Final Economic Analysis of Critical Habitat Designation for Seven West Coast Salmon and Steelhead ESUs

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ES.1 Introduction

The National Marine Fisheries Service (NOAA Fisheries) is designating critical habitat for four species of West Coast salmon and steelhead (Onchorynchus spp.) listed under the Endangered Species Act (ESA). The designations address 19 evolutionarily significant units (ESUs) of these species in the States of Washington, Oregon, Idaho, and California.

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.

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 federal funded, have a Federal permit, or otherwise have a "nexus" with a Federal agency, must modify actions that potentially 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.

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 2005a). Other impacts are also covered in separate reports, for example impacts on small businesses.

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 ESA defines 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 West Coast 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 of 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.

On February 16, 2000, NOAA Fisheries published final critical habitat designations for 19 ESUs, thereby completing designations for all 25 ESUs listed at the time (65 FR 7764). The 19 designations included more than one hundred and fifty river subbasins in Washington, Oregon, Idaho, and California. Within each occupied subbasin, NOAA Fisheries designated as critical habitat those lakes and river reaches accessible to listed fish along with the associated riparian zone, except for reaches on Indian land. Areas considered inaccessible included areas above long-standing natural impassable barriers and areas above impassable dams, but not areas above ephemeral barriers such as failed culverts.

In considering the economic impact, NOAA Fisheries determined that the critical habitat designations would impose very little or no additional requirements on Federal agencies beyond those already imposed by the listing of the species themselves. The ESA's prohibition against adversely modifying critical habitat applies only to Federal agencies, which under section 7 of the ESA are also prohibited from jeopardizing the continued existence of listed species. NOAA Fisheries reasoned that since it was designating only occupied habitat, there would be few or no actions that adversely modified critical habitat that also did not jeopardize the continued existence of the species. Therefore, there would be no economic impact as a result of the designations (65 FR 7764, 7765, February 16, 2000).

The National Association of Homebuilders (NAHB) challenged the designations in District Court in Washington, D.C. as having inadequately considered the economic impacts of the critical habitat designations (National Ass'n of Homebuilders v. Evans, 2002 WL 1205743 No. 00-CV-2799 (D.D.C.). NAHB also challenged NOAA Fisheries' designation of Essential Fish Habitat (EFH) (Pacific Coast Salmon Fishery Management Plan, 2000). While the NAHB litigation was pending, the Court of Appeals for the 10th Circuit issued its decision in New Mexico Cattle Growers' Association v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001) (NMCA). In that case, the Court rejected the FWS approach to economic analysis, which was similar to the approach taken by NOAA Fisheries in the final rule designating critical habitat for 19 ESUs of West Coast salmon and steelhead. The Court ruled that "Congress intended that the FWS conduct a full analysis of all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes." Subsequent to the 10th Circuit decision, NOAA Fisheries entered into and sought judicial approval of a consent decree resolving the NAHB litigation. That decree provided for the withdrawal of critical habitat designations for the 19 salmon and steelhead ESUs and dismissed NAHB's challenge to the EFH designations. The District Court approved the consent decree and vacated the critical habitat designations by Court order on April 30, 2002 (National Ass'n of Homebuilders v. Evans, 2002 WL 1205743 (D.D.C. 2002).

On September 3, 2003, the Pacific Coast Federation of Fishermen's Associations (PCFFA), Institute for Fisheries Resources, the Center for Biological Diversity, the Oregon Natural Resources Council, the Pacific Rivers Council, and the Environmental Protection Information Center (PCFFA et al., filed a complaint alleging NOAA Fisheries's failure to timely designate critical habitat for the 19 ESUs. NOAA Fisheries filed with the D.C. District Court an agreement resolving that litigation and establishing a schedule for designation of critical habitat.

In keeping with the Consent Decree, in December 2004, NOAA Fisheries published proposed critical habitat designations for eight ESUs of salmon and five ESUs of O. mykiss (for the latter ESUs, NOAA Fisheries used the species' scientific name rather than "steelhead because that the time they were being proposed for revision to include both anadromous (steelhead) and resident (rainbow/redband) forms of the species as described in 69 FR 33101m June 14, 2004) in the Pacific Northwest (69 FR 74572, December 14, 2005) and two salmon and five O. mykiss ESUs in California (69 FR 71880, December 10, 2004).

The proposed rule subject to this analysis addresses the following seven ESUs under the jurisdiction of the agency's Southwest Region: (1) California Coastal chinook salmon; (2) Central Valley spring-run chinook salmon; (3) Central California Coast steelhead; (4) California Central Valley steelhead; (5) Northern California steelhead; (6) South-Central California Coast steelhead; and (7) Southern California steelhead. The comment period for the proposed critical habitat designations was originally open until February 14, 2005. On February 7, 2005 (70 FR 6394), NOAA Fisheries announced a court-approved Amendment to the Consent Decree which revised the schedule for completing the designations and extended the comment period until March 14, 2005, and the date to submit final rules to the Federal Register as August 15, 2005.

This report supports the final designation of critical habitat for the seven California ESUs.

ES.3 Framework for the Analysis

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 impact to be included in the analysis.

For the purposes of this report, a “particular are” is defined as a Hydrologic Sub-Area (HSA), as delineated by CalWater, the official California watershed map. These HSAs are referred to in this report as “watersheds.” Figure ES-1 shows all HSAs occupied by one or more of the seven ESUs. Table ES-1 lists the number of occupied watersheds for each ESU. Tables ES-2 and ES-3 provide other demographic and economic information at the ESU level. Importantly, these tables include all occupied watersheds considered for critical habitat designation, not just those that are part of the final designation.

Figure ES-1
SEVEN WEST COAST SALMON AND STEELHEAD ESUS WATERSHEDS IN NOAA'S SOUTHWEST REGION

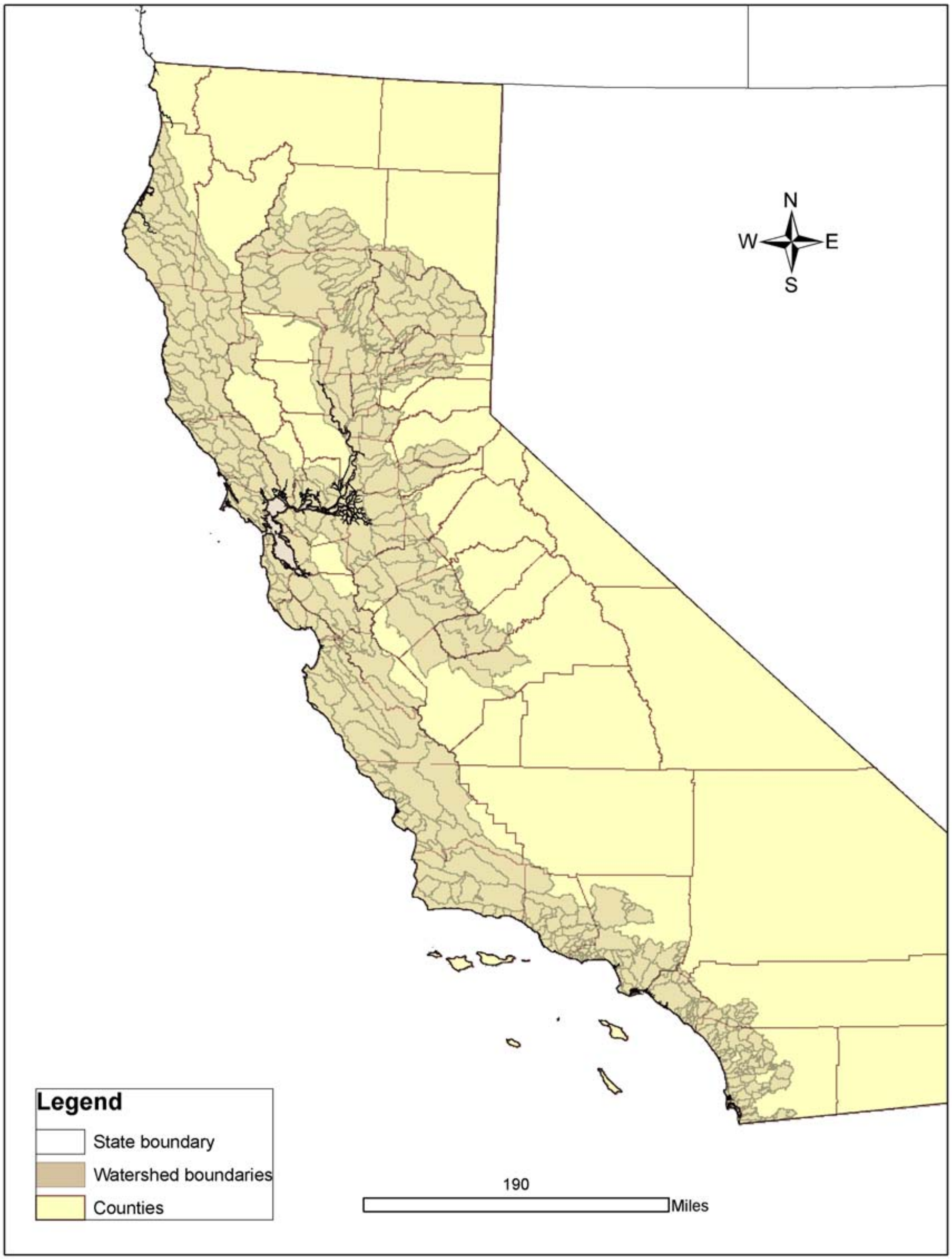

Table ES-1 **NUMBER OF OCCUPIED WATERSHEDS BY ESU**	
ESU	**Watersheds**
California Coastal chinook salmon	47
Central Valley spring-run chinook salmon	37
Central California Coast steelhead	46
California Central Valley steelhead	67
Northern California steelhead	52
South-Central California Coast steelhead	30
Southern California steelhead	32
Notes: The sum of the number of watersheds in each ESU may exceed the actual number of watershed proposed as some watersheds are proposed for designation for more than one ESU.	

Table ES-2
DEMOGRAPHICS FOR COUNTIES AND ESUs

ESU	Population		Area (sq. miles)		Population Density	
	Counties	ESU	Counties	ESU	County	ESU
California Coastal chinook salmon	968,303	428,262	19,461	7,444.00	49.8	82.3
Central Valley spring-run chinook salmon	6,257,268	1,758,267	31,338	8,151	199.7	179.7
Central California Coast steelhead	9,418,030	5,526,021	16,278	5,284	578.6	994.5
California Central Valley steelhead	7,818,201	3,041,659	49,432	13,821	158.2	191.8
Northern California steelhead	844,024	169,718	18,673	6,908	45.2	24.6
South-Central California Coast steelhead	4,096,822	701,525	19,265	5,896	212.7	201.0
Southern California steelhead	18,785,717	698,276	32,514	4,219	577.8	556.0

Table ES-3
INCOME AND EMPLOYMENT FOR COUNTIES AND ESUs

ESU	Personal Income ($1000)		Total Employment	
	Counties	ESU	Counties	ESU
California Coastal chinook salmon	30,164,000	13,066,000	550,174	248,342
Central Valley spring-run chinook salmon	200,507,000	50,630,000	3,405,202	961,582
Central California Coast steelhead	395,433,000	265,562,000	6,048,254	3,778,130
California Central Valley steelhead	238,194,000	80,952,000	4,179,904	1,547,107
Northern California steelhead	25,462,000	4,048,000	466,207	94,504
South-Central California Coast steelhead	153,749,000	23,298,000	2,523,835	406,360
Southern California steelhead	571,651,000	22,217,000	10,870,809	421,876

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 cost benefit framework. For reasons discussed here and in NMFS (2004d), 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 areas 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.

The economic analysis of the costs 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." 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.

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.

This approach is consistent with NOAA Fisheries' decision to conduct the 4(b)(2) process in part at the level of an individual watershed. It is less well-suited for examining the economic impacts at the regulatory level- that is, at the level of designating critical habitat in the aggregate for all seven ESUs. Although this analysis presents aggregated estimates of these impacts, they are a straightforward summation of the impacts estimated at the watershed level.[1]

In considering the first step of this framework, this analysis notes that the critical habitat areas under consideration for the seven ESUs of West Coast salmon and steelhead cover approximately 32 million acres in California. For the purposes of this analysis, each ESU is analyzed separately. This analysis also aggregates many of the results for the seven ESUs considered together. This involves more than just summing the results for each ESU because some watersheds are in more than one ESU. A simple sum would therefore double-count the results from such a watershed.

For the second step, the history of NOAA Fisheries consultations for the seven ESUs of West Coast salmon and steelhead under consideration was examined. The database for these seven ESUs indicates that from 2000 to 2003,[2] the SWR of NOAA Fisheries engaged in over 1,098 consultation and technical assistance efforts, involving roughly 30 different Federal agencies. This consultation history provides a rich source of information on the types of activities that are likely to be affected by critical habitat designation.

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[1] The summation does not take place at the ESU level but at the individual HSA level. This is because some HSA watersheds are in more than one ESU, so that a sum of the ESU-level impacts would double count those watersheds' impacts. If the estimated impact for a HSA watershed is different for two or more ESUs, this analysis applied the highest estimate for the summation.

[2] Approximately 97 percent of the consultations in the database occurred between 2000-2003. The database is incomplete for earlier years.

From this consultation record, the following set of activity types was developed to be subject to this economic analysis:

- 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]

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

The following summarizes the cost estimates for each type of activity:

<u>Hydropower Projects</u>

- Projects with installed capacity of less than 5MW: $2.1 million ($24,000 to $4.2 million).
- Projects with installed capacity ranging from 5 to 20 MW: $5.76 million ($0 to $11.5 million).
- Projects with installed capacity of greater than 20 MW that do not have but may require, fish passage facilities: $73.85 million ($11.5 million to $136 million).
- Projects with installed capacity of greater than 20 MW that have, or will not require, fish passage facilities: $45.23 million ($11.5 million to $79.1 million).
- Projects with installed capacities of greater than 20 MW where the status of fish passage is currently unknown: $56.4 million ($11.5 million to $101.3 million).
- Projects with unknown installed capacity: $7.53 million ($1.4 million to $13.6 million).

[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 effectively based on section 7 of the ESA, agricultural pesticide applications are included as an activity even though it is largely absent from the consultation record.

- Costs of dam removal: $24 million.
- Dams with known/planned modification costs: various.

Non-Hydropower Dams and Water Supply Structures

- Infrastructure costs: $2.1 million ($24 thousand to $4.2 million).
- Operation of water projects (e.g., flow regime, withdrawal constraints): Not quantified.

Federal Land Management Activities (excluding grazing)

- 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;
- Northern California: $8.95 ($4.91 to $12.98) per non-wilderness acre and $0.44 ($0.23 to $0.66) per wilderness acre;
- Southern California: $12.16 ($6.04 to $18.27) per non-wilderness acre and $0.70 ($0.38 to $1.02) per wilderness acre.

Livestock Grazing on Federal Land

- Livestock grazing: $29.00 per acre per year ($11.00 to $48.00).

Transportation projects

- Bridge and culvert projects: $41,000 to $105,000 per project (range depends on project mileage).
- Road projects: $36,000 - 97,000 per project (range depends on project mileage).

Utility Line Projects

- Outfall structure and pipelines: $101,000 ($100,000 to $102,000).

In-stream activities (excluding dredging)

- Boat dock, boat launch, bank stabilization: $54,500 ($25,000 to $84,000).

Dredging projects

- Dredging: $821,000 ($332,000 to $1,300,000).
- Dredging of San Francisco Bay: $651,000 (162,000 to $1,140,000).

EPA NPDES-permitted Activities

- Temperature Management Plan compliance activities for Major Projects: $630,000 (476,000 to $784,000).
- Temperature Management Plan compliance activities for Minor Projects: $72,000 ($0 to $144,000).

Sand and Gravel Mining

- Sand and gravel mining: $1.35 million.

Residential and Commercial Development

- Residential and commercial development: $235,000 ($230,000 to $240,000).

Agricultural Pesticide Applications

- Agricultural pesticide applications: dependent on crop type and County.

The fourth step used spatial data on the location of projects for each activity type and estimated the annual volume of an activity type in a particular area. Where an activity has different sub-types or scales, a separate level was estimated for each.

For each type of activity, Appendix B discusses the important assumptions that have the potential to introduce error to the results, and the likely direction(s) of the error(s). Table ES-4 below lists some of these assumptions.

Table ES-4
MAJOR ASSUMPTIONS AND POTENTIAL ERRORS

Assumption	Direction of Potential Error
For most types of activities, project modifications recommended in biological opinions are included as an impact of section 7 implementation, even if they appear to overlap particular baseline elements, such as fish passage provisions. As a result, the impact of section 7 implementation over and above the baseline elements may be overstated.	+
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.	+/-
For Federal lands management activities, this analysis assumes 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.	+

Table ES-4 MAJOR ASSUMPTIONS AND POTENTIAL ERRORS	
Assumption	**Direction of Potential Error**
This analysis assumes that Federal land management agencies carry out land management activities consistently within geographical areas (e.g Cleveland and Sierra National Forests are assumed to conduct the same mix of activities because they fall within the Southern California region). 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.	+/-
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.	-
This analysis assumes 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.	-
This analysis assumes 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.	+
This analysis assumes that the court-ordered injunction restricting pesticide use represents the likely outcome of section 7 consultations for this activity. Future consultation may find more flexible ways to avoid jeopardy or adverse modification.	+
This analysis assumes that there are no adjustments in cropping or pesticide practices possible nor are there alternative beneficial uses of land.	+
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

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

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

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.

ES.5 Economic Impacts of Critical Habitat Designation

Below, a series of tables is presented that summarizes the results of the analysis for the seven West Coast salmon and steelhead ESUs. Table ES-5 gives the annual total impact for each ESU. In this table and in Tables ES-7 and ES-8, the results are presented for six different cases, using three cost estimate levels (Low, Midpoint, High) and two discount rates (7% and 3%). Table ES-6 gives the annual total impact for each type of activity and for each ESU. Tables ES-7 and ES-8 list the average, median, maximum, and minimum annual total impact for the individual watersheds in each ESU.

In assessing the aggregate cost of the seven critical habitat designations, the figures given below for the individual ESUs cannot be added together to obtain an aggregate annual impact for all ESUs. Some watersheds are included in more than one ESU and so a simple summation would duplicate the impacts for these watersheds. These tables are based on the full set of occupied watersheds considered for critical habitat designation. Also, the 4(b)(2) exclusion process used one of these cases - mid-range cost estimate at a seven percent discount rate - to weigh the benefits and costs of the designation.

Lastly, this analysis emphasizes 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."[4] The estimates of impacts should then be interpreted as the sum of two types of impacts:

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[4] New Mexico Cattle Growers' Association v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th 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.

Table ES-5 ANNUALIZED IMPACT OF SECTION 7 IMPLEMENTATION		
Discount Rate	**Cost Estimate**	**Annual Total Impact**
California Coastal chinook salmon ESU		
7%	High	$16,691,000
	Midpoint	$10,993,000
	Low	$5,288,000
3%	High	$16,628,000
	Midpoint	$10,944,000
	Low	$5,252,000
Central Valley spring-run chinook salmon ESU		
7%	High	$47,221,000
	Midpoint	$29,233,000
	Low	$11,216,000
3%	High	$42,887,000
	Midpoint	$26,799,000
	Low	$10,700,000
Central California Coast steelhead ESU		
7%	High	$30,377,000
	Midpoint	$18,577,000
	Low	$6,828,000
3%	High	$30,193,000
	Midpoint	$18,433,000
	Low	$6,684,000
California Central Valley steelhead ESU		
7%	High	$61,985,000
	Midpoint	$38,235,000
	Low	$14,471,000
3%	High	$57,557,000
	Midpoint	$35,743,000
	Low	$13,915,000
Northern California steelhead ESU		
7%	High	$12,861,000
	Midpoint	$8,773,000
	Low	$4,677,000
3%	High	$12,807,000
	Midpoint	$8,773,000
	Low	$4,649,000

Table ES-5 ANNUALIZED IMPACT OF SECTION 7 IMPLEMENTATION		
Discount Rate	**Cost Estimate**	**Annual Total Impact**
South-Central California Coast steelhead ESU		
7%	High	$27,268,000
	Midpoint	$16,857,000
	Low	$6,087,000
3%	High	$27,581,000
	Midpoint	$16,817,000
	Low	$6,054,000
Southern California steelhead ESU		
7%	High	$29,635,000
	Midpoint	$19,423,000
	Low	$9,204,000
3%	High	$29,606,000
	Midpoint	$19,395,000
	Low	$9,175,000
Aggregate Impacts for all ESUs*		
7%	High	$160,236,000
	Midpoint	$100,531,000
	Low	$40,813,000
3%	High	$155,550,000
	Midpoint	$97,800,000
	Low	$40,038,000
* The impact estimate for "all ESUs" includes costs for all the watersheds that were considered for designation and not just the watersheds known to be occupied by one or more of the ESUs		

Table ES-6 ANNUAL TOTAL IMPACT BY TYPE OF ACTIVITY		
Type of Activity	**Annual Total Impact**	**% of total**
California Coastal chinook salmon ESU		
Hydropower Dams	$320,000	2.9%
Non-hydropower Dams	$1,071,000	9.7%
Federal Lands Management (non-wilderness)	$6,721,000	61.1%
Federal Lands Management (wilderness)	$47,000	0.4%
Grazing	$1,200	0.01%
Transportation Projects	$147,000	1.3%
Utility Line Projects	$0	0.0%
Instream Activities	$277,000	2.5%
Dredging	$117,000	1.1%
EPA NPDES-permitted Activities	$213,000	1.9%
Sand & Gravel Mining	$293,000	2.7%
Residential & Commercial Development	$337,000	3.1%
Agricultural Pesticide Applications	$1,450,000	13.2%
Central Valley spring-run chinook salmon ESU		
Hydropower Dams	$9,115,000	31.2%
Non-hydropower Dams	$1,506,000	5.2%
Federal Lands Management (non-wilderness)	$4,888,000	16.7%
Federal Lands Management (non-wilderness)	$37,000	0.1%
Grazing	$76,000	0.3%
Transportation Projects	$580,000	2.0%
Utility Line Projects	$76,000	0.3%
Instream Activities	$2,439,000	8.4%
Dredging	$3,624,000	12.4%
EPA NPDES-permitted Activities	$463,000	1.6%
Sand & Gravel Mining	$361,000	1.2%
Residential & Commercial Development	$2,093,000	7.2%
Agricultural Pesticide Applications	$3,957,000	13.6%
Central California Coast steelhead ESU		
Hydropower Dams	$11,000	0.1%
Non-hydropower Dams	$4,294,000	23.4%
Federal Lands Management (non-wilderness)	$288,000	1.6%
Federal Lands Management (wilderness)	$0	0.0%
Grazing	$1,700	0.01%
Transportation Projects	$484,000	2.6%
Utility Line Projects	$0	0.0%
Instream Activities	$559,000	3.0%
Dredging	$1,526,000	8.3%
EPA NPDES-permitted Activities	$824,000	4.5%
Sand & Gravel Mining	$135,000	0.7%

Table ES-6 ANNUAL TOTAL IMPACT BY TYPE OF ACTIVITY		
Type of Activity	**Annual Total Impact**	**% of total**
Residential & Commercial Development	$1,669,000	9.1%
Agricultural Pesticide Applications	$8,595,000	46.8%
California Central Valley steelhead ESU		
Hydropower Dams	$9,830,000	25.7%
Non-hydropower Dams	$3,043,000	8.0%
Federal Lands Management (non-wilderness)	$5,223,000	13.7%
Federal Lands Management (wilderness)	$37,000	0.1%
Grazing	$87,000	0.2%
Transportation Projects	$957,000	2.5%
Utility Line Projects	$114,000	0.3%
Instream Activities	$2,609,000	6.8%
Dredging	$3,624,000	9.5%
EPA NPDES-permitted Activities	$676,000	1.8%
Sand & Gravel Mining	$518,000	1.4%
Residential & Commercial Development	$3,204,000	8.4%
Agricultural Pesticide Applications	$8,314,000	21.8%
Northern California steelhead ESU		
Hydropower Dams	$331,000	3.8%
Non-hydropower Dams	$233,000	2.7%
Federal Lands Management (non-wilderness)	$7,271,000	82.9%
Federal Lands Management (wilderness)	$48,000	0.5%
Grazing	$130	0.0%
Transportation Projects	$25,000	0.3%
Utility Line Projects	$0	0.0%
Instream Activities	$246,000	2.8%
Dredging	$0	0.0%
EPA NPDES-permitted Activities	$154,000	1.8%
Sand & Gravel Mining	$248,000	2.8%
Residential & Commercial Development	$55,000	0.6%
Agricultural Pesticide Applications	$161,000	1.8%
South-Central California Coast steelhead ESU		
Hydropower Dams	$182,000	1.1%
Non-hydropower Dams	$2,227,000	13.4%
Federal Lands Management (non-wilderness)	$2,006,000	12.1%
Federal Lands Management (wilderness)	$128,000	0.8%
Grazing	$41,000	0.3%
Transportation Projects	$164,000	1.0%
Utility Line Projects	$303,000	1.8%
Instream Activities	$514,000	3.1%
Dredging	$163,000	1.0%

Table ES-6 ANNUAL TOTAL IMPACT BY TYPE OF ACTIVITY		
Type of Activity	**Annual Total Impact**	**% of total**
EPA NPDES-permitted Activities	$180,000	1.1%
Sand & Gravel Mining	$113,000	0.7%
Residential & Commercial Development	$452,000	2.7%
Agricultural Pesticide Applications	$10,153,000	61.1%
Southern California steelhead ESU		
Hydropower Dams	$0	0.0%
Non-hydropower Dams	$997,000	5.1%
Federal Lands Management (non-wilderness)	$10,029,000	51.6%
Federal Lands Management (wilderness)	$357,000	1.8%
Grazing	$98,000	0.5%
Transportation Projects	$145,000	0.8%
Utility Line Projects	$707,000	3.6%
Instream Activities	$491,000	2.5%
Dredging	$3,284,000	16.9%
EPA NPDES-permitted Activities	$154,000	0.8%
Sand & Gravel Mining	$45,000	0.2%
Residential & Commercial Development	$549,000	2.8%
Agricultural Pesticide Applications	$2,569,000	13.2%
Aggregate Impacts for all ESUs		
Hydropower Dams	$10,353,000	10.3%
Non-hydropower Dams	$11,217,000	11.2%
Federal Lands Management (non-wilderness)	$24,817,000	24.7%
Federal Lands Management (wilderness)	$569,000	0.6%
Grazing	$228,000	0.2%
Transportation Projects	$1,775,000	1.8%
Utility Line Projects	$1,124,000	1.1%
Instream Activities	$3,922,000	3.9%
Dredging	$7,538,000	7.5%
EPA NPDES-permitted Activities	$1,907,000	1.9%
Sand & Gravel Mining	$1,059,000	1.1%
Residential & Commercial Development	$5,929,000	5.9%
Agricultural Pesticide Applications	$30,093,000	29.9%

Table ES-7
ANNUAL TOTAL IMPACTS FOR INDIVIDUAL WATERSHEDS

Discount Rate	Cost Estimate	Annual Total Impact			
		Average	Median	Maximum	Minimum
California Coastal chinook salmon ESU					
7%	High	$355,000	$126,000	$1,721,000	$0
	Midpoint	$234,000	$83,000	$1,142,000	$0
	Low	$113,000	$40,000	$561,000	$0
3%	High	$354,000	$126,000	$1,705,000	$0
	Midpoint	$233,000	$83,000	$1,134,000	$0
	Low	$112,000	$40,000	$560,000	$0
Central Valley spring-run chinook salmon ESU					
7%	High	$1,276,000	$761,000	$9,988,000	$11,500
	Midpoint	$790,000	$449,000	$5,570,000	$8,300
	Low	$303,000	$199,000	$1,728,000	$4,000
3%	High	$1,159,000	$730,000	$7,158,000	$11,500
	Midpoint	$724,000	$449,000	$4,002,000	$8,300
	Low	$289,000	$198,000	$1,720,000	$4,000
Central California Coast steelhead ESU					
7%	High	$660,000	$283,000	$8,600,000	$0
	Midpoint	$404,000	$198,000	$5,211,000	$0
	Low	$148,000	$87,000	$1,822,000	$0
3%	High	$656,000	$279,000	$8,594,000	$0
	Midpoint	$401,000	$195,000	$5,205,000	$0
	Low	$145,000	$81,000	$1,817,000	$0
California Central Valley steelhead ESU					
7%	High	$925,000	$464,000	$9,994,000	$0
	Midpoint	$571,000	$257,000	$5,574,000	$0
	Low	$216,000	$112,000	$1,793,000	$0
3%	High	$859,000	$464,000	$7,437,000	$0
	Midpoint	$553,000	$257,000	$4,611,000	$0
	Low	$208,000	$112,000	$1,784,000	$0
Northern California steelhead ESU					
7%	High	$247,000	$28,000	$1,721,000	$0
	Midpoint	$169,000	$20,000	$1,142,000	$0
	Low	$90,000	$9,600	$560,000	$0
3%	High	$246,000	$29,000	$1,706,000	$0
	Midpoint	$168,000	$20,000	$1,134,000	$0
	Low	$89,000	$9,600	$560,000	$0

Table ES-7 ANNUAL TOTAL IMPACTS FOR INDIVIDUAL WATERSHEDS					
Discount Rate	**Cost Estimate**	**Annual Total Impact**			
		Average	**Median**	**Maximum**	**Minimum**
South-Central California Coast steelhead ESU					
7%	High	$921,000	$394,000	$5,091,000	$490
	Midpoint	$562,000	$257,000	$2,881,000	$384
	Low	$203,000	$127,000	$804,000	$279
3%	High	$919,000	$392,000	$5,088,000	$490
	Midpoint	$561,000	$255,000	$2,878,000	$384
	Low	$202,000	$125,000	$803,000	$279
Southern California steelhead ESU					
7%	High	$926,000	$424,000	$7,155,000	$0
	Midpoint	$607,000	$276,000	$4,735,000	$0
	Low	$288,000	$128,000	$2,311,000	$0
3%	High	$925,000	$423,000	$7,155,000	$0
	Midpoint	$606,000	$274,000	$4,735,000	$0
	Low	$287,000	$127,000	$2,311,000	$0
Aggregate Impacts for all ESUs					
7%	High	$719,000	$828,000	$9,994,000	$0
	Midpoint	$451,000	$188,000	$5,574,000	$0
	Low	$183,000	$78,000	$2,311,000	$0
3%	High	$698,000	$278,000	$8,594,000	$0
	Midpoint	$439,000	$185,000	$5,205,000	$0
	Low	$180,000	$75,000	$2,311,000	$0

Section 1
Introduction and Background

1.1 Introduction

The National Marine Fisheries Service (NOAA Fisheries) is designating critical habitat for five species of West Coast salmon and steelhead (Onchorynchus spp.) listed under the Endangered Species Act (ESA). The designations will address 19 Evolutionarily Significant Units (ESUs) of these species in the States of Washington, Oregon, Idaho, and California. Section 4(b)(2) of the ESA requires NOAA Fisheries to consider the economic 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.[5] The report covers; seven ESUs in California; 13 ESUs in Washington, Oregon, and Idaho are covered in a separate report. This section provides background information on the proposed designations and discusses the biology and habitat use of West Coast 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 ESA listing, a group of organisms must constitute a "species." Section 3 of ESA defines 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 West Coast 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 of 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,

[5] This structure of this report is based on the economic analysis of the proposed designation of the 13 ESUs in the Northwest Region. Primary data for this report were gathered by Industrial Economics, Inc., which also prepared supplementary material for Sections 3, 4, 5 and Appendices D and E of this report.

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, "based on the best scientific and commercial data available," an area 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.

On February 16, 2000, NOAA Fisheries published final critical habitat designations for 19 ESUs, thereby completing designations for all 25 ESUs listed at the time (65 FR 7764). The 19 designations included more than one hundred and fifty river subbasins in Washington, Oregon, Idaho, and California. Within each occupied subbasin, NOAA Fisheries designated as critical habitat those lakes and river reaches accessible to listed fish along with the associated riparian zone, except for reaches on Indian land. Areas considered inaccessible included areas above long-standing natural impassable barriers and areas above impassable dams, but not areas above ephemeral barriers such as failed culverts.

In considering the economic impact, NOAA Fisheries determined that the critical habitat designations would impose very little or no additional requirements on Federal agencies beyond those already imposed by the listing of the species themselves. The ESA's prohibition against adversely modifying critical habitat applies only to Federal agencies, which are also prohibited from jeopardizing the continued existence of listed species. NOAA Fisheries reasoned that because it was designating only occupied habitat, there would be few or no actions that adversely modified critical habitat that also did not jeopardize the continued existence of the species. Therefore, there would be no economic impact as a result of the designations (65 FR 7764, 7765, February 16, 2000).

The National Association of Homebuilders (NAHB) challenged the designations in District Court in Washington, D.C. as having inadequately considered the economic impacts of the critical habitat designations (National Ass'n of Homebuilders v. Evans, 2002 WL 1205743 No. 00-CV-2799 (D.D.C.). NAHB also challenged NOAA Fisheries' designation of Essential Fish Habitat (EFH) (Pacific Coast Salmon Fishery Management Plan, 2000). While the NAHB litigation was pending, the Court of Appeals for the 10th Circuit issued its decision in New Mexico Cattle Growers' Association v. U.S. Fish and Wildlife Service, 248 F.3d 1277 (10th Cir. 2001) (NMCA). In that case, the Court rejected the FWS approach to economic analysis, which was similar to the approach taken by NOAA Fisheries in the final rule designating critical habitat for 19 ESUs of West Coast salmon and steelhead. The Court ruled that "Congress intended that the FWS conduct a full analysis of all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes." Subsequent to the 10th Circuit decision, NOAA Fisheries entered into and sought judicial approval of a consent decree resolving the NAHB litigation. That decree provided for the withdrawal of critical habitat designations for the 19 salmon and steelhead ESUs and dismissed NAHB's challenge to the EFH designations. The District Court approved the consent decree and vacated the critical habitat designations by Court order on April 30, 2002 (National Ass'n of Homebuilders v. Evans, 2002 WL 1205743 (D.D.C. 2002).

On September 3, 2003, the Pacific Coast Federation of Fishermen's Associations (PCFFA), Institute for Fisheries Resources, the Center for Biological Diversity, the Oregon Natural Resources Council, the Pacific Rivers Council, and the Environmental Protection Information Center (PCFFA et al., filed a complaint alleging NOAA Fisheries's failure to timely designate critical habitat for the 19 ESUs. NOAA Fisheries filed with the D.C. District Court an agreement resolving that litigation and establishing a schedule for designation of critical habitat.

This reports supports the final designation of critical habitat for seven ESUs under the jurisdiction of the NOAA Fisheries' Southwest Region: (1) California Coastal chinook salmon; (2) Central Valley spring-run chinook salmon; (3) Central California Coast steelhead; (4) California Central Valley steelhead; (5) Northern California steelhead; (6) South-Central California Coast steelhead; and (7) Southern California steelhead. In separate rulemaking NOAA Fisheries' Northwest Region addresses critical habitat for the remaining ESUs subject to the PCFFA et al. complaint.

1.3 West Coast Salmon and Steelhead Biology and Habitat Use

West Coast 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.[6] 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.

[6] Groot, C. and L. Margolis, Pacific Salmon Life Histories, Univ. B.C. Press, Vancouver, B.C., 1991, p. 564.

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.[7] 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.[8] 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

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" with a Federal agency, must modify actions that have the potential to harm listed salmon and steelhead.[9] These modifications may have economic costs and other negative impacts, ranging in magnitude from modest to hundreds of millions of dollars. To the extent that the modifications

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[7] Spence, B.C. et al., An Ecolsystem Approach to Salmonid Conservation, TR-4501-96-6057, ManTech Environmental Research Services Corp., Corvallis, Oregon, 1996.

[8] McElhany, P., et al., Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units, U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-42, 2000, p. 156.

[9] The term "Federal nexus" or "nexus" refers to activities or projects that the Federal government carries out, funds, or permits.

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 in this report, 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. Some of these other impacts are also covered in the separate report, including impacts on tribes (SWR 4(b)(2) report).

Section 2 of this report outlines the framework for the economic analysis. That section explains how economic analysis fits into that process and outlines 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 designations, as well as information on other laws and regulations that afford West Coast salmon and steelhead 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. That section of the report also describes the methods used to project the occurrence of these activities over space and time. Finally, Section 5 presents a summary of the results of the analysis for each 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, this report presents results of the analysis in two ways. First, the 4(b)(2) process is conducted at the level of a "particular area," which is defined as a Hydrologic Sub-Area (HSA), as defined by CalWater, the official California watershed map. The economic analysis estimates the annualized potential impacts 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, the aggregated results are presented at the ESU-level and for all ESUs combined. 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 analysis supports these determinations by aggregating all the watershed-level impacts for each ESU to gauge the impacts at the ESU level. Similarly, all watersheds are aggregated regardless of the ESUs to gauge the impacts for the entire extent of the seven critical habitat designations. This latter aggregation is not the same as summing the ESU-level impacts because a watershed may be in more than one ESU, and so a simple summation would double-count such a watershed. Instead, the annualized potential impacts are summed across all watersheds with regard to the ESU to which a watershed belongs. If a watershed belongs to more than one ESU, the estimated impact may vary, in which case the highest estimated impact is used for the aggregation.

Section 2
Framework for the Economic Analysis

2.1 Introduction

The process of designating critical habitat under the ESA includes analyzing 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. The statute does not specify the exact geographic scale of these subareas, nor does it dictate the form of the economic analysis and the type of impacts to be included in the analysis.

This section presents the framework NOAA Fisheries is using to analyze the economic impacts of critical habitat designation. It begins by discussing this framework in broad terms. Economic analyses of regulatory actions commonly use a standard benefit-cost framework. NOAA Fisheries has chosen a framework more akin to a cost-effectiveness one; this section presents a discussion of this issue from an economic standpoint. It then outlines the 4(b)(2) process, which utilizes biological, economic, and other information. Finally, this section discusses 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.[10] Each also has well known drawbacks, both theoretical and practical, as discussed below 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.[11] BCA is a well-established procedure for assessing the "best" course or scale of action, where "best" is that course which maximizes net benefits.[12] Because BCA assesses the value of an activity in that way, however, it requires a single metric – most commonly dollars – be used to gauge both benefits and costs.

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[10] U.S. Office of Management and Budget. Circular A-4, Regulatory Analysis, September 17, 2003 (hereafter, OMB 2003).

[11] OMB 2003.

[12] Zerbe, R. and D. Dively, Benefit Cost Analysis in Theory and Practice, 1994.

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 itself, 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 volume of the modifications.[13]

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 ESA section 7 regulations increase the protections afforded West Coast salmon and steelhead habitat, they produce real benefits to those species. 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.[14] Again, in principle, the quantified biological benefits could be evaluated in terms of willingness-to-pay, the standard economic measure of value for BCA, and the measure recommended by OMB.[15] 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. 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.

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[13] 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. Stigma effects are discussed in the context of residential and commercial development in Section 4.3.9 of this report.

[14] See, for example, D. Olsen, J. Richards, and R. D. Scott, Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs, Rivers 2(1): 44-56 (1991); J. B. Loomis, Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey, Water Resources Research 32(2): 441-447 (1996); and D. Layton, G. Brown and M. Plummer, Valuing Multiple Programs to Improve Fish Populations, Report to the Washington State Department of Ecology (1999).

[15] Zerbe, R., and D. Dively, 1994; OMB 2003.

2.2.2 Cost-effectiveness Analysis

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

> 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).[16]

Ideally, CEA quantifies both the benefits and costs of a regulatory action but with different metrics. 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 health-related quantitative measure.[17]

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 to cost in dollars) 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 to dollars.

Standard CEA presumes that benefits can be measured with a cardinal or even continuous measure.[18] For critical habitat designation, however, constructing such a measure for the biological benefits is problematic. Although protecting habitat for West Coast salmon and steelhead has unquestionable benefits, it would be difficult to quantify the benefits reliably with a single biological metric given the state of the science.[19] There are models for estimating numbers of salmon that might be produced from a watershed under different sets of environmental conditions.[20] While such models give quantified results, the accuracy of the quantified projections is unknown as data both on the

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[16] OMB 2003.

[17] For a full discussion of CEA in this context, see M. L. Gold, J. E. Siegel, L. B. Russell, and M. C. Weinstein, Cost Effectiveness in Health and Medicine: The Report of the Panel on Cost-Effectiveness in Health and Medicine, Oxford University Press, New York, 1996.

[18] A cardinal measure has the important attribute of being susceptible to arithmetic. 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."

[19] Ecosystem Recovery Planning for Listed Salmon: An Integrated Assessment Approach for Salmon Habitat, Edited by Timothy J. Beechie, *et al.*, Northwest Fisheries Science Center, 2003.

[20] For example, see Mobrand Biometrics, Inc., The EDT Method, 1999.

relationships between environmental conditions and numbers of fish and the actual conditions of habitat in a given area are not available. This leads to 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 such models at the scale required for West Coast salmon would be time-consuming and costly. Thus, applying CEA in its standard form is not possible.

An alternative form of CEA is one that develops an ordinal measure of the biological benefits of critical habitat designation. 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 then be combined with estimates of the economic costs of critical habitat designation in a framework that essentially adopts that of cost-effectiveness. Individual habitat areas can be assessed using both their biological evaluation and economic cost, so that 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 form of CEA 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 CEA 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 modified form of CEA is the inability to discern variation in benefits among those areas that have the same conservation value rank. A likely outcome is that using the modified CEA will lead to an outcome with higher expected costs of achieving any given level of conservation than one produced with standard CEA or BCA. This limitation should be compared to the greater feasibility of the modified CEA, however.

As is seen in the next part of this section, NOAA Fisheries has chosen a framework for its 4(b)(2) process that is similar to what is described as the modified form of CEA. This has implications for the economic analysis of critical habitat designation, which will be outlined following a discussion of the 4(b)(2) process.

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

Specific areas that fall within 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.

> 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 will take to implement section 4(b)(2) involves these steps:

- Step 1: Identify specific areas meeting the definition of critical habitat

- Step 2: Conduct a section 4(b)(2) analysis:
  - Step 2.1: Determine the benefit of designation;
  - Step 2.2: Determine the impact of designation;
  - Step 2.3: Determine whether benefits of exclusion outweigh benefits of designation
  - Step 2.4: Determine whether the exclusions will result in extinction of the species.

NOAA Fisheries' SWR 4(b)(2) report 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."[21] 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

[21] This methodology is fundamental to economic analysis and not peculiar to the analysis of critical habitat designations or other forms of regulations. See U.S. Environmental Protection Agency, Guidelines for Preparing Economic Analyses, EPA-240-R-00-003, September 2000.

habitat designation are being overlooked or ignored. Expressing these benefits in terms comparable to the costs of designation was not possible as the full set of data necessary was not available.[22] In principle, the economic analysis would still cover both the economic benefits of inclusion as well as the economic benefits of exclusion. The designation of critical habitat may have ancillary benefits unrelated to West Coast salmon and steelhead. 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 habitat designation, which are sometimes referred 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;

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 for each ESU.

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 areas. For West Coast salmon and steelhead, NOAA Fisheries used standard watershed units, which this analysis defines as a Hydrologic Sub-Area (HSA), as defined by CalWater, the official California watershed map (this report refers to these HSAs as "watersheds") for the purpose of delineating a "particular area." Occupied estuarine and marine areas were also considered by the agency. Estuarine areas are crucial for juvenile salmonids given their multiple

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[22] 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 from the designation. Numerous estimates exist of the monetary value of improved salmon populations (see, for example, Alkire 1994; Bell *et al.* 2003; Davis and Radke 1995; ECONorthwest 1999; Layton *et al.* 1999; Loomis 1996; Olsen *et al.* 1991; Radtke *et al.* 1999; Radke 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 noted in Layton (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.

functions as areas for rearing/feeding, freshwater-saltwater acclimation, and migration.[23] Nearshore areas also provide important habitat for rearing/feeding and migrating salmonids.

The remainder of this section discusses each step in detail. The subsequent sections of the report give the details of how the analysis was implemented.

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, however, and so information is presented on the region's current socioeconomic state.

The second part 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. The NMCA decision, however, called this approach into question.[24] In that case, the Tenth Circuit Court of Appeals called for "a full analysis of all of the economic impacts of a critical habitat designation, regardless of whether those impacts are attributable co-extensively to other causes." Consistent with this decision, NOAA Fisheries will include the following in its analyses of the impacts of critical habitat designation:

- 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. Importantly, not all elements of the ESA are considered as co-extensive with critical habitat designation. In particular, section 9 of the ESA, which applied 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.

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[23] Simenstad, C.A., K.L. Fresh, and E.O. Salo, The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. In: V. Kennedy, editor. Estuarine comparisons. Academic Press, New York pp. 343-364, 1982; Marriott, D., and 27 contributors, Lower Columbia River and Columbia River Estuary Subbasin Summary, Report Prepared for the Northwest Power Planning Council, dated May 17, 2002.

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

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

- Overlapping and pre-existing CH designations;

- ESA protections for the seven West Coast salmon and steelhead ESUs 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 a clear separation can not be made, the impacts of habitat protection are attributed to the designation of critical habitat and the implementation of section 7.

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. A review of NOAA Fisheries past consultations under section 7 was undertaken 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 always presented.[25]

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, this analysis assumes sufficient expenditures are made to make the necessary modifications. Similarly, if the activity is one that is permitted or funded by a Federal agency, this analysis assumes 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 West Coast salmon and steelhead 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

[25] Stigma effects are discussed in the context of residential and commercial development in Section 4.3.9 of this report.

Budget.[26] In accordance with the latest guidelines, costs are evaluated using both seven percent and a three percent discount rate. The 4(b)(2) exclusion process uses the estimates based on a seven percent 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:

> 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.[27]

The FWS made similar assumptions in the economic analyses for two other critical habitat designations.[28]

In the case at hand, however, examination of the consultation record for West Coast salmon and steelhead provides no guidance to distinguish incremental from co-extensive impacts. Consultations that produce an outcome declaring adverse modification are exceptionally rare for these species. To see this, consider the consultation record, shown in Table 2-1, for three species of Snake River salmon (fall chinook, summer/spring chinook, and sockeye), which were listed and had critical habitat designated in the early 1990s.

The absence in the consultation record of purely adverse modification judgments does not mean that critical habitat designation has no impact. Clearly, a decision to make a final determination of either adverse modification or jeopardy is very rare. This is expected if the Federal agency undertaking the action anticipates what modifications may be needed and implements them prior to consultation. But the absence of such clear cases means that deducing the incremental impacts of critical habitat

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[26] OMB 2003.

[27] M.L. Schamberger, J. J. Charbonneau, M. J. Hay, and R. L. Johnson, Economic Analysis of Critical Habitat Designation Effects for the Northern Spotted Owl, 1992, pg 34.

[28] D.S. Brookshire, M. McKee, and G. Watts, Draft Economic Analysis of Proposed Critical Habitat Designation in the Colorado River Basin for the Razorback Sucker, Humpback Chub, Colorado Squawfish, and Bonytail, 1993; and D.S. Brookshire, M. McKee, and C. Schmidt, Economic Analysis of Critical Habitat Designation in the Virgin River Basin for the Woundfin and Virgin River Chub, 1995.

designation is difficult and is unlikely to produce the simple approach taken in previous analyses where a specific proportion is used.

Nevertheless, the consultation record for all West Coast salmon and steelhead does support, at least qualitatively, the conclusion 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 consistent with an assumption that the incremental impacts are roughly proportional to the total (adverse modification plus 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 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.[29]

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. This analysis also considers the likelihood of a project triggering a consultation and requiring modifications. In some cases, relevant information was available on the likelihood for a specific project, while in most other cases the analysis employs 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.[30] This is in keeping with the guidance of the Office of Management and Budget and in accord with E.O. 12866.[31]

Data to support such an analysis are not available, however, and the geographic scope of the designations make this approach impractical. A simpler approach provides an acceptable alternative under a robust set of circumstances. In cases where the scale of activity 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

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[29] Simply put, if P×X > P×Y, then X > Y. Information on the relative sizes of total impacts (that is, 10 × X and 10 × Y) thus provides useful information about the relative sizes of the incremental impacts (X and Y), even without information on the factor of proportionality (that is, P).

[30] EPA 2000; and OMB 2003.

[31] OMB 2003.

type of project or action. With few exceptions, the projects and actions covered in this analysis appear to meet this standard.

The 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 impacts under most circumstances.

This framework assumes that the per-project costs are not affected by the amount of critical habitat designated for an ESU (or across ESUs). 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 and market-level effects are significant. This may 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 used in this report is a straightforward one, summing project-level impacts to estimate the total impact of designating a watershed as critical habitat. Limitations in this framework are noted, and more are considered for each activity in Section 4. 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-effective 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. The seven ESUs in California intersect 46 counties. These ESUs are protected by a complex web of other Federal, State, and local laws and regulations. This section begins with a brief overview of the geographic scope of the designations, and then discuss first the economic baseline and then the legal and regulatory baseline.

3.2 Geographic Scope of the Critical Habitat Designations

The critical habitat areas under consideration for the seven ESUs of West Coast salmon and steelhead in California cover over 23 million acres. HSAs (watersheds) and nearshore areas constitute the "particular areas" or the geographic units of analysis for this report. Table 3-1 below lists the number of watersheds by State for each ESU, while Table 3-2 lists the average and range of the watersheds' size for each ESU. Appendix A lists the watersheds in each ESU and gives the watershed and subbasin names. It is noted here and considered in more detail later that a watershed may be considered for designation in more than one ESU.

The geographic scope of the critical habitat designations and the number of watersheds are quite large. For this reason, this analysis discusses issues such as the baselines (see below) and the methods used in the analysis (see Section 4 of this analysis) in the body of the report, but the bulk of the results of the economic analysis is presented in Appendix B.

3.3 Economic Baseline

In presenting baseline information on the economic characteristics of the watersheds in the seven ESUs, this analysis faces 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, as Figures 2 through 8 illustrate. 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. For example, three counties in California have less than five square miles in critical habitat areas being considered for one or more ESUs. Describing a baseline in terms of the socioeconomic characteristics of these counties would not be representative of the true baseline.

Table 3-1
NUMBER OF OCCUPIED WATERSHEDS BY ESU

ESU	Watersheds
California Coastal chinook salmon	47
Central Valley spring-run chinook salmon	37
Central California Coast steelhead	46
California Central Valley steelhead	67
Northern California steelhead	52
South-Central California Coast steelhead	30
Southern California steelhead	32

Notes: The sum of the number of watersheds in each ESU may exceed the actual number of watershed proposed as some watersheds are proposed for designation for more than one ESU.

One way to present a more accurate economic picture of the ESUs and their constituent watersheds is to apportion a County's economic activity between the area within the County being considered for critical habitat designation and the area 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. Estimating the population within 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 produces a more accurate picture of the potential impacts on that County.

Table 3-2 SIZE OF OCCUPIED WATERSHEDS BY ESU			
	Size of watershed (square miles)		
ESU	Average	Maximum	Minimum
California Coastal chinook salmon	158	413	3
Central Valley spring-run chinook salmon	220	1,074	15
Central California Coast steelhead	115	422	15
California Central Valley steelhead	206	1,074	6
Northern California steelhead	133	413	3
South-Central California Coast steelhead	197	1,495	3
Southern California steelhead	132	1,145	1.0

Using spatial data on County and watershed boundaries and on U.S. Census block data from the 2000 census, the population of each watershed is estimated, and for each County-watershed intersection. From these, the proportion of each counties population that lives in an area being considered for critical habitat designation is determined. By applying the assumption of uniform per-capita economic activity throughout a County, estimates of economic activity in that portion of a County potentially impacted by critical habitat are derived.

