenue,[45] potential lost net revenues at this site are approximately \$11,000 per year, or a present value (at a 7%discount rate) of \$1.35 million for the 30-mile mining area over the 5-year life of the permit.

Because substitute sites may be available to a producer, the actual loss in net revenues may be smaller than amount obtained assuming a substitute site is not used. Because critical habitat may cover a wide area, however, its coverage could create a need to travel a substantial distance to a substitute site, possible rendering the substitute site uneconomical.[46] Without information on the proximity of such substitute sites, we assume that net revenues lost to producers when gravel restrictions are imposed can be estimated in a manner similar to the one used above.

Because the area was mined successfully for 32 years, we consider this area to be a good source of gravel. Clearly, not all sand and gravel mining areas will produce equivalent loss of the product. Moreover, the value per mile of sand and gravel mining activities depends on many factors, including depth of operation. Rough estimates of a few sample sites suggest that per-mile annual production may vary from 3,000 to 30,000 tons.[47] This analysis currently assumes that identified and currently-producing sand and gravel mining sites will produce gravel at rates similar to the ones in the above example.

A 11.4 Spatial and Temporal Distribution of Activity

We identified sand and gravel mining tracts in Oregon, Washington, and Idaho using latitude and longitude data from the USGS "Active mines and mineral plants" (1997). We assume that each sand and gravel mining site in the areas under consideration will be involved in a consultation at some point over the next 30 years. We also assume that the probability of consultation in a given year is equal across that time period.

Whether or not a particular site will actually be required to modify its operations depends on many factors, including:

- whether the sand and gravel mining occurs in a salmon- or steelhead-bearing stream;
- the type of mining planned (wet-pit mining, bar skimming or scalping, and dry-pit mining)
- whether the planned mining activity will occur during spawning or migration of salmon; and
- whether the planned mining activity already incorporates mitigation measures to reduce sedimentation, bank stability, channel widening, and so forth.

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45. This figure is a gross operating margin (Risk Management Association 2002).

46. For every 30 miles that aggregate has to travel, the costs of transportation double (California Department of Conservation 2001).

47. Estimated from sites characteristics included in California Department of Conservation (2001).

For this reason, we consider the possibility that no modification will be required for a sand and gravel mining operation. Without more detailed information on the distribution of site attributes, we assign an equal probability to the two possible events, modification and no modification. Moreover, we also assume that restrictions will be in effect for five years of the 30 year forecast period, after which a substitute site is used or some other alternative is chosen that eliminates the loss in net revenue.

A 11.5 Annual Expected Modification Cost Estimates

To derive the annual expected modification cost for sand and gravel mining, we combine the cost estimates and assumptions we have made in the following way:

1) If a consultation occurs and modifications are required, the cost of the modifications equals the lost net revenue over a five year period derived from the example above, or $1.35 million.
2) The probability that a consultation will occur in a given year is 0.033, and the probability that the modifications will be required is 0.50.

The resulting annual expected modification cost for sand and gravel mining is given in Table A-34.

Table A-34
Estimated Annual Expected Per-Project Costs for Sand and Gravel Mining

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost
Sand and Gravel Mining	Mining on non-Federal lands	$1,352,106	$22,535

A 11.6 Assumptions and Potential Errors

Table A-35 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-35
Sand and Gravel Mining: Assumptions and Potential Errors

Assumption	Direction of Potential Error
This analysis assumes that each sand and gravel mining site in critical habitat is likely to bear costs associated with section 7 implementation for salmon and steelhead over the next 30 years, and assumes an equal probability of those costs being borne in any one year in that time period.	+

Table A-35 Sand and Gravel Mining: Assumptions and Potential Errors	
Assumption	**Direction of Potential Error**
This analysis assumes that substitutes are unavailable to sand and gravel mining companies who are required to reduce mining efforts in salmon and steelhead critical habitat areas.	+/-
Impacts attributable to critical habitat designation for specific sand and gravel mining operations are not available. As a result, the cost/impacts identified are based on a small sample of projects, and may not precisely capture impacts incrementally attributable to critical habitat or section 7 of the ESA. In addition, impacts at specific projects are likely to vary.	+/-
This analysis assumes that a typical mining operation will be 30 miles of mining for 5 years, with a profit margin of 25 percent.	+/-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

A 12. Residential and Commercial Development

A 12.1 Overview

- This analysis assesses impacts on residential and commercial development, but excludes impacts that are covered elsewhere (roads, utility lines, and so forth).[48] The most common federal nexus for residential and related development activities is an Army Corps of Engineers (USACE) permit for construction or expansion of stormwater outfalls, discharge or fill of wetlands, flood control projects, bank stabilization, and instream work.[49]

48. Infrastructure impacts are captured in the analyses of transportation, instream activities, and utility line projects.

49. Personal communication with DeeAnn Kirkpatrick, NOAA Puget Sound Habitat Conservation Division, Fishery Biologist Southern Puget Sound Region, October 31, 2003. Personal communication with Eric Shott, NMFS Santa Rosa Field Office Section 7 Coordinator, November 5, 2003. Personal communication with Gary Stern, NMFS Santa Rosa Field Office, San Francisco Bay Team Leader, November 5, 2003.

- We estimate the per-project cost of section 7 implementation on residential and related development projects as $235,000 ($230,000 to $240,000), using costs of implementing state recommended stormwater plans. The estimate includes costs of the stormwater pollution prevention plan, permanent stormwater site plan, and stormwater best management practice operation and maintenance.

- The designation of critical habitat for West Coast salmon and steelhead is unlikely to have significant impacts to this activity by increasing costs to developers, reducing revenues, imposing mitigation costs, or resulting in project delays. The designation of critical habitat will have a negligible impact on regional market supply for residential, commercial, or industrial land and thus the primary impacts will be felt by individual property owners. There are three reasons significant impacts are not anticipated. First, the historical consultation record suggests that section 7 consultation regarding West Coast salmon and steelhead are rare. Second, the resulting project modifications are relatively small and/or have been captured by other activities (e.g., utility line activities). Third, the land markets in the watersheds covered in this proceeding area are relatively unconstrained (e.g., market substitution to competitive and comparable sites can easily occur). All of these factors contribute to a low impact to development.

A 12.2 Background

The potential for adverse economic impacts arising from constraints on residential and related development is a frequent concern to communities in which critical habitat has been proposed for designation. The nature and magnitude of any economic impact attributable to critical habitat designation will depend upon baseline land and housing market conditions and the extent to which a designation distorts these initial conditions. A common concern is that the designation of critical habitat may reduce the overall amount of land available to the market, and increase the price of developed land and housing.

If critical habitat designation inhibits the development potential of some parcels, the supply of land available for development will be reduced. In areas that are already highly developed, or where developable land is scarce for other reasons (i.e., non-critical habitat-related regulations), this reduction in available land and the corresponding increase in price could be significant, and ultimately translate into fewer housing units being built within the affected market, affecting both producers and consumers. In areas where developable land is relatively plentiful, however, developers and builders will be able to identify substitute sites for projects, thereby limiting economic impacts to the owners of specific parcels that suffer a diminishment in their land's value.

In addition to the primary economic impacts identified above, commenters on previous economic analyses of critical habitat designation have described additional categories of economic and financial effects in residential and commercial development markets, generally falling into the category of regional economic impacts (Elliott D. Pollack and Company 1999). Regional economic impacts reflect changes in *local* output, employment and taxes. The principal category of regional impacts associated with critical habitat designation in areas of residential development involves potential changes in revenues and employment in construction-related firms and other industries that support builders and developers. Specifically, commenters have suggested that if development activity decreases in a given area, these secondary industries are likely to suffer severe economic consequences.