Demographic and economic information is presented in both forms: for the County as a whole and for the portion of the County's population estimated to be in watersheds covered by the ESU. Tables 3-3 and 3-4 summarize this information on an ESU-basis. In each case, this analysis presents a figure that sums over all the counties covered by an 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 3-3
DEMOGRAPHICS FOR COUNTIES AND ESUS

ESU	Population		Area (sq. miles)		Population Density	
	Counties	ESU	Counties	ESU	County	ESU
California Coastal chinook salmon	968,303	428,262	19,461	7,444.00	49.8	82.3
Central Valley spring-run chinook salmon	6,257,268	1,758,267	31,338	8,151	199.7	179.7
Central California Coast steelhead	9,418,030	5,526,021	16,278	5,284	578.6	994.5
California Central Valley steelhead	7,818,201	3,041,659	49,432	13,821	158.2	191.8
Northern California steelhead	844,024	169,718	18,673	6,908	45.2	24.6
South-Central California Coast steelhead	4,096,822	701,525	19,265	5,896	212.7	201.0
Southern California steelhead	18,785,717	698,276	32,514	4,219	577.8	556.0

Table 3-4
INCOME AND EMPLOYMENT FOR COUNTIES AND ESUS

	Personal Income ($1000)		Total Employment	
ESU	**Counties**	**ESU**	**Counties**	**ESU**
California Coastal chinook salmon	30,164,000	13,066,000	550,174	248,342
Central Valley spring-run chinook salmon	200,507,000	50,630,000	3,405,202	961,582
Central California Coast steelhead	395,433,000	265,562,000	6,048,254	3,778,130
California Central Valley steelhead	238,194,000	80,952,000	4,179,904	1,547,107
Northern California steelhead	25,462,000	4,048,000	466,207	94,504
South-Central California Coast steelhead	153,749,000	23,298,000	2,523,835	406,360
Southern California steelhead	571,651,000	22,217,000	10,870,809	421,876

3.4 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, including critical habitat designations for West Coast salmon and steelhead ESUs not covered by this proposal. 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.

3.4.1 ESA habitat protections other than Section 7

In the current state of the world, where critical habitat is not designated for the seven ESUs, the ESA can still protect habitat in three ways:

1. ESA sections other than section 7 for the seven ESUs;

2. Existing critical habitat designations for other West Coast salmon and steelhead that pre-date this proposal; and

3. ESA protections for non-salmon and non-steelhead species where the habitat for those other species overlaps the habitat for the seven ESUs and these protections provide ancillary benefits for West Coast salmon and steelhead.

Absent section 7 protections, West Coast salmon and steelhead 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, in the seven ESUs under consideration, NOAA Fisheries has conducted consultations over the past few years 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 West Coast salmon and steelhead 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.

A second source of habitat protection under the ESA stems from the fact that individuals from different ESUs may occupy the same geographic area, so that protecting habitat for one ESU may conserve the habitat of another ESU. This presents two cases for the establishment of the baseline, depending on whether the overlap is between new and existing areas or between new critical habitat areas.

The first case is for an overlap between the proposed designations and existing designations for West Coast salmon ESUs that are not part of this proposal. Given the uncertainty that these existing designations will remain in place in their current configuration, they are not included in the baseline. Moreover, because of the cost-effectiveness framework, so long as these designations are not also counted as part of the baseline when NOAA considers the benefit of designation for each ESU, this analysis will still present an accurate picture of the benefits of designation versus the benefits of exclusion.

Overlap also exists among the ESUs that are under consideration. The resolution of this issue is more complicated. Ideally, where critical habitat proposals overlap and afford similar (but not necessarily identical) protections, the analysis should consider the designations jointly. When actions take place simultaneously, there is no way to assign economic effects individually unless there is a logical or some other ordained order for the actions. If that is the case, an alternative is to analyze them sequentially: The effects of the "first" designation would be analyzed under an initial set of baseline conditions, and then any overlapping designations would be analyzed using a baseline that included the prior designation(s). This is not possible for the West Coast salmon and steelhead ESUs, however, as NOAA Fisheries is proposing to designate them as a package.

Because none of the seven ESUs has critical habitat designated in the current state of the world, and because the probability exists (from the point of view of this analysis) that critical habitat in fact may not be designated for certain watersheds, this analysis applied the following assumption: Where two or more of the ESUs under consideration overlap in terms of proposed critical habitat, the protections afforded by designating critical habitat for one ESU are not included in the baseline for the analysis of the impacts of the other ESUs.

Finally, other species listed under the ESA may occupy the same geographic area as West Coast salmon and steelhead, and thereby afford some protection to the latter's habitat. To the extent that the ESA protections for these species provide ancillary benefits to West Coast salmon and steelhead, those benefits should be included in the baseline.

A fundamental problem in incorporating these benefits into the baseline, however, is that they depend on the status of a species other than West Coast salmon and steelhead. If the status of that species improves, critical habitat could be revised but not based on any consideration of the status of West Coast salmon and steelhead. For that reason, this analysis does not generally consider these benefits to be part of the baseline.

3.4.2 Other laws and regulations that protect habitat

Federal laws other than the ESA, and State and local laws and regulations may protect West Coast salmon and steelhead 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 West Coast salmon and steelhead habitat. In those cases, this analysis incorporates the economic impacts of these other measures into the baseline, in that it does not consider them even if section 7 also covers them. In other cases where the link is less clear or direct, this analysis adopts a conservative stance and assumes that the effects of the law or regulations and those of critical habitat designation do not overlap.

Below, the major sources of legal and regulatory baseline protection are discussed in terms of their relevance to the analytical baseline. The "baseline status" notation is as follows:

- **Baseline status: No**. This analysis 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 West Coast 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 West Coast 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 West Coast 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 West Coast salmon and steelhead habitat are incorporated into the baseline, as the impacts would occur without section 7 consultation and therefore not included in the cost assessment.

This section also lists 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 West Coast salmon and steelhead.

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. For example, the 1995 Bay-Delta Water Quality Control Plan and Water Right Decision 1641 incorporates objectives such as providing water for fish and wildlife, including anadromous fish. Costs associated with this and other existing water control plans are considered baseline protection in this analysis.

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 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.

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 West Coast salmon and steelhead within National Forests, primarily through its authorization of the Northwest Forest Plan (NWFP) and PACFISH. NWFP and PACFISH provide numerous protections for salmon species related to Federal lands management activities (The NWFP and PACFISH are 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 West Coast salmon and steelhead. NWFP protections that are not reinforced through section 7 (e.g., as project modifications in biological opinions) are considered baseline protections.

Northwest Forest Plan (1994)[32]
Baseline status: Partial

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 (the range of the Northern spotted owl, Western Oregon, Western Washington, and Northwestern California). 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. The Aquatic Conservation Strategy (ACS) component of the plan specifically provides for fishery habitat, protection, and restoration.

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 a cost of section 7 in this analysis. 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 West Coast salmon and steelhead.

[32] NOAA Fisheries and the Fish and Wildlife Service recently clarified their application of section 7 to the Northwest Forest Plan. See Record of Decision, Amending Resource Management Plans for Seven Bureau of Land Management Districts and Land and Resource Management Plans for Nineteen National Forests Within the Range of the Northern Spotted Owl Decision to Clarify Provisions Relating to the Aquatic Conservation Strategy, U.S. Department of Agriculture, Forest Service, and U.S. Department of the Interior, Bureau of Land Management, March 2004.

<u>PACFISH (Interim strategies for managing anadromous fish-producing watersheds) (1995)</u>
Baseline status: Partial

For anadromous fish-producing watersheds on Federal lands in eastern Oregon, Washington, Idaho and Northern California that are not covered by the Northwest Forest Plan (NWFP), USFS and BLM adopted a management strategy to arrest the degradation and begin the restoration of anadromous fish protection. This strategy was intended to be in place only for 18-months, beginning in February of 1995, but continues to be implemented.

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.

Federal lands management activities in the NWFP planning area are affected by PACFISH. 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 a cost of section 7 in this analysis. For section 7 consultations that do occur, they may include project modifications that would already have occurred under PACFISH. 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 West Coast salmon and steelhead.

<u>Federal Power Act (16 U.S.C. § 800 1920, as amended)</u>
Baseline status: No

The Federal Power Act (FPA) was promulgated 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 West Coast salmon and steelhead 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).

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.[33]

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 West Coast salmon and steelhead habitat by requiring consultation concerning the species with NOAA Fisheries for all in-stream 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 West Coast salmon and steelhead. As a result, recommendations generated from FWCA are considered to be coextensive with section 7, and these costs are included in this analysis.

Rivers and Harbors Act (33 USC §§ 401 et seq. 1938)
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, U.S. Army Corps of Engineers (USACE) and requires that all investigations and improvements include due regard for wildlife conservation.

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[33] This is a strong assumption, as there is evidence for particular dams that the application of the FPA alone has the ability to impose substantial modifications on FERC-licensed projects that benefit West Coast salmon and steelhead (Interview, Source TK). NOAA Fisheries has not yet considered this possibility comprehensively – that is, for every FERC-licensed project in each ESU. For that reason, this draft analysis categorized modifications that may be attributable to the FPA as not being part of the baseline. As a result, this analysis may overstate the costs of section 7 implementation for West Coast salmon and steelhead.

This Act may provide protection to the West Coast salmon and steelhead from in-stream 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 West Coast salmon and steelhead according to the RHS, this analysis overstates the impact of section 7 implementation for West Coast salmon and steelhead. RHA protections that are not reinforced through section 7 (e.g., as project modifications in biological opinions) are considered baseline protections.

National Environmental Policy Act (42 USC §§ 4321-4345 1969)
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 the West Coast salmon and steelhead 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.

Wilderness Act (16 USC §§ 1131-1136 1964)
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 West Coast salmon and steelhead 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, this analysis 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.

<u>The Sikes Act Improvements Act (16 USC §670 1997)</u>
Baseline status: N/A

The Sikes Improvement Act (SIA) requires military installations to prepare and implement an Integrated Natural Resources Management Plan (INRMP). The purpose of the INRMP is to provide for:

- The conservation and rehabilitation of natural resources on military installations;

- The sustainable multipurpose use of the resources, which shall include hunting, fishing, trapping, and nonconsumptive uses; and

- Subject to safety requirements and military security, public access to military installations to facilitate the use of the resources.

INRMPs developed in accordance with SAIA may provide protection to the West Coast salmon and steelhead habitat on military lands.

The recent National Defense Authorization Act for Fiscal Year 2004 (Public Law No. 108-136) amended the ESA, affecting areas eligible for designation as critical habitat. Specifically, section 4(a)(3)(B)(I) of the ESA (16 U.S.C. 1533(A)(3)) provides that: "The Secretary shall not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan prepared under section 101 of the Sikes Act (16 U.S.C. 670a), if the Secretary determines in writing that such plan provides a benefit to the species for which critical habitat is proposed for designation." The Act also added "national security" as an impact to be considered in the 4(b)(2) process.

NOAA Fisheries has contacted the Department of Defense for information on DOD INRMPs and the benefits they might afford West Coast salmon and steelhead, as well as the potential impacts on national security of the designations. These two areas are considered in a separate report, and therefore any impacts from the Sikes Act are not considered in this analysis, but will play a role in the 4(b)(2) process.

<u>Long-Term Management Strategy (LTMS) For the Placement of Dredged Material in the San Francisco Bay Region</u>
Baseline status: Yes

The LTMS is a multi-agency effort on the part of the U.S. Armu Corps of Engineers (USACE), EPA, NOAA and others to eliminate unnecessary dredging and maintain in an economically and environmentally sound manner those channels necessary for navigation in San Francisco Bay and Estuary. The LTMS considered three long-term strategies for channel maintenance, all of which attempt to reduce the amount of sediment disposed within the San Francisco Bay estuary. The

LTMS also establishes dredging windows for salmon and other aquatic species. Seasonal limitations on dredging were established to accommodate salmon spawning.

NOAA reviews USACE dredging permit applications at the programmatic level, as opposed to the individual permit level, unless projects cannot occur within the allotted dredging windows and a formal consultation is required. Based on historical project experience, this is expected to occur approximately 14 percent of the time. As dredging project windows and establishment of appropriate disposal sites are required by the LTMS, these potential project modifications are considered baseline protection for the salmon and steelhead.

California Environmental Quality Act (CEQA) (California Natural Resources Code §15065(a))
Basline Status: No

CEQA is a California State statute that requires State and local agencies (known as "lead agencies") to identify the significant environmental impacts of their actions and to avoid or mitigate those impacts, if feasible. Projects carried out by Federal agencies are not subject to CEQA provisions. CEQA instructs the lead agency (typically a county or city community development or planning department in the case of land development projects) to examine impacts from a broad perspective, taking into account the value of species' habitats that may be impacted by the project in an Environmental Impact Report (EIR). The lead agency must determine which, if any, project impacts are potentially significant and, for any such impacts identified, whether feasible mitigation measures or feasible alternatives will reduce the impacts to a level less than significant. It is within the power of a lead agency to decide that negative impacts are acceptable in light of economic, social, or other benefits generated by the project.

Where listed species are present on the project site, the EIR's biological component is required to discuss and evaluate habitat impacts, as well as present project alternatives. This requirement is unchanged after Federal designation of critical habitat; CEQA makes no reference to critical habitat. This analysis does not quantify compliance with CEQA and, as Federal agencies are not subject to CEQA, does not consider this State regulation to offer significant baseline protection to the salmon and steelhead.

Central Valley Project Improvement Act
Baseline Status: Yes

Passed in 1992 by Congress, the Central Valley Project Improvement Act (CVPIA) is an addendum to the Central Valley Project Act that promotes environmental protection and restoration within California's Central Valley. The CVPIA has two objectives: preserving fish and wildlife and their habitats, and increasing the benefits of the Central Valley Project by adding incentives to use agricultural water more efficiently. To accomplish these objectives, the CVPIA allows contractors to participate in water markets, changes the pricing structure for the water contractor's, creates a restoration fund to finance activities that enhance fish and wildlife and their habitat, and allocates water for environmental uses. The CVPIA reallocates 600,000 to 800,000 acre-feet of Central Valley Project water yield annually from agricultural to environmental and other non-agricultural purposes. California Water System Operations Environmental Funding. These reallocation of resources is considered to be part of the baseline for this analysis.

<u>CALFED and the Environmental Water Account</u>
Baseline Status: Partial

The California Bay-Delta Authority (CALFED), established by legislation enacted in 2002, provides a permanent governance structure for the collaborative California State-Federal water management effort that began in 1994. A key component of CALFED's Water Management Strategy, the Environmental Water Account (EWA) was created to address two problems, declining fish populations and unreliable water supplies. Its purpose is to better protect fish by making it possible to modify water project operations in the Bay-Delta and still meet the needs of water users.

The EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers and releases it as needed to protect fish and compensate water users. For example, EWA managers might coordinate with water project operators to curtail pumping at specific times to avoid harming fish, and then provide water to cities and farms to compensate for the reduced pumping. While the creation of the EWA are not attributed to the designation of critical habitat for the salmon, expenses related to this program are provided in Appendix C to provide context for understanding the impacts of changes to water operations and water use that may occur after critical habitat designation.

<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.

California Endangered Species Act (California Fish and Game Code §§ 2050, et seq.) - The CESA parallels the main provisions of the Federal Endangered Species Act and is administered by the California Department of Fish and Game (DFG). CESA prohibits the "taking" (the California Fish and Game Code defines "take" as "hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill") of listed species except as otherwise provided in State law. The CESA also applies the take prohibitions to species petitioned for listing ("candidate species").

Z'berg-Nejedly Forest Practice Act of 1973 (Cal. Pub. Res. Code §§ 4511 - 4628) - Also referred to as the California Forest Practice Act, this act regulates all timber harvesting in California on all non-federal land. CDF oversees enforcement of California's forest practice regulations. Under the Forest Practice Act, Timber Harvesting Plans (THPs) are submitted to CDF for commercial timber harvesting on all non-federal timberlands. The Act requires that all private forest land be replanted within five years and that a certain number of dead trees be left in harvest areas for birds and animals that need them.

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

4.1 Introduction

This section presents the estimated impacts of section 7 on an activity that may affect West Coast salmon and steelhead by modifying habitat. The subsequent section presents estimates of impacts for all activities at the watershed level. This section begins by discussing the consultation history of the seven West Coast salmon and steelhead ESUs, then presents the types of activities included in the analysis and the modifications typically needed to comply with section 7. For each type of activity, this section summarizes the expected costs of these modifications and the methods used to project the activity's occurrence over space and time. Section 5 presents estimates of aggregate impacts at the watershed level. Appendix B gives a more detailed discussion of the methods used to estimate impacts.

4.2 Consultation History

NOAA Fisheries has compiled an extensive history of consultations for the seven ESUs of West Coast salmon and steelhead under consideration since the listings of these ESUs in the 1990's. The database for these seven ESUs indicates that from 2000 to 2003,[34] the SWR of NOAA Fisheries engaged in over 1,098 consultation and technical assistance efforts, involving roughly 30 different Federal agencies, most notably the Army Corps of Engineers (657 consultations), Federal Highway Administration (137), and Forest Service (79). About ten percent of the consultations were formal and about 64 percent were informal.[35] The remainder consisted of pre-consultation and technical assistance (16 percent), and other types of consultations not specified (ten percent).

Table 4-1 provides more detailed information on the consultation history. This section first lists the Federal agencies that have been most often involved in salmon and/or steelhead consultation during 2000-2003.

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[34] Approximately 97 percent of the consultations in the database occurred between 2000-2003. The database is incomplete for earlier years.

[35] A formal consultation involves the issuance of a biological opinion and incidental take statement by either of the Services. If a proposed Federal action may affect a listed species or designated critical habitat, formal consultation is required (except when the Services concur, in writing, that a proposed action "is not likely to adversely affect" listed species or designated critical habitat). [50 CFR §402.02, 50 CFR §402.14]. An informal consultation is an optional process that includes all discussions and correspondence between the Services and a Federal agency or designated non-Federal representative, prior to formal consultation, to determine whether a proposed Federal action may affect listed species or critical habitat. This process allows the Federal agency to utilize the Services' expertise to evaluate the agency's assessment of potential effects or to suggest possible modifications to the proposed action which could avoid potentially adverse effects.

This consultation history provides a rich source of information on the types of activities that are likely to be affected by critical habitat designation.[36] Table 4-2 lists types that have been the subject of five or more consultations during 2000-2003, along with the number of consultations for that type of action.[37] The most common type of activity covered in the consultation record was bridge repair or construction (142), followed by bank stabilization (95), breakwater, dock, or pier projects (91 consultations), road construction or maintenance (89), dredging (82), and habitat restoration or improvement projects (61).

4.3 Types of Activities

The following set of activity types for the economic analysis was derived from the consultation record:

- 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; and
- Agricultural pesticide applications.[38]

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

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[36] Consultations are not the only source of information, of course, because direct impacts through section 7 consultations are not the only source of critical habitat designation and section 7 impacts. Impacts from other laws or regulations may be triggered by the designation, or the designation may have so-called "stigma" effects. The section 7 consultation record will not provide information to document these types of impacts.

[37] A single consultation can cover multiple types of activities.

[38] The Environmental Protection Agency (EPA) was recently enjoined from authorizing the application of a set of pesticides within a certain distance of “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 this analysis, in that the restrictions on pesticide use can be viewed as a habitat-related impact of section 7.

Table 4-1
FEDERAL AGENCIES INVOLVED IN TEN OR MORE WEST COAST SALMON AND STEELHEAD CONSULTATIONS IN THE SWR

Federal Agency	Number of Consultations
Corps of Engineers	657
Federal Highway Administration	137
Forest Service	79
Bureau of Reclamation	40
Fish and Wildlife Service	27
Bureau of Land Management	24
Army Department	22
National Park Service	18
Natural Resource Conservation Service	16
Federal Emergency Management Agency	11
National Oceanic Atmospheric Administration	10

Table 4-2
ACTIONS INVOLVED IN WEST COAST SALMON AND STEELHEAD CONSULTATIONS WITH GREATER THAN FIVE CONSULTATIONS IN THE SWR

Type of Action	No. of Consultations
Bridge Repair/Construction	142
Bank Stabilization	95
Breakwater/Dock/Pier	91
Road Construction/Maintenance	89
Dredging	82
Habitat Restoration/Improvement	61
Culvert	44
Boat Ramp Repair/Construction	32
Stormwater Drainage	32
Water Systems	32
Construction - Other	25
Fish Passage/Trapping	25
Flood Control	21
Pipeline Construction/Repair	21
Pilings	19
Dam Maintenance/Operation	18
Levee Maintenance	13
Vegetation Management	13
Drilling	11
National Fire Plan	17
Rip-rap	11
Water Diversion	11
Excavation/Mining	10
Watershed Activities	10
Channel Repair/Reconstruction	9
Gravel	9
Erosion Control	8
Fire Management	8
Timber Harvest/Sales	7
Fill	6
Harbor/Marina	6
Recreation	6
Riparian Work	6
Timber Sale	6
Seismic	6
Grazing	5
Research	5
Sewage/Wastewater	5

4.3.1 Hydropower Dams

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. 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 agencies responsible for hydropower activities in the area covered by the seven ESUs are the Federal Energy Regulatory Commission (FERC), U.S. Army Corps of Engineers (USACE), and the U.S. Bureau of Reclamation (USBR).

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. The USACE and USBR also own and/or operate hydropower projects within the proposed critical habitat for West Coast salmon and steelhead. While there is no formal procedure for regular review of federally-operated projects, any change in operations or existing infrastructure may generate consultation regarding impact to the salmon/steelhead.

Multiple hydropower-related Federal and State regulations provide protection to the 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.[39] 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 Service) and Commerce (NOAA Fisheries).

Through the consultation process, NOAA Fisheries may recommend reasonable and prudent alternatives (RPAs) regarding hydropower projects. These RPAs, which NOAA Fisheries considers 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.[40] 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

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[39] Federal Power Act, 16 U.S.C. § 803(j) (1986).

[40] 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.

land and water rights.[41] Operational changes are changes in hydropower production level or method, and may be engendered by modification to the flow regime.[42]

Individual hydropower dams vary substantially in their potential for harming West Coast 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, hydropower dams are divided into several categories, based on generating capacity and the nature of the impacts (modification *v.* removal). Capital and programmatic modification costs are then estimated 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 of 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.[43]

The necessity, level, and method of flow regime changes accommodate the biological needs of West Coast 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.

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[41] 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 in-stream construction; and increased pollution control standards.

[42] 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.

[43] Lon Peters, Memorandum to Industrial Economics, Inc. "ESA Costs for the Hydropower Sector." November 18, 2003.

For this reason, estimate for flow regime changes are not attributed to specific project and therefore to specific watersheds. Data are available for a few, larger hydropower projects, however. These data are used to illustrate the potential magnitude of these costs at the aggregate level of all ESUs later in this section. This issue is also discussed in more detail in Appendix B.

Hydropower projects that are part of the Central Valley Project comprise a unique type of hydropower activity. Three Central Valley Project hydropower dams fall within the boundaries of the potential critical habitat for West Coast salmon and steelhead, but all projects may adversely affect the habitat through their operations. The implementation of section 7 for the salmon and steelhead ESUs under consideration has had significant impacts on hydropower operations, particularly to the Federal Columbia River Power System (FCRPS) in the Northwest Region (NWR). Attributing these impacts to the designation of critical habitat for a particular watershed, however, is problematic for reasons discussed in section 4.4.2.1.

The impacts of section 7 and critical habitat designation on hydropower flow regimes, while real and substantial, do not fit into the framework set by section 4(b)(2) of analyzing "the economic impact . . . of specifying any particular area as critical habitat."

4.3.2 Non-hydropower Dams and Other Water Supply Structures

Projects covered by this activity type include 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 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 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 (including 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 West Coast salmon and steelhead. 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 like hydropower dams, the necessity, level, and method of operation or flow regime changes to accommodate the biological needs of West Coast salmon and steelhead at a non-hydropower or water supply project are determined on a case by case basis. While historical data exist to inform understanding of the value of forgone water or agricultural production, reliable data does not exist 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.[44] For this reason, estimate for flow regime changes can not be attributed to specific projects and therefore to specific watersheds.

4.3.3 Federal Lands Management and Grazing Permits

A Federal nexus exists for all management activities occurring on Federal lands. The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) have many similar land management goals and regulations, and frequently consult together. For these reasons, the activities of the two agencies are grouped together 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[45], permitting of livestock grazing[46], and permitting of various use permits. These activities are divided 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 recent consultation history shows that nearly 17 percent of section 7 consultations for West Coast salmon and steelhead are conducted with the USFS or the BLM on various land management activities. The outcomes of these consultations are likely influenced by several important baseline regulations. In particular, the Northwest Forest Plan and PACFISH guidelines provide numerous baseline protections to West Coast salmon and steelhead.

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.

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[44] Huppert et al. (2003).

[45] 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.

[46] 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.

For Federal lands in Oregon, Washington, Idaho, and Northern California not covered by the NWFP, USFS and BLM adopted a management strategy specifically for anadromous fish protection.[47] 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.

4.3.4 Transportation Projects

Transportation projects that affect West Coast salmon and steelhead habitat are wide ranging and 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).

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 the majority of the 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 (SPCCP) 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.

4.3.5 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

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[47] This strategy was intended to be in place only for 18 months, beginning in February of 1995, but continues to be implemented.

and Harbors Act permits, while FERC consults on pipeline projects that have the potential to impact threatened and endangered species and their habitat.[48] 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.[49] Therefore, some of the project modification costs estimated to be attributable to West Coast salmon and steelhead critical habitat may be overestimated as these measures may already be required.

4.3.6 In-stream Activities, Including Dredging

Actions associated with in-stream activities that could impact West Coast salmon and steelhead include construction or repair of breakwaters, docks, piers, pilings, bulkheads, boat ramp, and dredging. Although these projects are commonly undertaken by private or non-Federal parties, in most cases they must obtain a USACE permit. The USACE must then consult with NOAA Fisheries under section 7 of the ESA.

Turbidity associated with in-stream 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. In-stream activity impacts on invertebrate colonies may result in some loss of salmonid prey. Finally, entrainment of West Coast salmon and steelhead 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 controls, and timing restrictions. For dredging, the modifications could include work window constraints, extension of the prescribed work window, additional survey work, and mobilization costs.

[48] Personal communication with Robert Arvedlund, Federal Energy Regulatory Commission, February 25, 2003

[49] Federal Energy Regulation Commission. *Wetland and Waterbody Construction and Mitigation Procedures*. January 17, 2003.

4.3.7 National Pollutant Discharge Elimination System Permitted (NPDES) Activities

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, facilities that require permits under NPDES must now ensure that effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards.[50] 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 West Coast salmon and steelhead 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 West Coast salmon and steelhead are known to spawn or rear. As a result, NPDES-permitted facilities in the West Coast Northwest are required to ensure that their effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards.[51] 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.

4.3.8 Sand and Gravel Mining

Mining activities that affect West Coast salmon and steelhead 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.[52] 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

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[50] U. S. Environmental Protection Agency, EPA Region 10 Guidance For Pacific Northwest State and Tribal Temperature Water Quality Standards, EPA 910-B-03-002, April 2003.

[51] U.S. Environmental Protection Agency. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA.

[52] "NOAA Fisheries National Gravel Extraction Policy," National Marine Fisheries Service, 2002.

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.[53] 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.[54]

Gravel mining may result in 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.[55]

4.3.9 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.

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 impact 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 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

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[53] "NOAA Fisheries National Gravel Extraction Policy," National Marine Fisheries Service, 2002. NOAA Fisheries is in the process of revising this guidance.

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

[55] "NOAA Fisheries National Gravel Extraction Policy," National Marine Fisheries Service, 2002.

economic impacts.[56] 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.[57] 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, the 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.[58]

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 can be

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[56] Elliott D. Pollack and Company, The Economic and Fiscal Impact of the Designation of 60,060 Acres of Privately Owned Land in Pima County, Arizona as Critical Habitat for the Cactus Ferruginous Pygmy-Owl, prepared for Southern Arizona Homebuilders Association, February 25, 1999.

[57] Ibid.

[58] Meyer, Stephen M. 1998. "The Economic Impact of the Endangered Species Act on the Housing and Real Estate Markets." New York University Environmental Law Journal. 6(450):1-13.

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, project modification costs are expected to be modest (anticipated to range from $230,000 to $240,000 per project as discussed in the Section 4.4 of this report) and, according to NOAA Fisheries personnel, consultations regarding development projects are rare.[59]

This assessment is supported by the consultation history. Few consultations regarding residential and related development have occurred in recent years. More importantly, none of the formal consultations on development have evaluated the entire project. Past consultations have addressed only the specific activities with a Federal nexus that have the potential to affect West Coast salmon and steelhead, such as stormwater outfall structures. Project modifications have included timing restrictions for in-stream work, best management practices (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.

4.3.10 Agricultural Pesticide Applications

Under the ESA, the 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 consultation completed in the past decade to this end.

In January 2004, the EPA was enjoined from authorizing the application of a set of pesticides within certain distances from “salmon-supporting waters.”[60] 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.

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[59] 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. Personal communication with Gary Stern, NOAA Fisheries Santa Rosa Field Office, San Francisco Bay Team Leader, November 5, 2003.

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

The court in Washington Toxics Coalition versus EPA imposed two types of restrictions on application 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. These restrictions are used as a proxy for the types of modifications section 7 is likely to impose on pesticide application activities.

4.4 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, the framework’s focus on individual projects and watersheds makes an accurate estimate of these costs at the watershed level programmatic. Nevertheless, they are discussed on a general level. Second, modifying a project to bring it into compliance with section 7 can be costly. These costs may occur following consultation, if the party responsible for the activity adopts whatever measures NOAA Fisheries specifies, or they may 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. This analysis accounts 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, this analysis does not consider two other possible avenues for impacts to occur. It assumes that activities located in critical habitat will incur the modification costs identified (according to the estimated probabilities). Alternatively, the project could be moved (if possible) to a location that does not affect West Coast salmon and steelhead, or the project could be cancelled. A basic assumption underlying any 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, the assumption that projects will not be relocated or cancelled means that, the approach likely overstates the cost of section 7 impacts.

4.4.1 Consultation Costs

A routine feature of economic analyses of critical habitat designation is an accounting of the costs of the consultation themselves. The geographic scope of the West Coast salmon and steelhead designations and the nature of the available data preclude a watershed-by-watershed accounting of these costs. Instead, these costs are discussed generally but specific costs are not attributed to particular areas.

The data utilized in this analysis account for the level of projects that may be modified subsequent to or in anticipation of a section 7 consultation. While the cost of a consultation is a real impact of section 7, it is not easily allocated to a specific area given the methods for assessing project volumes for the following reasons.

First, a single consultation can cover more than one project. While the majority of consultations cover a single project, the exceptions are important. For example, programmatic consultations determine how a type or types of project, not the projects themselves, can be modified to ensure they comply with section 7. As a result, these consultation can cover large numbers of projects.

While programmatic consultations are likely to be more costly, the cost per project is likely to be significantly lower than the per-project cost for non-programmatic consultations. For that reason, applying a constant per-project cost estimate would significantly inflate the estimated level of consultation cost. Moreover, when multi-project consultations occur, they are likely to cover a wide geography. This makes it difficult to attribute those consultation costs to a particular area such as a single watershed.

A second difficulty stems from the method used in this analysis to measure the volume of Federal lands management activities, which are a significant source of cost impacts. Based on an analysis of programmatic consultations, this analysis uses a per-acre cost estimate, rather than a per-project estimate. Because of this, there is no way to gauge the number of consultations associated with the level of activity in a particular area. In any case, given that many of these activities are in fact covered by programmatic consultations, using the number of projects to estimate consultation costs would be inaccurate. For both of these reasons, consultation costs are not estimated for each particular area.

Although the estimation of consultation costs at the watershed level is not feasible, we are able to estimate these costs at the aggregate level for all seven West Coast salmon and steelhead ESUs, broken down by activity type, type of consultation (formal, informal, programmatic, and technical advice or pre-consultations) and agency (NOAA Fisheries and other Federal agencies). To estimate costs borne by NOAA Fisheries, NOAA biologists estimated time in weeks spent on individual salmon consultations during 2004. These estimates were then sorted by activity type and translated 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, relevant staff at agency offices across the region that are involved in salmon consultations were contacted. 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 4-3 presents estimates of these per-consultation costs that resulted from the interviews with NOAA Fisheries and other federal and state agency personnel. Of note, 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 will become more familiar with the process and are more likely to incorporate salmon concerns earlier in the project planning process, thereby streamlining future administrative costs. Thus, these "annual" estimates are likely to overstate future administrative costs to these agencies.

Using these per-consultation cost estimates, annual consultation costs were estimated for the seven West Coast salmon and steelhead ESUs by multiplying the number of annual past consultations for each activity (e.g., hydropower) and type (e.g., informal), by their estimated cost per consultation.[61] Assuming the distribution of consultation types is the same across the types of activities, annual consultation costs are assumed to range from $2.4 million to $15.3 million, or $3.6 million using the median estimates for each consultation type. Table 4-4 presents these annual estimated consultation costs by activity.

[61] This estimation was based on an analysis of the consultation record between 2001 and 2003. To the extent that the number of consultations or their distribution across activity types changes, the actual level of consultation costs could be higher or lower than the estimated level in this section.

Table 4-3
CONSULTATION COSTS (PER CONSULTATION) BY ACTIVITY AND CONSULTATION TYPE
FOR WEST COAST SALMON AND STEELHEAD

Activity	Cost range	Formal Consultations	
		NOAA Costs	Total
Hydropower dams	Minimum	$18,400	$21,600
	Maximum	$55,100	$2,255,100
	Median	$36,700	$43,000
	Outliers		$0
Non-hydropower dams and water supply projects	Minimum	$6,900	$10,100
	Maximum	$68,900	$2,268,900
	Median	$37,900	$44,200
	Outliers		$0
Federal Lands Management	Minimum	$13,800	$14,800
	Maximum	$20,700	$26,500
	Median	$17,200	$21,000
	Outliers		$0
Development	Minimum	$9,200	$12,000
	Maximum	$9,200	$79,700
	Median	$9,200	$34,800
	Outliers		$0
In-Stream Work	Minimum	$1,400	$4,200
	Maximum	$4,600	$16,800
	Median	$3,000	$6,700
	Outliers		$0
Mining	Minimum	$26,400	$29,200
	Maximum	$79,200	$319,200
	Median	$52,800	$134,900
	Outliers		$0
Transportation	Minimum	$2,300	$18,600
	Maximum	$11,500	$46,400
	Median	$6,900	$27,100
	Outliers		$0
Utility Lines	Minimum	$3,400	$6,200
	Maximum	$18,400	$48,700
	Median	$10,900	$23,100
	Outliers		$0
Other	Minimum	$0	$0
	Maximum	$9,200	$18,400
	Median	$4,600	$9,200
	Outliers		

Table 4-3
CONSULTATION COSTS (PER CONSULTATION) BY ACTIVITY AND CONSULTATION TYPE
FOR WEST COAST SALMON AND STEELHEAD

Activity	Cost range	Programmatic Consultations	
		NOAA Costs	Total
Hydropower dams	Minimum	$18,400	$2,218,400
	Maximum	$55,100	$2,255,100
	Median	$36,700	$2,236,700
	Outliers	$0	$0
Non-hydropower dams and water supply projects	Minimum	$6,900	$2,206,900
	Maximum	$68,900	$2,268,900
	Median	$37,900	$2,237,900
	Outliers	$0	$0
Federal Lands Management	Minimum	$13,800	$44,800
	Maximum	$20,700	$74,700
	Median	$17,200	$37,700
	Outliers	$0	$0
Development	Minimum	$9,200	$79,700
	Maximum	$9,200	$79,700
	Median	$9,200	$79,700
	Outliers	$0	$0
In-Stream Work	Minimum	$1,400	$13,600
	Maximum	$4,600	$16,800
	Median	$3,000	$15,200
	Outliers	$0	$0
Mining	Minimum	$26,400	$266,400
	Maximum	$79,200	$319,200
	Median	$52,800	$292,800
	Outliers	$0	$0
Transportation	Minimum	$2,300	$37,200
	Maximum	$11,500	$46,400
	Median	$6,900	$41,800
	Outliers	$0	$0
Utility Lines	Minimum	$3,400	$33,700
	Maximum	$18,400	$48,700
	Median	$10,900	$41,200
	Outliers	$0	$0
Other	Minimum	$0	$0
	Maximum	$9,200	$9,200
	Median	$4,600	$4,600
	Outliers	$0	$0

Table 4-3
CONSULTATION COSTS (PER CONSULTATION) BY ACTIVITY AND CONSULTATION TYPE FOR WEST COAST SALMON AND STEELHEAD

Activity	Cost range	Informal Consultations	
		NOAA Costs	Total
Hydropower dams	Minimum	$600	$3,800
	Maximum	$600	$30,600
	Median	$600	$17,200
	Outliers	$0	$0
Non-hydropower dams and water supply projects	Minimum	$1,100	$4,300
	Maximum	$6,900	$36,900
	Median	$4,000	$20,600
	Outliers	$0	$0
Federal Lands Management	Minimum	$2,300	$3,300
	Maximum	$4,600	$7,100
	Median	$3,400	$5,200
	Outliers	$0	$0
Development	Minimum	$1,400	$4,200
	Maximum	$1,400	$4,200
	Median	$1,400	$4,200
	Outliers	$0	$0
In-Stream Work	Minimum	$1,100	$3,900
	Maximum	$2,900	$5,700
	Median	$2,000	$4,800
	Outliers	$0	$0
Mining	Minimum	$1,100	$3,900
	Maximum	$1,100	$3,900
	Median	$1,100	$3,900
	Outliers	$0	$0
Transportation	Minimum	$700	$17,000
	Maximum	$9,200	$25,500
	Median	$4,900	$21,200
	Outliers	$0	$0
Utility Lines	Minimum	$500	$3,300
	Maximum	$6,900	$9,700
	Median	$3,700	$6,500
	Outliers	$0	$0
Other	Minimum	$0	$0
	Maximum	$4,600	$9,200
	Median	$2,300	$4,600
	Outliers	$0	

Table 4-3
CONSULTATION COSTS (PER CONSULTATION) BY ACTIVITY AND CONSULTATION TYPE
FOR WEST COAST SALMON AND STEELHEAD

Activity	Cost range	Technical Advice/Pre-Consultation	
		NOAA Costs	Total
Hydropower dams	Minimum	$600	$600
	Maximum	$600	$600
	Median	$600	$600
	Outliers	$0	$0
Non-hydropower dams and water supply projects	Minimum	$0	$0
	Maximum	$6,900	$6,900
	Median	$3,400	$3,400
	Outliers	$0	$0
Federal Lands Management	Minimum	$2,300	$2,300
	Maximum	$18,400	$18,400
	Median	$10,300	$10,300
	Outliers	$0	$0
Development	Minimum	$200	$200
	Maximum	$200	$200
	Median	$200	$200
	Outliers	$0	$0
In-Stream Work	Minimum	$1,100	$1,100
	Maximum	$20,700	$20,700
	Median	$10,900	$10,900
	Outliers	$0	$0
Mining	Minimum	$1,100	$1,100
	Maximum	$1,100	$1,100
	Median	$1,100	$1,100
	Outliers	$0	$0
Transportation	Minimum	$500	$500
	Maximum	$9,200	$9,200
	Median	$4,800	$4,800
	Outliers	$0	$0
Utility Lines	Minimum	$200	$200
	Maximum	$200	$200
	Median	$200	$200
	Outliers	$0	$0
Other	Minimum	$4,600	$4,600
	Maximum	$4,600	$4,600
	Median	$4,600	$4,600
	Outliers	$0	$0

Table 4-4 ANNUAL CONSULTATION COSTS BY ACTIVITY AND CONSULTATION TYPE FOR WEST COAST SALMON AND STEELHEAD IN CALIFORNIA						
Activity/ Consultation Type	**Cost Range**	**Annual Cost Estimates**				
		Formal	**Informal**	**Programmatic**	**TA/PC**	**Total**
Hydropower	Minimum	$18,300	$17,500	$ 147,900	$ 700	$ 184,400
	Maximum	$ 1,910,700	$ 141,200	$150,300	$ 700	$ 2,202,900
	Median	$36,400	$79,400	$ 149,100	$ 700	$ 265,600
Water Supply	Minimum	$ 35,500	$ 82,400	$ 610,600	$ -	$ 728,500
	Maximum	$7,977,800	$ 706,800	$ 627,700	$32,600	$ 9,344,900
	Median	$ 155,400	$ 394,600	$ 619,200	$ 16,000	$ 1,185,200
Federal Lands Management	Minimum	$ 52,000	$ 63,200	$ 12,400	$ 10,900	$138,500
	Maximum	$ 93,200	$ 136,000	$ 20,700	$ 86,800	$ 336,700
	Median	$ 73,800	$ 99,600	$10,400	$ 48,600	$ 232,400
Development	Minimum	$ 20,300	$38,800	$10,600	$ 500	$ 70,200
	Maximum	$135,100	$ 38,800	$10,600	$ 500	$ 185,000
	Median	$ 59,000	$ 38,800	$10,600	$ 500	$ 108,900
In-Stream Work	Minimum	$ 107,800	$ 545,400	$27,500	$37,900	$ 718,600
	Maximum	$431,300	$ 797,200	$33,900	$ 713,200	$ 1,975,600
	Median	$ 172,000	$ 671,300	$ 30,700	$ 375,600	$ 1,249,600
Mining	Minimum	$ 23,500	$ 17,100	$ 16,900	$1,200	$58,700
	Maximum	$ 256,900	$17,100	$ 20,200	$ 1,200	$ 295,400
	Median	$ 108,600	$ 17,100	$18,500	$ 1,200	$145,400
Transportation	Minimum	$71,700	$357,000	$ 11,300	$ 2,600	$ 442,600
	Maximum	$ 178,900	$535,500	$ 14,100	$47,600	$776,100
	Median	$104,500	$445,200	$12,700	$ 24,800	$587,200
Utility Lines	Minimum	$ 6,000	$17,500	$2,600	$ 300	$ 26,400
	Maximum	$47,500	$51,500	$ 3,700	$ 300	$ 103,000
	Median	$ 22,500	$ 34,500	$3,200	$300	$60,500
Other	Minimum	$ -	$ -	$ -	$ 6,800	$ 6,800
	Maximum	$ 20,300	$ 55,200	$ 800	$ 6,800	$83,100
	Median	$ 10,100	$ 27,600	$ 400	$ 6,800	$44,900
All Activities	**Minimum**	**$ 335,100**	**$ 1,138,900**	**$ 839,800**	**$ 60,900**	**$ 2,374,700**
	Maximum	**$ 11,051,700**	**$ 2,479,300**	**$ 882,000**	**$ 889,700**	**$ 15,302,700**
	Median	**$ 668,500**	**$ 1,708,500**	**$ 844,400**	**$ 425,900**	**$ 3,647,300**

4.4.2 Per-project Costs and the Occurrence of Impacts

For each type of activity, this analysis 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 estimates are the basic elements of the approach used in the analysis. The method for making these estimates follows 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, the stream of expenditures is discounted using both a three percent and seven percent discount rate. (For the purposes of the discussion in this report, sometimes only the results for the seven percent discount rate are presented.[62] The summary tables and the full set of results in the appendices report the results for both discount rates.)

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 used, however, vary widely in the length of time covered. For that reason, this analysis uses individual time periods over which to forecast an activity type's occurrence. In some cases, a period of one year is used, as estimates are available of the annual volume of an activity. In other cases, the period is longer, sometimes set by the periodicity of permits or other considerations.

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

4) *Calculate the annualized 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, the uncertainty regarding the need to modify is recognized, and so this last step incorporates the probabilities estimated in that step. This analysis first calculates the expected cost of modifications for a particular year (the probability that the modification will take place in a given year multiplied by the cost of modification) for each year in the forecast period. Each year's expected cost (again, three percent and seven percent discount rates are both used) is then discounted and the sum is taken 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, this present value is annualized to obtain an expected modification cost.[63]

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[62] In many instances, changing the discount rate does not change the cost estimate because this analysis uses annualized costs, where the cost stream is uniform. The uniformity comes from the assumption that, for most activities, modification expenditures are borne in one year but the exact date is uncertain and assumed to be distributed uniformly over the forecast period. Under these assumptions, the annual expected value (that is, the one-year modification expenditure multiplied by the probability of the modification occurring in that year) is constant, and is therefore equal to the annualized expected cost regardless of the discount rate.

[63] Incorporating uncertainty over time in this way means that the actual modification costs for a specific activity may vary substantially from the estimates on a year-to-year basis. 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.

In almost all cases, a range of possible modification costs is presented. Because the data sources for the cost estimates do not constitute a random sample, an average over the range of estimated costs can not be used as the "representative" estimate. This analysis therefore assumes that the endpoints of the range represent the minimum and maximum values of a symmetric cost distribution, and uses the midpoint of the range as the representative cost estimate.

The remainder of this section summarizes the methods for deriving cost estimates for each activity's potential modifications, as well the estimates and their ranges (assuming a seven percent discount rate). Following that, this section describes how the spatial and temporal occurrence of the activity was estimated. Finally, for each activity, potential limitations of the analytical methods are presented. The discussion below is summarized in Table 4-6, and a more detailed presentation is given in Appendix B.

4.4.2.1 Hydropower Projects

Cost Estimates

Capital and Programmatic modifications:
For hydropower dams, the magnitude of potential modification costs varies widely across dams. To account for some of this variation, this activity type is divided into several categories. Data regarding California hydropower projects was less comprehensive than the available Northwest region hydropower data, for example regarding the status of fish passage and amount of installed capacity. Because of this, the likelihood of a hydropower project possessing particular traits is often extrapolated from the available data regarding hydropower projects in the Northwest as described below.

- <u>Projects with installed capacity of less than 5MW: $2.1 million ($24,000 - $4.2 million)</u>. According to FERC guidelines, hydroelectric projects with an installed capacity of less than five megawatts (MW) may be exempted from the licensing process. 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.

- <u>Projects with installed capacity ranging from 5 to 20MW: $5.75 million ($0 to $11.5 million).</u> The high-end of this estimate comprises: 1) Capital costs, such as facilities improvements, of $8 million, from a survey of 17 hydropower projects in the Northwest United States; 2) Species surveys at $2,600 per year for ten years (BPA 1992), 3) Research on species survival and passage efficiency at $150,000 per year for ten years (Huppert et al 1996); and 4) Water quality monitoring at $200,000 per year for ten years (Huppert et. al., 1996). These costs represent the suite of project modifications most likely to be recommended at medium-sized hydropower projects.

- <u>Projects with installed capacity of greater than 20MW that already have, or will not require, fish passage facilities: $45.2 million ($11.5 million to $79.1 million)-Northwest Region Only.</u> The Pacific Northwest Hydrosite Database (PNHD) used for the economic analysis of hydropower projects for the Northwest Region includes information on the status of fish passage facilities at each project, specifying that facilities are present, not required, not present, or unknown. 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 for fish passage-related costs).

- <u>Projects with installed capacity of greater than 20MW that do not have, but may require, fish passage facilities: $73.9 million ($11.5 million to $136 million)-Northwest Region Only.</u> The high-end of the cost range is the high-end cost for project modifications to a hydropower project from a 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.

- <u>Projects with installed capacities of greater than 20MW where the status of fish passage is currently unknown: $56.4 million ($11.5 million to $101.3 million).</u> 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. This cost estimate therefore reflects at 61 percent chance of the project modifications resulting in costs of $45.2 million and a 39 percent change of modifications resulting in costs of $73.9 million as described above. The cost estimates for the high and low end of the range of costs is likewise calculated.

- <u>Projects with unknown installed capacity: $7,530,000 ($1.4 million to $13.6 million).</u> Where installed capacity is unknown, the cost estimate reflects the likelihood of the project having various levels of installed capacity based on the available data regarding hydropower projects in the Northwest. In the Northwest region, 81.2 percent of dams have installed capacity of less than five MW, 6.4 percent have installed capacity between five and 20 MW, and 12.4 percent have an installed capacity of greater than 20 MW.

Operational modifications (forgone power revenues and power purchases):
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.

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; the method of augmenting/changing flows at a specific project; and project-specific operational models. Thus, 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 impacts modeling exercise would be possible, though massive and complex. For hydraulically-coupled dams like the Federal Columbia River Power System (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, particularly in NOAA Fisheries' NWR. These data are used to illustrate the potential magnitude of these costs.

Table 4-5
COSTS OF FISH AND WILDLIFE MODIFICATIONS TO HYDROPOWER PROJECTS

Dam	River	Annual Fish & Wildlife Costs: Capital and Programmatic	Annual Fish & Wildlife Costs: 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 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.

Table 4-5 **COSTS OF FISH AND WILDLIFE MODIFICATIONS** **TO HYDROPOWER PROJECTS**
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.

Spatial Distribution

- This analysis applies latitude/longitude data from the USACE National Inventory of Dams and the California Department of Water Resources, Bulletin 17 for all hydroelectric projects in the SWR to project spatial occurrence.[64]

Temporal Distribution

- For Federal Energy Regulatory Commission (FERC) licensed dams, section 7 consultation and subsequent project modification is anticipated to begin concurrent with the expiration of the current FERC license.

- Federal dams are not subject to FERC relicensing and, as such, operations may not be reviewed on a standard schedule. Some Federal hydroelectric projects undergo an operations review approximately every ten years. This analysis assumes that consultation for Federal dams will occur sometime within the next ten years for each Federal hydropower project. An equal probability is assigned to this consultation beginning in each year over the next ten years (i.e, a consultation has a ten percent probability of occurring in any given year).

- Dams with installed capacity less than 5MW are assumed to have a ten percent probability of incurring modification costs during the next twenty years, with the probability distributed uniformly over the period.

[64] California Department of Water Resources, Division of Safety of Dams. Dams within the Jurisdiction of the State of California, Bulletin 17.

- Where the licensing information is not available, this analysis assumes that consultation will occur sometime over the next 30 years, due to the fact that FERC licenses typically last 30 to 50 years. This analysis assigns an equal probability to this consultation beginning in each year over the next 30 years.

- Costs of project modifications to hydropower projects are assumed to be incurred uniformly over a ten year time period beginning in the year of potential section 7 consultation.

Caveats

- Spatial data for hydropower projects may vary according to data source. This is due to the fact that data sources may map the location of any number of components of the project, including dam infrastructure, turbine, powerhouse, afterbay, or forebay. To the extent possible, this analysis uses the location of dam infrastructure for the spatial analysis. No comprehensive dam location and attribute data layer exists, however. 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.

- No comprehensive forecast for consultations at hydropower dams exists. To estimate the expected start date for future consultation, this analysis employs 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.

- Hydropower projects may be required to provide additional flow for West Coast salmon and steelhead, and as a result may experience significant economic impacts to the extent that increased flow results in decreased or redistribution of power generation. Specific dam projects that will be required to provide this flow, and how (e.g., spill) the flow augmentation may be achieved, are difficult to predict. The likelihood of a particular project being required to provide flow for salmon will depend on many factors, including biological significance of the dam project to West Coast salmon and 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 estimates of modification costs for hydropower projects assigned to a particular watershed.

4.4.2.2 Non-Hydropower Dams and Water Supply Structures

Cost estimates

- <u>Capital and Programmatic costs: $2.1 million ($24 thousand to $4.2 million).</u>
For dams other than hydropower projects, capital (and maintenance) costs to accommodate salmon and steelhead needs were estimated from several case studies of municipal water intake projects (estimated to range from $24,000 to $670,000). Using PNHD data, costs to install fish passage and

fish screens were estimated to range from $92,000 to $4.2 million. Because dam projects may bear any combination of the costs estimated, costs are estimated to range from $24,000 to $4.2 million for dams that are required by section 7 consultation to accommodate West Coast salmon and steelhead needs. The current analysis assumes 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 costs associated with salmon needs at some point over the next 20 years. This time frame reflects the past rate of formal consultation on non-hydropower related projects in the consultation record (approximately 10 per year). Other non-hydropower dams are assumed to have a ten percent probability of consultation and modification during this period.