A second category of regional impacts identified by commenters to past critical habitat analyses concerns the potential for forgone tax revenues associated with reduced residential development. That is, reduced development potential in an area may lead to lower real estate and other tax revenues. In many cases, however, the lower revenue will be offset by a reduction in municipal expense; thus, it is important that any estimated impacts in this category are net of these service expenditures.

Finally, in more extreme cases, concern has been expressed regarding the broader impact of critical habitat designation on regional economies. Specifically, some individuals have questioned whether designation will delay and/or impair an area's ability to realize economic growth by influencing development patterns. Whether further development of a region is, on net, desirable is a point of contention in many markets. Nonetheless, with the exception of cases in which critical habitat designation precludes a large proportion of available land from development, designation is unlikely to substantially affect the course of regional economic development (Meyer 1998).

In some cases, the public may believe that critical habitat designation will depress private property values below the levels associated with anticipated project modifications described above. That is, the public may perceive that, all else being equal, a property that is designated as critical habitat will be stigmatized and have lower market value than an identical property that is not within the boundaries of critical habitat. Public attitudes about the limits and costs that critical habitat may impose can cause real economic effects to the owners of property, regardless of whether such limits are actually imposed.

The designation of critical habitat for the West Coast salmon and steelhead ESUs under consideration is unlikely to increase costs to developers, reduce revenues, impose mitigation costs, or result in project delays, at least in significant amounts. There are two reasons significant impacts are not anticipated. First, unlike terrestrial species, habitat for West Coast salmon and steelhead is not itself part of the supply of developable land. For this reason, protection of the aquatic habitat need not take the form of supplanting development if the impacts of the development (whatever they might be) can be mitigated. As a result, section 7 consultations regarding the ESUs for real estate developments are usually limited to specific components of the development and are expected to have no direct impact on the supply of land or housing. Second, as seen in the next part of this section, project modification costs are expected to be modest (anticipated to range from $230,000 to $240,000 per project) and, according to NOAA Fisheries personnel, consultations regarding development projects are rare.[50]

For this reason, the available data also do not support an expectation of significant stigma effects. Section 7 has no strong historical connection to restrictions on private property, and there is no expectation that this lack of a connection will change in the future. If such stigmatization does occur, it seems likely that experience with the actual strictures of critical habitat designation will remove any (negative) premium that might be characterized as a stigma effect.

A 12.3 Cost Assessment

We used information from the Washington Department of Ecology as the basis for our cost assessment (WDOE 2001). Table A-36 lists the typical modifications associated with development projects and presents a range of costs. To determine this range, we combined all potential project modification costs and applied the average project cost to each project. This is likely to be an overestimate because it is the cost of implementing the State of Washington's suggested stormwater management plan and other states may not require as stringent standards as this plan.[51] We assume that costs will be borne in one year.

Table A-36
Estimated Per-Project Costs of Modifications for Development Projects

Activity	Typical Project Modifications	Estimated Costs
Residential and Commercial Development	- Implement state recommended stormwater plans. - Activities to reduce stormwater volume and/or pollutants. - Minimizing hardscape of the outfall structure. - Vegetation replacement.	$235,000 ($230,000 - 240,000)

50. Personal communications with DeeAnn Kirkpatrick, NOAA Puget Sound Habitat Conservation Division, Fishery Biologist Southern Puget Sound Region, October 31, 2003; Eric Shott, NOAA Fisheries Santa Rosa Field Office Section 7 Coordinator, November 5, 2003; and Gary Stern, NOAA Fisheries Santa Rosa Field Office, San Francisco Bay Team Leader, November 5, 2003.

51. This guidance document's implementation is not required except in the case of municipal stormwater systems that require a NPDES permit. Implementation may also be required by local zoning laws or as other permit requirements. Personal communication with Ed O'Brien, Washington Department of Ecology personnel, November 7, 2003.

A 12.4 Spatial and Temporal Distribution of Activity

To estimate the level and location of development-related impacts, we used EPA data on the level and locations of State-issued NPDES stormwater permits and USACE permit data. Information from USACE permits for stormwater systems would be the ideal data, as they have information on location, cover development activities, and have a clear federal nexus. Only one USACE district (Seattle), however, identified stormwater projects in their permit data. NPDES stormwater permits are overly inclusive, as not all State-issued permits are for projects which would require the modifications recommended by NOAA Fisheries (e.g., a single family home would not require an extensive stormwater management system).

We therefore needed to find another way to identify potentially impacted projects. We assumed that the ratio of the Seattle USACE stormwater permits (which have a clear federal nexus) to State-issued NPDES stormwater permits in the area covered by the Seattle USACE district could be applied to other areas. This approach found 86 of the 104 NPDES stormwater permits issued by Washington Department of Ecology from 2000 to 2003 lay within the boundary of Seattle USACE jurisdiction. There were five unique stormwater permits identified in the Seattle USACE data from 2000 to 2003. This proportion (0.058 USACE-permitted stormwater projects per 1 State-issued NPDES stormwater permits) was then used to adjust the level of State-issued NPDES permits for stormwater projects in a particular area.

We assume that each development-related project is certain to bear these modification costs and that the costs are borne in one year.

A 12.5 Annual Expected Modification Cost Estimates

The assumptions that modification costs are certain and they are borne in one year produce the annual expected modification costs shown in Table A-37.

Table A-37
Estimated Annual Expected Per-Project Costs for Residential and Commercial Development

Activity	Sub-activity	Present Value of Costs	Annual Expected Cost*
Residential and Commercial Development	New development	$235,000	$13,865

*The annual expected cost is adjusted to reflect the probability (0.058) that a USACE-permitted activity would require a stormwater modification, as noted in section D.10.4

A 12.6 Assumptions and Potential Errors

Table A-38 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-38
Development Projects: Assumptions and Potential Errors

Assumption	Direction of Potential Error
State and local laws do not require similar provisions to the Minimum Requirements for Stormwater Management of Washington Department of Ecology.	+
Historic location of stormwater permits is the most reasonable predictor of future locations available.	+/-
Stormwater system costs for Washington Department of Ecology recommended systems are the most reasonable estimates of the cost of project modifications for development.	+/-
NOAA stormwater system recommendations do not overlap with state or local laws.	+/-
Other consultations related to development may occur through associated infrastructure and are captured in these other activities.	+/-

- : May result in an underestimate of real costs
+ : May result in an overestimate of real costs
+/- : Has an unknown effect on estimates

A 13. Agricultural Pesticide Applications

A 13.1 Overview

- The Environmental Protection Agency (EPA) was recently enjoined from authorizing the application of a set of pesticides within certain distances from "salmon-supporting waters." The effect of this injunction is to impose two types of restrictions on applications of pesticides covered in the lawsuit. For aerial applications, no pesticides can be applied within 100 yards of "salmon-supporting waters"; for ground applications, the distance is 20 yards. We use these restrictions as a proxy for the types of modifications section 7 is likely to have.

- We considered three crop types (oil seed and grain farming, vegetable and melon farming, and fruit and tree nut farming) separately. Using data from the USDA's National Agricultural Statistics Service (NASS), we derived estimates of the net agricultural operational revenue per acre for each crop type in each county covered by an ESU. Under the assumption that the court-ordered restrictions on pesticide applications force the affected land out of production, these estimates are then a measure of the cost of section 7 implementation.
- Using NOAA Fisheries spatial data on the salmon and steelhead distribution, we created buffers of 100 yards and 20 yards on each side of the streams occupied by the salmon and steelhead under consideration. We measured the amount of land affected by the pesticide restrictions using USGS National Land Cover Data (NLCD). We then applied the per-acre cost estimates to these acreage estimates to obtain the costs of section 7 implementation on agricultural pesticide applications.

A 13.2 Background

Under the Endangered Species Act, the Environmental Protection Agency (EPA) must consult with the Fish and Wildlife Service and NOAA Fisheries to ensure that the registration of products under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) complies with section 7 of the ESA. Because of the complexity of consultations to examine the effects of pest-control products, there have been almost no consultations completed in the past decade.

In 2004, the EPA was enjoined from authorizing the application of a set of pesticides within a certain distances from "salmon supporting waters."[52] For aerial applications, the distance is 100 yards; for ground applications, the distance is 20 yards. The basis for this injunction was the EPA's failure to consult with NOAA Fisheries under section 7 of the ESA concerning possible adverse effects of pesticide application on ESA-protected salmon and steelhead. The injunction has been allowed to remain in place by the Ninth Circuit Court of Appeals, and so as of the date of this report, the court-ordered restrictions continue to apply.[53] Because of the link between section 7 and these restrictions, we used the two sets of "no-spray buffers" to set a range of possible impacts.

A 13.3 Cost Assessment

Our analysis focused on agricultural pesticide applications and the associated impacts of the no-spray buffers. We assumed that the effect of the court-ordered restrictions was to force agricultural land out of production, resulting in the loss of any positive net revenue earned from the land. We considered three crop types separately:

52. *Washington Toxics Coalition, et al., v. EPA*, C01-0132 (W.D. WA), January 22, 2004.

53. *Washington Toxics Coalition et. al v. EPA*, No. 04-35138, May 4 and June 22, 2004.

- Oil seed and grain farming(NAICS industry code 1111) - This category comprises operations engaged in growing oilseed and/or grain crops, and operations engaged in producing oilseed and/or grain seeds, including corn silage and grain silage

- Vegetable and melon farming (NAICS industry code 1112) - This category comprises operations engaged in growing vegetables or melon crops; producing vegetable and melon seeds; or growing vegetable and/or melon bedding plants

- Fruit and tree nut farming (NAICS industry code 1113) - This category comprises operations engaged in growing fruit and/or tree nut crops.[54]

For each crop type, we used the data from the USDA National Agricultural Statistics Service, 2002 Census of Agriculture, on the acres of cropland and net operational dollar gain (ignoring government payments) on a county basis. Dividing the latter by the former produced an estimate of the average net operational dollar gain per acre by crop type and county. Table A-39 presents a summary of these estimates.

Table A-39
Net Operational Dollar Gain by Crop Type and County

State	State average and county range by crop type		
	Oil seed and grain farming	Vegetable and melon farming	Fruit and tree nut farming
Idaho	\$34 (-\$191 to \$234)	\$239 (-\$68 to \$939)	\$111 (-\$1,105 to \$1,264)
Oregon	\$9 (-\$260 to \$105)	\$338 (-\$1,070 to \$6,517)	\$216 (-\$646 to \$3,583)
Washington	\$30 (-\$1,226 to \$202)	\$367 (-\$3,145 to \$4,176)	\$754 (-\$2,519 to \$3,623)

As can be seen in this table, in some cases the Census data show a negative net operational dollar gain. In the long run, an economic enterprise is unlikely to operate if net revenue is negative. For this reason, we set net operational dollar gain to zero if it was negative for a particular county and crop type. For other counties and crop types, the Census data were missing, in which case we substituted the state average for that crop type. These adjusted figures are then used as estimates of the modifications costs for agricultural pesticide applications.

54. USDA, National Agricultural Statistics Service. 2002 Census of Agriculture: Appendix A.

A 13.4 Spatial and Temporal Distribution of Activity

Assessing the spatial distribution of the section 7 impacts required us first to interpret the phrase "salmon supporting waters," which is the basis for the court-ordered restrictions. We used NOAA Fisheries spatial data to identify stream reaches that are occupied by salmon or steelhead for each of the 12 ESUs under consideration.[55] For the purposes of this analysis, these reaches are taken as the "salmon supporting waters" to which the court-ordered restrictions are applied. Because occupied reaches vary by ESU, the spatial distribution of the impacts also varies by ESU.

The next step was to create 100-yard and 20-yard buffers around these stream reaches. These buffers identified the areas where aerial and ground pesticide applications, respectively, are restricted by the court order. We then estimated the number of acres within these buffers for each of the three crop types using U.S. Geological Survey National Land Cover Data (NLCD).[56] The three land cover types were

- Small Grains (NLCD 83) - Areas used for the production of graminoid crops such as wheat, barley, oats, and rice
- Row Crops (NLCD 82) - Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton
- Orchards/Vineyards/Other (NLCD 61) - Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals

This produced acreage estimates for each watershed, divided into separate county portions where a watershed spanned more than one county.

Because the NLCD data are based on satellite imagery from the early-to-mid 1990s, we adjusted the acreage estimates using county-level data (and state-level data where county-level data were missing) on changes in acreages of each crop type between 1992 and 2002, using the 1992 and 2002 Census of Agriculture, respectively. We applied the ratio of the 2002/1992 acreages to our crop acreage estimates, which "inflates" them to 2002 levels.

Finally, we assume that the impacts of the agricultural pesticide application restrictions are certain and borne as an annual impact. Because we have no data on the distribution of spraying by application type (aerial or ground), we assume there is a 50% probability of each type. For the High

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55. We also considered nearshore areas and the Lower Columbia River area as occupied reaches, and so treated them as "salmon supporting waters."

56. There is a slight mismatch between the NASS and the NLCD data sets. The NASS data on agricultural revenues places corn in the oil seed and grain farming category, while the NLCD data on land cover types places it in the row crop category. Corn is not a significant crop in any of the counties under consideration, however.

and Low cost estimates, we assume that pesticide applications are 100% aerial and 100% ground, respectively, which implies that all buffers would be 100 yards and 20 yards, respectively.

A 13.5 Annual Expected Modification Cost Estimates

The assumptions that modification costs are certain and they are borne in one year produce the annual expected modification costs shown in Table A-40.

Table A-40
Estimated Annual Expected Per-Project Costs for Agricultural Pesticide Applications

Activity	Present Value of Costs	Annual Expected Cost
Agricultural Pesticide Applications	\$0 - 6,517 per acre, depending on crop type and county	\$0 - 6,517 per acre, depending on crop type and county

A 13.6 Assumptions and Potential Errors

Table A-41 presents the key assumptions of the economic analysis for this type of activity, as well as the direction of potential error introduced by the assumptions.

Table A-41
Agricultural Pesticide Applications: Assumptions and Potential Errors

Assumption	Direction of Potential Error
We assume the court-ordered injunction represents the likely outcome of future section 7 consultations. If consultation may find more flexible ways to avoid jeopardy and adverse modification, the impacts of section 7 implementation may be lower.	+
We assume that agricultural land owners can make no adjustment in their crop and pesticide practices nor are there alternative beneficial uses of land.	+
We assume there are no adverse spillover effects of pesticide restrictions on agricultural land adjacent to the pesticide buffers. If the restrictions increase the cost of managing adjacent land, the impacts of section 7 implementation may be higher.	-
We assume that the base case consists of a 50% probability that each acre of land currently has aerial or ground pesticide applications.	-/+

Table A-41 Agricultural Pesticide Applications: Assumptions and Potential Errors	
We assume that negative per-acre returns are not representative of the actual impact.	+
We assume that the measured, positive per-acre returns are representative of the actual impact.	-/+
We assume that the adjustment for acreage between 1992 and 2002 represents the actual change in acreage during that period.	-/+

A 14. Summary

Table A-42 below summarizes the cost estimates for the different types of activities.