- <u>Operational (flow regime) costs (no estimates for a particular watershed).</u>
Costs to provide additional water flow for salmon are difficult to estimate because reliable data on water quantity changes attributable to section 7 consultation, now and in the future, do not exist. There also does not appear to be a consensus of how varying flow requirements will be implemented throughout the designation. More detail is provided in Appendix B.

Spatial Distribution

- This analysis applies latitude/longitude data for dams other than hydroelectric projects from the USACE National Inventory of Dams to project the spatial occurrence of this activity type, covering 648 dams in the California..

Temporal Distribution

- Limited data exist regarding maintenance schedules for non-hydropower projects. This analysis assumes that a consultation, if it occurs, will occur sometime over the next 20 years, based on the historic frequency of consultation of these project types.

- This analysis assumes that federally regulated dams and dams with large reservoirs are certain to face consultation and modification during a twenty year period, with the probability distributed uniformly across this period. Other non-hydropower project dams are assigned a probability of incurring costs related to West Coast salmon and steelhead of ten percent.

Caveats

- Spatial data for dam projects other than hydropower projects may vary according to data source. This is due to the fact that data sources may map the location of any number of components of the project, including dam infrastructure, as separate features. 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.

- No comprehensive forecast for consultations at non-hydropower dams exists. Consultations at particular non-hydropower projects are assumed to occur with uniform probability over the next 20 years.

- While non-hydropower dam and water supply projects may be required to provide additional flow for salmon and steelhead, the specific dam projects that will be required to provide this flow are difficult to predict. The likelihood of a particular project being required to provide flow for salmon will depend on many factors, including biological significance of the dam project to salmon 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 providing additional flow for West Coast salmon and steelhead are not included in estimates of modification costs for non-hydropower and water supply projects assigned to a particular watershed.

4.4.2.3 Federal Land Management Activities (excluding grazing)

Cost estimates

- <u>Land management activities: $4.91 to $18.27 annual cost per acre (non-wilderness areas) and $0.23 to $1.02 annual cost per acre (wilderness areas).</u>
Programmatic activities of the BLM and USFS are grouped into one category because they have similar land management goals and regulations, and because they frequently consult together. Locations of future USFS projects are projected using data from quarterly Statement of Proposed Actions (SOPAs) released by national forests. Within each of two regions (Northern and Southern California), SOPA projects are grouped into ten activity categories. To create an estimated frequency of these activities, a regional average number of activities from SOPAs was estimated on an annual basis. Projects occurring on BLM lands are assumed to occur with the same relative frequency as those occurring on national forest lands within the same region.

- For each category of activity, past section 7 consultation project modifications were documented and costs were estimated. Per-acre estimates of project modification costs were developed using the average annual number of projects for each forest divided by forest acreage.

- Costs of project modifications to programmatic Federal land management projects are incurred in one year.

Spatial Distribution

- The locations of future USFS projects are projected using data from Statement of Proposed Actions (SOPAs) released by specific National Forest Units. This analysis identifies acres of land within BLM Districts and National Forests per watershed within each of the two regions using GIS land ownership data. Data from representative SOPAs are averaged to provide an estimate of the types of projects that may occur on these Federal lands. The number of activities projected to occur is then based on the acreage of Federal lands in each watershed.

- Projects occurring on BLM lands are assumed to occur with the same relatice frequency as those occurring on USFS lands within the same region.

Temporal Distribution

- On average, the number of projects listed in each SOPA generally represents the number of projects that will occur on a National Forest in a given year.

Caveats

- This analysis assumes that the SOPA lists all proposed and ongoing activities occurring within each national forest, and that these activities tend to occur with seasonal regularity.

- This analysis assumes that the amount of Federal lands management activity within each watershed that is impacted by section 7 is related to the amount of Federal land within that watershed.

4.4.2.4 Livestock Grazing on Federal Land

Cost estimate

<u>- Livestock Grazing: $29.00 per acre per year ($11.00 to $48.00).</u>
Grazing on Federal lands requires a permit from the appropriate land management agency. Direct costs of compliance with section 7 are estimated by grazing allotment on a per-acre basis. These costs are then distributed according to the amount of Federal grazing lands in each watershed. This analysis assumes the modification costs are composed primarily of capital improvement (fencing) to the grazing land and annual maintenance costs.

Spatial Distribution

- Federal grazing lands were identified by intersecting spatial coverages for statewide grazing allotments with a USFS/BLM ownership coverage in the study area.

Temporal Distribution

- This analysis assumes that each acre of Federal lands grazing will bear modification costs for section 7 consultations related to West Coast salmon or steelhead at some point over the next ten years, when the permit is renewed. This analysis assumes an equal probability of the consultation in a given year within the ten year period.

Caveats

- This analysis assumes that consultation related to livestock grazing on Federal land is certain to occur and the modifications costs are borne in one year.

4.4.2.5 Transportation Projects

Cost estimates

- Bridge and Culvert Projects: $41,000 - $105,000 per project (range depends on project mileage). Transportation projects are typically required to have a consultation when they involve permitting or funding by the Army Corps of Engineers (USACE), Federal Highways Administration (FHWA) and/or the Federal Aviation Administration (FAA). Per-project estimates of the direct costs of compliance with section 7 were developed using cost per project miles for variable costs combined with per project fixed costs. Project modifications costs include bank stabilization, monitoring and evaluation, habitat improvement, spill prevention contaminant control plan, erosion control, timing restrictions, and so forth.

- Road Projects: $35,000 - $105,000 per project (range depends on project mileage). Transportation projects are typically required to have a consultation when they involve permitting or funding by the Army Corps of Engineers (USACE), Federal Highways Administration (FHWA) and/or the Federal Aviation Administration (FAA). Per project estimates of the direct costs of compliance with section 7 are developed using cost per project mile for variable costs combined with per project fixed costs. Project modification costs include bank stabilization, monitoring and evaluation, habitat improvement, spill prevention contaminant control plan, erosion control, and timing restrictions, etc.

- All costs of project modifications to transportation projects are assumed to be borne in one year.

Spatial Distribution

- The location of transportation projects is based on spatial data from transportation plans for California, specifically the California Transportation Investment System (CTIS), that identifies locations of historic and future projects.

Temporal Distribution

- Although the transportation plans vary in scope (three to six years), it is assumed that the point locations of these projects represent "typical" locations of transportation projects initiated and completed over a five year time horizon.

Caveats

- According to the transportation plans, the vast majority of projects are forecast to occur within a five-year time frame. This analysis therefore employs a forecast period of five years for transportation projects and assumes that all scheduled projects will occur within this forecast period. In reality, a number of projects are scheduled to occur beyond the forecast period. In these instances, this analysis overstates the costs of these projects.

- Spatial data identifies the location of specific transportation projects expected to occur over a given time period. Because the time frame of transportation plans do not match the 2003 to 2008 forecast period for the analysis, the actual locations of future projects may differ slightly from those listed in the transportation plans, but are expected to occur in similar geographic areas (e.g., urban centers).

4.4.2.6 Utility Line Projects

Cost estimates

- Outfall Structure and Pipelines: $101,000 ($100,000 to $102,000). Utility line projects are typically required to have a consultation with USACE for permitting of outfall structure and pipelines. The cost estimate represents a range of costs for standard modifications to utility projects including, implementing erosion control measures, directional drilling, restoration of construction sites, and timing restrictions.

Spatial Distribution

- The location of utility projects is based on the latitude and longitude of historic USACE permits for utility line and outfall structure projects. Permit data were collected from the Los Angeles, Sacramento, and San Francisco USACE Districts. The data include locations of permits from approximately 1996 to 2003, and vary by district.

Temporal Distribution

- This analysis assumes that consultation related to projected permit applications is certain to occur and the modifications costs are borne in one year.

Caveats

- Historic location of USACE permits for utilities is the most reasonable predictors of future locations available.

4.4.2.7 In-stream Activities (excluding dredging)

Cost estimates

- Boat Dock, Boat Launch, Bank Stabilization: $54,500 ($25,000 to $84,000).
Boat dock, boat launch, and bank stabilization projects are typically required to have a consultation through a connection with USACE permits. This estimate represents the midpoint of a range of costs for modifications typically found in consultations. These costs include shoreline planting, construction materials restrictions, use of bubble curtains, habitat improvement, spill prevention contaminant control plan, erosion control, and timing restrictions, and so forth.

Spatial Distribution

- The location of in-stream projects is based on the latitude and longitude of historic USACE permits excluding 1) activities likely to be captured elsewhere in the analysis (e.g., roads, bridges, dredging), and 2) activities not included in the analysis (e.g., restoration). Permit data were collected from the Los Angeles, San Francisco, and Sacramento USACE Districts. The data include permits from 1996 to 2003, and vary by district.

Temporal Distribution

- This analysis assumes that consultation related to projected permit applications is certainto occur and that modification costs are borne in one year

Caveats

- Historic location of USACE permits for utilities is the most reasonable predictors of future locations available.

4.4.2.8 Dredging Projects

Cost estimates

- Dredging: $821,000 ($332,000 to $1,300,000).
Dredging projects are typically required to have a consultation through a connection with USACE permits. This estimate represents the midpoint of a range of costs for modifications typically found in consultations. These costs include work window constraints, extension of the prescribed work window, additional survey work, and mobilization costs.

- Dredgingof San Francisco Bay: $651,000 ($162,000 to $1,140,000).
In the San Francisco Bay, dredging is regulated by a Long-Term Management Strategy (LTMS) For the Placement of Dredged Material in the San Francisco Bay Region. The LTMS gives dredging windows, disposal sites, and targets for distribution of dumping among sites. NOAA treats these permit applications programmatically unless projects cannot occur within the dredging windows and a formal consultation is required. Based on historical project experience, this is expected to occur 14 percent of the time. As work windows and disposal sites are required by the LTMS, these potential project modifications are considered baseline. Therefore, mobilization costs are the only costs attributable to the designation of critical habitat, these costs are anticipated to be incurred 14 percent of the time, and include dredging windows, disposal sites, and targets for distribution of dumping among sites.

Spatial Distribution

- The location of dredging projects is based on the latitude and longitude of historic USACE dredging permits. Permit data were collected from the San Francisco, Los Angeles, and Sacramento USACE Districts. The data include permits from 1996 to 2003, and vary by district.

Temporal Distribution

- For the purposes of this analysis, it is assumed that consultation related to projected permit applications is certain to occur and that modification costs are borne in one year.

Caveats

- Historic location of USACE permits for utilities is the most reasonable predictors of future locations available.

4.4.2.9 NPDES-permitted Activities

Cost estimates

- <u>Temperature Management Plan Compliance activities for Major Projects: $816,000 ($582,000 to $1,110,200).</u>
National Pollutant Discharge Elimination System (NPDES) permitted facilities are required to ensure effluent discharge does not raise the temperature in receiving waters above site-specific minimum temperature standards. The section 7 consultation record indicates salmon concerns have produced more restrictive measures for temperature controls. The high end of the range includes annual operation and maintenance costs of up to $685,200 and total capital costs of $425,000 over 20 years. This range in costs represent direct compliance costs for "major" NPDES facilities, defined as those facilities discharging greater than one million gallons per day based on an EPA economic assessment of four major NPDES-permitted facilities in Oregon.[65]

- <u>Temperature Management Plan Compliance activities for Minor Projects: $136,000 ($0 - $272,000).</u> The high end of the range includes annual operation and maintenance costs of up to $6,800. The range in costs represent direct compliance costs for "minor" NPDES facilities, defined as those facilities discharging less than one million gallons per day based on an EPA economic assessment of a sample of five minor NPDES-permitted facilities in Oregon.

Spatial Distribution

- The location of future consultation regarding compliance with temperature water quality criteria is based on the latitude and longitude of major and minor National Pollutant Discharge Elimination System (NPDES) permitted facilities within a watershed. This analysis assumes facilities will undertake various measures to ensure the temperature of surrounding waterways do not exceed regulatory standards developed specifically to protect West Coast salmon and steelhead.

- Permit data were collected from the Washington Department of Ecology, Oregon Department of Environmental Quality, EPA Region 10, and EPA Region 9 and represent the location of facilities as of 2003 or 2004.

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[65] Science Applications International Cooperation: *Economic Analysis of the Proposed Water Quality Standards Rule for the State of Oregon* . Science Applications International Corporation. Reston, VA. 2003. EPA No. 68-C-99-252.

- Based on the historical section 7 consultation record, not all NPDES-permitted facilities are likely to undergo section 7 consultation. Accordingly, the analysis assumes that 25 percent of major facilities and 20 percent of minor facilities will incur costs, based on an EPA study examining the economic impact to facilities of the temperature regulations. The level of activities per watershed is adjusted to reflect this probability.

Temporal Distribution

- The analysis assumes that consultations related to temperature compliance will occur immediately (with the probabilities specified above).

Caveats

- EPA's study assumed that facilities in designated spawning and rearing watersheds would incur temperature management costs.

4.4.2.10 Sand and Gravel Mining

Cost estimates

- <u>Sand and gravel mining: $1.35 million.</u> Sand and gravel mining activities typically require USACE permits under section 401 and 404 of the Clean Water Act. Using a case study, this analysis estimates the cost reductions in the volume of gravel production due to section 7 implementation using a case study. In this case study, a loss in net revenues of approximately $11,000 per mile annually was estimated, assuming no substitution of alternate sites, for a total value of $1.35 million for the whole site over the life of the permit. Because some projects are unlikely to require modifications for salmon (for example, if they occur on non-fish-bearing streams or outside the West Coast salmon and steelhead spawning season), this analysis assumes that each site has a 50 percent probability of being required to modify its operations.

Spatial Distribution

- Locations of ongoing and potential mining sites were identified using latitude/longitude data from the USGS "Active Mines and Mineral Plants" (1997).

Temporal Distribution

- This analysis assume there exists an equal probability of consultation beginning in each year over the next 30 years.

Caveats

- This analysis may overstate the likelihood of consultations on sand and gravel mining because not all active and potential mine sites are likely to bear costs for salmon conservation measures. The likelihood of future consultation at a particular site depends on the several factors including the season in which mining activity occurs and the proximity of the mine to fish-bearing streams.

4.4.2.11 Residential and Commercial Development

Cost estimates

- Residential and Commercial Development: $235,000 ($230,000 to $240,000). Development projects are typically required to have a consultation through a connection with stormwater permits. This estimate represents the midpoint of a range of costs associated with constructing a stormwater management plan that conforms with salmon requirements. This includes costs of the stormwater pollution prevention plan, permanent stormwater site plan, and stormwater best management practice operation and maintenance.

- Based on the section 7 consultation record, not all permit applications undergo section 7 consultation. Accordingly, the analysis applies a probability of six percent, representing the proportion of all permits likely to undergo consultation in each watershed relative to the total number of permits in each watershed potentially burdened by consultation. This probability is based on a review of State-issued NPDES stormwater permits resulting in section 7 consultation with the Seattle District of the USACE over the past three years. As a result, six percent of all projected State permits in each watershed are presumed to be burdened by section 7 consultation and related compliance costs.

Spatial Distribution

- As a proxy for the location of development activities potentially burdened by compliance requirements, the analysis employs recent NPDES stormwater permit data by State for residential and commercial development. Specifically, the analysis assumes that the number and location of future development activities constrained by West Coast salmon and steelhead protections are reasonably approximated by the proportion of NPDES stormwater permits resulting in consultation in the past.

- These historical permit data were collected from the Washington Department of Ecology, Oregon Department of Environmental Quality, and EPA Region 9 and 10. Industrial permit data were excluded, as this activity is captured through the analysis of EPA water quality regulations, utility, and in-stream projects. In general, the analysis relies on approximately three years of State NPDES stormwater permit data.

Temporal Distribution

- This analysis assumes that consultation related to projected permit applications is certain to occur and that modification costs are borne in one year.

Caveats

- Availability of historic permit data varies by State.

4.4.2.12 Agricultural Pesticide Applications

Cost estimates
- <u>Agricultural pesticide applications (varies by crop type and county).</u> Three crop types (orchards and vineyards, row crops, and small grains) are considered separately. Using data from the USDA's National Agricultural Statistics Service (NASS), estimates of the net agricultural revenue per acre are derived for each crop type in each county covered by an ESU. Under the assumption that the court-ordered restrictions on pesticide applications forces the affected land out of production, these estimates are a measure of the cost of section 7 enforcement.

Spatial distribution
- The court-ordered restrictions are applied as no-spray buffers along "salmon-supporting waters." NOAA Fisheries interprets this phrase to mean stream reaches occupied by salmon or steelhead from the seven ESUs. USGS National Land Cover Data (NLCD) from 1992 was used to estimate the amounts of the three crop types within the two sizes of buffers (100 yards and 20 yards).

Temporal distribution
- This analysis assumes that implementation of no-spray buffers is certain to occur and that the costs of foregone production are borne in one year.

4.5 Summary

Table 4-6 below summarizes the cost estimates for the different types of activities.

Table 4-6 SUMMARY OF ACTIVITY COST ESTIMATION							
Activity	**Sub-activity**	**Cost Unit**	**Mid-range Cost Estimate**	**Present Value of Cost Stream**	**Forecast Period**	**Likelihood of Modifications**	**Annualized Expected Cost**
Hydropower Dams*	Small (0 - 5 MW)	per dam	$2,120,000	$1,123,000	20 years	10% over 20 years	$11,000
	Medium (5 - 20 MW)		$5,750,000	$1,916,000	50 years	100% over 50 years	$139,000
	Large (>20 MW), fish passage unknown		$56,390,000	$34,593,000	50 years	100% over 50 years	$2,507,000
	Unknown capacity		$7,530,000	$2,506,000	50 years	100% over 30 years	$182,000
Non-hydropower Dams	Federal and large non-hydropower dams	per dam	$2,120,500	$1,123,000	20 years	100% over 20 years	$106,000
	Small non-Federal Non-hydropower dams					10% over 20 years	$10,000
Federal Land Management Activities (non-wilderness areas)	Northern California	per acre	$8.95	$8.95	1 year	100%	$8.95
	Southern California		$12.16	$12.16			$12.16
Federal Land Management Activities (wilderness areas)	Northern California	per acre	$0.44	$0.44	1 year	100%	$0.44
	Southern California		$0.70	$0.70			$0.70
Livestock Grazing on Federal Land	Grazing	per acre	$29.00	$20	10 years	100%	$2.90

Table 4-6 SUMMARY OF ACTIVITY COST ESTIMATION							
Activity	**Sub-activity**	**Cost Unit**	**Mid-range Cost Estimate**	**Present Value of Cost Stream**	**Forecast Period**	**Likelihood of Modifications**	**Annualized Expected Cost**
Transportation**	Bridges & culverts (small)	per project & mile	$27,800 + variable costs (dependent on size of project)	project specific	5 years	100%	project specific
	Bridges & culverts (medium)		$55,500 + variable costs	project specific			project specific
	Bridges & culverts (large)		$84,300 + variable costs	project specific			project specific
	Roads (small)	per project & mile	$22,800 + variable costs	project specific	5 years	100%	project specific
	Roads (medium)		$47,000 + variable costs	project specific			project specific
	Roads (large)		$71,300 + variable costs	project specific			project specific
Utility Lines	Outfall structures and pipelines	per project	$101,000	$75,000	8 years	100%	$13,000
Instream Activities	Dredging	per project	$821,000	$612,000	8 years	100%	$102,000
	Dredging of San Francisco Bay	per project	$651,000	$486,000	8 years	100%	$81,000
	Boat dock, boat ramps, bank stabilization	per project	$54,500	$41,000	8 years	100%	$7,000

Table 4-6
SUMMARY OF ACTIVITY COST ESTIMATION

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Modifications	Annualized Expected Cost
EPA Water Quality Temperature Compliance	Minor facility	per facility	$136,000	$72,000	20 years	20%	$1,000
	Major facility	per facility	$816,000	$630,000	20 years	25%	$15,000
Sand and Gravel Mining	Mining on non-Federal lands	per site	$1,649,000	$280,000	30 years	50%	$23,000
Residential and Commercial Development	New development	per project	$235,000	$235,000	1 year	6%	$14,000
Agricultural Pesticide Applications	Oil seed and grain farming	per acre	varies by county and crop type	varies by county and crop type	1 year	100%	varies by county and crop type
	Vegetable and melon farming						
	Fruit and tree nut farming						

*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.
**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

This section presents a summary of the economic impacts of critical habitat designation for the seven ESUs of West Coast salmon and steelhead considered in this analysis. Because of the large numbers of watersheds and nearshore areas that constitute the particular areas, the results are summarized by showing their range and other summary statistics for each ESU.

This section first discusses the aggregation of individual activity impacts into a total impact for each area, and some qualifications on the results. It then examines two different ways of grouping types of impacts that provide useful economic information to the exclusion process. Finally, this section presents a summary of the results for each ESU. The full set of results is given in Appendix D.

As noted, the 4(b)(2) exclusion process operates at the level of a particular watershed, not at the level of the designation as a whole. For this reason, the variation of impacts across areas is an important factor in conducting that process. To illustrate this variation, this section presents a series of figures that identify which areas fall into different impact categories. These categories are for illustrative purposes only, however, as the 4(b)(2) procedure used the potential cost estimate itself, not the category.

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 a 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, this analysis applies a straightforward "unit-cost" approach to estimate the aggregate impacts for each watershed. Using the spatial data described in Section 4 above, the annual volume of an activity type in a particular area is estimated. Where an activity has different sub-types or scales, a separate level was estimated for each. This analysis then uses the annualized expected modification cost to calculate the economic impact of critical habitat designation for a particular area, using the following formula:

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

Two important elements of this estimation warrant closer examination: variation in the discount rate and per-project modification costs. Both of these are considered in the following ways. First, using the guidance from OMB, a three percent discount rate is substituted for the seven percent discount rate used in the base case calculations.[66] Second, using the ranges of modification costs (where available) described in Section 4 and Appendix B, a Low and High case are estimated for the annualized expected per-unit costs. For both cases, the estimates are substituted into the equation above.[67] This produced six cases, using the two discount rates (three and seven percent) and three cost estimates (Midpoint, High, and Low).

Although the high and low ends of the cost range are used 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 was chosen as the base case in this analysis. 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 in a small fraction of the cases. For the upper and lower bounds of the aggregate impact costs to be reached, it would have to ve that every individual project has the characteristics necessary to reach the upper or lower bound, which is not the case. Nevertheless, this information is presented to illustrate how variation in the underlying 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. This report does 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 West Coast salmon and steelhead. 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. As noted previously, 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 require a clear, quantifiable link between the regulation and a change in the availability or

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[66] OMB, 2003.

[67] Uncertainty over the estimated volume of projects was not determined. The use of the chosen spatial data and the projection methods do not allow for analytical derivation of a range.

cost of a set of economic goods and services. In some previous analyses of critical habitat designation, such a link existed (or was at least 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.[68] This assumption allowed the analysis to estimate the impacts of the designation on regional levels of employment and County revenues.

Specifying the link between critical habitat designation and a change in an economic good or service so precisely is not possible for the West Coast salmon and steelhead designations. In the Initial Regulatory Flexibility Analysis for this rulemaking, NOAA Fisheries discusses the impacts of the designations on small entities. In that report, NOAA identifies a set of links between the different types of activities identified here and different industry groups that may bear the cost of some of the impacts to those activities. These links are presented in Table 5-1.

In some cases, the link between the activity and an 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. Working against this possibility, however, are the large number of dams and the need to document certain modifications (e.g., changes in flow) on an individual basis, when these modifications are highly uncertain prospectively. Thus, the data needed to support such an effort are not available even in this case.

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 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 results is downward, in that costs of critical habitat designation are underestimated at the level of the ESU. On the other hand, other potential sources of error exist that would produce an overestimate of the impact, as discussed in several instances above. The aggregate direction of these potential error is therefore unknown.

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[68] M.L. Schamberger, J. J. Charbonneau, M. J. Hay, and R. L. Johnson, Economic Analysis of Critical Habitat Designation Effects for the Northern Spotted Owl, 1992.

Table 5-1
INDUSTRY GROUPS AND CRITICAL HABITAT DESIGNATION IMPACTS

Type of Activity Impacted by Critical Habitat Designation	Industry Groups associated with Impacted Activity
Hydropower Dams	Hydroelectric Power Generation NAICS 22111
Non-hydropower Dams	Water Supply and Irrigation Systems NAICS 22131
Federal Lands Management	Forestry and Logging NAICS 113
Grazing	Beef Cattle Ranching & Farming NAICS 112111
Transportation	Highway, Street, and Bridge Construction NAICS 237310
Utility Lines	Electric Services NAICS 2211
	Natural Gas Distribution NAICS 221210
	Sewage Treatment Facilities NAICS 221320
Instream Activities	Construction-General, Water, Sewer, Pipeline, Communication & Powerline Construction NAICS 237110, 237120, 237130
	Marinas NAICS 713930
Dredging	Heavy Construction SIC 1629
NPDES-permitted Activities	Fishing, Hunting, Trapping NAICS 114
	Food and Kindred Products NAICS 311
	Sewage Services NAICS 221320
	Paper Mills NAICS 322121, 322122
	Pulp Mills NAICS 322110
	Lumber and Wood Products NAICS 321
Mining	Construction Sand and Gravel Mining NAICS 212321
Development	Subdividers and Developers SIC 6552
Agricultural Pesticide Application	Oil Seed and Grain Farming NAICS 1111 Vegetable and Melon Farming NAICS 1112 Fruit and Tree Nut Farming 1113

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. NOAA Fisheries recognizes 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, 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 influence economic efficiency.[69] The location and concentration of impacts may in part determine the equity of the regulation, however. To support consideration of this issue, the set of activity types are divided into two types: those likely to have economic impacts locally and those likely to have economic impacts at a broader geographic scale.[70] For each activity, this analysis 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 5-2.

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 Federal lands management (which is funded at the Federal level). This analysis does 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.

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[69] This approach is recommended by OMB (2003) and EPA (2000).

[70] This division was made using best professional judgment.

Table 5-2 ACTIVITY TYPES WITH LOCAL AND NON-LOCAL IMPACT	
Local Impact Activity Types	**Non-local Impact Activity Types**
Non-hydropower Dams Utility Line Projects Instream Activities Dredging Projects NPDES-permitted Activities Sand & Gravel Mining Residential and Commercial Development Agricultural Pesticide Applications	Hydropower Dams Federal Lands Management (wilderness and non-wilderness areas) Grazing Transportation Projects

The second type of grouping categorized activity types by the location of the activity within the watershed. NOAA Fisheries is considering the designation of only the migratory corridor within a watershed and the exclusion of the tributary areas. If this course is followed, only a portion of the estimated impacts (that is, those associated with the migratory corridor) would be attributable to critical habitat designation. The original estimation of the location of activity types did not differentiate the location within a watershed, however. Similar to the approach above, this analysis identifies types of activities that were more likely to be located along migratory corridors.[71] The analysis also draws on discussions with NOAA Fisheries' biologists familiar with section 7 consultations. Again, the division is categorical, which presumes a higher likelihood of being present in one area or another, but not a certainty. Table 5-3 presents the migratory and tributary grouping of activities.

[71] This division was made using best professional judgment. NOAA intends to refine this division and welcomes comment on data and methods for doing so.

Table 5-3 ACTIVITY TYPES AND LOCATION	
Activity Types located in tributary areas	**Activity Types located in migratory corridors**
Mining Transportation Federal Lands Management (wilderness and non-wilderness areas) Grazing Non-hydropower Dams Development Agricultural Pesticide Applications	Utility Lines Dredging Instream Activities NPDES-permitted Activities Hydropower Dams

5.4 Summary of the Results for Seven West Coast Salmon and Steelhead ESUs

Below, a brief narrative covering the results is presented for each ESU, followed by a series of tables, and finally by a figure illustrating the basic results. The emphasis is on illustrating the variation in the impact of section 7 and critical habitat designation for individual watersheds in each ESU. As noted, the number of particular areas considered in the report is quite large, making a detailed discussion of each area's result impractical.[72] The summary includes several important aspects of the results, including:

1) The total impact of the designation for the ESU overall;

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 in annualized terms and the sensitivity of the total impacts to variation in cost estimates and discount rates; and

4) The frequency of annual total impacts by cost category for individual watersheds in an ESU.

[72] Appendix D contains the full set of results for all watersheds, grouped by ESU. This set includes total, local and non-local, and migratory and tributary impacts for each of six cases (three per-project cost estimates and two discount rates), as well as the individual activity cost estimates presented in the same way.

For most of these, results for each of the six cases are listed: High/Mid/Low refers to the per-project cost estimate, and seven percent/ three percent refers to the discount rate.

This report also illustrates the total impacts at the individual watershed level by presenting a series of maps that display the impacts as categories of cost levels. Categories to illustrate were chosen based on the variation in impacts at the watershed level across each ESU. These categories were not used in the 4(b)(2) process, as their choice would be arbitrary given the continuous nature of the impact estimates.

Lastly, it is important to recognize 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 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."[73] 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.

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

5.4.1 California Coastal chinook salmon

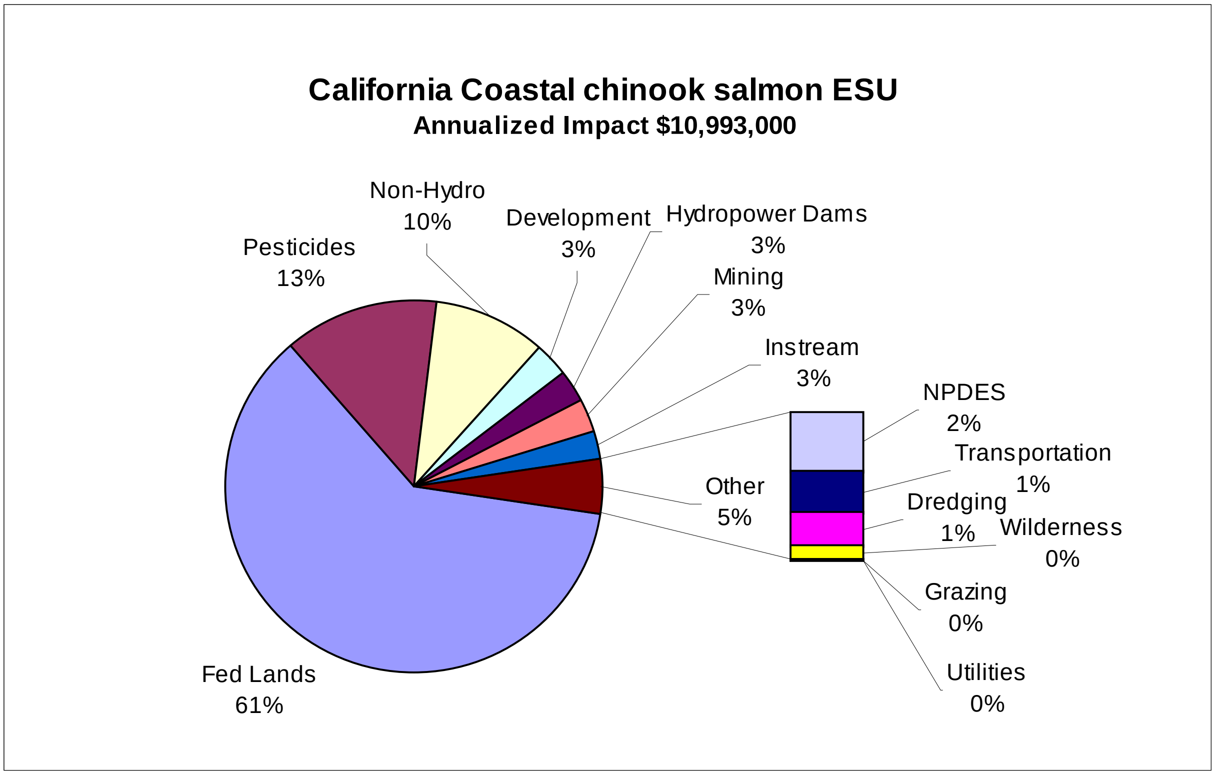
5.4.1.1 Watershed Characteristics

For this ESU, the analysis covers 47 watersheds, averaging 158 square miles in size and ranging from three to 413 square miles. The estimated total population for this ESU is 428,262 and the estimated total personal income is $13.06 billion.

5.4.1.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$16,691,000
Mid 7%	$10,993,000
Low 7%	$5,288,000
High 3%	$16,628,000
Mid 3%	$10,944,000
Low 3%	$5,252,000

5.4.1.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.1.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $234,000.
- The highest annualized total impact at the watershed level is $1,142,000 for Humboldt Bay, while the lowest non-zero total watershed impact is $4 for Ten Mile River; two watersheds are expected to experience zero impact.
- The activity with the highest impact is Federal Lands Management in non-wilderness areas which averages $143,000 across all watersheds in this ESU and ranges from $0 to $957,000.
- The activity with the lowest impact is Utility lines which has no impact within the watersheds comprising this ESU.
- One watershed has annualized total impacts of more than $1 million, while 18 have annualized total impacts less than $50 thousand.

Case	Total Annualized Impact for Individual Watersheds			
	Average	**Median**	**Maximum**	**Minimum**
High 7%	$355,000	$126,000	1,721,000	0
Mid 7%	$234,000	$83,000	$1,142,000	0
Low 7%	$113,000	$40,000	$561,000	0
High 3%	$354,000	$126,000	$1,705,000	0
Mid 3%	$233,000	$83,000	$1,134,000	0
Low 3%	$112,000	$40,000	$560,000	0

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	37	37	30	30	27	27
$200,000 - $500,000	9	9	7	7	6	6
$500,000 - $1,000,000	1	1	9	9	7	7
$1,000,000 - $2,500,000	0	0	1	1	7	7
> $2,500,000	0	0	0	0	0	0

5.4.2 Central Valley spring-run chinook salmon

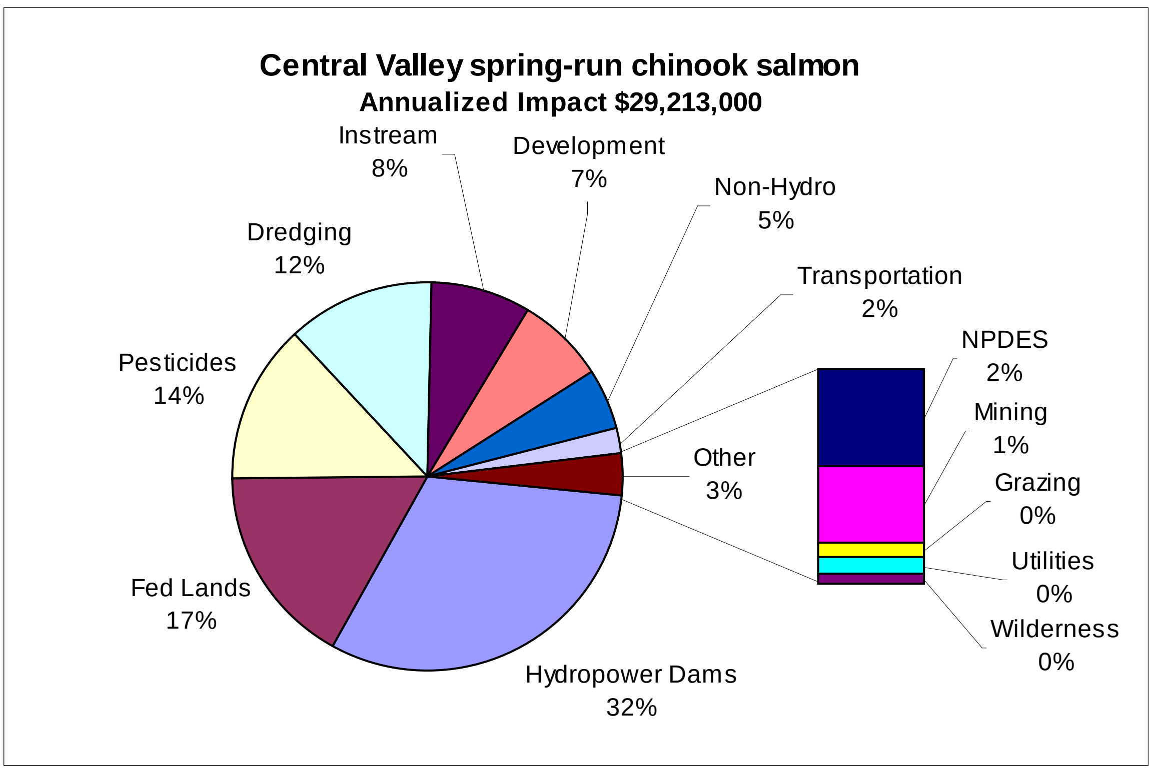
5.4.2.1 Watershed Characteristics

For this ESU, the analysis covers 37 watersheds, averaging 220 square miles in size and ranging from 15 to 1, 074 square miles. The estimated total population for this ESU is 1,758,267 and the estimated total personal income is $50.63 billion.

5.4.2.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$47,221,000
Mid 7%	$29,233,000
Low 7%	$11,216,000
High 3%	$42,887,000
Mid 3%	$26,799,000
Low 3%	$10,700,000

5.4.2.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.2.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $790,000.
- The highest annualized total impact at the watershed level is $5,570,000 for Lower Feather River, while the lowest is $8,300 for Colusa Trough.
- The activity with the highest impact is hydropower which averages $246,000 across all watersheds in this ESU and ranges from $0 to $5,280,000.
- The activity with the lowest impact is Federal lands management in wilderness areas which averages $990 across all watersheds in this ESU and ranges from $0 to $19,000.
- Nine watersheds have annualized total impacts of more than $1 million, while seven have annualized total impacts less than $50 thousand.

Case	**Total Annualized Impact for Individual Watersheds**			
	Average	**Median**	**Maximum**	**Minimum**
High 7%	$1,276,000	$761,000	$9,988,000	$11,500
Mid 7%	$790,000	$449,000	$5,570,000	$8,300
Low 7%	$303,000	$199,000	$1,728,000	$4,000
High 3%	$1,159,000	$730,000	$7,158,000	$11,500
Mid 3%	$724,000	$449,000	$4,002,000	$8,300
Low 3%	$289,000	$198,000	$1,720,000	$4,000

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	19	19	12	12	11	11
$200,000 - $500,000	11	10	8	7	3	3
$500,000 - $1,000,000	6	6	9	9	7	7
$1,000,000 - $2,500,000	1	2	6	7	12	12
> $2,500,000	0	0	2	2	4	4

5.4.3 Central California Coast Steelhead

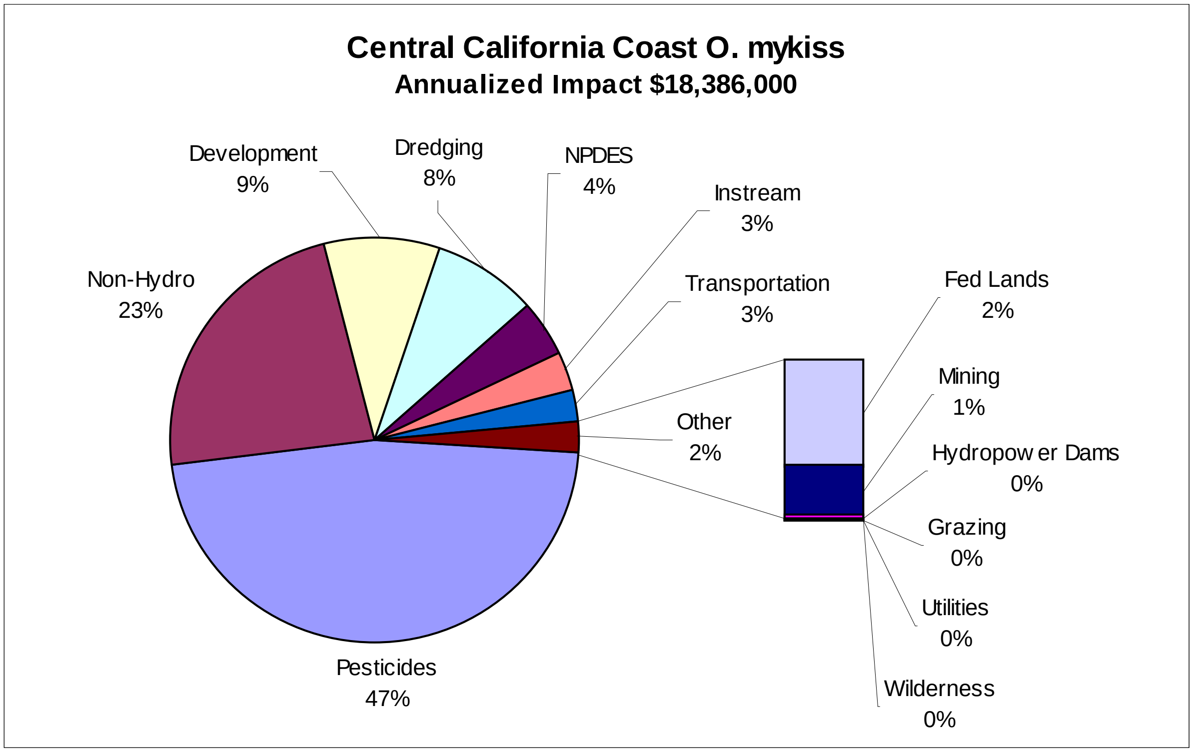
5.4.3.1 Watershed Characteristics

For this ESU, the analysis covers 46 watersheds, averaging 115 square miles in size and ranging from 15 to 422 square miles. The estimated total population for this ESU is 5,526,000 and the estimated total personal income is $265.6 billion

5.4.3.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$30,377,000
Mid 7%	$18,577,000
Low 7%	$6,828,000
High 3%	$30,193,000
Mid 3%	$18,433,000
Low 3%	$6,684,000

5.4.3.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.3.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $404,000.

- The highest annualized total impact at the watershed level is $5,211,000 for Napa River, while the lowest non-zero total watershed impact is $4 for Tunitas Creek; two watersheds are expected to experience zero impact.

- The activity with the highest impact is agricultural pesticide applications which averages $187,000 across all watersheds in this ESU and ranges from $0 to $4,366,000.

- The activities with the lowest impact are utility lines and Federal lands management of wilderness areas, which have no impact within the watersheds that comprise this ESU.

- Two watersheds have annualized total impacts of more than $1 million, and 13 have annualized total impacts less than $50 thousand.

Case	**Total Annualized Impact for Individual Watersheds**			
	Average	**Median**	**Maximum**	**Minimum**
High 7%	$660,000	$283,000	$8,600,000	$0
Mid 7%	$404,000	$198,000	$5,211,000	$0
Low 7%	$148,000	$87,000	$1,822,000	$0
High 3%	$656,000	$279,000	$8,594,000	$0
Mid 3%	$401,000	$195,000	$5,205,000	$0
Low 3%	$145,000	$81,000	$1,817,000	$0

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	34	34	23	23	18	17
$200,000 - $500,000	11	11	12	11	11	12
$500,000 - $1,000,000	0	0	9	10	8	8
$1,000,000 - $2,500,000	1	1	1	1	8	8
> $2,500,000	0	0	1	1	1	1

5.4.4 California Central Valley Steelhead

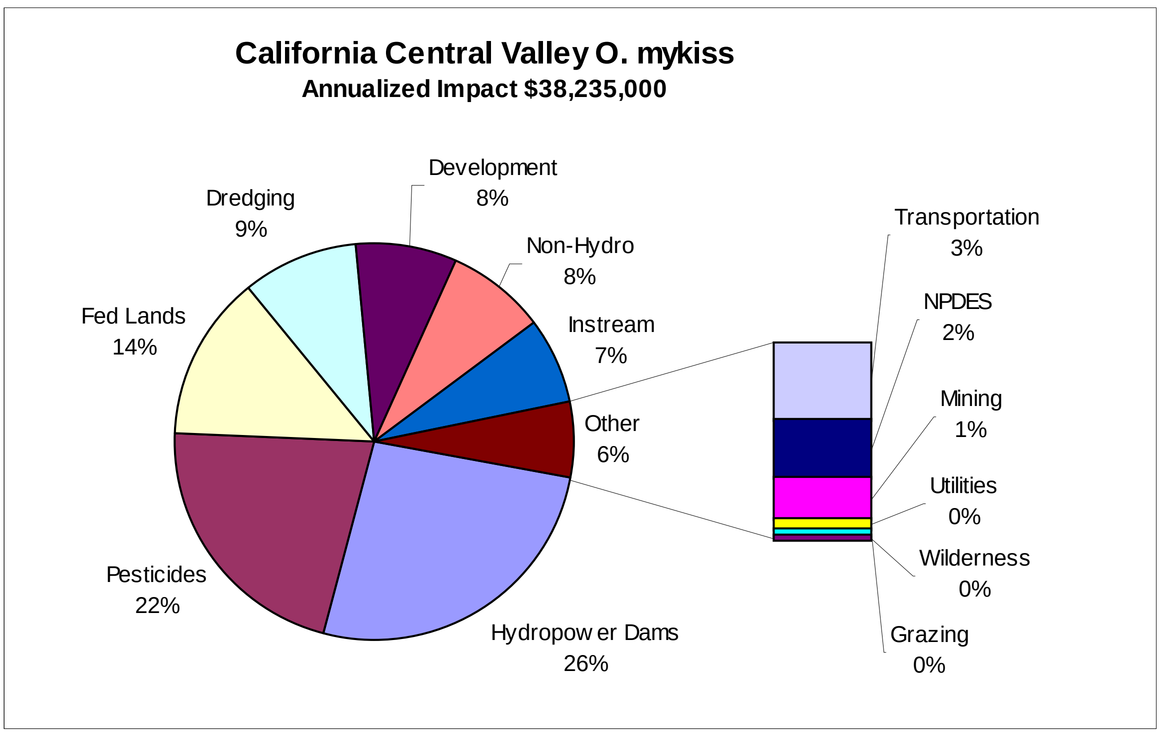
5.4.4.1 Watershed Characteristics

For this ESU, the analysis covers 67 watersheds, averaging 206 square miles in size and ranging from six to 1,074 square miles. The estimated total population for this ESU is 3,041,659 and the estimated total personal income is $80.95 billion.

5.4.4.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$61,985,000
Mid 7%	$38,235,000
Low 7%	$14,471,000
High 3%	$57,557,000
Mid 3%	$35,743,000
Low 3%	$13,915,000

5.4.4.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.4.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $571,000.
- The highest annualized total impact at the watershed level is $5,574,000 for Lower Feather River, while the lowest non-zero watershed impact is $2,200 for South Cow Creek; three watersheds are expected to experience zero impact.
- The activity with the highest impact is hydropower which averages $146,719 across all watersheds in this ESU and ranges from $0 to $5,280,000.
- The activity with the lowest impact is Federal lands management in wilderness areas which averages $547 across all watersheds in this ESU and ranges from $0 to $19,000.
- Ten watersheds have annualized total impacts of more than $1 million, while 15 have annualized total impacts less than $50 thousand.

	Total Annualized Impact for Individual Watersheds			
Case	**Average**	**Median**	**Maximum**	**Minimum**
High 7%	$925,000	$464,000	$9,994,000	$0
Mid 7%	$571,000	$257,000	$5,574,000	$0
Low 7%	$216,000	$112,000	$1,793,000	$0
High 3%	$859,000	$464,000	$7,437,000	$0
Mid 3%	$553,000	$257,000	$4,611,000	$0
Low 3%	$208,000	$112,000	$1,784,000	$0

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	43	43	27	27	24	24
$200,000 - $500,000	18	16	17	16	11	11
$500,000 - $1,000,000	5	6	13	14	11	11
$1,000,000 - $2,500,000	1	2	8	8	17	17
> $2,500,000	0	0	2	2	4	4

5.4.5 Northern California Steelhead

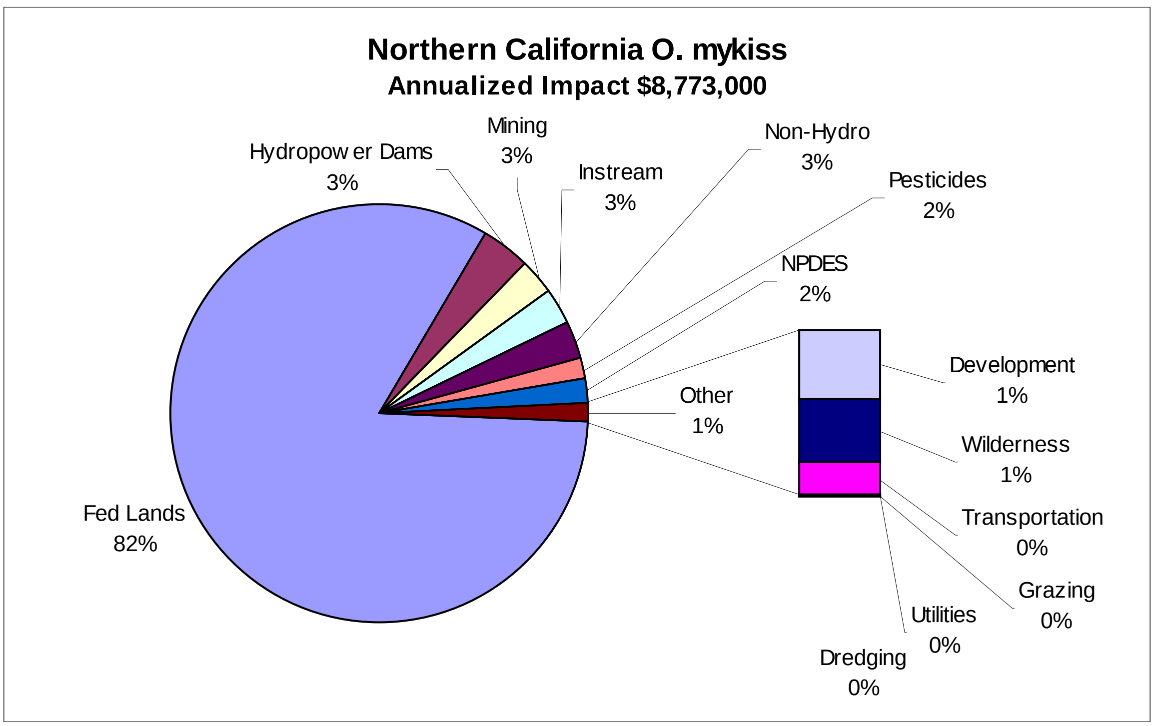
5.4.5.1 Watershed Characteristics

For this ESU, the analysis covers 52 watersheds, averaging 133 square miles in size and ranging from three to 413 square miles. The estimated total population for this ESU is 169,718 and the estimated total personal income is $4.05 billion.

5.4.5.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$12,861,000
Mid 7%	$8,773,000
Low 7%	$4,677,000
High 3%	$12,807,000
Mid 3%	$8,773,000
Low 3%	$4,649,000

5.4.5.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.5.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $169,000.

- The highest annualized total impact at the watershed level is $1,142,000 for Lake Pillsbury, while the lowest nonzero watershed impact is $1 for Alder Creek; seven watersheds have an impact of zero.

- The activity with the highest impact is Federal lands management of non-wilderness areas which averages $140,000 across all watersheds in this ESU and ranges from $0 to $957,000.

- The activities with the lowest impacts are utility lines and dredging which are not expected to experience any impact within the watersheds comprising this ESU.

- One watersheds have annualized total impacts of more than $1 million, while 29 have annualized total impacts less than $50 thousand.

	Total Annualized Impact for Individual Watersheds			
Case	**Average**	**Median**	**Maximum**	**Minimum**
High 7%	$247,000	$28,000	$1,721,000	$0
Mid 7%	$169,000	$20,000	$1,142,000	$0
Low 7%	$90,000	$9,600	$560,000	$0
High 3%	$246,000	$29,000	$1,706,000	$0
Mid 3%	$168,000	$20,000	$1,134,000	$0
Low 3%	$89,000	$9,600	$560,000	$0

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	43	43	40	40	38	38
$200,000 - $500,000	8	8	4	4	4	4
$500,000 - $1,000,000	1	1	7	7	5	5
$1,000,000 - $2,500,000	0	0	1	1	5	5
> $2,500,000	0	0	0	0	0	0

5.4.6 South-Central California Coast Steelhead

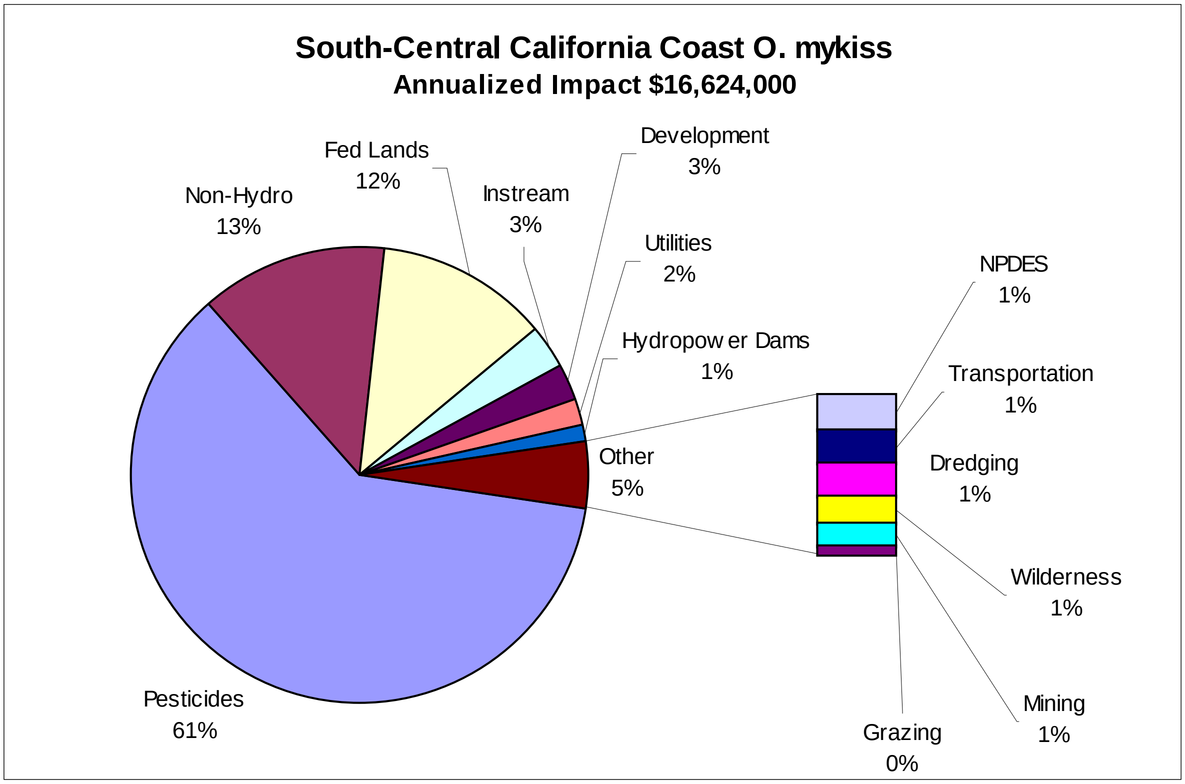
5.4.6.1 Watershed Characteristics

For this ESU, the analysis covers 30 watersheds, averaging 197 square miles in size and ranging from three to 1, 495 square miles. The estimated total population for this ESU is 701,525 and the estimated total personal income is $23.3 billion.

5.4.6.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$27,268,000
Mid 7%	$16,857,000
Low 7%	$6,087,000
High 3%	$27,581,000
Mid 3%	$16,817,000
Low 3%	$6,054,000

5.4.6.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.6.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $562,000.
- The highest annualized total impact at the watershed level is $2,881,000 for Paso Robles, while the lowest watershed impact is $384 for Arroyo De La Cruz; no watershed is expected to experience zero impact.
- The activity with the highest impact is agricultural pesticide applications which averages $338,000 across all watersheds in this ESU and ranges from $0 to $2,607,000.
- The activity with the lowest impact is grazing which averages $1,400 across all watersheds in this ESU and ranges from $0 to $14,600.
- Five watersheds have annualized total impacts of more than $1 million, and five have annualized total impacts less than $50 thousand.

Case	**Total Annualized Impact for Individual Watersheds**			
	Average	**Median**	**Maximum**	**Minimum**
High 7%	$921,000	$394,000	$5,091,000	$490
Mid 7%	$562,000	$257,000	$2,881,000	$384
Low 7%	$203,000	$127,000	$804,000	$279
High 3%	$919,000	$392,000	$5,088,000	$490
Mid 3%	$561,000	$255,000	$2,878,000	$384
Low 3%	$202,000	$125,000	$803,000	$279

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	19	19	13	13	8	8
$200,000 - $500,000	8	8	6	6	9	9
$500,000 - $1,000,000	3	3	6	6	5	5
$1,000,000 - $2,500,000	0	0	3	3	5	5
> $2,500,000	0	0	2	2	3	3

5.4.7 Southern California Steelhead

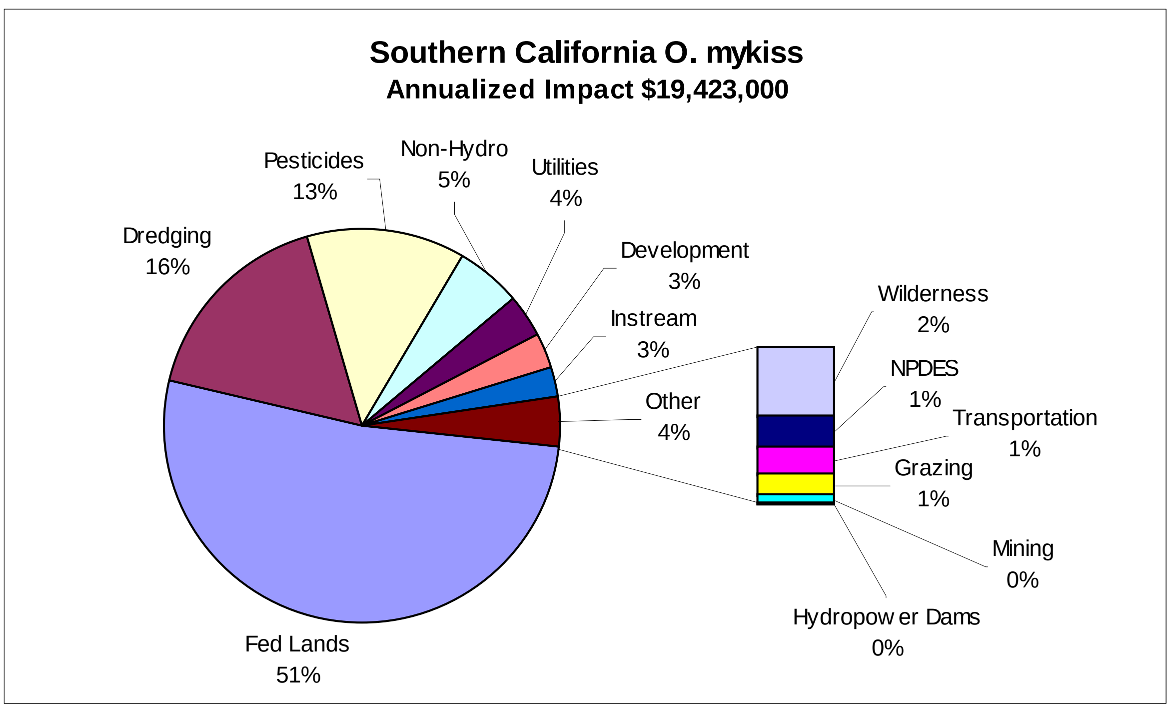
5.4.7.1 Watershed Characteristics

For this ESU, the analysis covers 32 watersheds, averaging 132 square miles in size and ranging from one to 1,145 square miles. The estimated total population for this ESU is 698,276 and the estimated total personal income is $22.22 billion.

5.4.7.2 Economic Impacts of Critical Habitat Designation for the Entire ESU

Case	Annualized Total Impact
High 7%	$29,635,000
Mid 7%	$19,423,000
Low 7%	$9,204,000
High 3%	$29,606,000
Mid 3%	$19,395,000
Low 3%	$9,175,000

5.4.7.3 Economic Impacts of Individual Activities for the Entire ESU



5.4.7.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $607,000.
- The highest annualized total impact at the watershed level is $4,735,000 for Cuyama Valley, while the lowest non-zero watershed impact is $18 for Arroyo Senuit; one watershed is expected to experience zero impact.
- The activity with the highest impact is Federal lands management of non-wilderness areas which averages $313,000 across all watersheds in this ESU and ranges from $0 to $4,424,000.
- The activity with the lowest impact is hydropower which is expected to experience zero impact in the watersheds that comprise this ESU.
- Five watersheds have annualized total impacts of more than $1 million, while seven have annualized total impacts less than $50 thousand.

Case	Total Annualized Impact for Individual Watersheds			
	Average	**Median**	**Maximum**	**Minimum**
High 7%	$926,000	$424,000	$7,155,000	$0
Mid 7%	$607,000	$276,000	$4,735,000	$0
Low 7%	$288,000	$128,000	$2,311,000	$0
High 3%	$925,000	$423,000	$7,155,000	$0
Mid 3%	$606,000	$274,000	$4,735,000	$0
Low 3%	$287,000	$127,000	$2,311,000	$0

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	18	18	12	12	10	10
$200,000 - $500,000	10	10	6	6	7	7
$500,000 - $1,000,000	2	2	9	9	6	6
$1,000,000 - $2,500,000	2	2	4	4	6	6
> $2,500,000	0	0	1	1	3	3

5.4.8 Aggregate Impacts for all ESUs

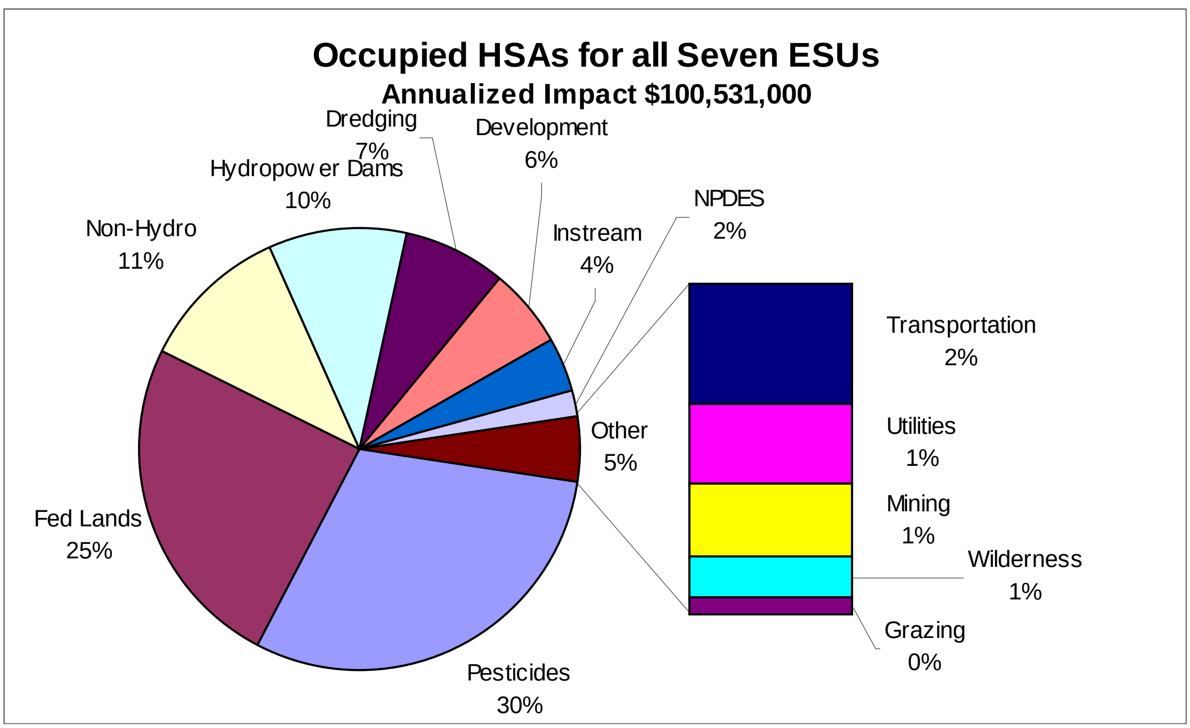
5.4.8.1 Watershed Characteristics

For all seven ESUs, the analysis considered 223 watersheds occupied by one or more of the seven ESUs. These watersheds average 159 square miles in size and ranging from one to 1,495 square miles. The estimated total population for all watersheds is 10,442,215.

5.4.8.2 Economic Impacts of Critical Habitat Designation for all ESUs

Case	Annualized Total Impact
High 7%	$160,236,000
Mid 7%	$100,531,000
Low 7%	$40,813,000
High 3%	$155,550,000
Mid 3%	$97,800,000
Low 3%	$40,038,000

5.4.8.3 Economic Impacts of Individual Activities for all ESUs



5.4.8.4 Economic Impacts at the Watershed Level

At a 7% discount rate and the midpoint per-project cost estimate:

- The average annualized total impact at the watershed level is $451,000.

- The highest annualized total impact at the watershed level is $5,574,000 for Lower Feather River, while the lowest non-zero watershed impact is $1 for Alder Creek; 13 watersheds are expected to experience zero impacts.

- The activity with the highest impact is agricultural pesticide applications, which averages $135,000 across all watersheds and ranges from $0 to $4,366,000.

- The activity with the lowest impact is grazing which averages $1,000 across all watersheds in this ESU and ranges from $0 to $87,000.

- 23 watersheds have annualized total impacts of more than $1 million, while 69 have annualized total impacts less than $50 thousand.

Case	Total Annualized Impact for Individual Watersheds			
	Average	**Median**	**Maximum**	**Minimum**
High 7%	$719,000	$828,000	$9,994,000	$0
Mid 7%	$451,000	$188,000	$5,574,000	$0
Low 7%	$183,000	$78,000	$2,311,000	$0
High 3%	$698,000	$278,000	$8,594,000	$0
Mid 3%	$439,000	$185,000	$5,205,000	$0
Low 3%	$180,000	$75,000	$2,311,000	$0

Frequency of Annualized Total Impacts for Individual Watersheds						
Watershed Annualized Total Impact	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
< $200,000	154	154	114	114	98	97
$200,000 - $500,000	53	52	43	42	41	42
$500,000 - $1,000,000	12	12	43	44	33	33
$1,000,000 - $2,500,000	4	5	17	17	40	40
> $2,500,000	0	0	6	6	11	11

Section 6
References

Alkire, Carolyn. 1994. The Living Landscape Vol. 1, Wild Salmon as Natural Capital. The Wilderness Society. Washington, D.C.

Bakkala, R.G. 1970. Synopsis of biological data on the chum salmon, Oncorhynchus keta Walbaum 1792. FAO species synop. No. 41, U.S. Fish. Wild. Serv. circ. 315. 89 p.

Bax, N.J. 1983. The early migration of juvenile chum salmon (Oncorhynchus keta) through Hood Canal - its variability and consequences. Ph.D. Dissertation, Univ. of Wash, Seattle, WA. 196 p.

Beamish, R.J., M. Folkes, R. Sweeting and C. Mahnken. 1998. Intra-annual changes in the abundance of coho, chinook, and chum salmon in Puget Sound in 1997. In Puget Sound Research Proceedings 1998, Puget Sound Water Quality Action Team, Olympia. (Available at http://www.psat.wa.gov/Publications/98_proceedings/pdfs/4c_beamish.pdf).

Beechie, T.J., E.A. Steel, P. Roni, and E. Quimby, 2003. Ecosystem Recovery Planning for Listed Salmon: An Integrated Assessment Approach for Salmon Habitat, NOAA Fisheries, Northwest Fisheries Science Center.

Bell, Kathleen P., Daniel Huppert, and Rebecca L. Johnson. 2003. "Willingness to Pay for Local Coho Salmon Enhancement in Coastal Communities" Marine Resource Economics. Vol. 18, pp. 15-31.

Bonneville Power Administration (BPA), 1992. "Implement Willamette Basin Mitigation Project." BPA Project Number 199206800. (Available at http://173.160.2.246/ Environment/EW/PROPOSALS/AIWP/2001/CD/projects/199206800.htm).

BPA, 2004. FY2005 Congressional Budget, Funding Profile by Subprogram. (Available at http://www.bpa.gov/corporate/dff/conbud/pdf/02a%20Fund%20Profile%20Rev%201-30-04.pdf).

Brookshire, D.S., M. McKee, and G. Watts, 1993. Draft Economic Analysis of Proposed Critical Habitat Designation in the Colorado River Basin for the Razorback Sucker, Humpback Chub, Colorado Squawfish, and Bonytail, U.S. Fish and Wildlife Service, Washington, D.C.

Brookshire, D.S., M. McKee, and C. Schmidt, 1995. Economic Analysis of Critical Habitat Designation in the Virgin River Basin for the Woundfin and Virgin River Chub, U.S. Fish and Wildlife Service, Washington, D.C.

California Department of Water Resources, 1993. Division of Safety of Dams. Dams within the Jurisdiction of the State of California, Bulletin 17

California Department of Conservation, 2001. “California Again Leads the Nation in Production of Non-Fuel Minerals,” press release, August 7, 2001, Sacramento, California.

Columbia Basin Bulletin, 2003. “Grant PUD Meets Survival Goals at Two Mid-Columbia Dams,” September 26, 2003.

Columbia Basin Bulletin, 2004. "Ninth Circuit Upholds Salmon Pesticide Ban During Appeal," June 25, 2004.

Interior Columbia Basin Technical Recovery Team (TRT). 2004. "Preliminary Guidelines for Population-level Abundance, Productivity, Spatial Structure, and Diversity Supporting Viable Salmonid Populations: An Update," December 13, 2004.

Davis, Shannon, and Hans Radtke. 1995. "Briefing Report: Economic Contribution of Salmon Produced in the Columbia River" December 13. The Research Group. Corvallis, Oregon.

ECONorthwest. 1999. "Salmon and the Economy: A Handbook for Understanding the Issues in Washington and Oregon." Prepared for: The Center for Watershed and Community Health, Portland State University.

Elliott D. Pollack and Company, 1999. The Economic and Fiscal Impact of the Designation of 60,060 Acres of Privately Owned Land in Pima County, Arizona as Critical Habitat for the Cactus Ferruginous Pygmy-Owl, prepared for Southern Arizona Homebuilders Association.

Environmental Protection Agency (EPA), 2000. Guidelines for Preparing Economic Analyses, EPA-240-R-00-003, Washington, D.C..

EPA, 2003. EPA Region 10 Guidance For Pacific Northwest State and Tribal Temperature Water Quality Standards, EPA 910-B-03-002, Washington, D.C.

Federal Energy Regulatory Commission (FERC), 2001. Hydroelectric Project Licensing Handbook.

FERC, 2003. Wetland and Waterbody Construction and Mitigation Procedures, Washington, D.C.

Fish and Wildlife Service (FWS), 2002. Lower Snake River Compensation Plan Office, Annual Report, Fiscal Year 2001, October 1, 2000 - September 30. (Available at http://lsnakecomplan.fws.gov/Reports/LSRCP/anreport.pdf).

Fraser, F.J., D.D. Bailey, and M.J. Wood. 1978. Big Qualicum River Salmon Development Project, Vol. 3. Experimental rearing of chum salmon juveniles (Oncorhynchus keta) in freshwater (1968-1970). Can. Fish. Mar. Serv. Tech. Rep. 752.

FWS, 2004. Final Economic Analysis of Critical Habitat Designation for the Bull Trout. (Available at http://pacific.fws.gov/bulltrout/final_colkla/pdf/BTFinalEA.pdf).

Gold, M.L. J.E. Siegel, L.B. Russell, and M.C. Weinstein, 1996. Cost Effectiveness in Health and Medicine: The Report of the Panel on Cost-Effectiveness in Health and Medicine, Oxford University Press, New York.

Grant County P.U.D., 2004. Figures for Salmon Update 2004, Ephrata, Washington.

Groot, C. and L. Margolis (editors). 1991. Pacific salmon life histories. Univ. B.C. Press, Vancouver, B.C., 564 p.

Hamilton, J. and N. Whittlesey, 1996. Cost of Using Water from the Snake River Basin to Augment Flows for Endangered Species. Presentation to the Snake River Salmon Economics Technical Committee.

Healey, M.C., 1982. Juvenile Pacific salmon in estuaries: the life support system. Pp. 315-341 in V.S. Kennedy (ed.) Estuarine Comparisons. Academic Press, New York, NY. 709 p.

Huppert, D., D.L. Fluharty, E. Doyle, and A. Benyounes, 1996. Economics of Snake River Salmon Recovery: A Report to the National Marine Fisheries Service.

Huppert, D., G. Green, W. Byers, A. Subkoviak, and A. Wenzl. 2004. Economics of Columbia River Initiative, Final Report to the Washington Department of Ecology and CRI Economics Advisory Committee.

Johnson, O.W., W.S. Grant, R.G. Kope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-32, 280 p.

Kohler, S., 2002. “California Non-Fuel Minerals 2002.” California Department of Conservation, California Geological Survey, Sacramento, California.

Layton, D., G. Brown, and M. Plummer, 1999. “Valuing Multiple Programs to Improve Fish Populations,” Report to the Washington State Department of Ecology.

Layton, David F., Gardner M. Brown, and Mark L. Plummer. "Valuing Multiple Programs to Improve Fish Populations." April 1999. Accessed at: www.salmonandeconomy.org/lowersnake.html.

Loomis, J.B., 1996. "Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey," Water Resources Research 32(2): 441-447.

Loomis, John. 1996. Measuring the economic benefits of removing dams and restoring the Elwha River: Results of a contingent valuation survey. Water Resources Research 32(2): 441-447.

Marriott, D., and 27 contributors. 2002. Lower Columbia River and Columbia River Estuary Subbasin Summary. Report Prepared for the Northwest Power Planning Council, dated May 17, 2002. (Available at: http://www.cbfwa.org/).

Martin, D.J., D.R. Glass, C.J. Whitmus, C A. Simenstad, D.A. Milward, E.C. Volk, M.L. Stevenson, P. Nunes, M. Savvoie, and R.A. Grotefendt. 1986. Distribution, seasonal abundance, and feeding dependencies of juvenile salmon and non-salmonid fishes in the Yukon River Delta. NOAA, OCSEAP Final Rep. 55(1988):381-770. Avail. Arctic Environment Assessment Center, 222 W. 8th Ave., No. 55, Anchorage, AK 99513.

Mazer, J.I., and M.P. Shepard. 1962. Marine survival, distribution and migration of pink salmon off the British Columbia coast. H.R. MacMillan Lectures in Fisheries, Univ. Brit. Col., Vancouver, B.C., Canada, p. 113-121.

McElhany, P., M.H. Ruckelshaus, M.J. Ford, T.C. Wainwright, and E.P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-42, 156p. (Available at http://www.nwfsc.noaa.gov/ publications/techmemos/tm42/tm42.pdf).

Meyer, S.M., 1998. “The Economic Impact of the Endangered Species Act on the Housing and Real Estate Markets.” New York University Environmental Law Journal. 6(450):1-13. Mobrand Biometrics, Inc., 1999. The EDT Method.

National Marine Fisheries Service (NMFS), 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.

NMFS, 1998. Supplemental Biological Opinion, Operation of the Federal Columbia River Power System Including the Smolt Monitoring Program and the Juvenile Fish Transportation Program: A Supplement to the Biological Opinion Signed on March 2, 1995, For the Same Projects.

NMFS, 2000. Biological Opinion, Reinitiation of Consultation on Operation of the Federal Columbia River Power System, Including the Juvenile Fish Transportation Program, and 19 Bureau of Reclamation Projects in the Columbia Basin.

NMFS, 2001. Biological Opinion of Corps of Engineers' Programmatic Consultation for Permit Issuance for 15 Categories of Activities in Oregon, March 21, 2001. OSB2001-0016.

NMFS, 2002. NMFS National Gravel Extraction Policy (draft). (Available at http://www.nmfs.noaa.gov/habitat/habitatprotection/pdf/gravelguidance.pdf).

NMFS, 2003a. Biological Opinion for Construction of a new boat dock at Columbia Cove Park, Okanogan County, Washington, May 16, 2003. 2001/01013.

NMFS, 2003b. Biological Opinion for McCormick Pier Repair Project, Willamette River Mile 11.3, Multnomah County, Oregon, May 23, 2003. 2002/01399.

NMFS, 2003c. Biological Opinion for Rouge River (Depot Street) Bridge Replacement Project, Jackson County, Oregon, October 23, 2003. 2002/00816.

NMFS, 2003d. Biological Opinion for the Georgia-Pacific Bulkhead Replacement Project, Yaquina River Basin, Lincoln County, Oregon, February 21, 2003. 2002/01314.

NMFS, 2003e. Biological Opinion for the Myrtle Creek and Tri-City Sanitary District Wastewater Treatment Plant Improvement, South Umpqua River, Douglas County, Oregon, April 30, 2003, 2002/00376.

NMFS, 2003f. Biological Opinion for the Port Of St. Helens Industrial Outfall and Portland General Electric Power Plant, Port Westward Industrial Park, Columbia River, Columbia County, Oregon, August 1, 2003. 2002/00013.

NMFS, 2003g. Biological Opinion of Corps for Miller Creek Wastewater Treatment Plant Outfall Replacement, WRIA 9, August 15, 2003, 2002/00355.

NMFS, 2003h. Draft Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Consultation, White River Hydroelectric Project FERC Project Number 2494-002.

NMFS, 2003i. Endangered Species Act Formal Section 7 and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Joe Bernert Towing Company Instream Gravel Mining Project, Lower Williamette River Basin, River Miles 27-56.6, Clackamas, Marion, and Yamhill Counties, Oregon (Corps No. 199601626).

NMFS, 2003j. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for U.S. Forest Service and Bureau of Land Management Programmatic Activities in Northwestern Oregon, NOAA Fisheries, 2002/01254 (FS) and 2002/01880 (BLM).

NMFS, 2003k. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for U.S. Forest Service Programmatic Culvert Replacement Activities in Washington and Eastern Oregon, NOAA Fisheries, 2003/00676.

NMFS, 2004a. Initial Assessment of NOAA Fisheries' Critical Habitat Analytical Review Teams For 13 Evolutionarily Significant Units of Pacific salmon and steelhead. NOAA Fisheries Northwest Region Report. October 2004. (Available from NOAA Fisheries at http://www.nwr.noaa.gov/1salmon/salmesa/crithab/CHsite.htm).

NMFS, 2004b. Memorandum from M. Longenbaugh (NOAA Fisheries) Through S. Landino (NOAA Fisheries) to D. Darm (NOAA Fisheries) re: review of integrated natural resource management plans in WA. September 29, 2004.

NMFS, 2004b. Memorandum from M. Longenbaugh (NOAA Fisheries) Through S. Landino (NOAA Fisheries) to D. Darm (NOAA Fisheries) re: review of integrated natural resource management plans in WA. September 29, 2004.

NMFS, 2004d. Designation of Critical Habitat for Pacific salmon and Steelhead: Draft 4(b)(2) Report. NOAA Fisheries Northwest Region Report. October 2004. (Available from NOAA Fisheries at http://www.nwr.noaa.gov/1salmon/salmesa/crithab/CHsite.htm).

NMFS, 2004e. Memorandum from G. Sims (NOAA Fisheries) to D. Darm (NOAA Fisheries) re: critical habitat and Indian lands. September 28, 2004.

NMFS, 2004f. Draft Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Consultation, License Amendment for Operation of the Baker River Hydroelectric Project (FERC No. 2150) through April 2006, Baker River, HUC 17110007, Skagit and Whatcom Counties, Washington.

NMFS, 2004g. Northwest Salmon Recovery: Integrating Habitat, Hydropower, Harvest and Hatchery Programs with State/Federal/Local Recovery Efforts, Report to Congress.

NMFS, 2004h. State/Tribal Review Draft, Biological Opinion, Operation of the Federal Columbia River Power System including the 19 Bureau of Reclamation Projects in the Columbia Basin (Revised and reissued pursuant to court order, NWF v. NMFS, Civ. No. CV 01-640-RE (D. Oregon)).

Northwest Power Planning Council (NPPC), 1997. Alternative Scenarios for Future Hydroelectric Operations: Preliminary Report.

NPPC, 2000. Analysis of Recommendations to Amend the Fish and Wildlife Program Relating to Mainstem Hydroelectric Operations, memorandum from John Fazio.

Northwest Power and Conservation Council (NPCC), 2004. Third Annual Report to the Northwest Governors on Expenditures of the Bonneville Power Administration to Implement the Columbia River Basin Fish and Wildlife Program of the Northwest Power and Conservation Council, 1978- 2002, Council Document 2004-3.

Northwest Power Planning Council (NPPC), 1997. Alternative Scenarios for Future Hydroelectric Operations: Preliminary Report.

NPPC, 2000. Analysis of Recommendations to Amend the Fish and Wildlife Program Relating to Mainstem Hydroelectric Operations, memorandum from John Fazio.

Olsen, D., J. Richards, and R. D. Scott, 1991. "Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs," Rivers 2(1): 44-56.

Olsen, Darryll, Jack Richards and R. Douglas Scott. 1991. Existence and sport values for doubling the size of Columbia River Basin salmon and steelhead runs. Rivers, 2(1):44-56.

Pacific Coast Salmon Fishery Management Plan. 2000. Amendment 14 to the Pacific Coast Salmon Plan (1997). (Available at http://www.pcouncil.org/salmon/salfmp/a14.html).

Peterman, R.M. 1978. Testing for density-dependent marine survival in Pacific salmonids. J. Fish. Res. Board Can. 35:1434-1450.

Peters, L., 2003. "ESA Costs for the Hydropower Sector," memorandum to Industrial Economics, Inc.

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.

Radtke, Hans, Shannon Davis, and Rebecca L. Johnson. 1999. "Lower Snake River Juvenile Salmon Migration Feasibility Study: Anadromous Fish Economic Study." Prepared for Foster Wheeler Environmental Corporation and U.S. Army Corps of Engineers.

Radtke, Hans. 1992. "Economic Contribution of Salmon to Oregon's Coastal Communities". Prepared for Governor's Coastal Initiative Conference. Yachats, Oregon.

Reading, D.C. 2005. The Potential Economic Impact of Restored Salmon and Steelhead Fishing in Idaho. Ben Johnson Associates, Inc.

Risk Management Association, 2002. RMA Annual Statement Studies, Philadelphia, Pennsylvania.

Sakuramoto, K., and S. Yamada. 1980. A study on the planting effect of salmon. 1. A mathematical model for the derivation of their rate of return and its applications. Bull. Jpn. Soc. Sci. Fish. 46(6):653-661.

Salo, E.O. 1991. Life history of chum salmon, Oncorhynchus keta. In C. Groot and L. Margolis (editors), Pacific salmon life histories, p. 231-309. Univ. B.C. Press, Vancouver, B.C.

Schamberger, M.L., J.J. Charbonneau, M.J. Hay, and R.L. Johnson, 1992. Economic Analysis of Critical Habitat Designation Effects for the Northern Spotted Owl, U.S. Fish and Wildlife Service, Washington, D.C.

Science Applications International Cooperation, 2003. Economic Analysis of the Proposed Water Quality Standards Rule for the State of Oregon, EPA No. 68-C-99-252, Reston, VA.

Simenstad, C.A., K.L. Fresh, and E.O. Salo. 1982. The role of Puget Sound and Washington coastal estuaries in the life history of Pacific salmon: an unappreciated function. In: V. Kennedy, editor. Estuarine comparisons. Academic Press, New York (343-364).

Spence, B.C., G.A. Lomnicky, R.M. Hughes, and R.P. Novitzki. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp., Corvallis, Oregon. (Available at http://www.nwr.noaa.gov/1habcon/habweb/habguide/ ManTech/front.htm).

U.S. Bureau of Reclamation (USBR), 1999. Snake River Flow Augmentation Impact Analysis Appendix, Prepared for the U.S. Army Corps of Engineers, Walla Walla District's Lower Snake River Juvenile Salmon Migration Feasibility Study and Environmental Impact Statement, United States Department of the Interior, Bureau of Reclamation, Pacific Northwest Region, Boise, Idaho.

U.S. Bureau of Reclamation (USBR), U.S. Army Corps of Engineers (USACE), and Bonneville Power Administration (BPA), 2003. Endangered Species Act 2003 Check-In Report for the Federal Columbia River Power System.

U.S. Department of Agriculture (USDA), 2003. "Economic Impact of Spray Buffers on Agriculture in the Pacific Northwest," Office of the Chief Economist, Washington, D.C.

Department of Energy (DOE), 2005. FY 2006 Congressional Budget Request, DOE/ME-0051, Volume 6, Power Marketing Administrations, Washington, D.C.

U.S. Environmental Protection Agency (EPA), 2000. Guidelines for Preparing Economic Analyses, EPA-240-R-00-003, Washington, D.C..

EPA, 2003. EPA Region 10 Guidance For Pacific Northwest State and Tribal Temperature Water Quality Standards, EPA 910-B-03-002, Washington, D.C.

U.S. Forest Service (USFS) and U.S. Bureau of Land Management (BLM), 2004. Record of Decision, Amending Resource Management Plans for Seven Bureau of Land Management Districts and Land and Resource Management Plans for Nineteen National Forests Within the Range of the Northern Spotted Owl Decision to Clarify Provisions Relating to the Aquatic Conservation Strategy.

Washington Department of Ecology (WDOE), 2001. Year 2001 Minimum Requirements for Stormwater Management in Western Washington Cost Analysis, Olympia, Washington. Washington Department of Fish and Wildlife (WDFW), 2003. Stream Habitat Restoration Guidelines. Washington Department of Transportation. Washington Department of Ecology, Olympia, Washington.

U.S. Office of Management and Budget (OMB), 2001. Memorandum for Heads of Executive Departments and Agencies, and Independent Regulatory Agencies, M-01-27, Washington, D.C.

OMB, 2003. Circular A-4, Regulatory Analysis, Washington, D.C..

Washington Department of Fish and Wildlife (WDFW) and Point No Point Treaty Tribes (PNPTT), 2000. Summer Chum Salmon Conservation Initiative – An Implementation Plan to Recover Summer Chum in the Hood Canal and Strait of Juan de Fuca Region. Washington Department of Fish and Wildlife. Olympia, WA. 800 p. (Available at: http://wdfw.wa.gov/fish/ chum/chum.htm).

Washington Department of Fish and Wildlife (WDFW), 2003. Stream Habitat Restoration Guidelines. Washington Department of Transportation. Washington Department of Ecology, Olympia, Washington.

Washington Department of Ecology (WDOE), 2001. Year 2001 Minimum Requirements for Stormwater Management in Western Washington Cost Analysis, Olympia, Washington.

Williams, G.D., R.M. Thom, M.C. Miller, D.L. Woodruff, N.R. Evans, and P.N. Best. 2003. Bainbridge Island Nearshore Assessment: Summary of Best Available Science. PNWD-3233. Prepared for the City of Bainbridge Island, Bainbridge Island, WA, by Battelle Marine Sciences Laboratory, Sequim, WA.

Zerbe, R., and D. Dively, 1994. Benefit Cost Analysis in Theory and Practice, New York: HarperCollins.

Appendix A

LIST OF WATERSHEDS BY ESU

California Coastal chinook salmon ESU		
Watershed	**Watershed Name**	**Subbasin**
110710	Orick	Boat Creek
110720	Beaver	Coyote Creek
110730	Lake Prairie	Bradford Creek
110810	Big Lagoon	Maple Creek
110820	Little River	Bulwinckle Creek
110910	Blue Lake	Mill Creek
110920	North Fork Mad River	Canyon Creek
110930	Butler Valley	Barry Ridge
111000	Eureka Plain	Arcata
111111	Ferndale	Alton
111112	Scotia	Pepperwood
111113	Larabee Creek	Blacksburg
111121	Hydesville	Cummings
111122	Bridgeville	Barker Creek
111123	Yager Creek	Bald Lessie
111131	Weott	Fox Camp
111132	Benbow	Bear Pen Creek
111133	Laytonville	Big Rock Creek
111141	Sequoia	Alder Point
111142	Spy Rock	Spy Rock
111150	North Fork Eel River	Antone Creek
111161	Outlet Creek	Outlet Creek
111162	Tomki Creek	Tomki Creek
111163	Lake Pillsbury	Lake Pillsbury
111171	Eden Valley	Bear Creek
111172	Round Valley	Alden Creek
111173	Black Butte River	Baldy Creek
111174	Wilderness	Bar Creek
111220	Capetown	Beer Bottle
111230	Mattole River	Apple Tree
111312	Wages Creek	Cottaneva Creek
111313	Ten Mile River	Ten Mile River
111320	Noyo River	Noyo River
111330	Big River	Berry Gulch
111340	Albion River	Big Salmon Creek
111350	Navarro River	Adams Creek
111370	Garcia River	Garcia River
111411	Guerneville	Adam and Eve Redwoods

California Coastal chinook salmon ESU		
Watershed	**Watershed Name**	**Subbasin**
111412	Austin Creek	Austin Creek
111422	Santa Rosa	Matanzas Creek
111423	Mark West	Lower Mark West Creek
111424	Warm Springs	Cherry Creek
111425	Geyserville	Ash Creek
111431	Ukiah	Ukiah
111433	Forsythe Creek	Corral Creek
Eel River Estuary	Eureka Plain	Eureka Plain
Humboldt Bay	Ferndale	Ferndale

Central Valley Spring-Run chinook salmon ESU		
Watershed	**Watershed Name**	**Subbasin**
220312		
220410		
220610		
220710	Suisun Bay	Suisun Bay
550410	Lower Stony Creek	Lower Stony Creek
550420	Red Bluff	Red Bluff
550711	Inks Creek	Inks Creek
550712	Battle Creek	Battle Creek
550722	Inwood	Inwood
550810	Enterprise Flat	Enterprise Flat
550820	Lower Cottonwood	Lower Cottonwood
550914	Big Chico Creek	Big Chico Creek
550920	Deer Creek	Calf Creek
550942	Upper Mill Creek	Big Bend
550963	Antelope Creek	Antelope Creek
551000	Sacramento Delta	Sacramento Delta
551530	Lower Yuba River	Lower Yuba River
551540	Lower Feather River	Lower Feather River
551712	Browns Valley	Browns Valley
551713	Mildred Lake	Mildred Lake
551714	Englebright	Englebright
551720	Nevada City	Nevada City
551921	Lower American	Lower American
551922	Pleasant Grove	Pleasant Grove
552010	Sycamore-Sutter	Sycamore-Sutter
552021	Colusa Trough	Colusa Trough
552030	Sutter Bypass	Sutter Bypass
552040	Butte Basin	Butte Basin
552130	Upper Little Chico	Bolt Creek
552310	Thomes Creek	Alder Creek
552433	South Fork	Buck Creek
552436	Platina	Arbuckle Gulch
552440	Spring Creek	Rock Creek
552462	Kanaka Peak	Andrews Creek
554300	North Diablo Range	North Diablo Range
554400	San Joaquin Delta	San Joaquin Delta
551510	Lower Bear River	Lower Bear River

Central California Coast steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
111411	Guerneville	Adam and Eve Redwoods
111412	Austin Creek	Austin Creek
111421	Laguna	Blucher Creek
111422	Santa Rosa	Matanzas Creek
111423	Mark West	Lower Mark West Creek
111424	Warm Springs	Cherry Creek
111425	Geyserville	Ash Creek
111426	Sulphur Creek	Frasier Creek
111431	Ukiah	Ukiah
111433	Forsythe Creek	Corral Creek
111510	Salmon Creek	Fay Creek
111530	Estero Americano	Ebabias Creek
220112	Walker Creek	Arroyo
220113	Lagunitas Creek	Halleck Creek
220120	Point Reyes	Abbotts Lagoon
220130	Bolinas	Alamere Creek
220221	San Mateo Coastal	Denniston Creek
220222	Half Moon Bay	Mills Creek
220223	Tunitas Creek	Lobitos Creek
220230	San Gregorio Creek	Clear Creek
220240	Pescadero Creek	Bradley Creek
220312	Bay Waters	Bay Waters
220320	San Rafael	Belvedere Lagoon
220330	Berkeley	Claremont Creek
220410	Bay Channel	Bay Channel
220420	Eastbay Cities	Crow Creek
220440	San Mateo Bayside	Bear Gulch Reservoir
220510	Dumbarton South	Dumbarton South
220530	Coyote Creek	Coyote Creek
220540	Guadalupe River	Alamitos Creek
220550	Palo Alto	Corte Madera Creek
220610	San Pablo Bay	San Pablo Bay
220620	Novato	Arroyo Avichi
220630	Petaluma River	Adobe Creek
220640	Sonoma Creek	Bear Creek
220650	Napa River	Bear Canyon
220660	Pinole	Briones Reservoir
220710	Suisun Bay	Suisun Bay

Central California Coast steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
220721	Benicia	Benicia
220722	Suisun Creek	Lake Curry
220731	Pittsburg	Pittsburg
220733	Martinez	Alhambra Creek
330411	Davenport	Big Creek
330412	San Lorenzo	Bean Creek
330413	Aptos-Soquel	Aptos Creek
330420	Ano Nuevo	Arroyo de los Frijoles

California Central Valley steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
220312		
220410		
220610		
220710	Suisun Bay	Suisun Bay
550410	Lower Stony Creek	Lower Stony Creek
550420	Red Bluff	Red Bluff
550711	Inks Creek	Inks Creek
550712	Battle Creek	Battle Creek
550721	Ash Creek	Ash Creek
550722	Inwood	Inwood
550731	South Cow Creek	South Cow Creek
550732	Old Cow Creek	Old Cow Creek
550733	Little Cow Creek	Little Cow Creek
550810	Enterprise Flat	Enterprise Flat
550820	Lower Cottonwood	Lower Cottonwood
550914	Big Chico Creek	Big Chico Creek
550920	Deer Creek	Calf Creek
550942	Upper Mill Creek	Big Bend
550962	Dye Creek	Camposew Ridge
550963	Antelope Creek	Antelope Creek
550964	Paynes Creek	Paynes Creek
551000	Sacramento Delta	Sacramento Delta
551110	Elmira	Elmira
551120	Lower Putah Creek	Lower Putah Creek
551422	Auburn	Auburn
551510	Lower Bear River	Lower Bear River
551530	Lower Yuba River	Lower Yuba River
551540	Lower Feather River	Lower Feather River
551712	Browns Valley	Browns Valley
551713	Mildred Lake	Mildred Lake
551714	Englebright	Englebright
551720	Nevada City	Nevada City
551921	Lower American	Lower American
551922	Pleasant Grove	Pleasant Grove
552010	Sycamore-Sutter	Sycamore-Sutter
552021	Colusa Trough	Colusa Trough
552030	Sutter Bypass	Sutter Bypass
552040	Butte Basin	Butte Basin

California Central Valley steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
552110	Upper Dry Creek	Upper Dry Creek
552120	Upper Butte Creek	Hole in Rock
552130	Upper Little Chico	Bolt Creek
552310	Thomes Creek	Alder Creek
552433	South Fork	Buck Creek
552435	Ono	Bee Creek
552436	Platina	Arbuckle Gulch
552440	Spring Creek	Rock Creek
552462	Kanaka Peak	Andrews Creek
553111	Herald	Herald
553120	Lower Mokelumne	Lower Mokelumne
553130	Lower Calaveras	Lower Calaveras
553221	Big Canyon Creek	Big Canyon Creek
553223	North Fork Cosumnes	North Fork Cosumnes
553224	Omo Ranch	Omo Ranch
553240	Sutter Creek	Amador Creek
553310	New Hogan Reservoir	Gopher Ridge
553410	Table Mountain	Owl Creek
553510	Manteca	Manteca
553530	Riverbank	Riverbank
553550	Turlock	Turlock
553560	Montpelier	Montpelier
553570	El Nido-Stevinson	El Nido-Stevinson
553580	Merced	Merced
553590	Fahr Creek	Fahr Creek
554110	Patterson	Patterson
554120	Los Banos	Los Banos
554300	North Diablo Range	North Diablo Range
554400	San Joaquin Delta	San Joaquin Delta

Northern California steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
110710	Orick	Boat Creek
110720	Beaver	Coyote Creek
110730	Lake Prairie	Bradford Creek
110810	Big Lagoon	Maple Creek
110820	Little River	Bulwinckle Creek
110910	Blue Lake	Mill Creek
110920	North Fork Mad River	Canyon Creek
110930	Butler Valley	Barry Ridge
110940	Ruth	Ruth
111000	Eureka Plain	Arcata
111111	Ferndale	Alton
111112	Scotia	Pepperwood
111113	Larabee Creek	Blacksburg
111121	Hydesville	Cummings
111122	Bridgeville	Barker Creek
111123	Yager Creek	Bald Lessie
111131	Weott	Fox Camp
111132	Benbow	Bear Pen Creek
111133	Laytonville	Big Rock Creek
111141	Sequoia	Alder Point
111142	Spy Rock	Spy Rock
111150	North Fork Eel River	Antone Creek
111161	Outlet Creek	Outlet Creek
111162	Tomki Creek	Tomki Creek
111163	Lake Pillsbury	Lake Pillsbury
111171	Eden Valley	Bear Creek
111172	Round Valley	Alden Creek
111173	Black Butte River	Baldy Creek
111174	Wilderness	Bar Creek
111210	Oil Creek	Guthrie
111220	Capetown	Beer Bottle
111230	Mattole River	Apple Tree
111311	Usal Creek	Jackass Creek
111312	Wages Creek	Cottaneva Creek
111313	Ten Mile River	Ten Mile River
111320	Noyo River	Noyo River
111330	Big River	Berry Gulch
111340	Albion River	Big Salmon Creek

Northern California steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
111350	Navarro River	Adams Creek
111361	Greenwood Creek	Cuffeys Point
111362	Elk Creek	Lower Elk Creek
111363	Alder Creek	Lower Alder Creek
111364	Brush Creek	Lower Brush Creek
111370	Garcia River	Garcia River
111381	North Fork Gualala River	Billings Creek
111382	Rockpile Creek	Rockpile Creek
111383	Buckeye Creek	Buckeye Creek
111384	Wheatfield Fork	Annapolis
111385	Gualala	Gualala
111390	Russian Gulch	Jewell Gulch
Eel River Estuary	Eureka Plain	Eureka Plain
Humboldt Bay	Ferndale	Ferndale

South-Central California steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
330510	Watsonville	Watsonville
330520	Santa Cruz Mountains	Santa Cruz Mountains
330530	South Santa Clara Valley	South Santa Clara Valley
330540	Pacheco-Santa Ana Creek	Pacheco-Santa Ana Creek
330550	San Benito River	San Benito River
330700	Carmel River	Carmel River
330800	Santa Lucia	Santa Lucia
330911	Neponset	Neponset
330920	Chualar	Chualar
330930	Soledad	Soledad
330940	Upper Salinas Valley	Upper Salinas Valley
330960	Arroyo Seco	Arroyo Seco
330970	Gabilan Range	Gabilan Range
330981	Paso Robles	Atascadero
331011	San Carpoforo	San Carpoforo
331012	Arroyo De La Cruz	Arroyo De La Cruz
331013	San Simeon	San Simeon
331014	Santa Rosa	Santa Rosa
331015	Villa	Villa
331016	Cayucos	Cayucos
331017	Old	Old
331018	Toro	Toro
331021	Morro	Morro
331022	Chorro	Chorro
331023	Los Osos	Los Osos
331024	San Luis Obispo Creek	San Luis Obispo Creek
331025	Point San Luis	Point San Luis
331026	Pismo	Pismo
331031	Oceano	Oceano
331700	Estrella River	Estrella River

Southern California steelhead ESU		
Watershed	**Watershed Name**	**Subbasin**
331210	Guadalupe	Guadalupe
331220	Sisquoc	Sisquoc
331230	Cuyama Valley	Cuyama Valley
331410	Lompoc	Lompoc
331420	Santa Rita	Santa Rita
331430	Buellton	Buellton
331440	Los Olivos	Los Olivos
331451	Santa Cruz Creek	Santa Cruz Creek
331510	Arguello	Arguello
331531	Goleta	Goleta
331532	Santa Barbara	Santa Barbara
331533	Montecito	Montecito
331534	Carpinteria	Carpinteria
440210	Lower Ventura River	Lower Ventura River
440220	Upper Ventura River	Upper Ventura River
440231	Upper Ojai	Upper Ojai
440232	Ojai Valley	Ojai Valley
440310	Oxnard Plain	Oxnard Plain
440321	Sulfer Springs	Sulfer Springs
440322	Sisar	Sisar
440331	Fillmore	Fillmore
440332	Topa Topa	Topa Topa
440341	Santa Felicia	Santa Felicia
440411	Topanga Canyon	Topanga Canyon
440421	Monte Nido	Monte Nido
440444	Arroyo Senuit	Arroyo Senuit
440811	East of Oxnard	East of Oxnard
440813	Point Mugu Lagoon	Point Mugu Lagoon
490123	Middle Trabuco	Middle Trabuco
490124	Gobernadora	Gobernadora
490127	Lower San Juan	Lower San Juan
490140	San Mateo Canyon	San Mateo Canyon

Appendix B
Estimating Section 7 Impacts and Costs

This appendix describes in detail each type of activity (and sub-activity, where applicable) included in the analysis:

- 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 and gravel mining
- Residential and commercial development
- Agricultural Pesticide Applications

In each case, the following is described:

- 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.

The assumptions and possible errors for the analysis for each type of activity is also presented.

Because the data sources for the cost estimates do not constitute a random sample, this analysis does not use an average over the range of estimated costs. It therefore assumes that the endpoints of the range represent the minimum and maximum values of a symmetric cost distribution, and uses the midpoint of the range as the representative cost estimate.

This appendix supports the analysis for both the seven California salmon steelhead ESUs as well as the 13 West Coast Northwest ESUs. For that reason, the appendix contains references to data and methods specific to the Northwest Region. This information is considered relevant to the analysis of impacts in both regions although the results for the West Coast Northwest ESUs are not included in the other parts of this analysis.

This appendix first discusses the method used for obtaining estimates of the annualized expected modification cost. It then discusses the application of this method to each activity type. Finally, this appendix presents a summary table for all activity types.

B.1 Method for estimating annualized expected modification costs

The method used involves the following components:

1) **Modification cost stream**
If a project needs to be modified to comply with section 7, this analysis assumes that the expenditures on those modifications begin today (year 0) and extend through year τ. This gives a stream of expenditures or costs, $\{C_0, \ldots, C_\tau\}$. In most cases, this analysis assumes $\tau = 0$ – 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.

2) **Forecast period for consultation**
This is the period over which each type of activity that may need to be modified to comply with section 7 is projected. The length of the 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, professional judgment defined 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 $0 \le t \le T$.
2) The probability, p_M, that consultation will result in a requirement to modify the project.

This analysis assumes 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, the calculation of the annualized expected modification cost proceeds as follows:

Step 1: Calculate the present value of the cost stream
The stream of costs, $\{C_i\}$, is used to calculate the 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
This analysis applies 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, $EC_t = p_t\, p_M\, PV_C$. It then calculates the present value of this expected cost, PV_{EC}, over the forecast period, using the discount rate, r :

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

Step 3: Annualization of *PV_{EC}*

Because *T* varies across activities, modification costs are expressed 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, $p_t\ p_M\ PV_C = (p_M\ PV_C)$/T, which is constant over time. This result in the following:

(4)
$$\mathbf{AEV_C = p_M\ PV_C\ /\ T.}$$

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.