Table A-42 Summary of Activity Cost Estimation							
Activity	**Sub-activity**	**Cost Unit**	**Cost Stream (Duration)**	**Present Value of Cost Stream**	**Forecast Period**	**Probability of Modifications**	**Annual Expected Per-Project Cost**
Hydropower Dams*	Small (0 - 5 MW)	per dam	\$2,120,500	\$2,120,000	20 years	$p_t = 0.05$ $p_M = 0.10$	\$10,603
	Medium (5 - 20 MW)		\$5,750,000	\$5,750,000	50 years	$p_t = 0.02$ $p_M = 1.00$	\$115,000
	Large (>20 MW), requires fish passage		\$73,850,000	\$73,850,000	50 years	$p_t = 0.02$ $p_M = 1.00$	\$1,477,000
	Large (>20 MW), does not require fish passage		\$45,230,000	\$45,230,000	50 years	$p_t = 0.02$ $p_M = 1.00$	\$904,600
	Large (>20 MW), fish passage unknown		\$56,390,000	\$56,390,000	50 years	$p_t = 0.02$ $p_M = 1.00$	\$1,127,800
	Unknown capacity		\$7,400,000	\$7,400,000	30 years	$p_t = 0.033$ $p_M = 1.00$	\$246,667
Non-hydropower Dams	Federal and large non-hydropower dams	per dam	\$2,120,500 (1 year)	\$2,120,500	20 years	$p_t = 0.05$ $p_M = 1$	\$106,025
	Small non-Federal Non-hydropower dams					$p_t = 0.05$ $p_M = 0.10$	\$10,603

Table A-42
Summary of Activity Cost Estimation

Activity	Sub-activity	Cost Unit	Cost Stream (Duration)	Present Value of Cost Stream	Forecast Period	Probability of Modifications	Annual Expected Per-Project Cost
Federal Land Management Activities (non-wilderness)	Idaho Federal land	per acre	$1.26 (1 year)	$1.26	Annual	$p_t = 1.0$ $p_M = 1.0$	$1.26
	Western Oregon & Western Washington Federal land		$5.90 (1 year)	$5.90			$5.90
	Eastern Oregon & Eastern Washington Federal land		$3.30 (1 year)	$3.30			$3.30
Federal Land Management Activities (wild-erness)	Idaho	per acre	$0.07 (1 year)	$0.07	Annual	$p_t = 1.0$ $p_M = 1.0$	$0.07
	Western Oregon & Western Washington		$0.29 (1 year)	$0.29			$0.29
	Eastern Oregon & Eastern Washington		$0.15 (1 year)	$0.15			$0.15
Livestock Grazing on Federal Land	Fencing	Stream miles	$11,500 + 2% annual maintenance for 30 years	$14,354	Immediate	$p_t = 1.0$ $p_M = 1.0$	$1,157

Table A-42
Summary of Activity Cost Estimation

Activity	Sub-activity	Cost Unit	Cost Stream (Duration)	Present Value of Cost Stream	Forecast Period	Probability of Modifications	Annual Expected Per-Project Cost
Transportation**	Bridges & culverts (small)	per project & mile	$27,800 + variable costs (1 year)	$41,778	5 years	$p_t = 0.20$ $p_M = 1.0$	$8,356
	Bridges & culverts (medium)		$55,500 + variable costs (1 year)	$69,478			$13,896
	Bridges & culverts (large)		$84,300 + variable costs (1 year)	$98,278			$19,656
	Roads (small)	per project & mile	$22,800 + variable costs (1 year)	$36,778	5 years	$p_t = 0.20$ $p_M = 1.0$	$7,356
	Roads (medium)		$47,000 + variable costs (1 year)	$60,978			$12,196
	Roads (large)		$71,300 + variable costs (1 year)	$85,278			$17,056
Utility Lines	Outfall structures and pipelines	per project	$101,000 (1 year)	$101,000	Annual	$p_t = 1.0$ $p_M = 1.0$	$101,000
Instream Activities	Dredging	per project	$821,000 (1 year)	$821,000	Annual	$p_t = 1.0$ $p_M = 1.0$	$821,000

Table A-42 Summary of Activity Cost Estimation							
Activity	**Sub-activity**	**Cost Unit**	**Cost Stream (Duration)**	**Present Value of Cost Stream**	**Forecast Period**	**Probability of Modifications**	**Annual Expected Per-Project Cost**
	Boat dock, boat ramps, bank stabilization	per project	$54,500 (1 year)	$54,500	Annual	$p_t = 1.0$ $p_M = 1.0$	$54,500
NPDES-permitted activities	Minor facility	per facility	O&M: $6,800 (20 years)	$72,039	Immediate	$p_t = 1.0$ $p_M = 0.20$	$1,360
	Major facility	per facility	Capital: $421,500 O&M: $19,725 (20 years)	$630,467	Immediate	$p_t = 1.0$ $p_M = 0.25$	$14,878
Sand and Gravel Mining	Mining on non-Federal lands	per site	$330,000 (5 years)	$1,353,065	30 years	$p_t = 0.033$ $p_M = 0.50$	$22,551
Residential and Commercial Development	New development	per project	$235,000 (1 year)	$235,000	Annual	$p_t = 1.0$ $p_M = 0.06$	$13,865
Agricultural Pesticide Applications	Agricultural cropping	per acre	$0 - 6,517, depending on crop type and county		Annual	100%	$0 - 6,517, depending on crop type and county

*The cost stream presented is the present value of costs.
**Transportation costs are presented for a project of average mileage (3.2 miles).

Appendix B
Potential Economic Impacts for Oregon Coast coho ESU
Individual Watersheds by Activity

Table B-1
Annual Potential Total Impact

	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$80,471	$83,684	$189,153	$183,496	$297,834	$283,309
1710020201	$75,498	$75,497	$134,208	$131,252	$192,918	$187,006
1710020202	$3,985	$3,985	$17,397	$17,397	$30,808	$30,808
1710020203	$22,919	$22,919	$60,100	$57,143	$97,280	$91,368
1710020204	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020205	$3,862	$3,862	$61,992	$56,079	$120,122	$108,297
1710020206	$7,611	$7,611	$9,302	$9,302	$10,993	$10,993
1710020301	$93,378	$93,378	$175,739	$175,739	$258,100	$258,100
1710020302	$426,646	$426,646	$812,884	$812,884	$1,199,122	$1,199,121
1710020303	$18,539	$18,539	$35,133	$35,133	$51,727	$51,727
1710020304	$87,574	$90,786	$234,825	$238,038	$382,077	$385,290
1710020305	$25,821	$29,033	$34,607	$37,820	$43,394	$46,606
1710020306	$13,787	$13,787	$23,038	$23,038	$32,290	$32,290
1710020307	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710020308	$7,880	$7,880	$37,665	$37,665	$67,450	$67,450
1710020309	$85,865	$85,865	$157,189	$157,189	$228,513	$228,513
1710020401	$14,507	$14,507	$15,242	$15,242	$15,977	$15,977
1710020402	$109,796	$109,796	$210,651	$210,651	$311,505	$311,505
1710020403	$51,934	$55,146	$224,265	$227,478	$396,597	$399,810
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$4,359	$4,359	$8,363	$8,363	$12,367	$12,367
1710020407	$123,500	$126,712	$239,882	$243,094	$356,264	$359,477
1710020408	$68,550	$68,550	$131,156	$131,156	$193,763	$193,763
1710020409	$60,280	$60,279	$100,794	$100,794	$141,308	$141,308

Table B-1
Annual Potential Total Impact

	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020501	$200,947	$200,947	$383,642	$383,642	$566,338	$566,338
1710020502	$243,821	$243,821	$469,313	$469,313	$694,805	$694,805
1710020503	$135,679	$135,679	$260,338	$260,338	$385,008	$385,008
1710020504	$419,660	$419,660	$869,861	$869,861	$1,320,062	$1,320,061
1710020505	$48,558	$48,558	$86,335	$86,335	$124,113	$124,113
1710020506	$83,197	$83,197	$159,619	$159,619	$236,041	$236,041
1710020507	$186,231	$186,231	$360,428	$360,428	$534,656	$534,656
1710020508	$24,769	$24,769	$47,520	$47,520	$70,272	$70,272
1710020601	$240,535	$240,535	$445,159	$445,159	$649,783	$649,783
1710020602	$65,084	$65,084	$124,868	$124,868	$184,651	$184,651
1710020603	$55,717	$55,717	$106,896	$106,896	$158,075	$158,075
1710020604	$141,164	$141,164	$269,958	$269,958	$398,753	$398,753
1710020605	$116,114	$116,114	$222,773	$222,773	$329,431	$329,431
1710020606	$106,121	$106,121	$203,601	$203,601	$301,080	$301,080
1710020607	$129,880	$129,880	$249,183	$249,183	$368,486	$368,486
1710020608	$267,754	$267,754	$502,503	$502,503	$737,251	$737,251
1710020701	$217,734	$217,734	$612,003	$612,003	$1,006,272	$1,006,272
1710030106	$12,314	$12,314	$23,739	$23,739	$35,209	$35,209
1710030107	$408,988	$408,988	$765,848	$765,848	$1,122,712	$1,122,712
1710030108	$359,281	$359,281	$689,307	$689,307	$1,019,334	$1,019,334
1710030109	$113,901	$113,901	$218,526	$218,526	$323,152	$323,152
1710030110	$92,524	$92,524	$179,040	$179,040	$265,555	$265,555
1710030111	$322,662	$322,662	$645,229	$645,229	$967,796	$967,796
1710030112	$52,848	$52,847	$392,080	$383,211	$731,313	$713,576
1710030201	$252,794	$252,794	$485,099	$485,099	$717,443	$717,443
1710030202	$317,868	$317,868	$609,923	$609,923	$902,006	$902,006
1710030203	$313,142	$313,142	$612,419	$612,419	$911,695	$911,695
1710030204	$167,777	$167,777	$323,418	$323,418	$479,058	$479,058

Table B-1 Annual Potential Total Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030205	$224,868	$224,868	$468,917	$465,961	$712,966	$707,053
1710030207	$161,074	$161,074	$386,980	$384,024	$612,887	$606,974
1710030208	$97,611	$97,611	$187,280	$187,280	$276,952	$276,952
1710030209	$143,204	$143,204	$310,083	$307,127	$476,962	$471,050
1710030210	$31,955	$31,955	$196,887	$188,018	$361,818	$344,081
1710030211	$111,523	$111,523	$304,999	$296,130	$498,474	$480,737
1710030212	$91,258	$91,258	$341,259	$338,302	$591,259	$585,347
1710030213	$147,197	$150,409	$560,147	$530,841	$973,098	$911,273
1710030301	$206,416	$206,416	$516,911	$505,086	$827,406	$803,756
1710030302	$65,504	$65,504	$175,746	$172,790	$285,988	$280,076
1710030303	$186,090	$186,090	$446,466	$446,466	$706,842	$706,842
1710030304	$91,179	$91,179	$243,037	$237,124	$394,895	$383,070
1710030305	$85,797	$85,797	$187,876	$187,876	$289,956	$289,956
1710030306	$199,710	$199,710	$383,156	$383,156	$566,603	$566,603
1710030307	$339,881	$339,881	$667,692	$667,692	$995,503	$995,503
1710030308	$79,480	$79,480	$236,608	$227,739	$393,737	$375,999
1710030401	$93,665	$93,665	$179,703	$179,703	$265,741	$265,741
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$39,584	$39,584	$107,074	$107,074	$174,564	$174,564
1710030404	$362,065	$374,915	$804,121	$808,101	$1,246,176	$1,241,288
1710030501	$283,932	$283,932	$544,746	$544,746	$805,561	$805,561
1710030502	$244,593	$244,593	$468,905	$468,905	$693,218	$693,218
1710030503	$31,187	$31,187	$147,440	$138,572	$263,694	$245,957
1710030504	$167,604	$167,604	$321,560	$321,560	$475,516	$475,516
1710030505	$152,678	$152,678	$324,638	$321,682	$496,599	$490,686
1710030506	$88,767	$88,767	$227,979	$222,066	$367,191	$355,366
1710030603	$81,557	$81,557	$221,217	$215,304	$360,898	$349,073
1710030604	$42,738	$42,738	$85,819	$82,863	$128,900	$122,988

Table B-2 Annual Potential Hydropower Impact						
	Cost Estimate and Discount Rate					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$0	$0	$0	$0	$0	$0
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$269	$269	$23,786	$23,786	$47,303	$47,303
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$0	$0	$0	$0	$0	$0

Table B-2 Annual Potential Hydropower Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$0	$0	$0	$0
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-2 Annual Potential Hydropower Impact						
	Cost Estimate and Discount Rate					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$0	$0	$0	$0	$0	$0
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$269	$269	$23,786	$23,786	$47,303	$47,303
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$0	$0	$0	$0	$0	$0
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$0	$0	$0	$0	$0	$0
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$0	$0	$0	$0

Table B-3 Annual Potential Non-hydropower Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020201	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020202	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020304	$1,346	$1,346	$118,931	$118,931	$236,516	$236,516
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$1,481	$1,481	$130,824	$130,824	$260,168	$260,168
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$269	$269	$23,786	$23,786	$47,303	$47,303
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$135	$135	$11,893	$11,893	$23,652	$23,652

Table B-3 Annual Potential Non-hydropower Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$135	$135	$11,893	$11,893	$23,652	$23,652
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$2,692	$2,692	$237,862	$237,862	$473,033	$473,033
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$404	$404	$35,679	$35,679	$70,955	$70,955
1710030112	$2,288	$2,288	$202,183	$202,183	$402,078	$402,078
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030207	$269	$269	$23,786	$23,786	$47,303	$47,303
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-3 Annual Potential Non-hydropower Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$404	$404	$35,679	$35,679	$70,955	$70,955
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$1,615	$1,615	$142,717	$142,717	$283,820	$283,820
1710030213	$673	$673	$59,466	$59,466	$118,258	$118,258
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030303	$1,211	$1,211	$107,038	$107,038	$212,865	$212,865
1710030304	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$404	$404	$35,679	$35,679	$70,955	$70,955
1710030404	$673	$673	$59,466	$59,466	$118,258	$118,258
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030506	$538	$538	$47,572	$47,572	$94,607	$94,607
1710030603	$135	$135	$11,893	$11,893	$23,652	$23,652
1710030604	$0	$0	$0	$0	$0	$0

Table B-4 Annual Potential Federal Lands Management (Non-wilderness) Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$16,566	$16,566	$31,783	$31,783	$47,000	$47,000
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$89,573	$89,573	$171,851	$171,851	$254,130	$254,130
1710020302	$401,632	$401,632	$770,559	$770,559	$1,139,485	$1,139,485
1710020303	$3,603	$3,603	$6,913	$6,913	$10,223	$10,223
1710020304	$20,358	$20,358	$39,058	$39,058	$57,757	$57,757
1710020305	$3,377	$3,377	$6,479	$6,479	$9,581	$9,581
1710020306	$9,982	$9,982	$19,150	$19,150	$28,319	$28,319
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$70,643	$70,643	$135,534	$135,534	$200,425	$200,425
1710020401	$800	$800	$1,536	$1,536	$2,271	$2,271
1710020402	$109,796	$109,796	$210,651	$210,651	$311,505	$311,505
1710020403	$12,773	$12,773	$24,505	$24,505	$36,238	$36,238
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$4,359	$4,359	$8,363	$8,363	$12,367	$12,367
1710020407	$102,548	$102,548	$196,746	$196,746	$290,943	$290,943
1710020408	$64,745	$64,745	$124,217	$124,217	$183,689	$183,689
1710020409	$7,999	$7,999	$15,347	$15,347	$22,695	$22,695
1710020501	$197,141	$197,141	$378,228	$378,228	$559,316	$559,316
1710020502	$243,821	$243,821	$467,788	$467,788	$691,754	$691,754
1710020503	$134,979	$134,979	$258,965	$258,965	$382,952	$382,952
1710020504	$260,736	$260,736	$500,239	$500,239	$739,742	$739,742