AEV_C is used to express the cost of section 7 impacts. In Section 5 of the report, this annual value is projected over a 20-year period to give a picture of the present value of the costs, but the annualized 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 are minimal. If this assumption is violated, the designation may raise market prices, which are used to evaluate the costs of the impacts. If this happens, the number (and order) of watersheds designated will affect the assessment of a given watershed's impacts.[74]

This possibility raises a difficult analytical issue. If cumulative impacts are present, the analysis should then 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 if data existed on cumulative effects, the possible combinations quickly become intractable.[75]

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

B.2 Hydropower Dams

B.2.1 Overview

- This analysis assesses impacts to hydropower projects that may result from future section 7 implementation for West Coast salmon and steelhead within the 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 modifications to infrastructure and operations that may be required in order to comply with the Endangered Species Act (ESA) for West Coast salmon and steelhead. The primary modifications analyzed are construction or improvements

[74] The problem is akin to identifying the "deciding vote" in an election that is won by a single vote. Any voter can lay claim to being the "deciding voter", as without that vote the election outcome would have been reversed. Only if votes are cast in a certain, fixed order could this claim be legitimate. Similarly, if market prices rise as designations accumulate, this effect can be attributed to any one of the watersheds being designated. The impact of designating a particular watershed, then, may be significantly different if the designation is the "first" or the "last."

[75] 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 steelhead ESU, with 287 watersheds, has 2.5×10^{86} possible combinations.

to fish passage facilities and programs; research and monitoring of water quality and fish passage efficiency offsite mitigation, such as land purchases for the purpose of conservation; and change to the flow regime (either level of flow or timing of flow). 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:

    - Installed capacity of less than five megawatts (MW): $2.1 million[76] ($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)[77]

- While costs were estimated for Federal Columbia River Power System (FCRPS) projects, Central Valley Project (CVP) projects, and projects within the mainstem Columbia, Snake, and Sacramento Rivers, 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, this analysis assumes

[76] Projects are assumed to have a ten percent likelihood of bearing these costs due to consultation.

[77] 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.

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 ten years. For small projects, this analysis assumes 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.

B.2.2 Background

Hydropower activities account for a relatively small percentage of section 7 consultations regarding West Coast salmon and steelhead in the past.[78] 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.[79]

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 analysis. 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.[80] 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 Service) and Commerce (NOAA Fisheries). The West Coast Northwest Electric

[78] Within the Northwest region, hydropower projects represent approximately five percent of historical section 7 formal consultations.

[79] *National Wildlife Fed'n, et al. v. Nat'l Marine Fisheries Serv., et al.*, 254 F. Supp.2d 1196 (W.D.Wa. 2003) (order finding the no-jeopardy conclusion in the 2000 plan to be arbitrary and capricious).

[80] Federal Power Act, 16 U.S.C. § 803(j) (1986).

Power Planning and Conservation Act (Northwest Power Act) also incorporates a Fish and Wildlife Program directing the West Coast Northwest Electric Power and Conservation Planning 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.[81]

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.[82] 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 rights.[83] Operational changes include changes in hydropower production level or method, and may be engendered by modification to flow regime.[84] For the remainder of this discussion, the first two categories of potential impacts are grouped together.

B.2.3 Cost Assessment

This analysis uses 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.

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[81] West Coast Northwest Electric Power Planning and Conservation Act, 16 U.S.C. §§ 839-839h.

[82] 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.

[83] 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.

[84] 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.

Capital and Programmatic Costs

The potential costs of project modifications are estimated for more than 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), these estimates are used in the analysis. Total per-project costs for these projects range from approximately $162 thousand to $136 million. As discussed below, the FCRPS also has ample information on project modifications, but these modifications are a mixture of section 7 implementation and other, major conservation measures.

Five hydropower projects in the Northwest Region within the watersheds covered by this analysis 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).[85]

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

For the majority of projects, the costs of project modifications are assumed to be incurred uniformly over a ten year time period beginning in the year of potential section 7 consultation. There are four exceptions to this rule: (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.[86] The present value of the cost estimates for each category are described in Table B-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 the West Coast salmon and steelhead (or their habitat) have been substantial, these impacts may vary by orders of magnitude depending on the particular hydropower project and specific flow regime recommendation. If direct spill is requested, spilled water no longer passes

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

[86] 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.

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 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.

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

- *Site-specific in-stream minimum flow requirements for West Coast salmon and steelhead.* Parameterized in-stream flow requirements for West Coast salmon and steelhead are imperative to identifying sites lacking sufficient stream flow for salmon and steelhead conservation. This information is also helpful in determining the incremental amount of water needed from upstream dams to increase flows downstream.

- *Method of augmenting/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 effected, specific information is needed on the type of operations 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 impacts modeling exercise would be possible, though massive and complex. For hydraulically-coupled dams like the Federal Columbia River Power System (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 watershed is complicated, if not impossible.

Table B-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	**Mid-Range 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	**Mid-Range 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 B-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	**Mid-Range 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 (Bonneville Power Administration. Fish and Wildlife Group. "Implement Willamette Basin Mitigation Project." BPA Project Number 199206800); - 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, Daniel D., Davil L. Fluharty, Eric E. Doyle, and Amjoun Benyounes. Economics of Snake River Salmon Recovery: A Report to National Marine Fisheries Service. October 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.

Table B-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**
4 (8 dams)	greater than 20	present or not needed	**Mid-Range 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]
5 (16 dams)	greater than 20	unknown	**Mid-Range 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.

Table B-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
6 (35 dams)	unknown	unknown	**Mid-Range 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] Federal Energy Regulatory Commission, Hydroelectric Project Licensing Handbook, April 2001.

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, estimates for flow regime changes can not be attributed to specific projects and therefore to specific watersheds. Data are available for a few, larger hydropower projects primarily in the Northwest, however. These data are used to illustrate the potential magnitude of these costs at the aggregate level.

Table B-2
COSTS OF FISH AND WILDLIFE MODIFICATIONS TO MAJOR HYDROPOWER DAMS

		Annual Fish & Wildlife Costs	
Dam	**River**	**Capital and Programmatic**	**Forgone Power Revenues**
1. Ariel Dam (Lake Merwin)	Lewis River	$7,700	$0
2. Baker River	Baker River	$11,749,000	$1,926,000
3. Faraday Dam	Clackamas River	$339,000	$0
4. Oak Grove (Timothy Lake)	Clackamas River, Oak Grove Fork	$339,000	Unknown
5. Priest Rapids	Columbia River	Unknown	$31,551,000
6. Oregon City (Smurfit)	Willamette River	$102,000	Unknown
7. Pelton Dam	Deschutes River	$1,282,000	Unknown
8. Pelton Reregulating Dam	Deschutes River	$244,000	Unknown
9. River Mill	Clackamas River	$339,000	Unknown
10. Rock Island	Columbia River	$428,000	$9,069,000
11. Rocky Reach	Columbia River	$6,477,000	$7,602,000
12. Round Butte Dam	Deschutes River	$1,526,000	Unknown
13. Swift No 1	Lewis River	$7,700	$0
14. Swift No 2	Lewis River	$7,700	$0
15. T W Sullivan (PGE)	Willamette River	$102,000	$0
16. West Linn (Simpson)	Willamette River	$102,000	$0
17. Yale Dam	Lewis River	$7,700	
Total for 17 Dams (known costs)		$23,058,000	$50,148,000

Table B-2
COSTS OF FISH AND WILDLIFE MODIFICATIONS TO MAJOR HYDROPOWER DAMS

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 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.

The Federal Columbia River Power System (FCRPS)

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.[87] The implementation of section 7 for the 13 West Coast salmon and steelhead ESUs under consideration in the Northwest Region has had significant impacts on the FCRPS, both in terms of capital structures and operations.[88] Attributing these impacts to the designation of critical habitat for a particular watershed however, is problematic for at least three reasons.

First, NOAA Fisheries implements section 7 for the FCRPS at the system level, in that the agency applies the jeopardy standard to the system as a whole, not to the operation of individual constituent parts. Because the system spans dozens of watersheds, it is not possible to assign section 7 impacts on an 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 constraint 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 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 capital, operations, and maintenance expenditures on conservation projects and the costs 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 Electric Power Planning and Conservation Act. Moreover, NOAA Fisheries has issued a revised biological opinion covering the FCRPS that is the subject of ongoing litigation. Thus, identifying past and future modifications for the FCRPS attributable to section 7 implementation is particularly problematic.

For these reasons, the impacts of section 7 implementation and other conservation measures on the FCRPS are included in this analysis, but the impacts are not divided on a watershed-by-watershed basis nor does this analysis attribute a subset of the impacts specifically to section 7 implementation.

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[87] USBR, USACE, BPA. Endangered Species Act 2003 Check-In Report for the Federal Columbia River Power System. September 2003.

[88] Section 7 of the ESA was first applied to the FCRPS in 1995, which predates the listing of the 13 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. While the FCRPS projects are in NOAA Fisheries' Northwest Region, impacts of salmon and steelhead conservation to these projects are considered relevant to the understanding of potential impacts to hydropower projects in both regions.

Tables B-3 and B-4 present estimates of these impacts for both types of modifications, giving historical and projects costs borne by the BPA.

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 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 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.

Table B-3
BONNEVILLE POWER ADMINISTRATION (BPA) FISH AND 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

Table B-3, continued
BONNEVILLE POWER ADMINISTRATION (BPA) FISH AND WILDLIFE COSTS FOR THE FCRPS, 1995 - 2004

Cost Element	Fiscal Year costs ($millions)[1]				10-year Average
	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 on the 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 B-4 BPA FISH AND 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)	

B.2.4 Spatial and Temporal Distribution of Activity

This analysis uses 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.[89] Although these databases include the FCRPS dams, they are not included in the analysis of impacts at the watershed level for the reasons described above. Latitude and longitude of hydroelectric projects in the Southwest region are from the USACE National Inventory of Dams and the California Department of Water Resources, Bulletin 17.[90]

In order to determine the likely date of consultation for a dam, a series of assumptions were made based on the nature of the Federal nexus. For FERC-licensed dams, section 7 consultation and 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 ten years. This analysis assumes 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

[89] 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.

[90] California Department of Water Resources, Division of Safety of Dams. Dams within the Jurisdiction of the State of California, Bulletin 17.

given year). For small projects (that is, less than five megawatts of installed capacity), consultation is assumed to have 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.

B.2.5 Annualized 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 the others. Table B-5 illustrates the annualized expected modification costs for the general estimates associated with each cost category as described in Table B-1.

Table B-5
ESTIMATED ANNUALIZED EXPECTED PER-PROJECT COSTS FOR HYDROPOWER DAMS

Activity	Sub-activity	Per-Project Costs	Annualized Expected Cost
Hydropower Dams	Installed capacity is less than 5MW	$2,120,000	$10,600
	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	$246,700

Note: Because 17 projects were assigned project-specific modification cost estimates, they are not included in this table. 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.

B.2.6 Assumptions and Potential Errors

Table B-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 B-6 HYDROPOWER DAMS: ASSUMPTIONS AND POTENTIAL ERRORS	
Assumption	**Direction of Potential Error**
To estimate the expected start date for future consultation, this analysis employs 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.	+/-
This analysis assumes that the scale of the project 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.	+
This analysis assumes 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.	+
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/O. mykiss 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.	*

Table B-6 HYDROPOWER DAMS: ASSUMPTIONS AND POTENTIAL ERRORS	
Assumption	**Direction of Potential Error**
To the extent possible, this analysis uses the location data 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.	

B.3 Non-hydropower Dams and Other Water Supply Activities

B.3.1 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 three 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).

- This analysis assumes 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, now and in the future, are too sparse to support an estimation of potential section 7 impacts for the non-hydropower 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 of section 7 impacts at the watershed level.

B.3.2 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. In addition, because some California State Water Project (SWP) facilities are used jointly with the Federal Central Valley Project (CVP), the SWP is also subject to consultation. Also, 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, this discussion of potential impacts is divided into two parts: 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 related to construction or improvement of dams, diversions, and intakes. Infrastructure construction projects have been modified in their design, scope, maintenance requirements, and/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 operation 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.

B.3.3 Cost Assessment

Capital and Programmatic Modifications

A variety of sources were considered to document typical costs for these types of modifications. An analysis of the Pacific Northwest Hydrosite Database (PNHD) 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, specific municipal water intake construction case studies were researched. Table B-7 presents the case studies, cost categories, and specific costs identified. Because non-hydropower dam projects may bear any combination of the identified modifications, costs are estimated to range from $24,000 to $4.2 million. The midpoint of this range, $2.1 million, is used as the cost estimate, assumed to be borne over one year.

Table B-7
CASE STUDIES OF OPERATIONAL MODIFICATION COSTS FOR NON-HYDROPOWER 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 for 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 in-stream 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 (USBR), a Federal nexus exists that can result in flow regime changes.

An example is the USBR Deschutes River Basin Projects, which spans Oregon four counties and consists of six major water supply dams and associated diversion facilities and canals. The project provides water sufficient to irrigate approximately 85,000 acres used produce grain, hay, mint, potatoes, seeds, and irrigated pasture. Total active capacity of the Federal reservoirs is 255,300 acre-feet. In February 2005, NOAA Fisheries issued a biological opinion for the operation and maintenance of the project, calling for minimum instream flows to protect Middle Columbia River steelhead.[91]

Table B-8 presents an overview of studies that have documented the cost of flow regime changes in water supply projects. The table identifies the change in water quantity considered and the estimated dollar value associated with that change.[92]

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[91] NOAA Fisheries, Ongoing Operation and Maintenance of the Deschutes River Basin Projects Deschutes River, Crooked River, and Clear Creek, Crook, Deschutes, Jefferson, and Wasco Counties, Oregon 17070306 (Lower Deschutes), 17070301 (Upper Deschutes), and 17070305 (Lower Crooked), February 17, 2005.

[92] Appendix C presents a more detailed review of this literature.

Table B-8 STUDIES OF WATER SUPPLY COSTS RELATED TO WATER PROJECT OPERATIONS		
Case Study	**Quantity of Water***	**Cost**
Hamilton and Whittlesey (1996), Average Annual Costs of Flow Augmentation	4.6 MAF	$291.7 million
	3.5 MAF	$234.3 million
	3.2 MAF	$214.4 million
	1.95 MAF	$155.3 million
	1.08 MAF	$81.4 million
Huppert et al. (2003), Effects on Agricultural Production as measured by Gross Revenue	1 MAF	$752.9 million
	700 KAF – 1 MAF	$476.2 – $752.9 million
	569 KAF – 1 MAF	$349.0 - $752.9 million
USBR (1999), Effects on Agricultural Production as measured by Gross Revenue	1 MAF	$90.2 - $243.7 million
CALFED Environmental Water Account, Cost of Fish Protection Measures	374,000 AF	$58.9 million
	227,000 AF	$32.14 million
*Average annual flow augmentation (MAF = million acre-feet; AF = acre-feet)		

As illustrated in Table D-8, 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. These flow requirements are not known for most dams and water supply structures that fall within the salmon and steelhead critical habitat areas. For example, there are no available data on how much of a change in the flow regimes for the Deschutes River Basin Projects will be needed to satisfy the biological opinion, or even if any change will be needed.

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.

Because data are not widely available on these attributes, the extent of flow regime changes for non-hydropower 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 (USBR) operations in the Snake River Basin above Brownlee Reservoir, including 12 USBR 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.[93] NOAA Fisheries recommended that the USBR 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 USBR's Snake River projects.

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

- Uncontracted space in USBR 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 B-9 presents the amounts, costs, and average cost per acre-foot for several water sources from which the USBR has rented or contracted for water on an annual basis. Table B-10 presents the same results for other cases where the USBR has purchased water either on a longer term contract or permanently.[94]

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 USBR on the Umatilla River Basin water supply projects, NOAA Fisheries, recommended that the USBR "avoid or minimize incidental take from dewatering McKay Creek from November through April by maintaining a minimum flow in McKay Creek."[95]; and in a consultation on the Deschutes River Basin water supply projects, NOAA Fisheries recommended that the USBR minimize incidental take by providing irrigation and flood control releases from upstream projects which will ensure streamflows on a weekly basis of 1,700 cfs into Lake Billy Chinook in October and November."[96]

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[93] 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.

[94] Not included in these tables are transactions the USBR makes with local rental pools that account for water purchased through contractual buy-backs. While the water projects presented in Tables B-9 and B-10 are within NOAA Fisheries' Northwest Region, their operations are considered relevant to the understanding of potential impacts of salmon conservation in both regions.

[95] NOAA Fisheries, Ongoing Operation of the Umatilla Project and the Umatilla Basin Project, April 23, 2004.

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

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. 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, this analysis does 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.

Table B-9 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	$2,315,000	$9.94
1996	194,667	$2,361,000	$12.13
1997	202,104	$2,416,000	$11.95
1998	200,325	$2,367,000	$11.82
1999	148,397	$1,727,000	$11.64
2000	162,325	$1,847,000	$11.38
2004	46,420	$675,000	$14.55
Payette Water District 65 (reservoir storage)			
1995	50,758	$322,000	$6.35
1996	56,000	$349,000	$6.24
1997	60,000	$369,000	$6.15
1998	50,000	$304,000	$6.08
1999	65,000	$389,000	$5.99
2000	50,000	$306,000	$6.12
2002	60,000	$353,000	$5.88
2003	64,500	$562,000	$8.71
2004	50,000	$425,000	$8.50
Boise River Water District 63 (reservoir storage)			
1995	2,000	$16,000	$8.15
1996	38,000	$304,000	$8.00
1997	2,000	$16,000	$7.89
Lemhi River (natural flow)			
2001	1,000	$230,000	$230.48
2002	1,000	$256,000	$255.67
2003	1,000	$251,000	$251.42
2004	1,000	$211,000	$211.00

Table B-9 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**
Idaho high lift pumpers (natural flow)			
2002	37,889	$2,063,000	$54.44
2003	43,137	$2,071,000	$48.01
2004	83,473	$3,683,000	$44.13
Grande Ronde River (natural flow)			
1996	64	$2,000	$28.88
1997	132	$4,000	$28.41
1998	198	$4,000	$18.73
1999	198	$4,000	$18.45
2000	198	$4,000	$18.04
2001	198	$3,000	$17.59
2002	198	$3,000	$17.33
2003	198	$3,000	$17.04
All Water Sources			
1995	285,597	$2,654,000	$9.29
1996	288,667	$3,015,000	$10.44
1997	264,104	$2,800,000	$10.60
1998	250,325	$2,671,000	$10.67
1999	213,397	$2,116,000	$9.92
2000	212,325	$2,153,000	$10.14
2001	1,198	$221,000	$184.72
2002	108,687	$2,998,000	$27.59
2003	108,637	$2,829,000	$26.04
2004	180,893	$4,995,000	$27.61

Table B-10 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**
Permanent buyback of Snake River projects storage space			
1996	35,000	$2,629,000	$75.13
1995	6,518	$1,150,000	$176.48
1995	15,878	$2,593,000	$163.28
Shoshone Bannock tribal water			
1998	$38,000	$1,925,000	$50.65
Ontario, Oregon farm (natural flow)			
1997	$17,649	$1,493,000	$84.61

B.3.4 Spatial and Temporal Distribution of Activity

Latitude and longitude data were used from the USACE National Inventory of Dams to locate dams other than hydropower projects. This database provided spatial information on 1,454 dams. 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 make it possible to identify a likely date for consultation. Instead, it is assumed that for most types of non-hydropower dams, a consultation will occur sometime over the next 20 years. This period was chosen based on the historic frequency of consultation for these project types. It is assumed that all federally-regulated dams and dams with large reservoirs will incur modification costs with certainty sometime during that period. A uniform distribution is used 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.

B.3.5 Annualized Expected Modification Cost Estimates

As noted above, this analysis assumes that modification costs are borne in one year; Federal and large non-hydropower dams are certain to bear these costs sometime 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 annualized expected modification cost estimates are given below in Table B-11:

Table B-11
ESTIMATED ANNUALIZED PER-PROJECT COSTS FOR NON-HYDROPOWER DAMS

Activity	Sub-activity	Per-Project Costs	Annualized Expected Cost
Non-hydropower dams	Federal and large dams	$2,120,500	$106,000
	Small non-Federal dams	$2,120,500	$10,600

B.3.6 Assumptions and Potential Errors

Table B-12 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 B-12
Non-hydropower 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 this analysis.	-
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	

B.4 Federal Lands Management (including grazing)

B.4.1 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. This analysis assess 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 project modifications as they 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.

- This analysis considers three types of Federal land management activities: programmatic, non-wilderness land management; programmatic wilderness land management; and grazing land management. This analysis further distinguishes 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;
  - Northern California: \$8.95 (\$4.91 to \$12.98) per non-wilderness acre and \$0.44 (\$0.23 to \$0.66) per wilderness acre;
  - Southern California: \$12.16 (\$6.04 to \$18.27) per non-wilderness acre and \$0.70 (\$0.38 to \$1.02) per wilderness acre.

- Impacts on livestock grazing estimated to result from future section 7 implementation for West Coast salmon and steelhead are \$29,000 (\$11,000 to \$47,000) annually per 1,000 acres of grazing land.

B.4.2 Background

A Federal nexus exists for all management activities occurring on Federal lands. Activities of the Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) are grouped into one "activity" category 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[97], permitting of livestock grazing[98], and permitting of various use permits. These activities are grouped into two activity types: General land management activities (classified into ten sub-activities) and permitting of livestock grazing.

Review of the recent consultation history (2001-2003) shows that nearly 18 percent of section 7 consultations for West Coast salmon and steelhead are conducted with the USFS and BLM on various land management activities. The outcomes of these consultations are likely influenced by 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, Idaho, and Northern California not covered by the NWFP, USFS and BLM have adopted a management strategy specifically for anadromous fish protection.[99] 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.

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[97] 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.

[98] 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.

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

B.4.3 Cost Assessment

B.4.3.1 Federal land management activities (excluding grazing)

This analysis first classifies 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, this analysis distinguishes between these two types of Federal lands. This analysis 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, this analysis estimates costs of each identified project modification for each of the ten activities and then combines 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 B-13 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, a low and a high cost are estimated 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 protection, the cost estimates for those lands were modified. Following discussions with USFS and BLM personnel, a likelihood of occurrence of each specific sub-activity was determined for both wilderness and non-wilderness lands.

To account for regional variation in the modification costs for Federal land management activities, this analysis classifies all National Forests and BLM districts into five regions based on geography: Idaho, Western Oregon and Washington, Eastern Oregon and Washington, Southern California, and Northern California. These classifications are summarized in Table B-13.

Table B-13
ESTIMATED COSTS OF PROJECT MODIFICATIONS FOR FEDERAL LANDS 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
Pump chance/ 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/ornamental rock collecting	- Include erosion control plans for quarries to protect fish	$5,000 to $10,000

Table B-13 ESTIMATED COSTS OF PROJECT MODIFICATIONS FOR FEDERAL LANDS MANAGEMENT ACTIVITIES (EXCLUDING GRAZING)		
Sub-activity	**Typical Project Modifications* (per-project)**	**Project Modification Costs**
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
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 and 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

Table B-13
ESTIMATED COSTS OF PROJECT MODIFICATIONS FOR FEDERAL LANDS MANAGEMENT ACTIVITIES (EXCLUDING GRAZING)

Sub-activity	Typical Project Modifications* (per-project)	Project Modification Costs
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

Table B-14 ASSESSMENT REGIONS FOR NATIONAL FORESTS AND BLM DISTRICTS		
Region	BLM District(s)	National Forests*
Southern California	Susanville District	**Cleveland National Forest**, **Sierra National Forest**, Los Padres National Forest
Northern California	Carson City District, Ukiah District, Bakersfield District	**Six-Rivers National Forest**, **Shasta-Trinity National Forest**, Stanislaus National Forest, Toiyabe National Forest, Tahoe National Forest, Plumas National Forest, Lassen National Forest, Eldorado National Forest
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.		

This analysis then applied quarterly SOPA's from National Forests to determine the number of each of the ten categories of projects that typically occur in each forest on an annual basis.[100] SOPA's include the same types of activities that are usually included in programmatic consultations on West Coast salmon and steelhead.

This analysis estimates 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. A per-acre cost is calculated 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. Finally, a regional per-acre cost is estimated by averaging the per-acre costs created in the previous step for each forest within the five regions. This process enabled the analysis to project costs to forests and land that did not have SOPA information available. Note that because of the variability in activities projected in the SOPAs and the number of acres of Federal lands for each area, costs-per-acre are quite different from one another across regions. Table B-15 lists the regional cost estimates and their ranges.

Table B-15
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)
	Northern California	$8.95 ($4.91 to $12.98)
	Southern California	$12.16 ($6.04 to $18.27)
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)
	Northern California	$0.44 ($0.23 to $0.66)
	Southern California	$0.70 ($0.38 to $1.02)

[100] Personal communication with Carol Brown, Sawtooth National Forest, March 10, 2005, suggested that the SOPA's are a good representation of typical activities that occur within forests in a "typical" year.

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.

B.4.3.2 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). For cases where costs could not be allocated to a specific allotment, the total cost of the modification are applied to each allotment. This may slightly inflate estimated costs on a per-project basis.

To determine costs of section 7 implementation for West Coast salmon and steelhead associated with Federal lands grazing modifications, this analysis 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. The number of acres was then determined for a typical grazing allotment in the areas under consideration areas using spatial data of allotments in these areas. This analysis uses the median number of acres (4,000 acres) in a sample of 4,300 allotments in Oregon, Washington, and Idaho.[101] Finally, a per-acre cost of section 7 implementation is estimated for salmon and steelhead for a grazing allotment by dividing the typical per-allotment cost by the number of acres in a typical allotment.

As above, this methodology assumes that each allotment will be required to comply with this full list of project modifications. This is unlikely because some grazing allotments within critical habitat may not contain primary constituent elements for salmon and steelhead and so their activity will not

[101] This analysis uses the ICBEMP spatial data for grazing allotments for Idaho, Oregon, and Washington to determine acreage of each allotment. Allotments with unique IDs were assumed to represent unique allotments. The average acreage in this sample of allotments was 14,200. By using the median acreage, this analysis conservatively assumes a higher cost per acre for grazing modifications (using the median: $11 to $47/acre for grazing modifications; Using the average: $3 to $13/acre).

be modified as a result of section 7 implementation. In addition the NWFP and PACFISH S&Gs for grazing (GM-1 thru GM-4),[102] and the "Interagency Implementation Team (IIT) 2000 Grazing Implementation Monitoring Module" for the Malheur National Forest and other National Forest and BLM Districts in Oregon provide protections to salmon and steelhead from adverse effects of grazing activities. Project modifications found in biological opinions for grazing 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.

B.4.4 Spatial and Temporal Distribution of Activity

B.4.4.1 Federal land management activities (excluding grazing)

This analyses relies on 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 California, Oregon, Washington and Idaho.

This analysis identified wilderness areas using spatial data (National Special Designated Areas) from the USFS, including both National Wilderness 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.[103] The annual level of SOPA activity is therefore used as an estimate of the typical annual level of activity. It is 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.

B.4.4.2 Livestock Grazing on Federal lands

This analysis identifies 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. In the NWR, the Interior Columbia Basin Ecosystem Management Project (ICBEMP) spatial data is used for grazing. For California, grazing land ownership data was collected from the *California Digital Conservation Atlas* and used to determine the locations of future section 7 consultations.

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[102] GM-1: Modify grazing practices...that retard or prevent attainment of Riparian Management Objectives or are likely to adversely affect anadromous fish. Suspend grazing if adjusting practices is not effective. GM-2: Locate new livestock handling and/or management facilities outside of RHCAs. For existing facilities, assure that facilities do not prevent attainment of Riparian Management Objectives or adversely affect listed anadromous fish. Relocate or close facilities where these objectives cannot be met. GM-3: Limit livestock trailing, bedding, watering, salting, loading, and other handling efforts to those areas and times that will not retard or prevent the attainment of RMOs or adversely affect listed anadromous fish. GM-4: Adjust wild horse and burro management to avoid impacts that prevent attainment of RMO or adversely affect listed anadromous fish.

[103] 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

Each acre of Federal lands grazing is assumed to be certain to bear costs of section 7 implementation at some point over the next ten years (the typical period for a grazing permit) and that the modification costs will be borne in a single year. It is assumed there is an equal probability of the consultation occurring over the ten year period.

B.4.5 Annualized Expected Modification Cost Estimates

For land management activities, this analysis assumes all costs are certain and borne in one year and the level of activity per acre is constant across years. Thus the regional per-acre cost estimate equals the annual expected modification cost. For grazing, the annualized expected modification cost incorporates the annual probability of a consultation (10%). These estimates are presented below in Table B-16.

Table B-16
ESTIMATED ANNUALIZED COSTS FOR FEDERAL LANDS MANAGEMENT AND GRAZING

Activity	Sub-activity	Annualized Cost (per-acre)
Federal land management, non-wilderness areas	Idaho	$1.26
	Western Oregon or Western Washington	$5.90
	Eastern Oregon or Eastern Washington	$3.30
	Northern California	$8.95
	Southern California	$12.16
Federal land management, wilderness areas	Idaho	$0.07
	Western Oregon or Western Washington	$0.029
	Eastern Oregon or Eastern Washington	$0.15
	Northern California	$0.44
	Southern California	$0.70
Livestock Grazing on Federal Land	Grazing	$1,157 per stream-mile
	California	$29.00

B.4.6 Assumptions and Potential Errors

Table B-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 B-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 implement-ation 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 (e.g Cleveland and Sierra National Forests are assumed to conduct the same mix of activities because they fall within the Southern California region). 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).	+/-
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, estimated costs of fuel reduction activities may be overstated.	+/-
- : May result in an underestimate of real costs + : May result in an overestimate of real costs +/- : Has an unknown effect on estimates	

B.5 Transportation Projects

B.5.1 Overview

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

- The method for estimating section 7 impacts on transportation projects is to measure the direct costs associated with section 7 implementation. First, a review of the relevant consultation history was undertaken and spatial data was used to identify the types and sizes of transportation projects planned to occur. The spatial data was then combined 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.

B.5.2 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.

The California Department of Transportation (Caltrans) has been engaged in an ongoing bridge retrofit program since the early 1970's. The 12,000+ bridges in the California Highway System, plus an additional 11,500 city and county bridges are inspected on a biennial basis. A major component of this program is the San Francisco-Oakland Bay Bridge East Span Seismic Safety Project (SFOBB), a major construction endeavor to upgrade the East Span section of the Bay Bridge to make it less susceptible to damage in an earthquake. Though details of the planned upgrade have not been finalized, the project is anticipated to have major economic and environmental implications and may result in a consultation with NOAA Fisheries.

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 B-18 lists both the effects from and the modifications typically required of transportation projects.

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 are the categories on which this analysis focuses.

Table B-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/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

B.5.3 Cost Assessment

To determine the costs of section 7 implementation for West Coast salmon and steelhead associated with transportation projects, spatial data and recent consultation history were examined to identify the typical characteristics of transportation projects in the areas under consideration. Typical project modifications were then defined by examining Reasonable and Prudent Measures and Terms and Conditions from past salmon and steelhead biological opinions on transportation projects. Costs of each identified project modification were estimated accordingly. Some costs vary continuously with project scale (usually measured by miles of roadway or feet of stream affected), and so costs were categorized 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 B-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 B-20, to provide a range of potential costs for each modification.

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, the relation between the two using data on both from biological opinions was contemplated. Unfortunately, instances where data on both road length and stream length impacted are available are rare, and so two cases were used 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.[104]

[104] In this case, the high end of the variable cost range is used as the representative cost estimate. Although the review of the data sources found projects with variable costs at the lower end of the range, the higher end is applicable in instances that are far more typical. This was not the case for other activities where a range of costs was determined.

Table B-19 ESTIMATED COSTS OF PROJECT MODIFICATIONS FOR TRANSPORTATION PROJECTS				
	Fixed Costs (per-project)*			Variable Costs (per linear foot of stream impacted)
Project Modifications	**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 during 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 control 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 contouring, mulching, seeding and planting with native vegetation	N/A	N/A	N/A	$10-$60
Monitoring and evaluation both during and following construction	$4,400	$7,700	11,000	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**	**$37.50-$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

B.5.4 Spatial and Temporal Distribution of Activity

California, Idaho, Washington, and Oregon have produced future transportation plans, which were 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 B-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 B-20
SUMMARY OF TRANSPORTATION PROJECTS POTENTIALLY AFFECTED BY CRITICAL HABITAT

State	Data Source	Time Frame for Planned Projects (years)*	Total Number of Projects within Areas under Consideration
Oregon	State Improvement Plans (STIP) 2002-2005	3	198
Idaho	State Improvement Plans (STIP) 2002- 2005	3	28
California	California Transportation Investment System (CTIS)	5	543
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

B.5.5 Annualized Expected Modification Cost Estimates

Using the data in the state transportation plans, the above formula was applied to each project in the plan. All modification costs are assumed to be certain and borne in one year, and the probability of a project bearing these costs is uniform through the 5 year period for transportation projects. As a result, the annualized 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. Table B-21 summarizes estimated and annualized expected costs for a project that involves the average mileage (3.2 miles).

Table B-21 ESTIMATED ANNUALIZED PER-PROJECT COSTS FOR TRANSPORTATION PROJECTS			
Activity	**Sub-activity**	**Present Value of Costs**	**Annualized Expected Cost**
Transportation*	Bridges & culverts (small)	$42,000	$8,000
	Bridges & culverts (medium)	$69,000	$14,000
	Bridges & culverts (large)	$98,000	$20,000
	Roads (small)	$37,000	$7,000
	Roads (medium)	$61,000	$12,000
	Roads (large)	$85,000	$17,000
*Transportation costs are presented for a project of average mileage (3.2 miles).			

B.5.6 Assumptions and Potential Errors

Table B-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 B-22 TRANSPORTATION PROJECTS: ASSUMPTIONS AND POTENTIAL ERRORS	
Assumption	**Direction of Potential Error**
This analysis assumes 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).	+/-

Table B-22 TRANSPORTATION PROJECTS: ASSUMPTIONS AND POTENTIAL ERRORS	
Assumption	**Direction of Potential Error**
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.	+/-
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 enable a reasonable forecast of 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	

B.6 Utility Line Projects

B.6.1 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 the 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 USACE and FERC. USACE consults with NOAA Fisheries regarding permits issued 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.[105] For projects that

[105] Personal communication with Robert Arvedlund, Federal Energy Regulatory Commission, February 25, 2003

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.[106] 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.

- Per-project costs of section 7 implementation on pipeline and outfall structure projects are estimated to be $101,000 ($100,000 to $102,000), using historical project modification costs.

B.6.2 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 B-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.

[106] *Wetland and Waterbody Construction and Mitigation Procedures.* Federal Energy Regulation Commission. January 17, 2003.

Table B-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: National Oceanic and Atmospheric Administration. Biological Opinion of Corps of Engineers' Programmatic Consultation for Permit Issuance for 15 Categories of Activities in Oregon, March 21, 2001. OSB2001-0016; National Oceanic and Atmospheric Administration. Biological Opinion for the Port Of St. Helens Industrial Outfall and Portland General Electric Power Plant, Port Westward Industrial Park, Columbia River, Columbia County, Oregon, August 1, 2003. 2002/00013. National Oceanic and Atmospheric Administration. Biological Opinion of Corps for Miller Creek Wastewater Treatment Plant Outfall Replacement, WRIA 9, August 15, 2003, 2002/00355. National Oceanic and Atmospheric Administration. Biological Opinion for the Myrtle Creek and Tri-City Sanitary District Wastewater Treatment Plant Improvement, South Umpqua River, Douglas County, Oregon, April 30, 2003, 2002/00376.	

B.6.3 Cost Assessment

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

Using the available data, it is not possible to distinguish between types of utility projects (pipeline projects *v.* outfall structure projects). As a result, projects were assigned an equal probability of involving 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 annualized expected modification cost for a project is then equal to the mid-range of these two figures, or $101,000 per-project.

Table B-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

B.6.4 Spatial and Temporal Distribution of Activity

The location of utility line projects was identified using data on the latitude and longitude of historic USACE permits on utility lines. This analysis assumes that the historic patterns of these permits are likely to predict the general location of potential future projects, which will then engage in consultations.[107] It is further assumed 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.

Limitations are 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

[107] Future consultations may also cover pipeline projects permitted by FERC. This analysis therefore maps pipeline right-of-ways in each watershed. Modification costs were not estimated 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. This analysis is therefore limited to known pipeline and outfall structures.

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 this method produces a reasonable geographic distribution of activity given available data.

B.6.5 Annualized 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 annualized expected modifications costs are equal to the estimated modifications costs, as shown in Table B-25.[108]

Table B-25
ESTIMATED ANNUALIZED PER-PROJECT COSTS FOR UTILITY LINE PROJECTS

Activity	Sub-activity	Per-Project Costs	Annualized Expected Cost
Utility Lines	Outfall structures and pipelines	$101,000	$13,000

B.6.6 Assumptions and Potential Errors

Table B-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.

[108] USACE permit data from different districts is adjusted to account for temporal differences in the data. For example, the data set from the Seattle USACE district covered 4 years, while the data set from the Sacramento district covered 8 years. The annual level of projects requiring modifications is estimated by dividing the level obtained from each district's data by the number of years covered by that district's data set.

Table B-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 results upward. - : This assumption is likely to bias results downward. +/- : This assumption could bias results upward or downward.	

B.7 Instream Activities (including Dredging)

B.7.1 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 the 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).[109]

[109] Personal communication with Wes Silverthorne, Economist Santa Rosa Field Office, California, NOAA personnel, January 9, 2004.

- 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 docks. For the purpose of the analysis, instream activities are divided 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.

- In the San Francisco Bay dredging is regulated by a Long-Term Management Strategy (LTMS) For the Placement of Dredged Material in the San Francisco Bay Region. The LTMS gives dredging windows, disposal sites, and targets for distribution of dumping among sites. NOAA Fisheries treats these permit applications programmatically unless projects cannot occur within the dredging windows and a formal consultation is required. Based on historical project experience, this is expected to occur 14 percent of the time. Because work windows and disposal sites are required by the LTMS these potential project modifications are considered baseline. Therefore, it is assumed that mobilization costs are the only costs attributable to section 7 implementation.

B.7.2 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 B-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 B-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 B-27
TYPICAL PROJECT MODIFICATIONS FOR INSTREAM ACTIVITIES (INCLUDING DREDGING)

Sub-activity	Typical Project Modifications
Bank Stabilization	- 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
Dredging	- Work windows - Dredge-material disposal requirements

Table B-27 TYPICAL PROJECT MODIFICATIONS FOR INSTREAM ACTIVITIES (INCLUDING DREDGING)	
Sub-activity	**Typical Project Modifications**
San Francisco Bay Dredging	- Dredging windows - Disposal sites - Targets for distribution of dumping among sites
Sources: National Oceanic and Atmospheric Administration. Biological Opinion for Construction of a new boat dock at Columbia Cove Park, Okanogan County, Washington, May 16, 2003. 2001/01013; National Oceanic and Atmospheric Administration. Biological Opinion for Rouge River (Depot Street) Bridge Replacement Project, Jackson County, Oregon, October 23, 2003. 2002/00816; National Oceanic and Atmospheric Administration. Biological Opinion for McCormick Pier Repair Project, Willamette River Mile 11.3, Multnomah County, Oregon, May 23, 2003. 2002/01399; National Oceanic and Atmospheric Administration. Biological Opinion for the Georgia-Pacific Bulkhead Replacement Project, Yaquina River Basin, Lincoln County, Oregon, February 21, 2003. 2002/01314; Personal communication with Peter Losavita, U.S. Army Corps of Engineers, San Francisco District, personnel, December 4, 2003.	

B.7.3 Cost Assessment

This analysis employs 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, costs are not separately estimated for bulkhead and breakwater projects, but it is assume they are included as part of other sub-activity projects. Table B-28 lists the different sub-activities with the typical project modifications and cost estimates.

Because of limitations in the spatial data, the first three sub-activities are combined – boat dock construction, boat launch construction, and bank stabilization projects – into one sub-activity. The midpoint of the associated range of costs is used as the expected 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. Costs are expected to be borne in a single year.

Table B-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
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	$34,000 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]
San Francisco Bay Dredging	- Dredging windows - Disposal sites - Targets for distribution of dumping among sites	$42,000 to $140,000

[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.
[3] Personal communication with Michael Dillabaugh, U.S. Army Corps of Engineers, San Francisco District, Operations and Readiness Division, Project Manager, November 24, 2003.

B.7.4 Spatial and Temporal Distribution of Activity

The best data currently available to predict the location of future instream activities is the latitude and longitude location of historic USACE permits. This analysis assumes 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). The annual level and locations of USACE permits for instream activities and dredging projects are further assumed to be representative of the annual level and locations of projects that need to be modified to comply with section 7 for salmon and steelhead.

Limitations exist 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 this method produces a reasonable geographic distribution of activity given available data.

B.7.5 Annualized Expected Modification Cost Estimates

As noted above, all modification costs are assumed to occur for each project to be borne in one year, and the annual level and locations of USACE permits for instream activities and dredging projects are assumed to be representative of the annual level and locations of projects that need to be modified to comply with section 7 for salmon and steelhead.[110] These assumptions produce the annualized expected modification costs for instream projects and dredging shown in Table B-29.

Table B-29
ESTIMATED ANNUALIZED PER-PROJECT COSTS
FOR INSTREAM ACTIVITY PROJECTS (INCLUDING DREDGING)

Activity	Sub-activity	Per-Project Costs	Annualized Expected Cost
Instream Activities	Boat dock, boat ramps, bank stabilization	$54,500	$54,500
Dredging	Dredging	$821,000	$821,000

[110] USACE permit data from different districts is adjusted to account for temporal differences in the data. For example, the data set from the Seattle USACE district covered 4 years, while the data set from the Sacramento district covered 8 years. The annual level of projects requiring modifications is estimated by dividing the level obtained from each district's data by the number of years covered by that district's data set.

B.7.6 Assumptions and Potential Errors

Table B-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.

Table B-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

B.8 National Pollutant Discharge Elimination System Permitted Facilities

B.8.1 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.[111] Facilities employ a range of temperature control strategies to meet these standards.

[111] U.S. Environmental Protection Agency, EPA Region 10 Guidance For Pacific Northwest State and Tribal Temperature Water Quality Standards, EPA 910-B-03-002, April 2003.

- 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.[112]

- 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.[113] 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.

B.8.2 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

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[112] Although California was not part of the Northwest Temperature Guidance Consultation, this analysis assumes that similar requirements to protect salmon in that state will lead to similar economic impacts in the future.

[113] Science Applications International Cooperation: *Economic Analysis of the Proposed Water Quality Standards Rule for the State of Oregon* . Science Applications International Corporation. Reston, VA. 2003. EPA No. 68-C-99-252.

represent a significant portion of the consultation record nor are they expected to increase in the future.[114]

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.

B.8.3 Cost Assessment

This analysis applies 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:

- 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, capital costs are assumed to be incurred in the first year, and operations and maintenance (O&M) costs are incurred uniformly over a 20 year period. Facilities were then divided 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.

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[114] 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 possibly 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 this analysis in that the restrictions on pesticide use can be viewed as a habitat-related impact of section 7.

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

Table B-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	$72,000
Major	$19,700 ($5,200 - $34,000)	$421,500	$630,500

B.8.4 Spatial and Temporal Distribution of Activity

This analysis identifies 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. This analysis assumes that if a facility is required to comply with the temperature criteria, it will do so immediately.

B.8.5 Annualized 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.

These ratios are employed 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 annualized expected modification costs are shown in Table B-32.

Table B-32 ESTIMATED ANNUALIZED PER-PROJECT COSTS FOR NPDES-PERMITTED ACTIVITIES			
Activity	**Sub-activity**	**Present Value of Costs**	**Annualized Expected Cost**
NPDES-permitted activities	Minor facility	$72,000	$1,360
	Major facility	$630,000	$14,900

B.8.6 Assumptions and Potential Errors

Table B-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 B-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.	+/-
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	

B.9 Sand and Gravel Mining

B.9.1 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.[115]

- 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.

- This analysis applies 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. This impact is not expected to result in a reduction in the overall market supply of gravel to the impacted regions.

B.9.2 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

[115] "NMFS National Gravel Extraction Policy," National Marine Fisheries Service, 2002 (NMFS Gravel Guidance). Of note, NOAA Fisheries is in the process of revising this guidance, though this draft guidance is expected to be consistent.

sediment.[116] 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.[117]

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.

B.9.3 Cost Assessment

The sand and gravel mining extraction policy for NOAA Fisheries states that "gravel removal quantities should be strictly limited so that gravel accumulation rates are sufficient to avoid extended impacts on channel morphology and anadromous fish habitat."[118] 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, information from one case that has sufficient information to estimate this cost is applied.[119]

The case concerned a site mined for 32 years by Joe Bernert Towing.[120] 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 the current value of $6.70/ton,[121] the gross value of the forgone production is about $44,500 per mile annually.[122] If net revenue for this industry is assumed to be 25 percent of gross revenue,[123] potential lost net revenues at this site are approximately $11,000 per

[116] NMFS Gravel Guidance.

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

[118] NMFS Gravel Guidance, 2002. NOAA Fisheries is in the process of revising this guidance.

[119] Data on these costs were the most difficult to obtain. For that reason, this analysis makes assumptions in estimating costs that may need revision.

[120] Endangered Species Act Formal Section 7 and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Joe Bernert Towing Company Instream Gravel Mining Project, Lower Williamette River Basin, River Miles 27-56.6, Clackamas, Marion, and Yamhill Counties, Oregon (Corps No. 199601626), October 6, 2003.

[121] Kohler, Susan. "California Non-Fuel Minerals 2002." California Department of Conservation, California Geological Survey, Sacramento, California, 2002.

[122] 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.

[123] This figure is a gross operating margin. RMA (Risk Management Association) Annual Statement Studies, 2002.

year, or a present value (at a seven percent 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.[124] Without information on the proximity of such substitute sites, it is assumed 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, it is considered to be a good source of gravel. Clearly, not all sand and gravel mining areas will produce equivalent amounts of 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.[125] 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.

B.9.4 Spatial and Temporal Distribution of Activity

This analysis identifies sand and gravel mining tracts in Oregon, Washington, Idaho, and California using latitude and longitude data from the USGS "Active mines and mineral plants" (1997). It assumes 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. The probability of consultation in a given year is assumed to be 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, and channel widening.

For this reason, this analysis considers that possibility that no modification will be required for a sand and gravel mining operation. Without more detailed information on the distribution of site

[124] For every 30 miles that aggregate has to travel, the costs of transportation double. "California Again Leads the Nation in Production of Non-Fuel Minerals", California Department of Conservation, August 7, 2001.

[125] Estimated from sites characteristics included in "California Again Leads the Nation in Production of Non-Fuel Minerals", California Department of Conservation, August 7, 2001.

attributes, an equal probability is assigned to the occurrence of the two possible events, modification and no modification. Moreover, it is also assumed 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.

B.9.5 Annualized Expected Modification Cost Estimates

To derive the annualized expected modification cost for sand and gravel mining, this analysis combines the cost estimates and assumptions 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 annualized expected modification cost for sand and gravel mining is given in Table B-34.

Table B-34
ESTIMATE ANNUALIZED PER-PROJECT COSTS FOR SAND AND GRAVEL MINING

Activity	Sub-activity	Present Value of Costs	Annualized Expected Cost
Sand and Gravel Mining	Mining on non-Federal lands	$1,353,000	$23,000

B.9.6 Assumptions and Potential Errors

Table B-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 B-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.	+
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	

B.10 Residential and Commercial Development

B.10.1 Overview

- This analysis assesses impacts on residential and commercial development, but excludes impacts that are covered elsewhere (roads, utility lines, and so forth).[126] The most common Federal nexus for residential and related development activities is USACE as they permit construction or expansion of stormwater outfalls, discharge or fill of wetlands, flood control projects, bank stabilization, and instream work.[127]

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

[127] 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.

- This analysis estimates 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 the 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 proposed critical habitat 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.

B.10.2 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.[128] 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 economic consequences.

A second category of regional impacts identified by commenters on 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.[129] 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.[130]

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 can be mitigated. As a result, section 7 consultations regarding the ESUs for real estate development are

[128] Elliott D. Pollack and Company, The Economic and Fiscal Impact of the Designation of 60,060 Acres of Privately Owned Land in Pima County, Arizona as Critical Habitat for the Cactus Ferruginous Pygmy-Owl, prepared for Southern Arizona Homebuilders Association, February 25, 1999.

[129] Ibid.

[130] Meyer, Stephen M. 1998. "The Economic Impact of the Endangered Species Act on the Housing and Real Estate Markets." New York University Environmental Law Journal. 6(450):1-13.

typically 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.[131]

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.

B.10.3 Cost Assessment

This analysis uses information from the Washington Department of Ecology as the basis for the cost assessment.[132] Table B-36 lists the typical modifications associated with development projects and presents a range of costs. To determine this range, all potential project modification costs were aggregated and this was applied as 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. These costs are assumed to be borne in one year.

Table B-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.	$230,000 to $240,000

[131] 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.

[132] Washington Department of Ecology Year 2001 Minimum Requirements for Stormwater Management in Western Washington Cost Analysis, August 2001.

B.10.4 Spatial and Temporal Distribution of Activity

To estimate the level and location of development-related impacts, EPA data on the level and locations of State-issued NPDES stormwater permits and USACE permit data were used. 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., single family home would not require an extensive stormwater management system).

This analysis 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.

In California, the facility city location was used from the Notice of Intent for Stormwater Discharges Associated with Construction Activities under a NPDES general permit from 2000 to 2003. This was done due to the large proportion (90 percent) of missing latitude and longitude points for NPDES permit locations in the NPDES spatial data. It is also assumed that areas of historic permits are likely sites for future construction or replacement of stormwater systems.

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

B.10.5 Annualized Expected Modification Cost Estimates

The assumption that all modification costs are certain and are borne in one year produces the annualized expected modification costs shown in Table B-37.

Table B-37
ESTIMATED ANNUALIZED PER-PROJECT COSTS
FOR RESIDENTIAL AND COMMERCIAL DEVELOPMENT

Activity	Sub-activity	Per-Project Costs	Annualized Expected Cost
Residential and Commercial Development	New development	$235,000	$14,000

B.10.6 Assumptions and Potential Errors

Table B-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 B-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

B.11 Agricultural Pesticide Applications

B.11.1 Overview

- This analysis assumes that pesticide restrictions on 20 and 100 yard buffer areas surrounding "salmon supporting waters" will preclude harvest on certain crop types.

- The value of three crop categories, oil seeds and grains, vegetables and melons, and fruit and tree nuts, within these buffer areas in the watersheds occupied by one or more of the ESUs is estimated to determine a foregone value of cropland due to pesticide restrictions.

- This analysis applied county-specific data on the average value per acre of the three crop categories from the National Agriculture Statistics Service (NASS) and spatial data from NOAA Fisheries to determine the number of acres of the three crop types in each occupied watershed.

B.11.2 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."[133] 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.[134] Because of the link between section 7 and these restrictions, this analysis used the two sets of "no-spray buffers" to set a range of possible impacts.

B.11.3 Cost Assessment

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

- 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.

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

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

- Fruit and tree nut farming (NAICS industry code 1113) - This category comprises operations engaged in growing fruit and/or tree nut crops.[135]

For each crop type, data from the USDA National Agricultural Statistics Service, 2002 Census of Agriculture, are used regarding the acres of cropland and net operational dollar gain (ignoring government payments) on a per-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 B-39 presents a summary of these estimates:

Table B-39
NET OPERATION DOLLAR GAIN BY 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)
California	$64 (-$1,019 to $275)	$1,075 (-$810 to $4,239)	$657 (-$5,315 to $4,656)

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, net operational dollar gain is set to zero if negative for a particular county and crop type. For other counties and crop types, the Census data were missing, in which case the appropriate State average for that crop type is substituted.