Table B-4 Annual Potential Federal Lands Management (Non-wilderness) Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$40,947	$40,947	$78,559	$78,559	$116,171	$116,171
1710020506	$83,197	$83,197	$159,619	$159,619	$236,041	$236,041
1710020507	$184,252	$184,252	$353,500	$353,500	$522,748	$522,748
1710020508	$24,769	$24,769	$47,520	$47,520	$70,272	$70,272
1710020601	$196,819	$196,819	$377,611	$377,611	$558,402	$558,402
1710020602	$65,084	$65,084	$124,868	$124,868	$184,651	$184,651
1710020603	$55,717	$55,717	$106,896	$106,896	$158,075	$158,075
1710020604	$127,411	$127,411	$244,447	$244,447	$361,483	$361,483
1710020605	$116,114	$116,114	$222,773	$222,773	$329,431	$329,431
1710020606	$106,121	$106,121	$203,601	$203,601	$301,080	$301,080
1710020607	$129,880	$129,880	$249,183	$249,183	$368,486	$368,486
1710020608	$233,301	$233,301	$447,604	$447,604	$661,907	$661,907
1710020701	$169,474	$169,474	$325,147	$325,147	$480,820	$480,820
1710030106	$9,495	$9,495	$18,217	$18,217	$26,939	$26,939
1710030107	$388,194	$388,194	$744,777	$744,777	$1,101,359	$1,101,359
1710030108	$359,212	$359,212	$689,173	$689,173	$1,019,133	$1,019,133
1710030109	$113,901	$113,901	$218,526	$218,526	$323,152	$323,152
1710030110	$92,524	$92,524	$177,514	$177,514	$262,504	$262,504
1710030111	$310,817	$310,817	$596,322	$596,322	$881,828	$881,828
1710030112	$22,415	$22,415	$43,005	$43,005	$63,594	$63,594
1710030201	$250,368	$250,368	$480,347	$480,347	$710,327	$710,327
1710030202	$316,084	$316,084	$606,429	$606,429	$896,773	$896,773
1710030203	$313,007	$313,007	$600,526	$600,526	$888,044	$888,044
1710030204	$167,777	$167,777	$321,892	$321,892	$476,007	$476,007
1710030205	$204,371	$204,371	$392,099	$392,099	$579,827	$579,827
1710030207	$151,937	$151,937	$291,502	$291,502	$431,067	$431,067
1710030208	$97,458	$97,458	$186,980	$186,980	$276,502	$276,502
1710030209	$138,853	$138,853	$266,398	$266,398	$393,944	$393,944

Table B-4 Annual Potential Federal Lands Management (Non-wilderness) Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$18,109	$18,109	$34,743	$34,743	$51,377	$51,377
1710030211	$107,528	$107,528	$206,299	$206,299	$305,070	$305,070
1710030212	$85,616	$85,616	$164,260	$164,260	$242,904	$242,904
1710030213	$10,526	$10,526	$20,194	$20,194	$29,862	$29,862
1710030301	$205,914	$205,914	$395,060	$395,060	$584,206	$584,206
1710030302	$38,691	$38,691	$74,231	$74,231	$109,771	$109,771
1710030303	$145,693	$145,693	$279,521	$279,521	$413,350	$413,350
1710030304	$91,044	$91,044	$174,675	$174,675	$258,305	$258,305
1710030305	$85,527	$85,527	$164,090	$164,090	$242,652	$242,652
1710030306	$199,710	$199,710	$383,156	$383,156	$566,603	$566,603
1710030307	$330,387	$330,387	$633,870	$633,870	$937,352	$937,352
1710030308	$57,561	$57,561	$110,434	$110,434	$163,307	$163,307
1710030401	$93,665	$93,665	$179,703	$179,703	$265,741	$265,741
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$31,569	$31,569	$60,567	$60,567	$89,565	$89,565
1710030404	$50,538	$50,538	$96,960	$96,960	$143,382	$143,382
1710030501	$283,852	$283,852	$544,589	$544,589	$805,327	$805,327
1710030502	$240,787	$240,787	$461,966	$461,966	$683,145	$683,145
1710030503	$16,564	$16,564	$31,779	$31,779	$46,994	$46,994
1710030504	$167,604	$167,604	$321,560	$321,560	$475,516	$475,516
1710030505	$127,962	$127,962	$245,503	$245,503	$363,045	$363,045
1710030506	$10,556	$10,556	$20,252	$20,252	$29,948	$29,948
1710030603	$76,292	$76,292	$146,372	$146,372	$216,452	$216,452
1710030604	$10,384	$10,384	$19,923	$19,923	$29,461	$29,461

Table B-5 Annual Potential Federal Lands Management (Wilderness) Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$0	$0	$0	$0	$0	$0
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$701	$701	$1,373	$1,373	$2,056	$2,056
1710020504	$0	$0	$0	$0	$0	$0

Table B-5 Annual Potential Federal Lands Management (Wilderness) Impact						
	Cost Estimate and Discount Rate					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$1,979	$1,979	$3,877	$3,877	$5,806	$5,806
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$2,819	$2,819	$5,522	$5,522	$8,270	$8,270
1710030107	$289	$289	$566	$566	$848	$848
1710030108	$69	$69	$134	$134	$201	$201
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$0	$0	$0	$0
1710030201	$2,426	$2,426	$4,752	$4,752	$7,117	$7,117
1710030202	$1,784	$1,784	$3,494	$3,494	$5,233	$5,233
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$153	$153	$300	$300	$450	$450
1710030209	$0	$0	$0	$0	$0	$0

Table B-5 Annual Potential Federal Lands Management (Wilderness) Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$0	$0	$0	$0	$0	$0
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$0	$0	$0	$0	$0	$0
1710030501	$80	$80	$156	$156	$234	$234
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$0	$0	$0	$0	$0	$0
1710030603	$1,325	$1,325	$2,594	$2,594	$3,885	$3,885
1710030604	$0	$0	$0	$0	$0	$0

Table B-6 Annual Potential Federal Grazing Lands Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$0	$0	$0	$0	$0	$0
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$0	$0	$0	$0	$0	$0

Table B-6 Annual Potential Federal Grazing Lands Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$0	$0	$0	$0
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-6 Annual Potential Federal Grazing Lands Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$0	$0	$0	$0	$0	$0
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$0	$0	$0	$0	$0	$0
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$0	$0	$0	$0	$0	$0
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$0	$0	$0	$0

Table B-7 Annual Potential Transportation Project Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$51,858	$51,858	$51,858	$51,858	$51,858	$51,858
1710020201	$21,354	$21,354	$21,354	$21,354	$21,354	$21,354
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$8,151	$8,151	$8,151	$8,151	$8,151	$8,151
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043
1710020303	$14,801	$14,801	$14,801	$14,801	$14,801	$14,801
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$9,238	$9,238	$9,238	$9,238	$9,238	$9,238
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$13,706	$13,706	$13,706	$13,706	$13,706	$13,706
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$20,534	$20,534	$20,534	$20,534	$20,534	$20,534
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$29,178	$29,178	$29,178	$29,178	$29,178	$29,178
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$13,721	$13,721	$13,721	$13,721	$13,721	$13,721

Table B-7 Annual Potential Transportation Project Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$13,618	$13,618	$13,618	$13,618	$13,618	$13,618
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$13,677	$13,677	$13,677	$13,677	$13,677	$13,677
1710020701	$8,131	$8,131	$8,131	$8,131	$8,131	$8,131
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$20,505	$20,505	$20,505	$20,505	$20,505	$20,505
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$0	$0	$0	$0
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-7 Annual Potential Transportation Project Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$13,618	$13,618	$13,618	$13,618	$13,618	$13,618
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$21,597	$21,597	$21,597	$21,597	$21,597	$21,597
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$14,173	$14,173	$14,173	$14,173	$14,173	$14,173
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$59,993	$59,993	$59,993	$59,993	$59,993	$59,993
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$14,488	$14,488	$14,488	$14,488	$14,488	$14,488
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$8,043	$8,043	$8,043	$8,043	$8,043	$8,043
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$0	$0	$0	$0

Table B-8 Annual Potential Utility Line Project Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$37,438	$37,438	$37,812	$37,812	$38,186	$38,186
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$37,438	$37,438	$37,812	$37,812	$38,186	$38,186
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$0	$0	$0	$0	$0	$0

Table B-8 Annual Potential Utility Line Project Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$37,438	$37,438	$37,812	$37,812	$38,186	$38,186
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$37,438	$37,438	$37,812	$37,812	$38,186	$38,186
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$0	$0	$0	$0
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-8 Annual Potential Utility Line Project Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$74,875	$74,875	$75,624	$75,624	$76,373	$76,373
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$0	$0	$0	$0	$0	$0
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$37,438	$37,438	$37,812	$37,812	$38,186	$38,186
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$0	$0	$0	$0

Table B-9 Annual Potential Instream Activity Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$0	$0	$0	$0	$0	$0
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$7,011	$7,011	$15,284	$15,284	$23,556	$23,556
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448

Table B-9 Annual Potential Instream Activity Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-9 Annual Potential Instream Activity Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$0	$0	$0	$0	$0	$0
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$28,078	$28,078	$61,211	$61,211	$94,343	$94,343
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710030506	$9,359	$9,359	$20,404	$20,404	$31,448	$31,448
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$0	$0	$0	$0

Table B-10 Annual Potential Dredging Projects Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$0	$0	$0	$0
1710020201	$0	$0	$0	$0	$0	$0
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$0	$0	$0	$0
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$124,293	$124,293	$307,363	$307,363	$490,433	$490,433

Table B-10 Annual Potential Dredging Projects Impact						
	Cost Estimate and Discount Rate					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$0	$0	$0	$0
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$0	$0	$0	$0
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$0	$0	$0	$0

Table B-10 Annual Potential Dredging Projects Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$0	$0	$0	$0
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$0	$0	$0	$0	$0	$0
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$0	$0	$0	$0
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$124,293	$124,293	$307,363	$307,363	$490,433	$490,433
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$0	$0	$0	$0	$0	$0
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$0	$0	$0	$0

Table B-11 Annual Potential NPDES-Permitted Activity Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$9,401	$12,613	$21,105	$24,317	$32,808	$36,021
1710020201	$0	$0	$3,051	$3,051	$6,102	$6,102
1710020202	$0	$0	$1,526	$1,526	$3,051	$3,051
1710020203	$0	$0	$0	$0	$0	$0
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$1,526	$1,526	$3,051	$3,051
1710020206	$0	$0	$1,526	$1,526	$3,051	$3,051
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$6,102	$6,102	$12,205	$12,204
1710020303	$0	$0	$1,526	$1,526	$3,051	$3,051
1710020304	$9,401	$12,613	$19,579	$22,791	$29,757	$32,970
1710020305	$9,401	$12,613	$15,002	$18,215	$20,604	$23,816
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$6,102	$6,102	$12,205	$12,204
1710020309	$0	$0	$6,102	$6,102	$12,205	$12,204
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$9,401	$12,613	$28,732	$31,945	$48,064	$51,276
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$9,401	$12,613	$19,579	$22,791	$29,757	$32,970
1710020408	$0	$0	$3,051	$3,051	$6,102	$6,102
1710020409	$0	$0	$9,154	$9,153	$18,307	$18,307
1710020501	$0	$0	$1,526	$1,526	$3,051	$3,051
1710020502	$0	$0	$1,526	$1,526	$3,051	$3,051
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$0	$0	$4,577	$4,577	$9,153	$9,153

Table B-11
Annual Potential NPDES-Permitted Activity Impact

	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$3,051	$3,051	$6,102	$6,102
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$9,154	$9,153	$18,307	$18,307
1710020701	$0	$0	$3,051	$3,051	$6,102	$6,102
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$1,526	$1,526	$3,051	$3,051
1710030111	$0	$0	$1,526	$1,526	$3,051	$3,051
1710030112	$0	$0	$15,256	$15,256	$30,511	$30,511
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$1,526	$1,526	$3,051	$3,051
1710030205	$0	$0	$4,577	$4,577	$9,153	$9,153
1710030207	$0	$0	$6,102	$6,102	$12,205	$12,204
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$7,628	$7,628	$15,256	$15,256

Table B-11 Annual Potential NPDES-Permitted Activity Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$15,256	$15,256	$30,511	$30,511
1710030211	$0	$0	$3,051	$3,051	$6,102	$6,102
1710030212	$0	$0	$0	$0	$0	$0
1710030213	$9,401	$12,613	$28,732	$31,945	$48,064	$51,276
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$0	$0	$4,577	$4,577	$9,153	$9,153
1710030303	$0	$0	$12,205	$12,205	$24,409	$24,409
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$1,526	$1,526	$3,051	$3,051
1710030308	$0	$0	$7,628	$7,628	$15,256	$15,256
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$3,051	$3,051	$6,102	$6,102
1710030404	$37,603	$50,452	$72,213	$85,063	$106,824	$119,674
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$3,051	$3,051	$6,102	$6,102
1710030503	$0	$0	$4,577	$4,577	$9,153	$9,153
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$3,051	$3,051	$6,102	$6,102
1710030506	$0	$0	$12,205	$12,205	$24,409	$24,409
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$0	$0	$1,526	$1,526	$3,051	$3,051

Table B-12 Annual Potential Mining Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020101	$0	$0	$84,703	$75,835	$169,407	$151,669
1710020201	$0	$0	$28,234	$25,278	$56,469	$50,556
1710020202	$0	$0	$0	$0	$0	$0
1710020203	$0	$0	$28,234	$25,278	$56,469	$50,556
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$0	$0	$56,469	$50,556	$112,938	$101,113
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$0	$0	$0	$0	$0	$0
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$0	$0	$0	$0	$0	$0

Table B-12 Annual Potential Mining Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$0	$0	$0	$0	$0	$0
1710030112	$0	$0	$84,703	$75,835	$169,407	$151,669
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$0	$0	$28,234	$25,278	$56,469	$50,556
1710030207	$0	$0	$28,234	$25,278	$56,469	$50,556
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$0	$0	$28,234	$25,278	$56,469	$50,556

Table B-12 Annual Potential Mining Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$0	$0	$84,703	$75,835	$169,407	$151,669
1710030211	$0	$0	$84,703	$75,835	$169,407	$151,669
1710030212	$0	$0	$28,234	$25,278	$56,469	$50,556
1710030213	$0	$0	$310,579	$278,061	$621,159	$556,121
1710030301	$0	$0	$112,938	$101,113	$225,876	$202,226
1710030302	$0	$0	$28,234	$25,278	$56,469	$50,556
1710030303	$0	$0	$0	$0	$0	$0
1710030304	$0	$0	$56,469	$50,556	$112,938	$101,113
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$0	$0	$84,703	$75,835	$169,407	$151,669
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$0	$0	$84,703	$75,835	$169,407	$151,669
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$84,703	$75,835	$169,407	$151,669
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$28,234	$25,278	$56,469	$50,556
1710030506	$0	$0	$56,469	$50,556	$112,938	$101,113
1710030603	$0	$0	$56,469	$50,556	$112,938	$101,113
1710030604	$0	$0	$28,234	$25,278	$56,469	$50,556