B.11.4 Spatial and Temporal Distribution of Activity

Assessing the spatial distribution of the section 7 impacts required interpretation of the phrase "salmon supporting waters," which is the basis for the court-ordered restrictions. NOAA Fisheries spatial data was used to identify stream reaches that are occupied by salmon or steelhead for each of the ESUs under consideration.[136] For the purposes of this analysis, these reaches are considered

[135] USDA, National Agricultural Statistics Service. 2002 Census of Agriculture: Appendix A.

[136] NOAA Fisheries also considered nearshore areas and the Lower Columbia River area as occupied reaches, and so treated them as "salmon supporting waters."

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. This analysis 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). The three land cover types considered were:

1. Small Grains (NLCD 83) - Areas used for the production of graminoid crops such as wheat, barley, oats, and rice.
2. Row Crops (NLCD 82) - Areas used for the production of crops, such as corn, soybeans, vegetables, tobacco, and cotton.[137]
3. 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.

This analysis assumes that the impacts of the agricultural pesticide application restrictions are certain and borne as an annual impact.

B.11.5 Annual Expected Modification Cost Estimates

Table B-40
ESTIMATED ANNUALIZED PER-PROJECT COSTS
FOR AGRICULTURAL PESTICIDE APPLICATIONS IN CALIFORNIA

Activity	Costs per Acre	Annualized Expected Cost
Oil seed and grain farming	$64 (-$1,019 to $275)	$64 (-$1,019 to $275)
Vegetable and melon farming	$1,075 (-$810 to $4,239)	$1,075 (-$810 to $4,239)
Fruit and Tree nut farming	$657 (-$5,315 to $4,656)	$657 (-$5,315 to $4,656)

[137] These three land cover types do not correspond with the NASS crop types exactly. This exception is that 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 the counties under consideration, however.

B.11.6 Assumptions and Potential Errors

Table B-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 B-41
AGRICULTURAL PESTICIDE APPLICATIONS: ASSUMPTIONS AND POTENTIAL ERRORS

Assumption	**Direction of Potential Error**
Court-ordered injunction represents likely outcome of section 7 consultations. Consultation, however, may result in more flexible ways to avoid jeopardy or adverse modification.	+
No adjustment in crop/pesticide practices (e.g., type or application method) are undertaken nor are there alternative beneficial uses of land.	+
No adverse spillover effects of pesticide ban on adjacent agricultural land exist.	-
Negative per-acre returns are not representative of actual impact.	+
Positive per-acre returns are representative of actual impact.	-/+
Pesticides subject to restrictions are applied to all croplands identified in NLCD..	+
Agricultural land is only land cover affected by the court-ordered restrictions on pesticide use.	-

B.12 Summary

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

Table B-42
SUMMARY OF ACTIVITY COST ESTIMATION

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Modifications	Annualized Expected Cost
Hydropower Dams*	Small (0 - 5 MW)	per dam	$2,120,000	$1,123,000	20 years	10% over 20 years	$11,000
	Medium (5 - 20 MW)		$5,750,000	1,916,000	50 years	100% over 50 years	$139,000
	Large (>20 MW), fish passage unknown		$56,390,000	$34,593,000	50 years	100% over 50 years	$2,507,000
	Unknown capacity		$7,530,000	$2,506,000	50 years	100% over 30 years	$182,000
Non-hydropower Dams	Federal and large non-hydropower dams	per dam	$2,120,500	$1,123,000	20 years	100% over 20 years	$106,000
	Small non-Federal Non-hydropower dams					10% over 20 years	$10,000
Federal Land Management Activities (non-wilderness areas)	Northern California	per acre	$8.95	$8.95	1 year	100%	$8.95
	Southern California		$12.16	$12.16			$12.16

Table B-42
SUMMARY OF ACTIVITY COST ESTIMATION

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Modifications	Annualized Expected Cost
Federal Land Management Activities (wilderness areas)	Northern California	per acre	$0.44	$0.44	1 year	100%	$0.44
	Southern California		$0.70	$0.70			$0.70
Livestock Grazing on Federal Land	Grazing	per acre	$29.00	$20	10 years	100%	$2.90
Transportation**	Bridges & culverts (small)	per project & mile	$27,800 + variable costs (dependent on size of project)	project specific	5 years	100%	project specific
	Bridges & culverts (medium)		$55,500 + variable costs	project specific			project specific
	Bridges & culverts (large)		$84,300 + variable costs	project specific			project specific

Table B-42
SUMMARY OF ACTIVITY COST ESTIMATION

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Modifications	Annualized Expected Cost
	Roads (small)	per project & mile	$22,800 + variable costs	project specific	5 years	100%	project specific
	Roads (medium)		$47,000 + variable costs	project specific			project specific
	Roads (large)		$71,300 + variable costs	project specific			project specific
Utility Lines	Outfall structures and pipelines	per project	$101,000	$75,000	8 years	100%	$13,000
Instream Activities	Dredging	per project	$821,000	$612,000	8 years	100%	$102,000
	Dredging of San Francisco Bay	per project	$651,000	$486,000	8 years	100%	$81,000
	Boat dock, boat ramps, bank stabilization	per project	$54,500	$41,000	8 years	100%	$7,000

Table B-42
SUMMARY OF ACTIVITY COST ESTIMATION

Activity	Sub-activity	Cost Unit	Mid-range Cost Estimate	Present Value of Cost Stream	Forecast Period	Likelihood of Modifications	Annualized Expected Cost
EPA Water Quality	Minor facility	per facility	$136,000	$72,000	20 years	20%	$1,000
Temperature Compliance	Major facility	per facility	$816,000	$630,000	20 years	25%	$15,000
Sand and Gravel Mining	Mining on non-Federal lands	per site	$1,649,000	$280,000	30 years	50%	$23,000
Residential and Commercial Development	New development	per project	$235,000	$235,000	1 year	6%	$14,000
Agricultural Pesticide Applications	Oil seed and grain farming	per ace	varies by county and crop type	varies by county and crop type	1 year	100%	varies by county and crop type
	Vegetable and melon farming						
	Fruit and tree nut farming						

*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.
**Transportation costs are presented for a project of average mileage (3.2 miles).

Appendix C
Water Supply Impacts Related to Salmon and Steelhead

As noted in Section 4, the impacts to water supply activities resulting from changes to flow water often cannot be analyzed on a watershed basis, as these activities affect multiple watersheds. If attributing the impacts of section 7 consultations and the resulting modifications to a particular watershed is not appropriate, then, as designating critical habitat or applying section 7 generally to *any* of those watersheds would bring about the same result. Nevertheless, assessing the potential magnitude of these impacts is important. Below, this appendix summarizes several studies that assess these magnitudes for the West Coast and California, although not in the context of critical habitat designation. This appendix also describes major water supply projects in those states.

This appendix supports the analysis for both the seven California salmon and steelhead ESUs and the 13 West Coast ESUs. For that reason, the appendix contains references to data and methods specific to the Northwest Region.

C.1 Review of Selected Literature

C.1.1 Economics Literature

1) Hamilton, J. and N. Whittlesey, Cost of Using Water from the Snake River Basin to Augment Flows for Endangered Species, 1996

This paper examines costs associated with the NOAA Fisheries Recovery Plan for salmon species on the Snake/Columbia system. Costs are based on flow targets (as of the date of the study) for the lower Snake River at Lower Granite Dam in spring/early summer and midsummer. The paper develops five scenarios that cover a broad range of flow target interpretations.

Results indicate a range of annual costs to agriculture from $81 million to $292 million for proposed flow augmentation. The flow augmentation cost range is developed through estimation of agricultural land retirement and agricultural participation in an interruptible water market. Affected agricultural acreage ranges from approximately 25 percent of the total irrigated acres in the region to 18 percent more than the total irrigated acres in the region. Flow augmentation allows for increased power production that offsets the gross cost to agriculture. Net of increased electric power production revenues resulting from increased flow, the annual costs of flow augmentation to agriculture are estimated to be between $50 million and $160 million.

Caveats to the research include the consideration of willing sellers only, the assumption that interruptible markets would only deliver up to 600,000 acre feet in dry years, the exclusion of third party costs including water shortage costs to downstream irrigators (i.e., from changes in runoff or aquifer recharge), costs related to flow management facilities, legal costs, and secondary impacts. Nonetheless, the authors argue that costs are conservative for several reasons.

It should be noted that scenarios related to the NMFS recovery plan are outdated. Nonetheless, the Hamilton and Whittlesey research provides understanding of the magnitude of costs that may be attributable to future flow augmentation scenarios.

2) Huppert, D. et al., Economics of Columbia River Initiative, Final Report to the Washington Department of Ecology and CRI Economics Advisory Committee, 2003.

The Huppert et al. study examines the economic effect of increased water withdrawal from the mainstem of Columbia River in Washington. The analysis considers effects on agricultural production, municipal and industrial water supplies, hydropower generation, flood control, river navigation, commercial and recreational fishing, regional impacts, and passive use values. Five different "management scenarios" are evaluated. Though fisheries-related regulation is likely to decrease water withdrawal from the tributaries of the Columbia, this research provides useful dollar value estimates associated with specific changes in water availability. This section examines the Huppert et al. estimates of agricultural and regional impacts.

The management scenarios evaluated in the Huppert et al. research were developed by Washington's Department of Ecology. The scenarios prescribe variation in the quantity of new water rights, fees, contingencies, and other requirements. Table C-1 describes the five management scenarios.

Table C-1
Five Management Scenarios

Scenario	Quantity of New Water Rights	Fees	Contingencies	Other Requirements
I.	1 MAF	None	None	Meet BMPs and meter withdrawals
II.	1 MAF	$10/acre-foot annually	300 KAF (80% of existing rights complying with BMPs)	Meet BMPs and meter withdrawals
III.	1 MAF	$20/acre-foot annually	300 KAF (80% of existing rights complying with BMPs)	Meet BMPs and meter withdrawals
IV.	None	$30/acre-foot annually	New withdrawals must be fully offset by transfers, conservation, or new storage	Meet BMPs and meter withdrawals
V.	Status Quo	None	Issuance of new rights follows current procedures and depends upon opinion of fishery managers	

The Huppert et al. research shows that the irrigation agriculture sector is significantly affected by allocation of additional water rights from the Columbia mainstem. New water rights allow the expansion of crop production. The analysis assumes that crop prices remain at current levels, and that the costs of production are reflected in crop budget studies. The study reports that new agricultural production will generate between $349.0 and $752.9 million in gross revenue, which corresponds to between $52.1 and $136.5 million in net revenue, as shown in Table C-2.

Table C-2
Summary of Effects on Agricultural Production and Value

Scenario	Gross Revenue ($ millions)	Net Revenue ($ millions)
I.	$752.9	$136.5
II.	$476.2 - $752.9	$79.8 - $136.5
III.	$349.0 – $752.9	$52.1 – $136.5
IV.	Unknown	Unknown
V.	None	None

Regional economic impacts are determined using the 1987 Washington Input-Output model. First, Huppert et al. estimate direct impacts, which consist of increased sales of raw and processed agricultural products, then estimate full effects, which consider the total (multiplied) effect of the direct impacts on the economy as a whole. The estimated Output impact measures the change in sales of all products, including raw materials, wholesale products, plus a retail sales margin. In addition, the Input-Output model estimates employment and value-added impacts. Results of the regional economic analysis are presented in Table C-3.

Table C-3
Summary of Economic Impacts of Agricultural Section Expansion

Scenario	Total Output Impact $2002 (in millions)	Total Employment Impact	Total Value-Added Impact
1 MAF	$4244.580	44,656	$2,023.6
700 KAF	$2195.634	23,812	$1,059.4
569 KAF	$1,570.09	17,160	$759.6

C.1.2 Engineering Literature

1) Snake River Flow Augmentation Impact Analysis Appendix, Prepared for the U.S. Army Corps of Engineers, Walla Walla District's Lower Snake River Juvenile Salmon Migration Feasibility Study and Environmental Impact Statement, United States Department of the Interior, Bureau of Reclamation, Northwest Region, Boise, Idaho, February 1999.

The USBR Snake River Flow Augmentation analysis uses a hydrology model of the upper Snake to predict the impacts from water shortage, then uses economic modeling to estimate the related dollar value impacts.

On March 2, 1995, NOAA Fisheries issued a biological opinion on the operation of the FCRPS with respect to endangered Snake River spring/summer chinook salmon , Snake River fall chinook salmon, and Snake River sockeye salmon. This biological opinion concluded that the effects of the proposed operations of Federal hydroelectric dams in the Columbia and Snake River basins would jeopardize the continued existence of the listed Snake River salmon stocks. Flow augmentation in the lower Snake River and the Columbia River is a key component of the 1995 biological opinion. Reclamation agreed to provide 427,000 acre-feet of flow augmentation.

In this study, USBR analyzes the effects of providing a flow augmentation in the following scenarios:

I. Base Case: Provide 427,000 acre-feet of flow augmentation water each year.
II. No Augmentation: Provide no water for flow augmentation (condition prior to 1991).
III. Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Irrigation shortages would be minimized by using large drawdowns of Reclamation reservoirs (i.e., storage reservoirs are operated to minimize the impact on irrigation).
IV. Provide up to 1,427,000 acre-feet of flow augmentation water to meet deficits in flow targets at Lower Granite Dam. Reservoir elevations would be maintained at or near the Base Case levels with shortages assumed by irrigation (i.e., storage reservoirs are operated to minimize the impact on recreation).

Changes in agricultural production, hydropower generation, and recreation due to the flow augmentation scenarios would have national and regional economic impacts. National economic impacts were identified for agriculture, hydropower, and recreation. Regional impacts were identified using input-output modeling (IMPLAN) for agriculture and recreation. National economic impacts on agriculture are provided in Table C-4, while regional economic impacts on agriculture attributable to flow augmentation are presented in Table C-5.

The national effects presented are direct effects (i.e., no multiplier effect is considered in the analysis). For agriculture, the direct effects are calculated using the value of production, or gross revenue, measured as the total production of an irrigated crop multiplied by its market value. A change in the value of production provides an estimate of the total direct loss in economic activity resulting from the prescribed water acquisition program. Water acquisition costs are calculated based on recent water acquisitions.

Table C-4
National Economic Effects on Agriculture (Direct Costs)*

Item	Scenario I	Scenario II	Scenario III	Scenario IV
Decrease in irrigated acres in average water-year	0[1]	0	$243,000	$360,000
Decrease in irrigated acres in dry water-year	([2])	([2])	$376,000	$643,000
Decrease in value of production in average water-year	0[3]	0	$90,204,000	$136,433,000
Decrease in value of production in dry water-year	([2])	([2])	$141,202,000	$243,737,000
Water acquisition cost (annual) low estimate	0	0	$10,414,000	$31,128,000
Water acquisition cost (annual) high estimate	0	0	$31,243,000	$87,157,000

* Direct costs include lost value of production, not broader market adjustments.
[1] Base Case average irrigated acreage is 3,364,000 acres
[2] Not estimated
[3] Base Case average value of production is $2,019,934,000

The study estimates regional economic impacts in three ways:

1) Reduced Irrigation. This estimate is of impacts stemming from the reduction in irrigated agricultural production only;
2) Reduced Irrigation With Payments to Farmers. This estimate adds the impacts of a hypothetical water acquisition program to those of a reduction in irrigated agriculture production; and
3) Reduced Irrigation With Forward Linkages. This estimate adds the effect of forward linkages to those of a reduction in irrigated agriculture production. That is, it adds the ripple effects to industries such as livestock and agricultural processing that use irrigated crops as a part of their production process.

The study also states that the second estimate, Reduced Irrigated Agriculture Production With Water Payments, is the best estimate of regional economic impacts.

Table C-5
Regional Economic Effects on Agriculture

Item	Scenario I	Scenario II	Scenario III	Scenario IV
Employment–jobs lost (annual)	0 [1]	0	2,543	3,612
Income lost (annual)	0 [2]	0	$44,700,000	$51,976,000
Sales lost (annual)	0 [3]	0	$95,200,000	$130,400,000

[1] Scenario I regional jobs total 658,543
[2] Scenario I regional income totals $23,310,023,000
[3] Scenario I regional sales total $46,777,512,000

According to the 2001 biological opinion (U.S. Bureau of Reclamation Operations and Maintenance of its Projects in the Snake River Basin above Brownlee Dam from Date Issued through March 2002, 5/2/2001), USBR anticipated that the prescribed flow augmentation (427,000 acre-feet) would not be available in 2001 or similar dry years for a variety of reasons. The 2001 biological opinion states:

> *NMFS' expectations for flow augmentation for the long term acknowledge that in very low water years like 2001, the opportunities for significant flow augmentation volumes from the upper Snake River basin would be limited. When combined with the reductions in stream flow depletions anticipated by other water interests, the proposed action for 2001 will yield volumes of flow augmentation within the range expected by the USBR in a low water year such as this one.*

The terms and conditions of the 2001 biological opinion require that USBR work toward procurement of water in an effort to meet the prescribed 427,000 acre-foot flow augmentation. Specifically, prior to entering into any agreement to commit uncontracted storage space in any of its reservoirs covered by the 2001 biological opinion to any use other than salmon flow augmentation, the USBR shall consult under section 7. In addition, USBR shall seek out water savings programs, describe the potential outcome of such storage, and identify those programs with the highest potential for streamflow improvement in the event of future droughts.

In the context of the 2001 biological opinion, it seems unlikely that NOAA Fisheries will require a 300 percent increase in flow augmentation in the future (the USBR study models an additional one million acre feet of flow augmentation). According to the study:

> *It is important to recognize that the 1,427,000 acre-foot scenarios for this analysis are only conceptual, and therefore, the analysis is conceptual. In some cases, due to a lack of empirical data, estimations and assumptions were used in developing*

modeling simulations. The model results cannot precisely depict all future operations and circumstances. The implementation of an additional 1 million acre-feet of flow augmentation would, most certainly, have an affect that reaches far beyond the scope of this theoretical analysis (USBR 1999).

The 1,427,000 acre foot augmentation cost estimates are useful, however, when interpreted as an extreme upper bound scenario.

2) California Water System Operations Environmental Funding

The California Bay-Delta Authority (CALFED), established by legislation enacted in 2002, provides a permanent governance structure for the collaborative California State-Federal water management effort that began in 1994. A key component of CALFED's Water Management Strategy, the Environmental Water Account (EWA) was created to address two problems, declining fish populations and unreliable water supplies. Its purpose is to better protect fish by making it possible to modify water project operations in the Bay-Delta and still meet the needs of water users.

The EWA buys water from willing sellers or diverts surplus water when safe for fish, then banks, stores, transfers and releases it as needed to protect fish and compensate water users. For example, EWA managers might coordinate with water project operators to curtail pumping at specific times to avoid harming fish, and then provide water to cities and farms to compensate for the reduced pumping.

The EWA does not provide all of the fish protection in the California water system. The regulatory baseline includes the biological opinions on winter-run salmon and delta smelt, the California State Water Control Board 1995 Delta Water Quality Control Plan, and 800,000 acre-feet of CVP water pursuant to the Central Valley Project Improvement Act (CVPIA).

EWA funding is representative of a portion of the costs associated with NOAA Fisheries' requirements related to operations of the CVP and SWP. In addition, the EWA funds additional recovery efforts above the regulatory baseline. EWA funding is presented in Exhibit C-6.

Table C-6 Environmental Water Account Funding ($ in Millions)								
	Program Year							Total
	2001	2002	2003	2004	2005	2006	2007	
Water & Power Acquisitions	$57.15	$31.48	$44.54	$40.40	$32.27			$205.84
Tier 3 Water			$6.25	$3.20				$9.45
Environmental Documentations	$1.39	$0.20	$0.25	$0.20	$0.20			$2.24
Oversight and Coordination	$0.36	$0.46	$0.36	$0.21	$0.06	$0.06	$0.06	$1.57
Actual and Expected Funding	$58.90	$32.14	$51.40	$44.01	$32.53	$0.06	$0.06	$219.10
Funding for years 1-2 (2001-2002) reflects actual State encumbrances & expenditures and Federal obligations. Funding for Year 3 reflects final State and Federal budgets. Funding for Year 4 reflects proposed Governor's and President's budgets. Expected funding in Years 5-7 includes remaining state bond funds until spent and ongoing State base funding, plus estimates for local matching to grants for years where bond funding is available. Note: Federal appropriations for Years 5-7 is dependent on a decision to continue the EWA beyond Year 4.								

C.2 Description of Major Water Projects in Critical Habitat Areas[138]

C.2.1 California

California's Federal Water Project - The Central Valley Project (CVP)

The CVP extends 400 miles from the Cascade Range near Redding in northern California to the Tehachapi Mountains near Bakersfield in southern California. Initial features of the project were built primarily to protect the Central Valley from water shortages and flooding. The CVP also improves river navigation, supplies domestic and industrial water, generates electric power, conserves fish and wildlife, creates opportunities for recreation, and enhances water quality. The CVP serves farms, homes, and industry in California's Central Valley as well as major urban centers in the San Francisco Bay Area; it is also the primary source of water for much of California's wetlands.

138. Note that this list includes all major projects in the CA, ID, OR and WA–some of these projects may fall outside of proposed critical habitat areas. This section is intended only to add context to the discussion above.

The CVP consists of 20 dams and reservoirs, 11 powerplants, and 500 miles of major canals, as well as conduits, tunnels, and related facilities. CVP operators manage approximately nine million acre-feet of water annually, delivering about 7 million acre-feet of water for agricultural, urban, and wildlife use. The CVP provides roughly 5 million acre-feet for farms, 600,000 acre-feet for municipal and industrial use, 800,000 acre-feet per year to fish and wildlife, and 410,00 acre-feet to State and Federal wildlife refuges and wetlands. In addition, the CVP generates 5.6 billion kilowatt hours of electricity annually to meet the needs of about 2 million people.

California's State Water Project (SWP)

The California State Water Project extends for more than 600 miles from northern California to southern California. The main purpose of the SWP is water supply. In addition, the Project provides flood control, recreation, and water for fish and wildlife. The SWP stores water and distributes it to 29 urban and agricultural water suppliers in Northern California, the San Francisco Bay Area, the San Joaquin Valley, the Central Coast, and Southern California. Of the contracted water supply, 70 percent goes to urban users and 30 percent goes to agricultural users.

Today, the Project includes 32 storage facilities, reservoirs and lakes; 17 pumping plants; 3 pumping-generating plants; 5 hydroelectric power plants; and about 660 miles of open canals and pipelines. The Project provides supplemental water to approximately 20 million Californians and about 660,000 acres of irrigated farmland. The Project makes deliveries to two-thirds of California's population.

C.2.2 Idaho

The Avondale Project

Rehabilitation of privately developed irrigation facilities on the 880 acre Avondale Project by the Bureau of Reclamation in 1954-1955 required the reconstruction of a pumping plant at the source of supply, Hayden Lake, and the construction of an elevated equalizing tank with a main water line and distribution system for sprinkler irrigation. However, the water source is now four deep wells drilled by the Avondale Irrigation District in lieu of pumping from Hayden Lake. Farming is on a part-time basis and subdividing continues since this is a popular resort area which also offers industrial employment.

The Boise Project

Boise Project furnishes a full irrigation water supply to about 224,000 acres and a supplemental supply to some 173,000 acres under special and Warren Act contracts. The irrigable lands are in southwestern Idaho and eastern Oregon.

Principal facilities include five storage dams (excluding Lucky Peak Dam constructed by the Corps of Engineers and Hubbard Dam, a reregulatory facility) which form reservoirs with a total capacity of 1,793,600 acre-feet (active 1,663,200 acre-feet), two diversion dams, three powerplants with a combined capacity of 50,200 kilowatts, seven pumping plants, canals, laterals, and drains.

To facilitate organization of the administrative and operating procedures, the irrigable project lands are divided into the Arrowrock and Payette Divisions. Some of the features serve only one division; other features serve both divisions as well as other nearby projects.

The Dalton Gardens Project

Dalton Gardens is a privately developed project 2 miles north of Coeur d'Alene, Idaho, and 30 miles east of Spokane, Washington, on the eastern edge of the extensive Spokane Valley plain, known as Rathdrum Prairie. The project's irrigation works include a pumping plant, equalizing reservoir and main line, and a distribution system that has been reconstructed to supply approximately 980 acres of land with an adequate sprinkler irrigation water supply.

The Lewiston Orchards Project

Private interests originally constructed the Lewiston Orchards Project beginning in 1906. Most of the project features have been rehabilitated or rebuilt by the Bureau of Reclamation. The project facilities include four diversion structures (Webb Creek, Sweetwater, West Fork, and Captain John) feeder canals, three small storage reservoirs (Soldiers Meadow, Reservoir "A", and Lake Waha) a domestic water system including a water filtration plant that is no longer in use, and a system for distribution of irrigation water. The domestic water supply initially provided by surface water resources now comes entirely from groundwater resources developed by the Lewiston Orchards Irrigation District. A full irrigation water supply is delivered to project lands totaling over 3,900 acres, and a dependable domestic water system is now provided for some 16,000 residents.

The Little Wood River Project

Little Wood River Project includes lands within an area 2 miles wide and 12 miles long upstream and downstream from Carey, Idaho, in the south-central section of the State. The project provides a supplemental irrigation water supply for approximately 9,550 acres of land. The principal construction feature is the enlarged Little Wood River Dam and Reservoir that serve previously constructed diversion and distribution works. Flood control is provided by operation of the reservoir on a forecast basis.

The Mann Creek Project

The Mann Creek Project in west-central Idaho consists of approximately 5,100 irrigable acres utilizing an existing distribution system in the narrow valleys of Mann and Monroe Creeks, both tributaries of the Weiser River. The natural flow of Mann Creek historically has been near its lowest point during the growing season when the demand for irrigation water is at its highest. Project development provides for storage of winter and spring flows of Mann Creek for use later in the irrigation season.

The Michaud Flats Project

The Michaud Flats Project provides irrigation for some 11,200 acres along the Snake River adjacent to the town of American Falls in southeastern Idaho. Surface flow of the Snake River, stored in space allotted to the project in American Falls (Minidoka Project) and Palisades (Palisades Project) Reservoirs, is pumped from below American Falls Reservoir into canals that serve 69 percent of the land. Return flow is used on as much of the land as it will serve, and ground water is pumped from wells to serve the remainder. The project area is part of 65 square miles of flat rolling land south of the Snake River between Pocatello and Eagle Rock known as the Michaud Flats. Irrigable land on the flats is divided by the western boundary of the Fort Hall Indian Reservation into a Michaud Flats extension of the Fort Hall Indian Project and the Michaud Flats Project.

The Minidoka Project

Minidoka Project lands extend discontinuously from the town of Ashton, in eastern Idaho along the Snake River, about 300 miles downstream to the town of Bliss in south-central Idaho. The project furnishes irrigation water from five reservoirs that have a combined active storage capacity of more than 3 million acre-feet.

The project works consist of Minidoka Dam and Powerplant and Lake Walcott, Jackson Lake Dam and Jackson Lake, American Falls Dam and Reservoir, Island Park Dam and Reservoir, Grassy Lake Dam and Grassy Lake, two diversion dams, canals, laterals, drains, and some 177 water supply wells.

The Owyhee Project

The Owyhee Project lies west of the Snake River in Malheur County, Oregon, and Owyhee County, Idaho. The project furnishes a full irrigation water supply to over 105,000 acres of land lying along the west side of the Snake River in eastern Oregon and southwestern Idaho. An additional 13,000 acres are furnished supplemental water. About 72 percent of the lands are in Oregon, and 28 percent in Idaho. Irrigable lands are divided into the Mitchell Butte, Dead Ox Flat, and Succor Creek Divisions. The key feature of the project is Owyhee Dam, on the Owyhee River about 11 miles southwest of Adrian, Oregon, which acts as both a storage and diversion structure. Project works also include canals, pipelines, tunnels, 9 pumping plants, laterals and drains.

The Palisades Project

The principal features of the project are Palisades Dam Reservoir, and Powerplant. Palisades Dam is on the South Fork of the Snake River at Calamity Point in eastern Idaho about 11 miles west of the Idaho-Wyoming boundary. The project provides a supplemental water supply to about 650,000 acres of irrigated land in the Minidoka and Michaud Flats Projects. The 176,600 kilowatt hydroelectric powerplant furnishes energy needed in the upper valley to serve irrigation pumping units, municipalities, rural cooperatives, and other power users. The principal features of the project are Palisades Dam, Reservoir, and Powerplant.

The Preston Bench Project

The Preston Bench Project, located in southeastern Idaho near the town of Preston, includes Mink Creek Canal which supplies irrigation water for 5,000 acres of highly developed land in the vicinity of Preston.

The Rathdrum Prairie Project

The Rathdrum Prairie Project area extends about 12 miles north and 13 miles west of Coeur d'Alene in the panhandle of Idaho. The initial project consisted of the Post Falls, Hayden Lake, and East Greenacres Units, totaling about 10,200 acres of irrigable land. However, in 1991, the landowners within the Post Falls Unit petitioned for dissolution of the operating entity, the Post Falls Irrigation District. By 1995, with approval of the Bureau of Reclamation, dissolution activities were completed. Currently there are about 7,000 irrigable acres in the Rathdrum Prairie Project.

Major facilities of the Post Falls Unit consisted of a pumping plant, 3,000 feet of discharge pipe, 9 miles of canal, and 20 miles of laterals.

Hayden Lake facilities consisted of a pumping plant, 2 miles of 27-inch-diameter discharge pipe, a 10,026-cubic foot storage tank, and a pipe distribution system. However, the Hayden Lake Irrigation District has since converted to a groundwater supply.

Primary facilities of the East Greenacres Unit include 14 wells in 3 well complexes, a 43,446 cubic-foot regulating reservoir, and a pipe distribution system.

The Ririe Project

The Ririe Project was constructed to impound and control the waters of Willow Creek, a Snake River tributary in eastern Idaho, for flood control, irrigation, and recreation. Significant fish and wildlife protection measures also are included. Major features include Ririe Dam and Lake, and a floodway bypass outlet channel.

The Spokane Valley Project

The Spokane Valley Project provides an irrigation and domestic water supply for lands lying east of the city of Spokane, extending eastward to the Washington-Idaho boundary and on into Idaho for a short distance. The diversion dam on the Spokane River and the canal system previously used were abandoned in 1967 favor of a pumping system from wells into a pressure pipeline system that now provides sprinkler irrigation and serves domestic, municipal, and industrial requirements.

C.2.3 Oregon

The Arnold Project

The Arnold Project, a private development southeast of Bend, Oregon, diverts water from the Deschutes River a short distance above Lava Island Falls for approximately 4,300 acres of irrigable land. Project features include Arnold Diversion Dam, Arnold Flume and Canal, and laterals.

The Baker Project

The Baker Project in east-central Oregon consists of two divisions, the Lower and the Upper. The Lower Division provides a supplemental water supply for about 7,300 acres along the Powder River about 10 miles northeast of Baker, Oregon. The Upper Division provides supplemental water for 19,000 acres, including some contiguous areas previously dry-farmed near the city of Baker.

The Burnt River Project

The Burnt River Project in east-central Oregon consists of a storage dam and reservoir that provides water for supplemental irrigation of some 15,600 acres which formerly depended entirely on the natural flow of the Burnt River.

The Crescent Lake Dam Project

The Crescent Lake Dam Project is composed of lands of the Tumalo Irrigation District on the west side of the Deschutes River near Bend, Oregon. The principal feature of the project is Crescent Lake Dam, located at the outlet of Crescent Lake. The lake is a large natural body of water formed in a glacial deposit high on the eastern slopes of the Cascade Range. Canals, pipelines, and distribution laterals in the project furnish a full irrigation water supply to over 8,000 acres of land. Developed by private interests, various project facilities have been rehabilitated by or through the assistance of the Bureau of Reclamation.

The Crooked River Project

The main body of the Crooked River Project lies north and west of Prineville, Oregon. The water resources of Ochoco Creek and Crooked River are used to furnish irrigation water for approximately 20,000 acres. Project features include Arthur R. Bowman Dam on the Crooked River, Ochoco Dam on Ochoco Creek, a diversion canal and headworks on the Crooked River, Lytle Creek Diversion Dam and Wasteway, two major pumping plants, nine small pumping plants, and Ochoco Main and distribution canals.

The Dalles Project

The Dalles Project, Western Division is located about 80 miles east of Portland, adjacent to the city of The Dalles, Oregon, on the south side of the Columbia River. Principal features are the Mill Creek Pumping Plant, a booster pumping plant, seven relift pumping plants, three concrete-lined reservoirs, one elevated steel storage tank, five steel regulating tanks, and 46 miles of buried pressure pipe. The division provides water for nearly 6,000 irrigable acres of land.

The Deschutes Project

The Deschutes Project lands are in the vicinity of Madras, Oregon. Principal features include Wickiup Dam and Reservoir, Crane Prairie Dam and Reservoir, Haystack Dam and Reservoir, North Unit Main Canal and lateral system, and the Crooked River Pumping Plant. The project furnishes a full supply of irrigation water for about 50,000 acres of land within the North Unit Irrigation District, and a supplemental supply for more than 48,000 acres in the Central Oregon Irrigation District and Crook County Improvement District No. 1.

The Grants Pass Project

The Grants Pass Project lies within the Rogue River Basin in southwestern Oregon. The project was constructed by private interests beginning in the 1920's and partially rehabilitated by the Bureau of Reclamation in 1949-1955. The project furnishes irrigation water to over 10,000 acres of land surrounding the town of Grants Pass, Oregon. Principal project features are the Savage Rapids Diversion Dam on the Rogue River, and the associated pipelines, pumping plants, canals, and laterals.

The Klamath Project
(Note that the re-assessment of critical habitat is not occurring within the area of this project.)

The irrigable lands of the Klamath Project are in south-central Oregon (62 percent) and north-central California (38 percent). The Project provides full service water to approximately 240,000 acres of cropland. Two main sources supply water for the project: Upper Klamath Lake and the Klamath River; and Clear Lake Reservoir, Gerber Reservoir, and Lost River, which are located in a closed basin. The total drainage area, including the Lost River and the Klamath River watershed above Keno, Oregon, is approximately 5,700 square miles.

The Owyhee Project

The Owyhee Project lies west of the Snake River in Malheur County, Oregon, and Owyhee County, Idaho. The project furnishes a full irrigation water supply to over 105,000 acres of land lying along the west side of the Snake River in eastern Oregon and southwestern Idaho. An additional 13,000 acres are furnished supplemental water. About 72 percent of the lands are in Oregon, and 28 percent in Idaho. Irrigable lands are divided into the Mitchell Butte, Dead Ox Flat, and Succor Creek Divisions. The key feature of the project is Owyhee Dam, on the Owyhee River about 11 miles southwest of Adrian, Oregon, which acts as both a storage and diversion structure. Project works also include canals, pipelines, tunnels, 9 pumping plants, laterals and drains.

The Rogue River Basin Project

The Talent Division of the Rogue River Basin Project is in the northeastern part of the Rogue River Basin in southwestern Oregon. Work on the division consisted of construction, rehabilitation, and improvement of the irrigation facilities of three irrigation districts in the vicinity of Medford, Oregon, and the provision for full and supplemental water for these lands. The work on the Medford and Rogue River Valley Irrigation Districts included rehabilitation and betterment of Fourmile Lake Dam, Fish Lake Dam, and the numerous structures which are a part of the Main and Medford Canals. An extensive collection, diversion, storage, and conveyance system was constructed to carry excess waters of the Rogue River and Klamath River Basins to the irrigated lands.

The Talent Irrigation District consists of approximately 15,500 irrigable acres. Medford Irrigation District has a water supply for 11,500 acres, and Rogue River Valley Irrigation District has a water supply for 8,300 acres. Additionally, the Talent Division provides electric power from a 16,000-kilowatt hydroelectric Green Springs Powerplant.

Principal features of the Talent Division include Howard Prairie Dam, Howard Prairie Delivery Canal, Keene Creek Dam, Green Springs Powerplant, the enlarged Emigrant Dam and Lake, and Agate Dam and Reservoir.

The Tualatin Project

The Tualatin Project area lies primarily in Washington County in the northwest part of the Willamette Basin, west of and adjacent to the city of Portland, Oregon. Some 17,000 acres of land are furnished irrigation water. Several communities and an industrial corporation are furnished untreated water for municipal and industrial use, and for quality control purposes. Fish and wildlife enhancement, recreation, and flood control are also important project functions.

Principal features include Scoggins Dam, Henry Hagg Lake, Patton Valley Pumping Plant, Spring Hill Pumping Plant, booster pumping plants, and piped lateral distribution systems.

The Umatilla Project

The original Umatilla Project furnishes a full supply of irrigation water to over 17,000 acres and a supplemental supply to approximately 13,000 acres. These lands, located in north-central Oregon, are divided into three divisions. The East Division is the Hermiston Irrigation District, the West Division is the West Extension Irrigation District, and the South Division includes the Stanfield and Westland Irrigation Districts. In addition, there are approximately 3,800 acres not included in an irrigation district that are provided either a full or supplemental water supply from McKay Reservoir under individual storage contracts.

Project features of the East Division are Cold Springs Dam and Reservoir, Feed Canal Diversion Dam and Canal, and Maxwell Diversion Dam and Canal. Three Mile Falls Diversion Dam on the Umatilla River and the 27-mile West Extension Main Canal are the principal features of the West Division. McKay Dam and Reservoir are the only features in the South Division.

Activities were initiated in the mid-1980´s under the Umatilla Basin Project to restore instream flows for anadromous fish and allow established irrigation to continue. These activities resulted in Umatilla River channel modifications, construction of fish ladders, fish traps and fish screens, and the construction of water exchange facilities (Phase I and Phase II) to deliver irrigation replacement water from the Columbia River.

The Vale Project

The Vale Project lands are located along the Malheur River and Willow Creek in east-central Oregon, surrounding the town of Vale. The project furnishes irrigation water to 35,000 acres of land. Features include Agency Valley Dam and Beulah Reservoir, Bully Creek Dam and Reservoir, Harper Diversion Dam, Vale Main Canal, and a distribution and drainage system. To supplement project needs, the Federal Government purchased one-half of the storage rights in the Warm Springs Reservoir built by the Warmsprings Irrigation District.

The Wapinita Project

The Wapinitia Project, Juniper Division, is on Juniper Flat in north-central Oregon. Juniper Flat is a plateau, 3 to 6 miles wide and approximately 17 miles long, between the Deschutes and White Rivers. Some 2,100 acres over a scattered area receive supplemental irrigation service from the project. The principal construction feature is Wasco Dam on Clear Creek, 0.5 mile below the outlet of Clear Lake, a natural lake in a mountain valley.

C.2.4 Washington

The Chief Joseph Project

The Chief Joseph Dam is on the Columbia River in north-central Washington and is a key structure in the comprehensive development of the Columbia River Basin. Storage water from the reservoir, and power revenues to assist in paying for irrigation features, are necessary for present and future irrigation development of the area.

The Columbia Basin Project

The Columbia Basin Project is a multipurpose development utilizing a portion of the resources of the Columbia River in the central part of the State of Washington. The key structure, Grand Coulee Dam, is on the main stem of the Columbia River about 90 miles west of Spokane, Washington. The extensive irrigation works extend southward on the Columbia Plateau 125 miles to the vicinity of Pasco, Washington, where the Snake and Columbia Rivers join.

Principal project features include Grand Coulee Dam, Franklin D. Roosevelt Lake, Grand Coulee Powerplant Complex, switchyards, and a pump-generating plant. Primary irrigation facilities are the Feeder Canal, Banks Lake, the Main, West, East High, and East Low Canals, O'Sullivan Dam, Potholes Reservoir, and Potholes Canal. There is over 300 miles of main canals, about 2,000 miles of laterals, and 3,500 miles of drains and wasteways on the project.

The project irrigation facilities were planned to deliver a full water supply to about 1.1 million acres of land previously used only for dry farming or grazing. About 671,000 acres are currently irrigated and further development is not anticipated. Power production facilities at Grand Coulee Dam are among the largest in the world; the total name plate generating capacity is rated at 6,809 megawatts.

The Okanogan Project

Project facilities include Conconully Dam and Reservoir, Salmon Lake Dam and Conconully Lake, Salmon Creek Diversion Dam, and canals and laterals to serve some 5,000 acres of irrigable lands along the Okanogan River in the vicinity of Okanogan, Washington.

The Spokane Valley Project

The Spokane Valley Project provides an irrigation and domestic water supply for lands lying east of the city of Spokane, extending eastward to the Washington-Idaho boundary and on into Idaho for a short distance. The diversion dam on the Spokane River and the canal system previously used were abandoned in 1967 favor of a pumping system from wells into a pressure pipeline system that now provides sprinkler irrigation and serves domestic, municipal, and industrial requirements.

The Yakima Project

The Yakima Project provides irrigation water for a comparatively narrow strip of fertile land that extends for 175 miles on both sides of the Yakima River in south-central Washington. The irrigable lands presently being served total approximately 464,000 acres.

There are seven divisions in the project: Storage, Kittitas, Tieton, Sunnyside, Roza, Kennewick, and Wapato. The Wapato Division is operated by the Bureau of Indian Affairs, but receives most of its water supply from the Yakima Project for irrigation of 136,000 acres of land. Over 45,000 acres not included in the seven divisions are irrigated by private interests under water supply contracts with the Bureau of Reclamation. Storage dams and reservoirs on the project are Bumping Lake, Clear Creek, Tieton, Cle Elum, Kachess, and Keechelus. Other project features are 5 diversion dams, canals, laterals, pumping plants, drains, 2 powerplants, and transmission lines.

Appendix D

ANNUALIZED IMPACTS BY ESU, ACTIVITY, AND WATERSHED

Appendix D.1
Annual Total Impact by Watershed

California Coastal chinook salmon						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$4	$4	$8	$8
110720	$10	$10	$18	$18	$25	$25
110730	$29	$29	$54	$54	$78	$78
110810	$0	$0	$11	$11	$22	$22
110820	$0	$0	$0	$0	$0	$0
110910	$63	$63	$65	$65	$67	$67
110920	$0	$0	$1	$1	$3	$3
110930	$207	$207	$388	$388	$568	$568
111000	$170	$181	$220	$232	$271	$282
111111	$83	$92	$108	$117	$133	$142
111112	$0	$0	$12	$12	$24	$24
111113	$0	$0	$1	$1	$1	$1
111121	$2	$2	$8	$8	$13	$13
111122	$318	$318	$561	$561	$803	$803
111123	$1	$1	$3	$3	$4	$4
111131	$5	$5	$9	$9	$12	$12
111132	$152	$152	$272	$272	$391	$391
111133	$40	$40	$83	$83	$126	$126
111141	$66	$66	$121	$121	$175	$175
111142	$52	$52	$94	$94	$137	$137
111150	$416	$416	$758	$758	$1,100	$1,100
111161	$83	$86	$156	$159	$228	$231
111162	$156	$156	$417	$423	$676	$689
111171	$450	$450	$831	$831	$1,211	$1,211
111172	$23	$23	$57	$57	$90	$90
111173	$491	$491	$896	$896	$1,299	$1,299
111174	$285	$285	$541	$541	$797	$797
111220	$23	$23	$23	$23	$23	$23
111230	$324	$324	$591	$591	$857	$857
111312	$0	$0	$1	$1	$3	$3
111313	$0	$0	$0	$0	$0	$0
111320	$13	$15	$36	$39	$60	$63
111330	$9	$9	$19	$19	$28	$28
111340	$0	$0	$0	$0	$0	$0
111350	$32	$32	$78	$78	$124	$124

California Coastal chinook salmon						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111370	$33	$33	$55	$55	$76	$76
111411	$80	$80	$268	$268	$456	$456
111412	$10	$10	$20	$20	$29	$29
111422	$194	$194	$440	$440	$687	$687
111423	$74	$77	$309	$312	$544	$547
111424	$212	$212	$619	$619	$1,026	$1,026
111425	$155	$158	$619	$622	$1,084	$1,087
111431	$304	$307	$725	$728	$1,146	$1,149
111433	$37	$37	$128	$128	$219	$219
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$88	$88	$192	$192	$295	$295
111163	$560	$561	$1,134	$1,142	$1,706	$1,721
TOTAL	**$5,252**	**$5,288**	**$10,944**	**$10,993**	**$16,628**	**$16,691**

Central Valley spring-run chinook salmon						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$70	$70	$99	$99	$129	$129
550420	$601	$610	$1,366	$1,374	$2,130	$2,139
550711	$18	$18	$35	$35	$52	$52
550712	$392	$395	$1,090	$1,114	$1,786	$1,830
550722	$4	$4	$18	$18	$32	$32
550810	$499	$513	$892	$906	$1,284	$1,299
550820	$5	$5	$48	$48	$90	$90
550914	$40	$40	$73	$73	$105	$105
550920	$469	$469	$857	$857	$1,243	$1,243
550942	$207	$207	$379	$379	$550	$550
550963	$246	$246	$449	$449	$652	$652
551000	$702	$705	$1,925	$1,928	$3,148	$3,151
551510	$51	$54	$75	$78	$100	$103
551530	$38	$38	$67	$67	$96	$96
551540	$847	$1,154	$4,002	$5,570	$7,158	$9,988
551712	$5	$5	$17	$17	$28	$28
551720	$34	$34	$257	$257	$480	$480
551921	$783	$788	$1,092	$1,160	$1,400	$1,531
551922	$734	$740	$997	$1,002	$1,259	$1,265
552010	$173	$173	$674	$674	$1,175	$1,175
552021	$5	$5	$8	$8	$11	$11
552030	$207	$210	$401	$404	$594	$597
552040	$344	$347	$783	$786	$1,222	$1,225
552130	$198	$199	$852	$915	$1,505	$1,628
552310	$533	$533	$1,076	$1,076	$1,619	$1,619
552433	$174	$174	$318	$318	$463	$463
552436	$387	$387	$706	$706	$1,025	$1,025
552440	$7	$7	$14	$14	$21	$21
552462	$11	$11	$21	$21	$31	$31
554300	$207	$212	$544	$550	$882	$887
554400	$1,720	$1,728	$3,891	$3,899	$6,061	$6,070
220312	$202	$214	$496	$508	$790	$802
220410	$181	$181	$618	$618	$1,055	$1,055
220610	$39	$39	$122	$122	$206	$206
220710	$133	$137	$385	$388	$636	$640
551713	$66	$70	$399	$416	$730	$761
551714	$366	$492	$1,751	$2,367	$3,137	$4,243
TOTAL	**$10,700**	**$11,216**	**$26,799**	**$29,223**	**$42,887**	**$47,221**

Central California Coast steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$142	$142	$442	$442	$741	$741
111412	$10	$10	$20	$20	$29	$29
111421	$132	$134	$204	$207	$277	$280
111422	$200	$200	$457	$457	$714	$714
111423	$207	$210	$702	$705	$1,198	$1,201
111424	$297	$297	$863	$863	$1,430	$1,430
111425	$328	$331	$1,103	$1,106	$1,879	$1,881
111426	$16	$16	$29	$29	$42	$42
111431	$358	$361	$882	$884	$1,405	$1,408
111433	$43	$43	$144	$144	$244	$244
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$2	$2	$3	$3
220112	$24	$24	$150	$150	$276	$276
220113	$11	$11	$221	$221	$431	$431
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$13	$13	$13	$13	$13	$13
220222	$20	$23	$53	$56	$86	$88
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$3	$3	$29	$29	$55	$55
220320	$79	$88	$81	$90	$83	$91
220330	$69	$72	$117	$120	$165	$168
220420	$207	$210	$568	$571	$928	$931
220440	$251	$274	$563	$586	$875	$898
220530	$310	$312	$887	$890	$1,465	$1,468
220540	$185	$185	$865	$865	$1,545	$1,545
220550	$180	$185	$364	$369	$559	$565
220620	$83	$86	$258	$261	$433	$436
220630	$142	$148	$211	$217	$280	$286
220640	$294	$297	$779	$782	$1,264	$1,267
220650	$1,817	$1,822	$5,205	$5,211	$8,594	$8,600
220660	$142	$154	$169	$181	$197	$208
220721	$90	$93	$428	$430	$765	$768
220722	$11	$11	$145	$145	$278	$278
220731	$232	$249	$290	$307	$349	$366
220733	$118	$135	$240	$257	$361	$378
330411	$5	$5	$63	$63	$120	$120

Central California Coast steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330412	$75	$78	$185	$188	$295	$298
330413	$29	$29	$33	$33	$36	$36
330420	$5	$5	$48	$48	$90	$90
220312	$202	$214	$496	$508	$790	$802
220410	$181	$181	$618	$618	$1,055	$1,055
220510	$0	$0	$0	$0	$0	$0
220610	$39	$39	$122	$122	$206	$206
220710	$133	$137	$385	$388	$636	$640
TOTAL	**$6,684**	**$6,828**	**$18,433**	**$18,577**	**$30,193**	**$30,337**

California Central Valley steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$73	$73	$108	$108	$143	$143
550420	$494	$502	$1,070	$1,078	$1,646	$1,654
550711	$18	$18	$35	$35	$52	$52
550712	$392	$395	$1,090	$1,114	$1,786	$1,830
550721	$0	$0	$0	$0	$0	$0
550722	$4	$4	$18	$18	$32	$32
550731	$1	$1	$2	$2	$3	$3
550732	$24	$24	$75	$75	$126	$126
550733	$41	$41	$76	$76	$111	$111
550810	$497	$511	$887	$902	$1,277	$1,292
550820	$6	$6	$48	$48	$90	$90
550914	$40	$40	$73	$73	$105	$105
550920	$469	$469	$857	$857	$1,243	$1,243
550942	$207	$207	$379	$379	$550	$550
550962	$8	$8	$14	$14	$20	$20
550963	$246	$246	$449	$449	$652	$652
550964	$54	$54	$98	$98	$143	$143
551000	$696	$698	$1,951	$1,954	$3,206	$3,209
551110	$169	$172	$254	$257	$339	$342
551120	$5	$5	$37	$37	$70	$70
551510	$58	$61	$107	$110	$156	$159
551530	$38	$38	$68	$68	$97	$97
551540	$847	$1,154	$4,006	$5,574	$7,165	$9,994
551712	$5	$5	$17	$17	$28	$28
551720	$34	$34	$257	$257	$480	$480
551921	$783	$788	$1,092	$1,160	$1,400	$1,531
551922	$802	$808	$1,198	$1,203	$1,593	$1,599
552010	$173	$173	$683	$683	$1,194	$1,194
552021	$5	$5	$8	$8	$12	$12
552030	$207	$210	$404	$407	$601	$604
552040	$443	$446	$1,099	$1,102	$1,755	$1,757
552110	$5	$5	$5	$5	$5	$5
552120	$10	$10	$18	$18	$26	$26
552130	$198	$199	$852	$915	$1,505	$1,628
552310	$533	$533	$1,076	$1,076	$1,619	$1,619
552433	$174	$174	$318	$318	$463	$463
552435	$9	$9	$121	$121	$233	$233

California Central Valley steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$387	$387	$706	$706	$1,025	$1,025
552440	$7	$7	$14	$14	$21	$21
552462	$11	$11	$21	$21	$31	$31
553111	$306	$311	$892	$897	$1,478	$1,483
553120	$378	$381	$865	$868	$1,351	$1,354
553130	$376	$376	$952	$952	$1,529	$1,529
553240	$102	$102	$213	$213	$324	$324
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$145	$148	$232	$235	$319	$322
553530	$404	$404	$676	$676	$948	$948
553550	$301	$306	$731	$737	$1,162	$1,168
553560	$5	$5	$203	$209	$401	$414
553570	$87	$90	$215	$218	$343	$346
553580	$260	$263	$442	$445	$623	$626
553590	$7	$7	$346	$346	$686	$686
554110	$124	$124	$357	$357	$589	$589
554120	$112	$112	$133	$133	$154	$154
554300	$207	$212	$544	$550	$882	$887
554400	$1,784	$1,793	$4,611	$4,619	$7,437	$7,446
220312	$202	$214	$496	$508	$790	$802
220410	$181	$181	$618	$618	$1,055	$1,055
220610	$39	$39	$122	$122	$206	$206
220710	$133	$137	$385	$388	$636	$640
551422	$140	$152	$571	$604	$1,000	$1,053
551713	$66	$70	$399	$416	$730	$761
551714	$366	$492	$1,751	$2,367	$3,137	$4,243
553221	$1	$1	$106	$106	$211	$211
553223	$3	$3	$233	$233	$464	$464
553224	$12	$15	$54	$57	$96	$99
TOTAL	**$13,915**	**$14,471**	**$35,743**	**$38,235**	**$57,557**	**$61,985**

Northern California steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$4	$4	$8	$8
110720	$10	$10	$18	$18	$25	$25
110730	$29	$29	$54	$54	$78	$78
110810	$0	$0	$11	$11	$22	$22
110820	$0	$0	$0	$0	$0	$0
110910	$63	$63	$65	$65	$67	$67
110920	$0	$0	$1	$1	$3	$3
110930	$207	$207	$388	$388	$568	$568
110940	$439	$439	$810	$810	$1,180	$1,180
111000	$170	$181	$220	$232	$271	$282
111111	$84	$92	$110	$118	$135	$144
111112	$0	$0	$12	$12	$24	$24
111113	$0	$0	$1	$1	$1	$1
111121	$2	$2	$8	$8	$14	$14
111122	$318	$318	$561	$561	$803	$803
111123	$1	$1	$3	$3	$4	$4
111131	$5	$5	$9	$9	$12	$12
111132	$152	$152	$272	$272	$391	$391
111133	$40	$40	$83	$83	$126	$126
111141	$66	$66	$121	$121	$175	$175
111142	$52	$52	$94	$94	$137	$137
111150	$416	$416	$758	$758	$1,100	$1,100
111161	$83	$86	$156	$159	$228	$231
111162	$156	$156	$417	$423	$676	$689
111171	$451	$451	$832	$832	$1,213	$1,213
111172	$23	$23	$57	$57	$90	$90
111173	$491	$491	$896	$896	$1,299	$1,299
111174	$285	$285	$541	$541	$797	$797
111210	$0	$0	$0	$0	$0	$0
111220	$23	$23	$23	$23	$23	$23
111230	$324	$324	$591	$591	$857	$857
111311	$0	$0	$1	$1	$1	$1
111312	$0	$0	$1	$1	$3	$3
111313	$0	$0	$0	$0	$0	$0
111320	$13	$15	$36	$39	$60	$63
111330	$9	$9	$19	$19	$28	$28
111340	$5	$5	$16	$16	$28	$28

Northern California steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$45	$45	$117	$117	$189	$189
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$4	$4	$12	$12	$20	$20
111370	$35	$35	$61	$61	$86	$86
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$21	$21	$42	$42
111385	$0	$0	$11	$11	$21	$21
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$88	$88	$192	$192	$295	$295
111163	$560	$561	$1,134	$1,142	$1,706	$1,721
TOTAL	**$4,649**	**$4,677**	**$8,733**	**$8,773**	**$12,807**	**$12,861**

South-Central California Coast steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$801	$804	$2,253	$2,256	$3,705	$3,708
330520	$4	$4	$135	$135	$266	$266
330530	$482	$482	$1,054	$1,054	$1,626	$1,626
330540	$2	$2	$138	$138	$274	$274
330550	$273	$273	$806	$806	$1,338	$1,338
330700	$182	$185	$540	$543	$898	$901
330800	$180	$180	$330	$330	$481	$481
330930	$465	$465	$1,294	$1,294	$2,124	$2,124
330940	$227	$227	$654	$654	$1,080	$1,080
330960	$238	$238	$448	$448	$659	$659
330981	$667	$670	$2,878	$2,881	$5,088	$5,091
331011	$5	$5	$12	$12	$18	$18
331012	$0	$0	$0	$0	$0	$0
331013	$3	$3	$7	$7	$11	$11
331014	$32	$32	$81	$81	$130	$130
331015	$33	$33	$65	$65	$97	$97
331016	$58	$58	$102	$102	$147	$147
331017	$3	$3	$110	$110	$216	$216
331018	$21	$21	$45	$45	$69	$69
331021	$106	$111	$204	$210	$302	$308
331022	$119	$119	$300	$300	$481	$481
331023	$62	$62	$137	$137	$212	$212
331024	$390	$396	$546	$552	$702	$708
331025	$15	$18	$18	$21	$21	$24
331026	$132	$134	$211	$214	$290	$293
331031	$282	$288	$581	$587	$880	$886
331027	$41	$41	$164	$164	$287	$287
330920	$264	$264	$665	$665	$1,067	$1,067
330970	$161	$163	$409	$418	$656	$671
330911	$803	$803	$2,629	$2,629	$4,454	$4,454
TOTAL	**$6,054**	**$6,087**	**$16,817**	**$16,857**	**$27,581**	**$27,628**

Southern California steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 3%**	**High - 3%**	**High - 7%**
331210	$463	$463	$545	$545	$627	$627
331220	$404	$404	$836	$836	$1,268	$1,268
331230	$2,311	$2,311	$4,735	$4,735	$7,155	$7,155
331410	$68	$71	$143	$146	$218	$221
331420	$233	$233	$632	$632	$1,032	$1,032
331430	$90	$90	$212	$212	$334	$334
331440	$305	$305	$581	$581	$857	$857
331451	$1,018	$1,018	$2,150	$2,150	$3,280	$3,280
331510	$656	$656	$1,538	$1,538	$2,420	$2,420
331531	$383	$385	$710	$713	$1,038	$1,041
331532	$425	$431	$1,066	$1,072	$1,707	$1,713
331533	$124	$124	$289	$289	$454	$454
331534	$219	$222	$557	$560	$895	$898
440210	$77	$80	$195	$198	$313	$316
440220	$735	$735	$1,746	$1,746	$2,757	$2,757
440231	$11	$11	$33	$33	$55	$55
440232	$189	$189	$501	$501	$813	$813
440310	$204	$206	$245	$248	$287	$290
440321	$128	$130	$260	$263	$392	$395
440322	$31	$31	$62	$62	$93	$93
440331	$97	$97	$236	$236	$374	$374
440332	$327	$327	$654	$654	$980	$980
440341	$127	$127	$323	$323	$519	$519
440411	$5	$5	$15	$15	$26	$26
440421	$12	$15	$24	$27	$36	$39
440444	$0	$0	$0	$0	$0	$0
440811	$370	$372	$860	$863	$1,351	$1,354
440813	$0	$0	$0	$0	$0	$0
490123	$100	$100	$104	$104	$108	$108
490124	$0	$0	$11	$11	$21	$21
490127	$0	$0	$0	$0	$0	$0
490140	$67	$67	$133	$133	$198	$198
TOTAL	**$9,175**	**$9,204**	**$19,395**	**$19,423**	**$29,606**	**$29,635**

Appendix D.2
Annual Hydropower Impacts by Watershed

California Coastal chinook salmon						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$132	$139	$264	$277
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111370	$0	$0	$0	$0	$0	$0
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$33	$34	$173	$182	$313	$328
TOTAL	**$33**	**$34**	**$305**	**$320**	**$577**	**$605**

Central Valley spring-run chinook salmon						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$66	$69	$479	$502	$889	$933
550722	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$719	$1,023	$3,715	$5,280	$6,712	$9,538
551712	$0	$0	$11	$11	$21	$21
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$173	$236	$345	$471
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552130	$33	$34	$343	$405	$651	$774
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$0	$0
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$66	$69	$346	$363	$625	$656
551714	$345	$471	$1,702	$2,318	$3,060	$4,167
TOTAL	**$1,228**	**$1,666**	**$6,768**	**$9,115**	**$12,304**	**$16,559**

Central California Coast steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111426	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$0	$0	$11	$11	$21	$21
220540	$0	$0	$0	$0	$0	$0
220550	$0	$0	$0	$0	$0	$0
220620	$0	$0	$0	$0	$0	$0
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$0	$0	$0	$0	$0	$0
220660	$0	$0	$0	$0	$0	$0
220721	$0	$0	$0	$0	$0	$0
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0
220733	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330411	$0	$0	$0	$0	$0	$0
330412	$0	$0	$0	$0	$0	$0
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$11**	**$11**	**$21**	**$21**

California Central Valley steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$66	$69	$479	$502	$889	$933
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$11	$11	$21	$21
550733	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$0	$0	$0	$0	$0	$0
551110	$0	$0	$0	$0	$0	$0
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$719	$1,023	$3,715	$5,280	$6,712	$9,538
551712	$0	$0	$11	$11	$21	$21
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$173	$236	$345	$471
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$33	$34	$343	$405	$651	$774
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$0	$0	$0	$0	$0	$0
553120	$0	$0	$0	$0	$0	$0
553130	$0	$0	$0	$0	$0	$0
553240	$0	$0	$11	$11	$21	$21
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$0	$0	$0	$0
553550	$0	$0	$0	$0	$0	$0
553560	$0	$0	$132	$139	$264	$277
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$0	$0	$11	$11	$21	$21
554110	$0	$0	$0	$0	$0	$0
554120	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$0	$0
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$99	$103	$519	$545	$938	$983
551713	$66	$69	$346	$363	$625	$656
551714	$345	$471	$1,702	$2,318	$3,060	$4,167
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$1,327**	**$1,769**	**$7,452**	**$9,830**	**$13,568**	**$17,882**

Northern California steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$11	$11	$21	$21
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$132	$139	$264	$277
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$33	$34	$173	$182	$313	$328
TOTAL	**$33**	**$35**	**$316**	**$331**	**$598**	**$626**

South-Central California Coast steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$0	$0	$0	$0	$0	$0
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$0	$0	$0	$0	$0	$0
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$0	$0	$0	$0
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$0	$0	$0	$0	$0	$0
331025	$0	$0	$0	$0	$0	$0
331026	$0	$0	$0	$0	$0	$0
331031	$0	$0	$0	$0	$0	$0
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$0	$0	$0	$0
330970	$33	$34	$173	$182	$313	$328
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$33**	**$34**	**$173**	**$182**	**$313**	**$328**

Southern California steelhead						
	Annual Hydropower Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$0	$0
331220	$0	$0	$0	$0	$0	$0
331230	$0	$0	$0	$0	$0	$0
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$0	$0	$0	$0
331451	$0	$0	$0	$0	$0	$0
331510	$0	$0	$0	$0	$0	$0
331531	$0	$0	$0	$0	$0	$0
331532	$0	$0	$0	$0	$0	$0
331533	$0	$0	$0	$0	$0	$0
331534	$0	$0	$0	$0	$0	$0
440210	$0	$0	$0	$0	$0	$0
440220	$0	$0	$0	$0	$0	$0
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$0	$0	$0	$0	$0	$0
440321	$0	$0	$0	$0	$0	$0
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Appendix D.3
Annual Non-Hydropower Dam Impacts by Watershed

California Coastal chinook salmon						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$11	$11	$21	$21
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$11	$11	$21	$21
111000	$0	$0	$11	$11	$21	$21
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$11	$11	$21	$21
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$11	$11	$21	$21
111133	$0	$0	$11	$11	$21	$21
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$1	$1	$64	$64	$127	$127
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$11	$11	$21	$21
111172	$0	$0	$11	$11	$21	$21
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$21	$21	$42	$42
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$21	$21	$42	$42
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$11	$11	$21	$21

California Coastal chinook salmon						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111370	$0	$0	$0	$0	$0	$0
111411	$1	$1	$53	$53	$105	$105
111412	$0	$0	$0	$0	$0	$0
111422	$2	$2	$212	$212	$422	$422
111423	$2	$2	$191	$191	$380	$380
111424	$1	$1	$74	$74	$148	$148
111425	$2	$2	$138	$138	$274	$274
111431	$2	$2	$180	$180	$358	$358
111433	$0	$0	$21	$21	$42	$42
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$12**	**$12**	**$1,071**	**$1,071**	**$2,130**	**$2,130**

Central Valley spring-run chinook salmon						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$11	$11	$21	$21
550420	$0	$0	$21	$21	$42	$42
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$11	$11	$21	$21
550722	$0	$0	$11	$0	$21	$21
550810	$2	$2	$201	$201	$401	$401
550820	$0	$0	$21	$21	$42	$42
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$0	$0	$32	$32	$63	$63
551510	$0	$0	$21	$21	$42	$42
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$11	$11	$21	$21
551712	$0	$0	$0	$0	$0	$0
551720	$2	$2	$212	$212	$422	$422
551921	$0	$0	$32	$32	$63	$63
551922	$0	$0	$32	$32	$63	$63
552010	$0	$0	$11	$11	$21	$21
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$11	$11	$21	$21
552040	$0	$0	$32	$32	$63	$63
552130	$2	$2	$212	$212	$422	$422
552310	$1	$1	$106	$106	$211	$211
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$3	$3	$233	$233	$464	$464
554400	$3	$3	$233	$233	$464	$464
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$1	$1	$53	$53	$105	$105
551714	$0	$0	$11	$11	$21	$21
TOTAL	**$17**	**$17**	**$1,516**	**$1,506**	**$3,015**	**$3,015**

Central California Coast steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$1	$1	$53	$53	$105	$105
111412	$0	$0	$0	$0	$0	$0
111421	$0	$0	$11	$11	$21	$21
111422	$2	$2	$212	$212	$422	$422
111423	$2	$2	$191	$0	$380	$380
111424	$1	$1	$74	$74	$148	$148
111425	$2	$2	$138	$138	$274	$274
111426	$0	$0	$0	$0	$0	$0
111431	$2	$2	$180	$180	$358	$358
111433	$0	$0	$21	$21	$42	$42
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$1	$1	$127	$127	$253	$253
220113	$2	$2	$212	$212	$422	$422
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$32	$32	$63	$63
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$21	$21	$42	$42
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$42	$42	$84	$84
220420	$4	$4	$350	$350	$696	$696
220440	$3	$3	$307	$307	$611	$611
220530	$4	$4	$318	$318	$633	$633
220540	$6	$6	$509	$509	$1,012	$1,012
220550	$2	$2	$159	$159	$316	$316
220620	$1	$1	$106	$106	$211	$211
220630	$0	$0	$42	$42	$84	$84
220640	$0	$0	$42	$42	$84	$84
220650	$6	$6	$562	$562	$1,118	$1,118
220660	$0	$0	$21	$21	$42	$42
220721	$3	$3	$265	$265	$527	$527
220722	$1	$1	$127	$127	$253	$253

Central California Coast steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220731	$1	$1	$53	$53	$105	$105
220733	$1	$1	$117	$117	$232	$232
330411	$0	$0	$42	$42	$84	$84
330412	$1	$1	$106	$106	$211	$211
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$42	$42	$84	$84
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$51**	**$51**	**$4,485**	**$4,294**	**$8,919**	**$8,919**

California Central Valley steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$11	$11	$21	$21
550420	$0	$0	$21	$21	$42	$42
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$11	$11	$21	$21
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$11	$11	$21	$21
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$21	$21	$42	$42
550733	$0	$0	$0	$0	$0	$0
550810	$2	$2	$201	$201	$401	$401
550820	$0	$0	$21	$21	$42	$42
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$0	$0	$32	$32	$63	$63
551110	$0	$0	$32	$32	$63	$63
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$21	$21	$42	$42
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$11	$11	$21	$21
551712	$0	$0	$0	$0	$0	$0
551720	$2	$2	$212	$212	$422	$422
551921	$0	$0	$32	$32	$63	$63
551922	$0	$0	$32	$32	$63	$63
552010	$0	$0	$11	$11	$21	$21
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$11	$11	$21	$21
552040	$0	$0	$32	$32	$63	$63
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$2	$2	$212	$212	$422	$422
552310	$1	$1	$106	$106	$211	$211
552433	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552435	$1	$1	$106	$106	$211	$211
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$3	$3	$244	$244	$485	$485
553120	$2	$2	$148	$148	$295	$295
553130	$0	$0	$42	$42	$84	$84
553240	$1	$1	$64	$64	$127	$127
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$11	$11	$21	$21
553550	$1	$1	$106	$106	$211	$211
553560	$0	$0	$21	$21	$42	$42
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$4	$4	$329	$329	$654	$654
554110	$0	$0	$0	$0	$0	$0
554120	$0	$0	$11	$11	$21	$21
554300	$3	$3	$233	$233	$464	$464
554400	$3	$3	$233	$233	$464	$464
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$11	$11	$21	$21
551713	$1	$1	$53	$53	$105	$105
551714	$0	$0	$11	$11	$21	$21
553221	$1	$1	$106	$106	$211	$211
553223	$3	$3	$233	$233	$464	$464
553224	$0	$0	$42	$42	$84	$84
TOTAL	**$34**	**$34**	**$3,043**	**$3,043**	**$6,051**	**$6,051**

Northern California steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$11	$11	$21	$21
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$11	$11	$21	$21
110940	$0	$0	$0	$0	$0	$0
111000	$0	$0	$11	$11	$21	$21
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$11	$11	$21	$21
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$11	$11	$21	$21
111133	$0	$0	$11	$11	$21	$21
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$1	$1	$64	$64	$127	$127
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$11	$11	$21	$21
111172	$0	$0	$11	$11	$21	$21
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$21	$21	$42	$42
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$21	$21	$42	$42
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$11	$11	$21	$21
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$21	$21	$42	$42
111385	$0	$0	$11	$11	$21	$21
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$3**	**$3**	**$233**	**$233**	**$464**	**$464**

South-Central California Coast steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$11	$11	$21	$21
330520	$1	$1	$127	$127	$253	$253
330530	$0	$0	$21	$21	$42	$42
330540	$2	$2	$138	$138	$274	$274
330550	$3	$3	$233	$0	$464	$464
330700	$1	$1	$127	$127	$253	$253
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$17	$17	$1,537	$1,537	$3,057	$3,057
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$0	$0	$0	$0
331016	$0	$0	$0	$0	$0	$0
331017	$1	$1	$106	$106	$211	$211
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$11	$11	$21	$21
331023	$0	$0	$0	$0	$0	$0
331024	$0	$0	$0	$0	$0	$0
331025	$0	$0	$0	$0	$0	$0
331026	$0	$0	$11	$11	$21	$21
331031	$1	$1	$117	$117	$232	$232
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$11	$11	$21	$21
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$11	$11	$21	$21
TOTAL	**$28**	**$28**	**$2,460**	**$2,227**	**$4,892**	**$4,892**

Southern California steelhead						
	Annual Impact on Water Supply Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$0	$0
331220	$0	$0	$0	$0	$0	$0
331230	$1	$1	$106	$106	$211	$211
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$11	$11	$21	$21
331451	$1	$1	$106	$106	$211	$211
331510	$1	$1	$127	$127	$253	$253
331531	$0	$0	$21	$21	$42	$42
331532	$1	$1	$106	$106	$211	$211
331533	$1	$1	$117	$117	$232	$232
331534	$1	$1	$117	$117	$232	$232
440210	$0	$0	$0	$0	$0	$0
440220	$3	$3	$223	$223	$443	$443
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$21	$21	$42	$42
440310	$0	$0	$0	$0	$0	$0
440321	$0	$0	$0	$0	$0	$0
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$11	$11	$21	$21
440411	$0	$0	$11	$11	$21	$21
440421	$0	$0	$11	$11	$21	$21
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$11	$11	$21	$21
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$11**	**$11**	**$997**	**$997**	**$1,982**	**$1,982**

Appendix D.4
Annual Federal Lands Management Impacts by Watershed

California Coastal chinook salmon						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$10	$10	$18	$18	$25	$25
110730	$29	$29	$54	$54	$78	$78
110810	$0	$0	$0	$0	$1	$1
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$207	$207	$377	$377	$547	$547
111000	$35	$35	$65	$65	$94	$94
111111	$3	$3	$5	$5	$7	$7
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$1	$1	$1	$1
111121	$0	$0	$0	$0	$0	$0
111122	$295	$295	$538	$538	$780	$780
111123	$1	$1	$3	$3	$4	$4
111131	$5	$5	$9	$9	$12	$12
111132	$126	$126	$230	$230	$333	$333
111133	$40	$40	$72	$72	$105	$105
111141	$66	$66	$121	$121	$175	$175
111142	$52	$52	$94	$94	$137	$137
111150	$410	$410	$747	$747	$1,083	$1,083
111161	$12	$12	$22	$22	$32	$32
111162	$156	$156	$284	$284	$412	$412
111171	$450	$450	$821	$821	$1,190	$1,190
111172	$19	$19	$35	$35	$51	$51
111173	$491	$491	$896	$896	$1,299	$1,299
111174	$267	$267	$487	$487	$706	$706
111220	$0	$0	$0	$0	$0	$0
111230	$324	$324	$591	$591	$857	$857
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$1	$1	$1	$1
111330	$9	$9	$17	$17	$25	$25
111340	$0	$0	$0	$0	$0	$0
111350	$16	$16	$29	$29	$42	$42
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$6	$6	$12	$12	$17	$17
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$3	$3	$6	$6	$9	$9
111425	$13	$13	$24	$24	$35	$35
111431	$111	$111	$202	$202	$293	$293
111433	$3	$3	$5	$5	$8	$8
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$525	$525	$957	$957	$1,389	$1,389
TOTAL	**$3,687**	**$3,687**	**$6,721**	**$6,721**	**$9,748**	**$9,748**

Central Valley spring-run chinook salmon						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$5	$5	$9	$9	$13	$13
550711	$16	$16	$29	$29	$42	$42
550712	$321	$321	$585	$585	$849	$849
550722	$3	$3	$6	$6	$8	$8
550810	$90	$90	$164	$164	$238	$238
550820	$0	$0	$0	$0	$0	$0
550914	$40	$40	$72	$72	$105	$105
550920	$466	$466	$849	$849	$1,231	$1,231
550942	$203	$203	$369	$369	$535	$535
550963	$246	$246	$449	$449	$651	$651
551000	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$14	$14	$25	$25	$36	$36
551921	$0	$0	$0	$0	$0	$0
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552130	$162	$162	$296	$296	$429	$429
552310	$529	$529	$965	$965	$1,400	$1,400
552433	$164	$164	$299	$299	$434	$434
552436	$385	$385	$701	$701	$1,017	$1,017
552440	$7	$7	$13	$13	$18	$18
552462	$10	$10	$18	$18	$26	$26
554300	$0	$0	$0	$0	$0	$0
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$21	$21	$38	$38	$55	$55
TOTAL	**$2,682**	**$2,682**	**$4,888**	**$4,888**	**$7,089**	**$7,089**

Central California Coast steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$6	$6	$12	$12	$17	$17
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$3	$3	$6	$6	$9	$9
111425	$13	$13	$24	$24	$35	$35
111426	$15	$15	$28	$28	$41	$41
111431	$111	$111	$202	$202	$293	$293
111433	$3	$3	$5	$5	$8	$8
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$1	$1
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$0	$0	$0	$0	$0	$0
220540	$0	$0	$0	$0	$0	$0
220550	$0	$0	$0	$0	$0	$0
220620	$0	$0	$0	$0	$0	$0
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$1	$1	$2	$2	$3	$3
220660	$0	$0	$0	$0	$0	$0
220721	$0	$0	$0	$0	$0	$0
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0
220733	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330411	$1	$1	$2	$2	$3	$3
330412	$1	$1	$2	$2	$3	$3
330413	$2	$2	$3	$3	$5	$5
330420	$0	$0	$1	$1	$1	$1
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$158**	**$158**	**$288**	**$288**	**$418**	**$418**

California Central Valley steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$0	$0	$0	$0
550420	$5	$5	$9	$9	$13	$13
550711	$16	$16	$29	$29	$42	$42
550712	$321	$321	$585	$585	$849	$849
550721	$0	$0	$0	$0	$0	$0
550722	$3	$3	$6	$6	$8	$8
550731	$1	$1	$2	$2	$2	$2
550732	$23	$23	$43	$43	$62	$62
550733	$40	$40	$73	$73	$106	$106
550810	$90	$90	$164	$164	$238	$238
550820	$0	$0	$0	$0	$0	$0
550914	$40	$40	$72	$72	$105	$105
550920	$466	$466	$849	$849	$1,231	$1,231
550942	$203	$203	$369	$369	$535	$535
550962	$8	$8	$14	$14	$20	$20
550963	$246	$246	$449	$449	$651	$651
550964	$54	$54	$98	$98	$142	$142
551000	$0	$0	$0	$0	$0	$0
551110	$0	$0	$0	$0	$0	$0
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$14	$14	$25	$25	$36	$36
551921	$0	$0	$0	$0	$0	$0
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552110	$0	$0	$0	$0	$1	$1
552120	$10	$10	$18	$18	$26	$26
552130	$162	$162	$296	$296	$429	$429
552310	$529	$529	$965	$965	$1,400	$1,400
552433	$164	$164	$299	$299	$434	$434
552435	$7	$7	$12	$12	$18	$18

California Central Valley steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$385	$385	$701	$701	$1,017	$1,017
552440	$7	$7	$13	$13	$18	$18
552462	$10	$10	$18	$18	$26	$26
553111	$0	$0	$0	$0	$0	$0
553120	$0	$0	$0	$0	$0	$0
553130	$0	$0	$0	$0	$0	$0
553240	$35	$35	$63	$63	$92	$92
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$0	$0	$0	$0
553550	$0	$0	$0	$0	$0	$0
553560	$0	$0	$0	$0	$0	$0
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$0	$0	$0	$0	$0	$0
554110	$0	$0	$0	$0	$0	$0
554120	$6	$6	$11	$11	$16	$16
554300	$0	$0	$0	$0	$0	$0
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$21	$21	$38	$38	$55	$55
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$2,865**	**$2,865**	**$5,223**	**$5,223**	**$7,574**	**$7,574**

Northern California steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$10	$10	$18	$18	$25	$25
110730	$29	$29	$54	$54	$78	$78
110810	$0	$0	$0	$0	$1	$1
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$207	$207	$377	$377	$547	$547
110940	$438	$438	$799	$799	$1,158	$1,158
111000	$35	$35	$65	$65	$94	$94
111111	$3	$3	$5	$5	$7	$7
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$1	$1	$1	$1
111121	$0	$0	$0	$0	$0	$0
111122	$295	$295	$538	$538	$780	$780
111123	$1	$1	$3	$3	$4	$4
111131	$5	$5	$9	$9	$12	$12
111132	$126	$126	$230	$230	$333	$333
111133	$40	$40	$72	$72	$105	$105
111141	$66	$66	$121	$121	$175	$175
111142	$52	$52	$94	$94	$137	$137
111150	$410	$410	$747	$747	$1,083	$1,083
111161	$12	$12	$22	$22	$32	$32
111162	$156	$156	$284	$284	$412	$412
111171	$450	$450	$821	$821	$1,190	$1,190
111172	$19	$19	$35	$35	$51	$51
111173	$491	$491	$896	$896	$1,299	$1,299
111174	$267	$267	$487	$487	$706	$706
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$324	$324	$591	$591	$857	$857
111311	$0	$0	$1	$1	$1	$1
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$1	$1	$1	$1
111330	$9	$9	$17	$17	$25	$25
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$16	$16	$29	$29	$42	$42
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$525	$525	$957	$957	$1,389	$1,389
TOTAL	**$3,989**	**$3,989**	**$7,271**	**$7,271**	**$10,546**	**$10,546**

South-Central California Coast steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$202	$202	$368	$368	$533	$533
330700	$8	$8	$14	$14	$20	$20
330800	$158	$158	$288	$288	$418	$418
330930	$2	$2	$3	$3	$5	$5
330940	$0	$0	$0	$0	$0	$0
330960	$204	$204	$372	$372	$539	$539
330981	$281	$281	$513	$513	$743	$743
331011	$1	$1	$1	$1	$2	$2
331012	$0	$0	$0	$0	$0	$0
331013	$3	$3	$5	$5	$7	$7
331014	$3	$3	$5	$5	$7	$7
331015	$1	$1	$1	$1	$2	$2
331016	$1	$1	$2	$2	$3	$3
331017	$2	$2	$3	$3	$5	$5
331018	$14	$14	$26	$26	$37	$37
331021	$24	$24	$44	$44	$64	$64
331022	$24	$24	$44	$44	$64	$64
331023	$0	$0	$0	$0	$0	$0
331024	$16	$16	$30	$30	$43	$43
331025	$3	$3	$6	$6	$9	$9
331026	$1	$1	$2	$2	$3	$3
331031	$24	$24	$43	$43	$63	$63
331027	$1	$1	$1	$1	$2	$2
330920	$0	$0	$0	$0	$0	$0
330970	$128	$128	$234	$234	$339	$339
330911	$0	$0	$0	$0	$1	$1
TOTAL	**$1,101**	**$1,101**	**$2,006**	**$2,006**	**$2,909**	**$2,909**

Southern California steelhead						
	Annual Impact of Federal Lands Management Activities Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$1	$1
331220	$320	$320	$644	$644	$968	$968
331230	$2,197	$2,197	$4,424	$4,424	$6,646	$6,646
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$19	$19	$39	$39	$59	$59
331440	$104	$104	$210	$210	$315	$315
331451	$995	$995	$2,004	$2,004	$3,011	$3,011
331510	$191	$191	$384	$384	$578	$578
331531	$89	$89	$179	$179	$270	$270
331532	$44	$44	$88	$88	$132	$132
331533	$43	$43	$87	$87	$131	$131
331534	$134	$134	$271	$271	$407	$407
440210	$0	$0	$0	$0	$0	$0
440220	$254	$254	$512	$512	$769	$769
440231	$2	$2	$5	$5	$7	$7
440232	$85	$85	$171	$171	$256	$256
440310	$0	$0	$0	$0	$0	$0
440321	$47	$47	$95	$95	$142	$142
440322	$31	$31	$62	$62	$92	$92
440331	$26	$26	$53	$53	$80	$80
440332	$283	$283	$571	$571	$857	$857
440341	$59	$59	$119	$119	$179	$179
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$1	$1	$2	$2	$3	$3
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$1	$1	$1	$1
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$54	$54	$109	$109	$164	$164
TOTAL	**$4,981**	**$4,981**	**$10,029**	**$10,029**	**$15,068**	**$15,068**

Appendix D.5
Annual Grazing Impacts by Watershed

California Coastal chinook salmon						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110720	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110730	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110810	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110820	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110910	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110920	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110930	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111000	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111111	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111112	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111113	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111121	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111122	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111123	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111131	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111132	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111133	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111141	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111142	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111150	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111161	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111162	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111171	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111172	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111173	$0.03	$0.03	$0.09	$0.09	$0.14	$0.14
111174	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111220	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111230	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111312	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111313	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111320	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111330	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111340	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111350	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111370	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

California Coastal chinook salmon						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111412	$0.09	$0.09	$0.23	$0.23	$0.37	$0.37
111422	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111423	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111424	$0.29	$0.29	$0.76	$0.76	$1.23	$1.23
111425	$0.03	$0.03	$0.08	$0.08	$0.13	$0.13
111431	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111433	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Eel River_Estuary	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Humboldt_Bay	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111163	$0.02	$0.02	$0.04	$0.04	$0.07	$0.07
TOTAL	**$0.45**	**$0.45**	**$1.20**	**$1.20**	**$1.94**	**$1.94**

Central Valley spring-run chinook salmon						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
550420	$1.12	$1.12	$2.96	$2.96	$4.79	$4.79
550711	$2.28	$2.28	$6.01	$6.01	$9.75	$9.75
550712	$1.90	$1.90	$5.01	$5.01	$8.12	$8.12
550722	$0.70	$0.70	$1.86	$1.86	$3.01	$3.01
550810	$17.31	$17.31	$45.63	$45.63	$73.95	$73.95
550820	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
550914	$0.04	$0.04	$0.11	$0.11	$0.18	$0.18
550920	$0.81	$0.81	$2.13	$2.13	$3.45	$3.45
550942	$0.47	$0.47	$1.25	$1.25	$2.03	$2.03
550963	$0.21	$0.21	$0.55	$0.55	$0.89	$0.89
551000	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551530	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551540	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551712	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551720	$0.18	$0.18	$0.47	$0.47	$0.77	$0.77
551921	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551922	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552010	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552021	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552030	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552040	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552130	$0.06	$0.06	$0.17	$0.17	$0.27	$0.27
552310	$0.87	$0.87	$2.30	$2.30	$3.72	$3.72
552433	$0.01	$0.01	$0.03	$0.03	$0.05	$0.05
552436	$1.72	$1.72	$4.53	$4.53	$7.33	$7.33
552440	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552462	$1.13	$1.13	$2.98	$2.98	$4.84	$4.84
554300	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
554400	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220312	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220610	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220710	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551713	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551714	$0.01	$0.01	$0.02	$0.02	$0.03	$0.03
TOTAL	**$28.83**	**$28.83**	**$76.00**	**$76.00**	**$123.17**	**$123.17**

Central California Coast steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
111411	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111412	$0.09	$0.09	$0.23	$0.23	$0.37	$0.37
111421	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111422	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111423	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111424	$0.29	$0.29	$0.76	$0.76	$1.23	$1.23
111425	$0.03	$0.03	$0.08	$0.08	$0.13	$0.13
111426	$0.22	$0.22	$0.59	$0.59	$0.95	$0.95
111431	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111433	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111530	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220112	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220113	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220130	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220221	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220222	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220223	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220230	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220240	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220320	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220330	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220420	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220440	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220530	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220540	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220550	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220620	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220630	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220640	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220650	$0.00	$0.00	$0.01	$0.01	$0.01	$0.01
220660	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220721	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220722	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220731	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220733	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Central California Coast steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330411	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330412	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330413	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330420	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220312	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220610	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220710	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
TOTAL	**$0.63**	**$0.63**	**$1.66**	**$1.66**	**$2.69**	**$2.69**

California Central Valley steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
550420	$1.12	$1.12	$2.96	$2.96	$4.79	$4.79
550711	$2.28	$2.28	$6.01	$6.01	$9.75	$9.75
550712	$1.90	$1.90	$5.01	$5.01	$8.12	$8.12
550721	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
550722	$0.70	$0.70	$1.86	$1.86	$3.01	$3.01
550731	$0.20	$0.20	$0.53	$0.53	$0.86	$0.86
550732	$0.16	$0.16	$0.42	$0.42	$0.67	$0.67
550733	$1.28	$1.28	$3.36	$3.36	$5.45	$5.45
550810	$17.31	$17.31	$45.63	$45.63	$73.95	$73.95
550820	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
550914	$0.04	$0.04	$0.11	$0.11	$0.18	$0.18
550920	$0.81	$0.81	$2.13	$2.13	$3.45	$3.45
550942	$0.47	$0.47	$1.25	$1.25	$2.03	$2.03
550962	$0.01	$0.01	$0.02	$0.02	$0.03	$0.03
550963	$0.21	$0.21	$0.55	$0.55	$0.89	$0.89
550964	$0.19	$0.19	$0.49	$0.49	$0.80	$0.80
551000	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551110	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551530	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551540	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551712	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551720	$0.18	$0.18	$0.47	$0.47	$0.77	$0.77
551921	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551922	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552010	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552021	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552030	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552040	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552110	$0.01	$0.01	$0.01	$0.01	$0.02	$0.02
552120	$0.08	$0.08	$0.20	$0.20	$0.32	$0.32
552130	$0.06	$0.06	$0.17	$0.17	$0.27	$0.27
552310	$0.87	$0.87	$2.30	$2.30	$3.72	$3.72
552433	$0.01	$0.01	$0.03	$0.03	$0.05	$0.05
552435	$1.12	$1.12	$2.95	$2.95	$4.77	$4.77

California Central Valley steelhead						
Watershed	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
	Low - 3%	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$1.72	$1.72	$4.53	$4.53	$7.33	$7.33
552440	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
552462	$1.13	$1.13	$2.98	$2.98	$4.84	$4.84
553111	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553130	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553240	$1.31	$1.31	$3.45	$3.45	$5.59	$5.59
553310	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553530	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553550	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553560	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553570	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553580	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553590	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
554110	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
554120	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
554300	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
554400	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220312	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220610	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
220710	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551422	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551713	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
551714	$0.01	$0.01	$0.02	$0.02	$0.03	$0.03
553221	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553223	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
553224	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
TOTAL	**$33.16**	**$33.16**	**$87.42**	**$87.42**	**$141.69**	**$141.69**

Northern California steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110720	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110730	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110810	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110820	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110910	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110920	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110930	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
110940	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111000	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111111	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111112	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111113	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111121	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111122	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111123	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111131	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111132	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111133	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111141	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111142	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111150	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111161	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111162	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111171	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111172	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111173	$0.03	$0.03	$0.09	$0.09	$0.14	$0.14
111174	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111210	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111220	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111230	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111311	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111312	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111313	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111320	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111330	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111340	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00

Northern California steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111361	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111362	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111363	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111364	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111370	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111381	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111382	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111383	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111384	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111385	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111390	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Eel River_Estuary	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Humboldt_Bay	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
111163	$0.02	$0.02	$0.04	$0.04	$0.07	$0.07
TOTAL	**$0.05**	**$0.05**	**$0.13**	**$0.13**	**$0.21**	**$0.21**

South-Central California Coast steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330520	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330530	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330540	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330550	$3.69	$3.69	$9.74	$9.74	$15.79	$15.79
330700	$0.06	$0.06	$0.16	$0.16	$0.25	$0.25
330800	$0.67	$0.67	$1.76	$1.76	$2.85	$2.85
330930	$0.03	$0.03	$0.09	$0.09	$0.15	$0.15
330940	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330960	$2.62	$2.62	$6.90	$6.90	$11.19	$11.19
330981	$5.52	$5.52	$14.56	$14.56	$23.60	$23.60
331011	$2.08	$2.08	$5.48	$5.48	$8.89	$8.89
331012	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331013	$0.01	$0.01	$0.03	$0.03	$0.05	$0.05
331014	$0.05	$0.05	$0.12	$0.12	$0.20	$0.20
331015	$0.02	$0.02	$0.05	$0.05	$0.08	$0.08
331016	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331017	$0.10	$0.10	$0.26	$0.26	$0.42	$0.42
331018	$0.01	$0.01	$0.02	$0.02	$0.04	$0.04
331021	$0.01	$0.01	$0.02	$0.02	$0.03	$0.03
331022	$0.12	$0.12	$0.32	$0.32	$0.53	$0.53
331023	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331024	$0.01	$0.01	$0.02	$0.02	$0.03	$0.03
331025	$0.07	$0.07	$0.19	$0.19	$0.32	$0.32
331026	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
331031	$0.26	$0.26	$0.69	$0.69	$1.11	$1.11
331027	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330920	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
330970	$0.12	$0.12	$0.32	$0.32	$0.52	$0.52
330911	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
TOTAL	**$15.46**	**$15.46**	**$40.75**	**$40.75**	**$66.04**	**$66.04**

Southern California steelhead						
	Annual Grazing Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0.04	$0.04	$0.09	$0.09	$0.15	$0.15
331220	$1.11	$1.11	$2.93	$2.93	$4.75	$4.75
331230	$33.06	$33.06	$87.16	$87.16	$141.25	$141.25
331410	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331420	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331430	$0.11	$0.11	$0.30	$0.30	$0.49	$0.49
331440	$0.29	$0.29	$0.76	$0.76	$1.23	$1.23
331451	$0.06	$0.06	$0.16	$0.16	$0.26	$0.26
331510	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331531	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331532	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331533	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
331534	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440210	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440220	$0.00	$0.00	$0.00	$0.00	$0.01	$0.01
440231	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440232	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440310	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440321	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440322	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440331	$0.80	$0.80	$2.10	$2.10	$3.41	$3.41
440332	$0.55	$0.55	$1.46	$1.46	$2.37	$2.37
440341	$1.08	$1.08	$2.85	$2.85	$4.62	$4.62
440411	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440421	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440444	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440811	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
440813	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
490123	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
490124	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
490127	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
490140	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
TOTAL	**$37.11**	**$37.11**	**$97.83**	**$97.83**	**$158.55**	**$158.55**

Appendix D.6
Annual Transportation Impacts by Watershed

California Coastal chinook salmon						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$12	$12	$12	$12	$12	$12
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$13	$13	$13	$13	$13	$13
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111422	$20	$20	$20	$20	$20	$20
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111431	$102	$102	$102	$102	$102	$102
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$147**	**$147**	**$147**	**$147**	**$147**	**$147**

Central Valley spring-run chinook salmon						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$20	$20	$20	$20	$20	$20
550420	$39	$39	$39	$39	$39	$39
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$25	$25	$25	$25	$25	$25
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$31	$31	$31	$31	$31	$31
551510	$25	$25	$25	$25	$25	$25
551530	$0	$0	$0	$0	$0	$0
551540	$49	$49	$49	$49	$49	$49
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$61	$61	$61	$61	$61	$61
551922	$123	$123	$123	$123	$123	$123
552010	$12	$12	$12	$12	$12	$12
552021	$0	$0	$0	$0	$0	$0
552030	$52	$52	$52	$52	$52	$52
552040	$32	$32	$32	$32	$32	$32
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$24	$24	$24	$24	$24	$24
554400	$86	$86	$86	$86	$86	$86
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$580**	**$580**	**$580**	**$580**	**$580**	**$580**

Central California Coast steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111421	$12	$12	$12	$12	$12	$12
111422	$20	$20	$20	$20	$20	$20
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111426	$0	$0	$0	$0	$0	$0
111431	$102	$102	$102	$102	$102	$102
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$13	$13	$13	$13	$13	$13
220222	$7	$7	$7	$7	$7	$7
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$25	$25	$25	$25	$25	$25
220330	$25	$25	$25	$25	$25	$25
220420	$24	$24	$24	$24	$24	$24
220440	$25	$25	$25	$25	$25	$25
220530	$32	$32	$32	$32	$32	$32
220540	$12	$12	$12	$12	$12	$12
220550	$19	$19	$19	$19	$19	$19
220620	$0	$0	$0	$0	$0	$0
220630	$25	$25	$25	$25	$25	$25
220640	$0	$0	$0	$0	$0	$0
220650	$37	$37	$37	$37	$37	$37
220660	$12	$12	$12	$12	$12	$12
220721	$24	$24	$24	$24	$24	$24
220722	$0	$0	$0	$0	$0	$0
220731	$32	$32	$32	$32	$32	$32

Central California Coast steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
220733	$13	$13	$13	$13	$13	$13
330411	$0	$0	$0	$0	$0	$0
330412	$24	$24	$24	$24	$24	$24
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$484**	**$484**	**$484**	**$484**	**$484**	**$484**

California Central Valley steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$20	$20	$20	$20	$20	$20
550420	$39	$39	$39	$39	$39	$39
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$25	$25	$25	$25	$25	$25
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$31	$31	$31	$31	$31	$31
551110	$13	$13	$13	$13	$13	$13
551120	$0	$0	$0	$0	$0	$0
551510	$25	$25	$25	$25	$25	$25
551530	$0	$0	$0	$0	$0	$0
551540	$49	$49	$49	$49	$49	$49
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$61	$61	$61	$61	$61	$61
551922	$123	$123	$123	$123	$123	$123
552010	$12	$12	$12	$12	$12	$12
552021	$0	$0	$0	$0	$0	$0
552030	$52	$52	$52	$52	$52	$52
552040	$32	$32	$32	$32	$32	$32
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$12	$12	$12	$12	$12	$12
553120	$14	$14	$14	$14	$14	$14
553130	$13	$13	$13	$13	$13	$13
553240	$13	$13	$13	$13	$13	$13
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$14	$14	$14	$14	$14	$14
553530	$125	$125	$125	$125	$125	$125
553550	$0	$0	$0	$0	$0	$0
553560	$0	$0	$0	$0	$0	$0
553570	$27	$27	$27	$27	$27	$27
553580	$108	$108	$108	$108	$108	$108
553590	$0	$0	$0	$0	$0	$0
554110	$12	$12	$12	$12	$12	$12
554120	$26	$26	$26	$26	$26	$26
554300	$24	$24	$24	$24	$24	$24
554400	$86	$86	$86	$86	$86	$86
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$957**	**$957**	**$957**	**$957**	**$957**	**$957**

Northern California steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$12	$12	$12	$12	$12	$12
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$13	$13	$13	$13	$13	$13
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$25**	**$25**	**$25**	**$25**	**$25**	**$25**

South-Central California Coast steelhead						
	Annual Total Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$14	$14	$14	$14	$14	$14
330520	$0	$0	$0	$0	$0	$0
330530	$38	$38	$38	$38	$38	$38
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$7	$7	$7	$7	$7	$7
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$7	$7	$7	$7	$7	$7
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$12	$12	$12	$12	$12	$12
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$0	$0	$0	$0	$0	$0
331025	$0	$0	$0	$0	$0	$0
331026	$7	$7	$7	$7	$7	$7
331031	$27	$27	$27	$27	$27	$27
331027	$0	$0	$0	$0	$0	$0
330920	$51	$51	$51	$51	$51	$51
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$164**	**$164**	**$164**	**$164**	**$164**	**$164**

Southern California steelhead						
	Annual Transportation Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$41	$41	$41	$41	$41	$41
331220	$0	$0	$0	$0	$0	$0
331230	$18	$18	$18	$18	$18	$18
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$0	$0	$0	$0
331451	$0	$0	$0	$0	$0	$0
331510	$0	$0	$0	$0	$0	$0
331531	$0	$0	$0	$0	$0	$0
331532	$0	$0	$0	$0	$0	$0
331533	$23	$23	$23	$23	$23	$23
331534	$27	$27	$27	$27	$27	$27
440210	$0	$0	$0	$0	$0	$0
440220	$0	$0	$0	$0	$0	$0
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$12	$12	$12	$12	$12	$12
440321	$0	$0	$0	$0	$0	$0
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$25	$25	$25	$25	$25	$25
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$145**	**$145**	**$145**	**$145**	**$145**	**$145**

Appendix D.7
Annual Wilderness Lands Impacts by Watershed

California Coastal chinook salmon						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$6	$6	$11	$11	$16	$16
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$17	$17	$33	$33	$49	$49
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$2	$2	$3	$3	$5	$5
TOTAL	**$25**	**$25**	**$47**	**$47**	**$70**	**$70**

Central Valley spring-run chinook salmon						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$3	$3	$6	$6	$9	$9
550942	$4	$4	$8	$8	$12	$12
550963	$0	$0	$0	$0	$0	$0
551000	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$2	$2	$3	$3	$5	$5
552433	$10	$10	$19	$19	$28	$28
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$0	$0
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$19**	**$19**	**$37**	**$37**	**$55**	**$55**

Central California Coast steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111426	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$0	$0	$0	$0	$0	$0
220540	$0	$0	$0	$0	$0	$0
220550	$0	$0	$0	$0	$0	$0
220620	$0	$0	$0	$0	$0	$0
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$0	$0	$0	$0	$0	$0
220660	$0	$0	$0	$0	$0	$0
220721	$0	$0	$0	$0	$0	$0
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220733	$0	$0	$0	$0	$0	$0
330411	$0	$0	$0	$0	$0	$0
330412	$0	$0	$0	$0	$0	$0
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

California Central Valley steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$3	$3	$6	$6	$9	$9
550942	$4	$4	$8	$8	$12	$12
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$0	$0	$0	$0	$0	$0
551110	$0	$0	$0	$0	$0	$0
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$2	$2	$3	$3	$5	$5
552433	$10	$10	$19	$19	$28	$28
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$0	$0	$0	$0	$0	$0
553120	$0	$0	$0	$0	$0	$0
553130	$0	$0	$0	$0	$0	$0
553240	$0	$0	$0	$0	$0	$0
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$0	$0	$0	$0
553550	$0	$0	$0	$0	$0	$0
553560	$0	$0	$0	$0	$0	$0
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$0	$0	$0	$0	$0	$0
554110	$0	$0	$0	$0	$0	$0
554120	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$0	$0
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$19**	**$19**	**$37**	**$37**	**$55**	**$55**

Northern California steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$1	$1	$1	$1
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$6	$6	$11	$11	$16	$16
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$17	$17	$33	$33	$49	$49
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$2	$2	$3	$3	$5	$5
TOTAL	**$25**	**$25**	**$48**	**$48**	**$71**	**$71**

South-Central California Coast steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$9	$9	$17	$17	$25	$25
330800	$20	$20	$38	$38	$57	$57
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$23	$23	$44	$44	$65	$65
330981	$9	$9	$17	$17	$25	$25
331011	$3	$3	$5	$5	$7	$7
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$0	$0	$0	$0
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$0	$0	$0	$0	$0	$0
331025	$0	$0	$0	$0	$0	$0
331026	$0	$0	$0	$0	$0	$0
331031	$4	$4	$7	$7	$11	$11
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$0	$0	$0	$0
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$68**	**$68**	**$128**	**$128**	**$191**	**$191**

Southern California steelhead						
	Annual Wilderness Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$0	$0
331220	$63	$63	$118	$118	$173	$173
331230	$38	$38	$71	$71	$104	$104
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$0	$0	$0	$0
331451	$21	$21	$39	$39	$57	$57
331510	$0	$0	$0	$0	$0	$0
331531	$0	$0	$0	$0	$0	$0
331532	$0	$0	$0	$0	$0	$0
331533	$0	$0	$0	$0	$0	$0
331534	$0	$0	$0	$0	$0	$0
440210	$0	$0	$0	$0	$0	$0
440220	$9	$9	$16	$16	$24	$24
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$0	$0	$0	$0	$0	$0
440321	$3	$3	$6	$6	$8	$8
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$42	$42	$78	$78	$114	$114
440341	$3	$3	$5	$5	$7	$7
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$13	$13	$23	$23	$34	$34
TOTAL	**$192**	**$192**	**$357**	**$357**	**$522**	**$522**

Appendix D.8
Annual Utilities Impacts by Watershed

California Coastal chinook salmon						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
Watershed	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

Central Valley spring-run chinook salmon						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$38	$38	$38	$38	$38	$38
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$25	$25	$25	$25	$26	$26
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$0	$0
554400	$13	$13	$13	$13	$13	$13
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$75**	**$75**	**$76**	**$76**	**$77**	**$77**

Central California Coast steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111426	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$0	$0	$0	$0	$0	$0
220540	$0	$0	$0	$0	$0	$0
220550	$0	$0	$0	$0	$0	$0
220620	$0	$0	$0	$0	$0	$0
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$0	$0	$0	$0	$0	$0
220660	$0	$0	$0	$0	$0	$0
220721	$0	$0	$0	$0	$0	$0
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220733	$0	$0	$0	$0	$0	$0
330411	$0	$0	$0	$0	$0	$0
330412	$0	$0	$0	$0	$0	$0
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

California Central Valley steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$38	$38	$38	$38	$38	$38
551110	$0	$0	$0	$0	$0	$0
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$25	$25	$25	$25	$26	$26
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$0	$0	$0	$0	$0	$0
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$25	$25	$25	$25	$26	$26
553120	$13	$13	$13	$13	$13	$13
553130	$0	$0	$0	$0	$0	$0
553240	$0	$0	$0	$0	$0	$0
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$0	$0	$0	$0
553550	$0	$0	$0	$0	$0	$0
553560	$0	$0	$0	$0	$0	$0
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$0	$0	$0	$0	$0	$0
554110	$0	$0	$0	$0	$0	$0
554120	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$0	$0
554400	$13	$13	$13	$13	$13	$13
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$113**	**$113**	**$114**	**$114**	**$115**	**$115**