Table B-13 Annual Potential Development Impact						
	Cost Estimate and Discount Rate					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
1710020101	$19,027	$19,027	$19,441	$19,441	$19,855	$19,855
1710020201	$0	$0	$0	$0	$0	$0
1710020202	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020203	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710020204	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020205	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020206	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710020301	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020302	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$19,027	$19,027	$19,441	$19,441	$19,855	$19,855
1710020305	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020306	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710020309	$15,222	$15,222	$15,553	$15,553	$15,884	$15,884
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$11,416	$11,416	$11,665	$11,665	$11,913	$11,913
1710020408	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020409	$22,833	$22,833	$23,329	$23,329	$23,825	$23,825
1710020501	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$11,416	$11,416	$11,665	$11,665	$11,913	$11,913

Table B-13 Annual Potential Development Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$0	$0	$0	$0	$0	$0
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$11,416	$11,416	$11,665	$11,665	$11,913	$11,913
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$11,416	$11,416	$11,665	$11,665	$11,913	$11,913
1710030112	$15,222	$15,222	$15,553	$15,553	$15,884	$15,884
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$15,222	$15,222	$15,553	$15,553	$15,884	$15,884
1710030207	$0	$0	$0	$0	$0	$0
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971

Table B-13 Annual Potential Development Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710030211	$0	$0	$0	$0	$0	$0
1710030212	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710030213	$34,249	$34,249	$34,994	$34,994	$35,738	$35,738
1710030301	$0	$0	$0	$0	$0	$0
1710030302	$11,416	$11,416	$11,665	$11,665	$11,913	$11,913
1710030303	$15,222	$15,222	$15,553	$15,553	$15,884	$15,884
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$7,611	$7,611	$7,776	$7,776	$7,942	$7,942
1710030404	$60,887	$60,887	$62,211	$62,211	$63,535	$63,535
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$15,222	$15,222	$15,553	$15,553	$15,884	$15,884
1710030506	$22,833	$22,833	$23,329	$23,329	$23,825	$23,825
1710030603	$3,805	$3,805	$3,888	$3,888	$3,971	$3,971
1710030604	$30,444	$30,444	$31,106	$31,106	$31,767	$31,767

Table B-14 Annual Potential Agricultural Pesticide Application Impact						
	Cost Estimate and Discount Rate					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
1710020101	$50	$50	$152	$152	$254	$254
1710020201	$6	$6	$80	$80	$155	$155
1710020202	$45	$45	$90	$90	$134	$134
1710020203	$146	$146	$654	$654	$1,162	$1,162
1710020204	$0	$0	$0	$0	$0	$0
1710020205	$57	$57	$109	$109	$162	$162
1710020206	$0	$0	$0	$0	$0	$0
1710020301	$0	$0	$0	$0	$0	$0
1710020302	$0	$0	$0	$0	$0	$0
1710020303	$0	$0	$0	$0	$0	$0
1710020304	$4	$4	$5	$5	$5	$5
1710020305	$0	$0	$0	$0	$0	$0
1710020306	$0	$0	$0	$0	$0	$0
1710020307	$0	$0	$0	$0	$0	$0
1710020308	$0	$0	$0	$0	$0	$0
1710020309	$0	$0	$0	$0	$0	$0
1710020401	$0	$0	$0	$0	$0	$0
1710020402	$0	$0	$0	$0	$0	$0
1710020403	$0	$0	$0	$0	$0	$0
1710020405	$0	$0	$0	$0	$0	$0
1710020406	$0	$0	$0	$0	$0	$0
1710020407	$0	$0	$0	$0	$0	$0
1710020408	$0	$0	$0	$0	$0	$0
1710020409	$0	$0	$0	$0	$0	$0
1710020501	$0	$0	$0	$0	$0	$0
1710020502	$0	$0	$0	$0	$0	$0
1710020503	$0	$0	$0	$0	$0	$0
1710020504	$0	$0	$0	$0	$0	$0

Table B-14
Annual Potential Agricultural Pesticide Application Impact

	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710020505	$0	$0	$0	$0	$0	$0
1710020506	$0	$0	$0	$0	$0	$0
1710020507	$0	$0	$0	$0	$0	$0
1710020508	$0	$0	$0	$0	$0	$0
1710020601	$6,144	$6,144	$17,844	$17,844	$29,543	$29,543
1710020602	$0	$0	$0	$0	$0	$0
1710020603	$0	$0	$0	$0	$0	$0
1710020604	$0	$0	$0	$0	$0	$0
1710020605	$0	$0	$0	$0	$0	$0
1710020606	$0	$0	$0	$0	$0	$0
1710020607	$0	$0	$0	$0	$0	$0
1710020608	$0	$0	$0	$0	$0	$0
1710020701	$0	$0	$0	$0	$0	$0
1710030106	$0	$0	$0	$0	$0	$0
1710030107	$0	$0	$0	$0	$0	$0
1710030108	$0	$0	$0	$0	$0	$0
1710030109	$0	$0	$0	$0	$0	$0
1710030110	$0	$0	$0	$0	$0	$0
1710030111	$25	$25	$37	$37	$49	$49
1710030112	$3,563	$3,563	$10,977	$10,977	$18,392	$18,392
1710030201	$0	$0	$0	$0	$0	$0
1710030202	$0	$0	$0	$0	$0	$0
1710030203	$0	$0	$0	$0	$0	$0
1710030204	$0	$0	$0	$0	$0	$0
1710030205	$5,141	$5,141	$16,561	$16,561	$27,981	$27,981
1710030207	$8,733	$8,733	$25,462	$25,462	$42,191	$42,191
1710030208	$0	$0	$0	$0	$0	$0
1710030209	$546	$546	$3,934	$3,934	$7,323	$7,323

Table B-14 Annual Potential Agricultural Pesticide Application Impact						
	Cost Estimate and Discount Rate					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
1710030210	$5,831	$5,831	$18,728	$18,728	$31,626	$31,626
1710030211	$3,996	$3,996	$10,945	$10,945	$17,895	$17,895
1710030212	$222	$222	$2,159	$2,159	$4,096	$4,096
1710030213	$3,855	$3,855	$16,940	$16,940	$30,025	$30,025
1710030301	$502	$502	$8,913	$8,913	$17,324	$17,324
1710030302	$15,262	$15,262	$45,146	$45,146	$75,030	$75,030
1710030303	$2,367	$2,367	$10,553	$10,553	$18,738	$18,738
1710030304	$0	$0	$0	$0	$0	$0
1710030305	$0	$0	$0	$0	$0	$0
1710030306	$0	$0	$0	$0	$0	$0
1710030307	$0	$0	$0	$0	$0	$0
1710030308	$0	$0	$0	$0	$0	$0
1710030401	$0	$0	$0	$0	$0	$0
1710030402	$0	$0	$0	$0	$0	$0
1710030403	$0	$0	$0	$0	$0	$0
1710030404	$0	$0	$0	$0	$0	$0
1710030501	$0	$0	$0	$0	$0	$0
1710030502	$0	$0	$0	$0	$0	$0
1710030503	$0	$0	$0	$0	$0	$0
1710030504	$0	$0	$0	$0	$0	$0
1710030505	$0	$0	$0	$0	$0	$0
1710030506	$0	$0	$1,894	$1,894	$3,787	$3,787
1710030603	$0	$0	$0	$0	$0	$0
1710030604	$1,910	$1,910	$5,031	$5,031	$8,152	$8,152