Northern California steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

South-Central California Coast steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$0	$0	$0	$0	$0	$0
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$0	$0	$0	$0	$0	$0
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$0	$0	$0	$0
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$200	$200	$202	$202	$204	$204
331025	$0	$0	$0	$0	$0	$0
331026	$0	$0	$0	$0	$0	$0
331031	$100	$100	$101	$101	$102	$102
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$0	$0	$0	$0
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$300**	**$300**	**$303**	**$303**	**$306**	**$306**

Southern California steelhead						
	Annual Utilities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$300	$300	$303	$303	$306	$306
331220	$0	$0	$0	$0	$0	$0
331230	$0	$0	$0	$0	$0	$0
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$100	$100	$101	$101	$102	$102
331451	$0	$0	$0	$0	$0	$0
331510	$100	$100	$101	$101	$102	$102
331531	$100	$100	$101	$101	$102	$102
331532	$0	$0	$0	$0	$0	$0
331533	$0	$0	$0	$0	$0	$0
331534	$0	$0	$0	$0	$0	$0
440210	$0	$0	$0	$0	$0	$0
440220	$100	$100	$101	$101	$102	$102
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$0	$0	$0	$0	$0	$0
440321	$0	$0	$0	$0	$0	$0
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$700**	**$700**	**$707**	**$707**	**$714**	**$714**

Appendix D.9
Annual Instream Activities Impacts by Watershed

California Coastal chinook salmon						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$4	$4	$8	$8	$12	$12
111111	$11	$11	$23	$23	$36	$36
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$4	$4	$8	$8	$12	$12
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$4	$4	$8	$8	$12	$12
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$4	$4	$8	$8	$12	$12
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$4	$4	$8	$8	$12	$12
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$7	$7	$16	$16	$24	$24
111431	$4	$4	$8	$8	$12	$12
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$88	$88	$192	$192	$295	$295
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$127**	**$127**	**$277**	**$277**	**$427**	**$427**

Central Valley spring-run chinook salmon						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$66	$66	$143	$143	$221	$221
550711	$0	$0	$0	$0	$0	$0
550712	$3	$3	$7	$7	$11	$11
550722	$0	$0	$0	$0	$0	$0
550810	$38	$38	$82	$82	$126	$126
550820	$3	$3	$7	$7	$11	$11
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$184	$184	$402	$402	$620	$620
551510	$0	$0	$0	$0	$0	$0
551530	$3	$3	$7	$7	$11	$11
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$75	$75	$164	$164	$252	$252
551922	$94	$94	$204	$204	$315	$315
552010	$16	$16	$34	$34	$53	$53
552021	$0	$0	$0	$0	$0	$0
552030	$6	$6	$14	$14	$21	$21
552040	$34	$34	$75	$75	$116	$116
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$38	$38	$82	$82	$126	$126
554400	$331	$331	$722	$722	$1,113	$1,113
220312	$94	$94	$204	$204	$315	$315
220410	$59	$59	$129	$129	$200	$200
220610	$19	$19	$41	$41	$63	$63
220710	$56	$56	$123	$123	$189	$189
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$1,119**	**$1,119**	**$2,439**	**$2,439**	**$3,759**	**$3,759**

Central California Coast steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$4	$4	$8	$8	$12	$12
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$7	$7	$16	$16	$24	$24
111426	$0	$0	$0	$0	$0	$0
111431	$4	$4	$8	$8	$12	$12
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$0	$0	$0	$0	$0	$0
220540	$4	$4	$8	$8	$12	$12
220550	$4	$4	$8	$8	$12	$12
220620	$0	$0	$0	$0	$0	$0
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$4	$4	$8	$8	$12	$12
220660	$0	$0	$0	$0	$0	$0
220721	$4	$4	$8	$8	$12	$12
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220733	$0	$0	$0	$0	$0	$0
330411	$0	$0	$0	$0	$0	$0
330412	$0	$0	$0	$0	$0	$0
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$0	$0	$0	$0
220312	$94	$94	$204	$204	$315	$315
220410	$59	$59	$129	$129	$200	$200
220510	$0	$0	$0	$0	$0	$0
220610	$19	$19	$41	$41	$63	$63
220710	$56	$56	$123	$123	$189	$189
TOTAL	**$257**	**$257**	**$559**	**$559**	**$862**	**$862**

California Central Valley steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$0	$0	$0	$0
550420	$66	$66	$143	$143	$221	$221
550711	$0	$0	$0	$0	$0	$0
550712	$3	$3	$7	$7	$11	$11
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$38	$38	$82	$82	$126	$126
550820	$3	$3	$7	$7	$11	$11
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$184	$184	$402	$402	$620	$620
551110	$16	$16	$34	$34	$53	$53
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$3	$3	$7	$7	$11	$11
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$75	$75	$164	$164	$252	$252
551922	$94	$94	$204	$204	$315	$315
552010	$16	$16	$34	$34	$53	$53
552021	$0	$0	$0	$0	$0	$0
552030	$6	$6	$14	$14	$21	$21
552040	$34	$34	$75	$75	$116	$116
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$25	$25	$55	$55	$84	$84
553120	$9	$9	$20	$20	$32	$32
553130	$3	$3	$7	$7	$11	$11
553240	$3	$3	$7	$7	$11	$11
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$3	$3	$7	$7	$11	$11
553550	$6	$6	$14	$14	$21	$21
553560	$0	$0	$0	$0	$0	$0
553570	$3	$3	$7	$7	$11	$11
553580	$3	$3	$7	$7	$11	$11
553590	$3	$3	$7	$7	$11	$11
554110	$0	$0	$0	$0	$0	$0
554120	$3	$3	$7	$7	$11	$11
554300	$38	$38	$82	$82	$126	$126
554400	$331	$331	$722	$722	$1,113	$1,113
220312	$94	$94	$204	$204	$315	$315
220410	$59	$59	$129	$129	$200	$200
220610	$19	$19	$41	$41	$63	$63
220710	$56	$56	$123	$123	$189	$189
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$1,197**	**$1,197**	**$2,609**	**$2,609**	**$4,022**	**$4,022**

Northern California steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$4	$4	$8	$8	$12	$12
111111	$11	$11	$23	$23	$36	$36
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$4	$4	$8	$8	$12	$12
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$4	$4	$8	$8	$12	$12
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$4	$4	$8	$8	$12	$12
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$88	$88	$192	$192	$295	$295
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$113**	**$113**	**$246**	**$246**	**$379**	**$379**

South-Central California Coast steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$4	$4	$8	$8	$12	$12
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$0	$0	$0	$0	$0	$0
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$7	$7	$16	$16	$24	$24
331015	$0	$0	$0	$0	$0	$0
331016	$25	$25	$55	$55	$84	$84
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$25	$25	$55	$55	$84	$84
331022	$50	$50	$109	$109	$168	$168
331023	$50	$50	$109	$109	$168	$168
331024	$75	$75	$164	$164	$252	$252
331025	$0	$0	$0	$0	$0	$0
331026	$0	$0	$0	$0	$0	$0
331031	$0	$0	$0	$0	$0	$0
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$0	$0	$0	$0
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$236**	**$236**	**$514**	**$514**	**$792**	**$792**

Southern California steelhead						
	Annual Instream Activities Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$25	$25	$55	$55	$84	$84
331220	$0	$0	$0	$0	$0	$0
331230	$0	$0	$0	$0	$0	$0
331410	$0	$0	$0	$0	$0	$0
331420	$50	$50	$109	$109	$168	$168
331430	$25	$25	$55	$55	$84	$84
331440	$0	$0	$0	$0	$0	$0
331451	$0	$0	$0	$0	$0	$0
331510	$0	$0	$0	$0	$0	$0
331531	$75	$75	$164	$164	$252	$252
331532	$0	$0	$0	$0	$0	$0
331533	$0	$0	$0	$0	$0	$0
331534	$0	$0	$0	$0	$0	$0
440210	$0	$0	$0	$0	$0	$0
440220	$0	$0	$0	$0	$0	$0
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$25	$25	$55	$55	$84	$84
440321	$25	$25	$55	$55	$84	$84
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$225**	**$225**	**$491**	**$491**	**$756**	**$756**

Appendix D.10
Annual Dredging Impacts by Watershed

California Coastal chinook salmon						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$47	$47	$117	$117	$187	$187
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$47**	**$47**	**$117**	**$117**	**$187**	**$187**

Central Valley spring-run chinook salmon						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$249	$249	$616	$616	$983	$983
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$0	$0	$0	$0	$0	$0
552010	$42	$42	$103	$103	$164	$164
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$125	$125	$308	$308	$491	$491
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$42	$42	$103	$103	$164	$164
554400	$581	$581	$1,437	$1,437	$2,293	$2,293
220312	$61	$61	$244	$244	$428	$428
220410	$122	$122	$488	$488	$855	$855
220610	$20	$20	$81	$81	$143	$143
220710	$61	$61	$244	$244	$428	$428
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$1,301**	**$1,301**	**$3,624**	**$3,624**	**$5,946**	**$5,946**

Central California Coast steelhead						
Watershed	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
111411	$0	$0	$0	$0	$0	$0
111412	$0	$0	$0	$0	$0	$0
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$47	$47	$117	$117	$187	$187
111426	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$47	$47	$117	$117	$187	$187
220540	$0	$0	$0	$0	$0	$0
220550	$0	$0	$0	$0	$0	$0
220620	$47	$47	$117	$117	$187	$187
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$0	$0	$0	$0	$0	$0
220660	$0	$0	$0	$0	$0	$0
220721	$47	$47	$117	$117	$187	$187
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220733	$0	$0	$0	$0	$0	$0
330411	$0	$0	$0	$0	$0	$0
330412	$0	$0	$0	$0	$0	$0
330413	$0	$0	$0	$0	$0	$0
330420	$0	$0	$0	$0	$0	$0
220312	$61	$61	$244	$244	$428	$428
220410	$122	$122	$488	$488	$855	$855
220510	$0	$0	$0	$0	$0	$0
220610	$20	$20	$81	$81	$143	$143
220710	$61	$61	$244	$244	$428	$428
TOTAL	**$452**	**$452**	**$1,526**	**$1,526**	**$2,599**	**$2,599**

California Central Valley steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$0	$0	$0	$0	$0	$0
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$0	$0	$0	$0	$0	$0
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$249	$249	$616	$616	$983	$983
551110	$0	$0	$0	$0	$0	$0
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$0	$0	$0	$0	$0	$0
551540	$0	$0	$0	$0	$0	$0
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$0	$0	$0	$0	$0	$0
552010	$42	$42	$103	$103	$164	$164
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$125	$125	$308	$308	$491	$491
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$0	$0	$0	$0	$0	$0
553120	$0	$0	$0	$0	$0	$0
553130	$0	$0	$0	$0	$0	$0
553240	$0	$0	$0	$0	$0	$0
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$0	$0	$0	$0
553550	$0	$0	$0	$0	$0	$0
553560	$0	$0	$0	$0	$0	$0
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$0	$0	$0	$0	$0	$0
554110	$0	$0	$0	$0	$0	$0
554120	$0	$0	$0	$0	$0	$0
554300	$42	$42	$103	$103	$164	$164
554400	$581	$581	$1,437	$1,437	$2,293	$2,293
220312	$61	$61	$244	$244	$428	$428
220410	$122	$122	$488	$488	$855	$855
220610	$20	$20	$81	$81	$143	$143
220710	$61	$61	$244	$244	$428	$428
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$1,301**	**$1,301**	**$3,624**	**$3,624**	**$5,946**	**$5,946**

Northern California steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$0	$0	$0	$0	$0	$0
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$0**	**$0**	**$0**	**$0**	**$0**	**$0**

South-Central California Coast steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$0	$0	$0	$0	$0	$0
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$0	$0	$0	$0	$0	$0
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$0	$0	$0	$0
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$0	$0	$0	$0	$0	$0
331025	$0	$0	$0	$0	$0	$0
331026	$0	$0	$0	$0	$0	$0
331031	$0	$0	$0	$0	$0	$0
331027	$41	$41	$163	$163	$285	$285
330920	$0	$0	$0	$0	$0	$0
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$41**	**$41**	**$163**	**$163**	**$285**	**$285**

Southern California steelhead						
	Annual Dredging Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$0	$0
331220	$0	$0	$0	$0	$0	$0
331230	$0	$0	$0	$0	$0	$0
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$0	$0	$0	$0
331451	$0	$0	$0	$0	$0	$0
331510	$332	$332	$821	$821	$1,310	$1,310
331531	$0	$0	$0	$0	$0	$0
331532	$332	$332	$821	$821	$1,310	$1,310
331533	$0	$0	$0	$0	$0	$0
331534	$0	$0	$0	$0	$0	$0
440210	$0	$0	$0	$0	$0	$0
440220	$332	$332	$821	$821	$1,310	$1,310
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$0	$0	$0	$0	$0	$0
440321	$0	$0	$0	$0	$0	$0
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$332	$332	$821	$821	$1,310	$1,310
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$1,328**	**$1,328**	**$3,284**	**$3,284**	**$5,240**	**$5,240**

Appendix D.11
Annual Water Quality Management (NPDES) Impacts by Watershed

California Coastal chinook salmon						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$1	$1	$3	$3
110920	$0	$0	$1	$1	$3	$3
110930	$0	$0	$0	$0	$0	$0
111000	$48	$60	$53	$65	$59	$70
111111	$36	$45	$37	$46	$39	$47
111112	$0	$0	$1	$1	$3	$3
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$1	$1	$3	$3
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$12	$15	$12	$15	$12	$15
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$3	$3	$5	$5
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$1	$1	$3	$3
111313	$0	$0	$0	$0	$0	$0
111320	$12	$15	$15	$18	$17	$20
111330	$0	$0	$1	$1	$3	$3
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$4	$4	$8	$8
111412	$0	$0	$0	$0	$0	$0
111422	$0	$0	$3	$3	$5	$5
111423	$12	$15	$13	$16	$15	$18
111424	$0	$0	$1	$1	$3	$3
111425	$12	$15	$12	$15	$12	$15
111431	$12	$15	$16	$19	$20	$23
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$144**	**$179**	**$178**	**$213**	**$212**	**$247**

Central Valley spring-run chinook salmon						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$36	$45	$41	$50	$47	$56
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$4	$4	$8	$8
550722	$0	$0	$0	$0	$0	$0
550810	$60	$74	$76	$91	$93	$107
550820	$0	$0	$3	$3	$5	$5
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$12	$15	$13	$16	$15	$18
551510	$12	$15	$13	$16	$15	$18
551530	$0	$0	$0	$0	$0	$0
551540	$12	$15	$13	$16	$15	$18
551712	$0	$0	$1	$1	$3	$3
551720	$0	$0	$1	$1	$3	$3
551921	$24	$30	$28	$34	$32	$38
551922	$24	$30	$27	$32	$29	$35
552010	$0	$0	$1	$1	$3	$3
552021	$0	$0	$0	$0	$0	$0
552030	$12	$15	$12	$15	$12	$15
552040	$12	$15	$15	$18	$17	$20
552130	$0	$0	$1	$1	$3	$3
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$1	$1	$3	$3
552462	$0	$0	$0	$0	$0	$0
554300	$24	$30	$24	$30	$24	$30
554400	$36	$45	$41	$50	$47	$56
220312	$48	$59	$48	$59	$48	$59
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$16	$20	$18	$22	$20	$23
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$328**	**$406**	**$384**	**$463**	**$441**	**$519**

Central California Coast steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111411	$0	$0	$4	$4	$8	$8
111412	$0	$0	$0	$0	$0	$0
111421	$12	$15	$15	$18	$17	$20
111422	$0	$0	$3	$3	$5	$5
111423	$12	$15	$13	$16	$15	$18
111424	$0	$0	$1	$1	$3	$3
111425	$12	$15	$12	$15	$12	$15
111426	$0	$0	$0	$0	$0	$0
111431	$12	$15	$16	$19	$20	$23
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$1	$1	$3	$3
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$12	$15	$13	$16	$15	$18
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$36	$45	$37	$46	$39	$47
220330	$12	$15	$17	$20	$23	$26
220420	$12	$15	$23	$26	$34	$37
220440	$96	$119	$102	$124	$107	$130
220530	$12	$15	$13	$16	$15	$18
220540	$0	$0	$3	$3	$5	$5
220550	$24	$30	$25	$31	$27	$32
220620	$12	$15	$12	$15	$12	$15
220630	$24	$30	$24	$30	$24	$30
220640	$12	$15	$12	$15	$12	$15
220650	$24	$30	$28	$34	$32	$38
220660	$48	$60	$52	$64	$56	$68
220721	$12	$15	$13	$16	$15	$18
220722	$0	$0	$0	$0	$0	$0
220731	$72	$89	$73	$91	$75	$92

Central California Coast steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220733	$72	$89	$78	$95	$83	$100
330411	$0	$0	$4	$4	$8	$8
330412	$12	$15	$16	$19	$20	$23
330413	$0	$0	$1	$1	$3	$3
330420	$0	$0	$0	$0	$0	$0
220312	$48	$59	$48	$59	$48	$59
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$16	$20	$18	$22	$20	$23
TOTAL	$605	$749	$680	$824	$755	$899

California Central Valley steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$36	$45	$41	$50	$47	$56
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$4	$4	$8	$8
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$60	$74	$76	$91	$93	$107
550820	$0	$0	$3	$3	$5	$5
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$12	$15	$13	$16	$15	$18
551110	$12	$15	$17	$20	$23	$26
551120	$0	$0	$0	$0	$0	$0
551510	$12	$15	$13	$16	$15	$18
551530	$0	$0	$0	$0	$0	$0
551540	$12	$15	$13	$16	$15	$18
551712	$0	$0	$1	$1	$3	$3
551720	$0	$0	$1	$1	$3	$3
551921	$24	$30	$28	$34	$32	$38
551922	$24	$30	$27	$32	$29	$35
552010	$0	$0	$1	$1	$3	$3
552021	$0	$0	$0	$0	$0	$0
552030	$12	$15	$12	$15	$12	$15
552040	$12	$15	$15	$18	$17	$20
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$1	$1	$3	$3
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$1	$1	$3	$3
552462	$0	$0	$0	$0	$0	$0
553111	$24	$30	$25	$31	$27	$32
553120	$12	$15	$12	$15	$12	$15
553130	$0	$0	$1	$1	$3	$3
553240	$0	$0	$3	$3	$5	$5
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$12	$15	$15	$18	$17	$20
553530	$0	$0	$4	$4	$8	$8
553550	$24	$30	$24	$30	$24	$30
553560	$0	$0	$1	$1	$3	$3
553570	$12	$15	$12	$15	$12	$15
553580	$12	$15	$17	$20	$23	$26
553590	$0	$0	$0	$0	$0	$0
554110	$0	$0	$0	$0	$0	$0
554120	$0	$0	$0	$0	$0	$0
554300	$24	$30	$24	$30	$24	$30
554400	$36	$45	$41	$50	$47	$56
220312	$48	$59	$48	$59	$48	$59
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$16	$20	$18	$22	$20	$23
551422	$32	$40	$32	$40	$32	$40
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$12	$15	$12	$15	$12	$15
TOTAL	**$480**	**$595**	**$561**	**$676**	**$642**	**$756**

Northern California steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$1	$1	$3	$3
110920	$0	$0	$1	$1	$3	$3
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$48	$60	$53	$65	$59	$70
111111	$36	$45	$37	$46	$39	$47
111112	$0	$0	$1	$1	$3	$3
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$1	$1	$3	$3
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$12	$15	$12	$15	$12	$15
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$3	$3	$5	$5
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$1	$1	$3	$3
111313	$0	$0	$0	$0	$0	$0
111320	$12	$15	$15	$18	$17	$20
111330	$0	$0	$1	$1	$3	$3
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$108**	**$134**	**$129**	**$154**	**$149**	**$175**

South-Central California Coast steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$12	$15	$13	$16	$15	$18
330520	$0	$0	$0	$0	$0	$0
330530	$0	$0	$0	$0	$0	$0
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$12	$15	$13	$16	$15	$18
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$1	$1	$3	$3
330960	$0	$0	$0	$0	$0	$0
330981	$12	$15	$17	$20	$23	$26
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$1	$1	$3	$3
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$1	$1	$3	$3
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$24	$30	$27	$32	$29	$35
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$24	$30	$24	$30	$24	$30
331025	$12	$15	$12	$15	$12	$15
331026	$12	$15	$12	$15	$12	$15
331031	$24	$30	$24	$30	$24	$30
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$0	$0	$0	$0
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$2	$2	$4	$4
TOTAL	**$132**	**$164**	**$149**	**$180**	**$166**	**$197**

Southern California steelhead						
	Annual Impact on Water Quality Permitting (NPDES) Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$0	$0
331220	$0	$0	$0	$0	$0	$0
331230	$0	$0	$1	$1	$3	$3
331410	$12	$15	$12	$15	$12	$15
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$0	$0	$0	$0
331451	$0	$0	$0	$0	$0	$0
331510	$0	$0	$0	$0	$0	$0
331531	$12	$15	$12	$15	$12	$15
331532	$24	$30	$24	$30	$24	$30
331533	$0	$0	$1	$1	$3	$3
331534	$12	$15	$12	$15	$12	$15
440210	$12	$15	$12	$15	$12	$15
440220	$0	$0	$0	$0	$0	$0
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$12	$15	$12	$15	$12	$15
440321	$12	$15	$12	$15	$12	$15
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$1	$1	$3	$3
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$12	$15	$13	$16	$15	$18
440444	$0	$0	$0	$0	$0	$0
440811	$12	$15	$12	$15	$12	$15
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$120**	**$149**	**$126**	**$154**	**$131**	**$160**

Appendix D.12
Annual Sand and Gravel Mining Impacts by Watershed

California Coastal chinook salmon						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$45	$45	$45	$45	$45	$45
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$68	$68	$68	$68	$68	$68
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$23	$23	$23	$23	$23	$23
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$23	$23	$23	$23	$23	$23
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$45	$45	$45	$45	$45	$45
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$23	$23	$23	$23	$23	$23
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$0	$0	$0	$0	$0	$0

California Coastal chinook salmon						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111370	$23	$23	$23	$23	$23	$23
111411	$45	$45	$45	$45	$45	$45
111412	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$293**	**$293**	**$293**	**$293**	**$293**	**$293**

Central Valley spring-run chinook salmon						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$45	$45	$45	$45	$45	$45
550420	$45	$45	$45	$45	$45	$45
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$113	$113	$113	$113	$113	$113
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$23	$23	$23	$23	$23	$23
551540	$23	$23	$23	$23	$23	$23
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$68	$68	$68	$68	$68	$68
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$23	$23	$23	$23	$23	$23
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$23	$23	$23	$23	$23	$23
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$361**	**$361**	**$361**	**$361**	**$361**	**$361**

Central California Coast steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
111411	$45	$45	$45	$45	$45	$45
111412	$0	$0	$0	$0	$0	$0
111421	$0	$0	$0	$0	$0	$0
111422	$0	$0	$0	$0	$0	$0
111423	$0	$0	$0	$0	$0	$0
111424	$0	$0	$0	$0	$0	$0
111425	$0	$0	$0	$0	$0	$0
111426	$0	$0	$0	$0	$0	$0
111431	$0	$0	$0	$0	$0	$0
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$23	$23	$23	$23	$23	$23
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$23	$23	$23	$23	$23	$23
220540	$0	$0	$0	$0	$0	$0
220550	$0	$0	$0	$0	$0	$0
220620	$0	$0	$0	$0	$0	$0
220630	$0	$0	$0	$0	$0	$0
220640	$0	$0	$0	$0	$0	$0
220650	$0	$0	$0	$0	$0	$0
220660	$0	$0	$0	$0	$0	$0
220721	$0	$0	$0	$0	$0	$0
220722	$0	$0	$0	$0	$0	$0
220731	$0	$0	$0	$0	$0	$0
220733	$0	$0	$0	$0	$0	$0

Central California Coast steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330411	$0	$0	$0	$0	$0	$0
330412	$23	$23	$23	$23	$23	$23
330413	$23	$23	$23	$23	$23	$23
330420	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$135**	**$135**	**$135**	**$135**	**$135**	**$135**

California Central Valley steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$45	$45	$45	$45	$45	$45
550420	$45	$45	$45	$45	$45	$45
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$113	$113	$113	$113	$113	$113
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$0	$0	$0	$0	$0	$0
551110	$23	$23	$23	$23	$23	$23
551120	$0	$0	$0	$0	$0	$0
551510	$0	$0	$0	$0	$0	$0
551530	$23	$23	$23	$23	$23	$23
551540	$23	$23	$23	$23	$23	$23
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$68	$68	$68	$68	$68	$68
551922	$0	$0	$0	$0	$0	$0
552010	$0	$0	$0	$0	$0	$0
552021	$0	$0	$0	$0	$0	$0
552030	$0	$0	$0	$0	$0	$0
552040	$23	$23	$23	$23	$23	$23
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$23	$23	$23	$23	$23	$23
553120	$0	$0	$0	$0	$0	$0
553130	$45	$45	$45	$45	$45	$45
553240	$23	$23	$23	$23	$23	$23
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$0	$0	$0	$0	$0	$0
553530	$0	$0	$0	$0	$0	$0
553550	$23	$23	$23	$23	$23	$23
553560	$0	$0	$0	$0	$0	$0
553570	$0	$0	$0	$0	$0	$0
553580	$0	$0	$0	$0	$0	$0
553590	$0	$0	$0	$0	$0	$0
554110	$0	$0	$0	$0	$0	$0
554120	$23	$23	$23	$23	$23	$23
554300	$23	$23	$23	$23	$23	$23
554400	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$518**	**$518**	**$518**	**$518**	**$518**	**$518**

Northern California steelhead						
Watershed	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$45	$45	$45	$45	$45	$45
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$68	$68	$68	$68	$68	$68
111111	$0	$0	$0	$0	$0	$0
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$23	$23	$23	$23	$23	$23
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$23	$23	$23	$23	$23	$23
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$45	$45	$45	$45	$45	$45
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$23	$23	$23	$23	$23	$23
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$0	$0	$0	$0	$0	$0
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$23	$23	$23	$23	$23	$23
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$248**	**$248**	**$248**	**$248**	**$248**	**$248**

South-Central California Coast steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$0	$0	$0	$0	$0	$0
330520	$0	$0	$0	$0	$0	$0
330530	$45	$45	$45	$45	$45	$45
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$23	$23	$23	$23	$23	$23
330800	$0	$0	$0	$0	$0	$0
330930	$0	$0	$0	$0	$0	$0
330940	$0	$0	$0	$0	$0	$0
330960	$0	$0	$0	$0	$0	$0
330981	$0	$0	$0	$0	$0	$0
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$0	$0	$0	$0	$0	$0
331015	$0	$0	$0	$0	$0	$0
331016	$0	$0	$0	$0	$0	$0
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$0	$0	$0	$0	$0	$0
331022	$0	$0	$0	$0	$0	$0
331023	$0	$0	$0	$0	$0	$0
331024	$0	$0	$0	$0	$0	$0
331025	$0	$0	$0	$0	$0	$0
331026	$45	$45	$45	$45	$45	$45
331031	$0	$0	$0	$0	$0	$0
331027	$0	$0	$0	$0	$0	$0
330920	$0	$0	$0	$0	$0	$0
330970	$0	$0	$0	$0	$0	$0
330911	$0	$0	$0	$0	$0	$0
TOTAL	**$113**	**$113**	**$113**	**$113**	**$113**	**$113**

Southern California steelhead						
	Annual Sand and Gravel Mining Impact Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$0	$0	$0	$0	$0	$0
331220	$0	$0	$0	$0	$0	$0
331230	$23	$23	$23	$23	$23	$23
331410	$0	$0	$0	$0	$0	$0
331420	$0	$0	$0	$0	$0	$0
331430	$0	$0	$0	$0	$0	$0
331440	$0	$0	$0	$0	$0	$0
331451	$0	$0	$0	$0	$0	$0
331510	$0	$0	$0	$0	$0	$0
331531	$0	$0	$0	$0	$0	$0
331532	$0	$0	$0	$0	$0	$0
331533	$0	$0	$0	$0	$0	$0
331534	$0	$0	$0	$0	$0	$0
440210	$0	$0	$0	$0	$0	$0
440220	$0	$0	$0	$0	$0	$0
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$23	$23	$23	$23	$23	$23
440321	$0	$0	$0	$0	$0	$0
440322	$0	$0	$0	$0	$0	$0
440331	$0	$0	$0	$0	$0	$0
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$0	$0	$0	$0
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$45**	**$45**	**$45**	**$45**	**$45**	**$45**

Appendix D.13
Annual Residential and Commercial Development Impacts by Watershed

California Coastal chinook salmon						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$18	$18	$18	$18	$19	$19
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$14	$14	$14	$14	$14	$14
111111	$18	$18	$18	$18	$19	$19
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$5	$5	$5	$5	$5	$5

California Coastal chinook salmon						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111370	$0	$0	$0	$0	$0	$0
111411	$5	$5	$5	$5	$5	$5
111412	$0	$0	$0	$0	$0	$0
111422	$158	$158	$161	$161	$165	$165
111423	$32	$32	$32	$32	$33	$33
111424	$41	$41	$41	$41	$42	$42
111425	$32	$32	$32	$32	$33	$33
111431	$9	$9	$9	$9	$9	$9
111433	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$329**	**$329**	**$337**	**$337**	**$344**	**$344**

Central Valley spring-run chinook salmon						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$0	$0	$0	$0	$0	$0
550420	$99	$99	$101	$101	$104	$104
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$149	$149	$152	$152	$155	$155
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$77	$77	$78	$78	$80	$80
551510	$14	$14	$14	$14	$14	$14
551530	$9	$9	$9	$9	$9	$9
551540	$14	$14	$14	$14	$14	$14
551712	$5	$5	$5	$5	$5	$5
551720	$18	$18	$18	$18	$19	$19
551921	$555	$555	$567	$567	$579	$579
551922	$456	$456	$466	$466	$476	$476
552010	$0	$0	$0	$0	$0	$0
552021	$5	$5	$5	$5	$5	$5
552030	$86	$86	$88	$88	$89	$89
552040	$59	$59	$60	$60	$61	$61
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$54	$54	$55	$55	$56	$56
554400	$451	$451	$461	$461	$471	$471
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$2,048**	**$2,048**	**$2,093**	**$2,093**	**$2,138**	**$2,138**

Central California Coast steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
111411	$5	$5	$5	$5	$5	$5
111412	$0	$0	$0	$0	$0	$0
111421	$72	$72	$74	$74	$75	$75
111422	$158	$158	$161	$161	$165	$165
111423	$32	$32	$32	$32	$33	$33
111424	$41	$41	$41	$41	$42	$42
111425	$32	$32	$32	$32	$33	$33
111426	$0	$0	$0	$0	$0	$0
111431	$9	$9	$9	$9	$9	$9
111433	$0	$0	$0	$0	$0	$0
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$0	$0
220112	$0	$0	$0	$0	$0	$0
220113	$9	$9	$9	$9	$9	$9
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$0	$0	$0	$0	$0	$0
220320	$18	$18	$18	$18	$19	$19
220330	$32	$32	$32	$32	$33	$33
220420	$167	$167	$171	$171	$174	$174
220440	$126	$126	$129	$129	$132	$132
220530	$122	$122	$124	$124	$127	$127
220540	$77	$77	$78	$78	$80	$80
220550	$131	$131	$134	$134	$137	$137
220620	$23	$23	$23	$23	$24	$24
220630	$77	$77	$78	$78	$80	$80
220640	$45	$45	$46	$46	$47	$47
220650	$199	$199	$203	$203	$207	$207
220660	$81	$81	$83	$83	$85	$85
220721	$0	$0	$0	$0	$0	$0
220722	$0	$0	$0	$0	$0	$0
220731	$126	$126	$129	$129	$132	$132
220733	$32	$32	$32	$32	$33	$33

Central California Coast steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330411	$0	$0	$0	$0	$0	$0
330412	$14	$14	$14	$14	$14	$14
330413	$5	$5	$5	$5	$5	$5
330420	$5	$5	$5	$5	$5	$5
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$1,633**	**$1,633**	**$1,669**	**$1,669**	**$1,704**	**$1,704**

California Central Valley steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
550410	$0	$0	$0	$0	$0	$0
550420	$99	$99	$101	$101	$104	$104
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$149	$149	$152	$152	$155	$155
550820	$0	$0	$0	$0	$0	$0
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$77	$77	$78	$78	$80	$80
551110	$95	$95	$97	$97	$99	$99
551120	$0	$0	$0	$0	$0	$0
551510	$14	$14	$14	$14	$14	$14
551530	$9	$9	$9	$9	$9	$9
551540	$14	$14	$14	$14	$14	$14
551712	$5	$5	$5	$5	$5	$5
551720	$18	$18	$18	$18	$19	$19
551921	$555	$555	$567	$567	$579	$579
551922	$456	$456	$466	$466	$476	$476
552010	$0	$0	$0	$0	$0	$0
552021	$5	$5	$5	$5	$5	$5
552030	$86	$86	$88	$88	$89	$89
552040	$59	$59	$60	$60	$61	$61
552110	$5	$5	$5	$5	$5	$5
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$36	$36	$37	$37	$38	$38
553120	$171	$171	$175	$175	$179	$179
553130	$59	$59	$60	$60	$61	$61
553240	$27	$27	$28	$28	$28	$28
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$95	$95	$97	$97	$99	$99
553530	$203	$203	$207	$207	$212	$212
553550	$180	$180	$184	$184	$188	$188
553560	$0	$0	$0	$0	$0	$0
553570	$0	$0	$0	$0	$0	$0
553580	$81	$81	$83	$83	$85	$85
553590	$0	$0	$0	$0	$0	$0
554110	$72	$72	$74	$74	$75	$75
554120	$54	$54	$55	$55	$56	$56
554300	$54	$54	$55	$55	$56	$56
554400	$451	$451	$461	$461	$471	$471
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$9	$9	$9	$9	$9	$9
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$3,136**	**$3,136**	**$3,204**	**$3,204**	**$3,272**	**$3,272**

Northern California steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
110710	$0	$0	$0	$0	$0	$0
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$18	$18	$18	$18	$19	$19
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$14	$14	$14	$14	$14	$14
111111	$18	$18	$18	$18	$19	$19
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$0	$0	$0	$0	$0	$0
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0

Northern California steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$5	$5	$5	$5	$5	$5
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$0	$0	$0	$0	$0	$0
111370	$0	$0	$0	$0	$0	$0
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$54**	**$54**	**$55**	**$55**	**$56**	**$56**

South-Central California Coast steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$27	$27	$28	$28	$28	$28
330520	$0	$0	$0	$0	$0	$0
330530	$108	$108	$111	$111	$113	$113
330540	$0	$0	$0	$0	$0	$0
330550	$0	$0	$0	$0	$0	$0
330700	$0	$0	$0	$0	$0	$0
330800	$0	$0	$0	$0	$0	$0
330930	$27	$27	$28	$28	$28	$28
330940	$5	$5	$5	$5	$5	$5
330960	$0	$0	$0	$0	$0	$0
330981	$122	$122	$124	$124	$127	$127
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$0	$0	$0	$0
331014	$5	$5	$5	$5	$5	$5
331015	$0	$0	$0	$0	$0	$0
331016	$23	$23	$23	$23	$24	$24
331017	$0	$0	$0	$0	$0	$0
331018	$0	$0	$0	$0	$0	$0
331021	$5	$5	$5	$5	$5	$5
331022	$0	$0	$0	$0	$0	$0
331023	$5	$5	$5	$5	$5	$5
331024	$50	$50	$51	$51	$52	$52
331025	$0	$0	$0	$0	$0	$0
331026	$27	$27	$28	$28	$28	$28
331031	$18	$18	$18	$18	$19	$19
331027	$0	$0	$0	$0	$0	$0
330920	$14	$14	$14	$14	$14	$14
330970	$0	$0	$0	$0	$0	$0
330911	$9	$9	$9	$9	$9	$9
TOTAL	**$442**	**$442**	**$452**	**$452**	**$461**	**$461**

Southern California steelhead						
	Annual Impact on Residential and Commercial Development Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$72	$72	$74	$74	$75	$75
331220	$0	$0	$0	$0	$0	$0
331230	$0	$0	$0	$0	$0	$0
331410	$23	$23	$23	$23	$24	$24
331420	$0	$0	$0	$0	$0	$0
331430	$9	$9	$9	$9	$9	$9
331440	$14	$14	$14	$14	$14	$14
331451	$0	$0	$0	$0	$0	$0
331510	$0	$0	$0	$0	$0	$0
331531	$50	$50	$51	$51	$52	$52
331532	$23	$23	$23	$23	$24	$24
331533	$54	$54	$55	$55	$56	$56
331534	$5	$5	$5	$5	$5	$5
440210	$5	$5	$5	$5	$5	$5
440220	$18	$18	$18	$18	$19	$19
440231	$0	$0	$0	$0	$0	$0
440232	$0	$0	$0	$0	$0	$0
440310	$131	$131	$134	$134	$137	$137
440321	$14	$14	$14	$14	$14	$14
440322	$0	$0	$0	$0	$0	$0
440331	$18	$18	$18	$18	$19	$19
440332	$0	$0	$0	$0	$0	$0
440341	$0	$0	$0	$0	$0	$0
440411	$5	$5	$5	$5	$5	$5
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$0	$0	$0	$0
440813	$0	$0	$0	$0	$0	$0
490123	$99	$99	$101	$101	$104	$104
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$537**	**$537**	**$549**	**$549**	**$560**	**$560**

Appendix D.14
Annual Agricultural Pesticide Application Impacts by Watershed

California Coastal chinook salmon						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$4	$4	$8	$8
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
111000	$1	$1	$2	$2	$4	$4
111111	$4	$4	$12	$12	$21	$21
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$2	$2	$8	$8	$13	$13
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$0	$0	$0	$0
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$0	$0	$0	$0	$0	$0
111350	$8	$8	$26	$26	$44	$44

California Coastal chinook salmon						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111370	$11	$11	$32	$32	$54	$54
111411	$30	$30	$162	$162	$293	$293
111412	$0	$0	$0	$0	$0	$0
111422	$14	$14	$45	$45	$76	$76
111423	$29	$29	$73	$73	$117	$117
111424	$167	$167	$496	$496	$824	$824
111425	$42	$42	$281	$281	$519	$519
111431	$65	$65	$208	$208	$351	$351
111433	$34	$34	$101	$101	$169	$169
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$407**	**$407**	**$1,450**	**$1,450**	**$2,493**	**$2,493**

Central Valley spring-run chinook salmon						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$5	$5	$24	$24	$43	$43
550420	$309	$309	$962	$962	$1,615	$1,615
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550810	$6	$6	$33	$33	$61	$61
550820	$2	$2	$17	$17	$32	$32
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
551000	$111	$111	$715	$715	$1,319	$1,319
551510	$0	$0	$2	$2	$4	$4
551530	$3	$3	$29	$29	$54	$54
551540	$31	$31	$178	$178	$325	$325
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$13	$13	$120	$120	$228	$228
552010	$103	$103	$513	$513	$923	$923
552021	$1	$1	$4	$4	$7	$7
552030	$51	$51	$225	$225	$399	$399
552040	$59	$59	$239	$239	$418	$418
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
554300	$0	$0	$0	$0	$1	$1
554400	$219	$219	$897	$897	$1,575	$1,575
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
TOTAL	**$913**	**$913**	**$3,957**	**$3,957**	**$7,001**	**$7,001**

Central California Coast steelhead						
Watershed	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
	Low - 3%	Low - 7%	Mid - 3%	Mid - 7%	High - 3%	High - 7%
111411	$92	$92	$335	$335	$578	$578
111412	$0	$0	$0	$0	$0	$0
111421	$35	$35	$93	$93	$151	$151
111422	$20	$20	$62	$62	$103	$103
111423	$161	$161	$466	$466	$771	$771
111424	$252	$252	$740	$740	$1,227	$1,227
111425	$215	$215	$764	$764	$1,314	$1,314
111426	$0	$0	$0	$0	$0	$0
111431	$118	$118	$364	$364	$610	$610
111433	$40	$40	$117	$117	$194	$194
111510	$0	$0	$0	$0	$0	$0
111530	$0	$0	$0	$0	$1	$1
220112	$0	$0	$0	$0	$0	$0
220113	$0	$0	$0	$0	$0	$0
220120	$0	$0	$0	$0	$0	$0
220130	$0	$0	$0	$0	$0	$0
220221	$0	$0	$0	$0	$0	$0
220222	$0	$0	$0	$0	$0	$0
220223	$0	$0	$0	$0	$0	$0
220230	$0	$0	$0	$0	$0	$0
220240	$3	$3	$8	$8	$13	$13
220320	$0	$0	$0	$0	$0	$0
220330	$0	$0	$0	$0	$0	$0
220420	$0	$0	$0	$0	$0	$0
220440	$0	$0	$0	$0	$0	$0
220530	$70	$70	$249	$249	$429	$429
220540	$87	$87	$255	$255	$423	$423
220550	$0	$0	$18	$18	$49	$49
220620	$0	$0	$0	$0	$0	$0
220630	$16	$16	$41	$41	$67	$67
220640	$236	$236	$678	$678	$1,121	$1,121
220650	$1,546	$1,546	$4,366	$4,366	$7,186	$7,186
220660	$0	$0	$1	$1	$1	$1
220721	$0	$0	$0	$0	$0	$0
220722	$10	$10	$17	$17	$25	$25
220731	$1	$1	$3	$3	$5	$5

Central California Coast steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
220733	$0	$0	$0	$0	$0	$0
330411	$4	$4	$14	$14	$24	$24
330412	$0	$0	$0	$0	$0	$0
330413	$1	$1	$1	$1	$2	$2
330420	$0	$0	$0	$0	$0	$0
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220510	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
TOTAL	**$2,909**	**$2,909**	**$8,595**	**$8,595**	**$14,293**	**$14,293**

California Central Valley steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
550410	$7	$7	$32	$32	$57	$57
550420	$202	$202	$666	$666	$1,130	$1,130
550711	$0	$0	$0	$0	$0	$0
550712	$0	$0	$0	$0	$0	$0
550721	$0	$0	$0	$0	$0	$0
550722	$0	$0	$0	$0	$0	$0
550731	$0	$0	$0	$0	$0	$0
550732	$0	$0	$0	$0	$0	$0
550733	$0	$0	$0	$0	$0	$0
550810	$4	$4	$29	$29	$54	$54
550820	$2	$2	$17	$17	$32	$32
550914	$0	$0	$0	$0	$0	$0
550920	$0	$0	$0	$0	$0	$0
550942	$0	$0	$0	$0	$0	$0
550962	$0	$0	$0	$0	$0	$0
550963	$0	$0	$0	$0	$0	$0
550964	$0	$0	$0	$0	$0	$0
551000	$104	$104	$740	$740	$1,376	$1,376
551110	$11	$11	$39	$39	$66	$66
551120	$5	$5	$37	$37	$70	$70
551510	$8	$8	$34	$34	$60	$60
551530	$3	$3	$29	$29	$55	$55
551540	$31	$31	$181	$181	$331	$331
551712	$0	$0	$0	$0	$0	$0
551720	$0	$0	$0	$0	$0	$0
551921	$0	$0	$0	$0	$0	$0
551922	$81	$81	$321	$321	$562	$562
552010	$103	$103	$523	$523	$942	$942
552021	$1	$1	$4	$4	$7	$7
552030	$51	$51	$229	$229	$406	$406
552040	$159	$159	$555	$555	$951	$951
552110	$0	$0	$0	$0	$0	$0
552120	$0	$0	$0	$0	$0	$0
552130	$0	$0	$0	$0	$0	$0
552310	$0	$0	$0	$0	$0	$0
552433	$0	$0	$0	$0	$0	$0
552435	$0	$0	$0	$0	$0	$0

California Central Valley steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
552436	$0	$0	$0	$0	$0	$0
552440	$0	$0	$0	$0	$0	$0
552462	$0	$0	$0	$0	$0	$0
553111	$158	$158	$471	$471	$784	$784
553120	$157	$157	$482	$482	$806	$806
553130	$256	$256	$784	$784	$1,312	$1,312
553240	$0	$0	$0	$0	$0	$0
553310	$0	$0	$0	$0	$0	$0
553410	$0	$0	$0	$0	$0	$0
553510	$24	$24	$106	$106	$189	$189
553530	$73	$73	$323	$323	$572	$572
553550	$66	$66	$381	$381	$695	$695
553560	$4	$4	$48	$48	$92	$92
553570	$45	$45	$169	$169	$294	$294
553580	$56	$56	$226	$226	$397	$397
553590	$0	$0	$0	$0	$1	$1
554110	$40	$40	$271	$271	$502	$502
554120	$0	$0	$1	$1	$2	$2
554300	$0	$0	$0	$0	$1	$1
554400	$283	$283	$1,617	$1,617	$2,951	$2,951
220312	$0	$0	$0	$0	$0	$0
220410	$0	$0	$0	$0	$0	$0
220610	$0	$0	$0	$0	$0	$0
220710	$0	$0	$0	$0	$0	$0
551422	$0	$0	$0	$0	$0	$0
551713	$0	$0	$0	$0	$0	$0
551714	$0	$0	$0	$0	$0	$0
553221	$0	$0	$0	$0	$0	$0
553223	$0	$0	$0	$0	$0	$0
553224	$0	$0	$0	$0	$0	$0
TOTAL	**$1,934**	**$1,934**	**$8,314**	**$8,314**	**$14,695**	**$14,695**

Northern California steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
110710	$0	$0	$4	$4	$8	$8
110720	$0	$0	$0	$0	$0	$0
110730	$0	$0	$0	$0	$0	$0
110810	$0	$0	$0	$0	$0	$0
110820	$0	$0	$0	$0	$0	$0
110910	$0	$0	$0	$0	$0	$0
110920	$0	$0	$0	$0	$0	$0
110930	$0	$0	$0	$0	$0	$0
110940	$0	$0	$0	$0	$0	$0
111000	$1	$1	$2	$2	$4	$4
111111	$4	$4	$13	$13	$23	$23
111112	$0	$0	$0	$0	$0	$0
111113	$0	$0	$0	$0	$0	$0
111121	$2	$2	$8	$8	$14	$14
111122	$0	$0	$0	$0	$0	$0
111123	$0	$0	$0	$0	$0	$0
111131	$0	$0	$0	$0	$0	$0
111132	$0	$0	$0	$0	$0	$0
111133	$0	$0	$0	$0	$0	$0
111141	$0	$0	$0	$0	$0	$0
111142	$0	$0	$0	$0	$0	$0
111150	$0	$0	$0	$0	$0	$0
111161	$0	$0	$0	$0	$0	$0
111162	$0	$0	$0	$0	$0	$0
111171	$0	$0	$1	$1	$1	$1
111172	$0	$0	$0	$0	$0	$0
111173	$0	$0	$0	$0	$0	$0
111174	$0	$0	$0	$0	$0	$0
111210	$0	$0	$0	$0	$0	$0
111220	$0	$0	$0	$0	$0	$0
111230	$0	$0	$0	$0	$0	$0
111311	$0	$0	$0	$0	$0	$0
111312	$0	$0	$0	$0	$0	$0
111313	$0	$0	$0	$0	$0	$0
111320	$0	$0	$0	$0	$0	$0
111330	$0	$0	$0	$0	$0	$0
111340	$5	$5	$16	$16	$28	$28

Northern California steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
111350	$21	$21	$65	$65	$110	$110
111361	$0	$0	$0	$0	$0	$0
111362	$0	$0	$0	$0	$0	$0
111363	$0	$0	$0	$0	$0	$0
111364	$4	$4	$12	$12	$20	$20
111370	$13	$13	$38	$38	$63	$63
111381	$0	$0	$0	$0	$0	$0
111382	$0	$0	$0	$0	$0	$0
111383	$0	$0	$0	$0	$0	$0
111384	$0	$0	$0	$0	$0	$0
111385	$0	$0	$0	$0	$0	$0
111390	$0	$0	$0	$0	$0	$0
Eel River_Estuary	$0	$0	$0	$0	$0	$0
Humboldt_Bay	$0	$0	$0	$0	$0	$0
111163	$0	$0	$0	$0	$0	$0
TOTAL	**$51**	**$51**	**$161**	**$161**	**$271**	**$271**

South-Central California Coast steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
330510	$747	$747	$2,187	$2,187	$3,626	$3,626
330520	$2	$2	$8	$8	$13	$13
330530	$291	$291	$840	$840	$1,388	$1,388
330540	$0	$0	$0	$0	$0	$0
330550	$65	$65	$195	$195	$325	$325
330700	$119	$119	$331	$331	$543	$543
330800	$0	$0	$2	$2	$3	$3
330930	$437	$437	$1,263	$1,263	$2,090	$2,090
330940	$222	$222	$648	$648	$1,073	$1,073
330960	$8	$8	$26	$26	$43	$43
330981	$213	$213	$647	$647	$1,081	$1,081
331011	$0	$0	$0	$0	$0	$0
331012	$0	$0	$0	$0	$0	$0
331013	$0	$0	$1	$1	$1	$1
331014	$18	$18	$56	$56	$95	$95
331015	$20	$20	$50	$50	$80	$80
331016	$9	$9	$23	$23	$36	$36
331017	$0	$0	$0	$0	$0	$0
331018	$7	$7	$19	$19	$32	$32
331021	$28	$28	$74	$74	$121	$121
331022	$45	$45	$136	$136	$227	$227
331023	$8	$8	$23	$23	$39	$39
331024	$25	$25	$76	$76	$128	$128
331025	$0	$0	$0	$0	$0	$0
331026	$39	$39	$106	$106	$173	$173
331031	$85	$85	$243	$243	$402	$402
331027	$0	$0	$0	$0	$0	$0
330920	$200	$200	$590	$590	$981	$981
330970	$0	$0	$2	$2	$4	$4
330911	$793	$793	$2,607	$2,607	$4,420	$4,420
TOTAL	**$3,382**	**$3,382**	**$10,153**	**$10,153**	**$16,924**	**$16,924**

Southern California steelhead						
	Annual Impact on Agricultural Pesticide Application Cost Estimate and Discount Rate ($1000s)					
Watershed	**Low - 3%**	**Low - 7%**	**Mid - 3%**	**Mid - 7%**	**High - 3%**	**High - 7%**
331210	$25	$25	$72	$72	$120	$120
331220	$19	$19	$71	$71	$122	$122
331230	$1	$1	$5	$5	$9	$9
331410	$33	$33	$108	$108	$183	$183
331420	$183	$183	$523	$523	$864	$864
331430	$36	$36	$109	$109	$181	$181
331440	$86	$86	$245	$245	$403	$403
331451	$0	$0	$0	$0	$0	$0
331510	$32	$32	$105	$105	$178	$178
331531	$56	$56	$182	$182	$308	$308
331532	$1	$1	$4	$4	$7	$7
331533	$3	$3	$6	$6	$9	$9
331534	$40	$40	$127	$127	$213	$213
440210	$61	$61	$179	$179	$297	$297
440220	$20	$20	$55	$55	$91	$91
440231	$9	$9	$28	$28	$48	$48
440232	$104	$104	$309	$309	$514	$514
440310	$1	$1	$10	$10	$19	$19
440321	$27	$27	$79	$79	$131	$131
440322	$0	$0	$0	$0	$0	$0
440331	$51	$51	$160	$160	$269	$269
440332	$1	$1	$3	$3	$6	$6
440341	$64	$64	$185	$185	$307	$307
440411	$0	$0	$0	$0	$0	$0
440421	$0	$0	$0	$0	$0	$0
440444	$0	$0	$0	$0	$0	$0
440811	$0	$0	$1	$1	$2	$2
440813	$0	$0	$0	$0	$0	$0
490123	$0	$0	$2	$2	$4	$4
490124	$0	$0	$0	$0	$0	$0
490127	$0	$0	$0	$0	$0	$0
490140	$0	$0	$0	$0	$0	$0
TOTAL	**$853**	**$853**	**$2,569**	**$2,569**	**$4,284**	**$4,284**