RECLAMATION

Managing Water in the West

Economics and Tribal Summary Technical Report

For the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon

U.S. Department of the Interior
Bureau of Reclamation
Technical Service Center
Denver, Colorado

September 2011

Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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The information in this Economics and Tribal Summary Technical Report was prepared cooperatively by the following agencies:

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

U.S. Department of the Interior
Office of Policy Analysis
Bureau of Reclamation
U.S. Fish and Wildlife Service

Acronyms and Abbreviations

AAA	American Automobile Association
BCA	benefit-cost analysis
BCR	benefit-cost ratio
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BO	Biological Opinion
CDFG	California Department of Fish and Game
DOI	U.S. Department of the Interior
EDRRA	Evaluation of Dam Removal and Restoration of Anadromy
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FERC	Federal Energy Regulatory Commission
HMP	Harvest Management Plan
KB_HEM	Klamath Basin Hydrologic and Economic model
KBRA	Klamath Basin Restoration Agreement
KHSA	Klamath Hydroelectric Settlement Agreement
KMZ	Klamath Management Zone
KWAPA	Klamath Water and Power Association
IGD	Iron Gate Dam
IMPLAN	IMpact analysis for PLANning
LKR	Lower Klamath River
MW	megawatt(s)
NED	National Economic Development
NED BCA	National Economic Development Benefit-Cost Analysis
NMFS	National Marine Fisheries Service
NOAA Fisheries	National Oceanic and Atmospheric Administration's National Marine Fisheries Service
NWFSC	Northwest Fisheries Science Center
ODFW	Oregon Department of Fish and Wildlife
O&M	operation and maintenance
OM&R	operations, maintenance, and replacement
P&Gs	*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, March 10, 1983
Reclamation	Bureau of Reclamation
RED	Regional Economic Development
SCF	Sectional Center Facility
SONCC	Southern Oregon Northern California Coast
UKR	Upper Klamath River
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WURP	Water Use Retirement Program

Executive Summary

This Economics and Tribal Summary Technical Report summarizes the economics and tribal analyses. Section 3.3 of the Klamath Hydroelectric Settlement Agreement (KHSA) directs the Secretary to consider the following factors in his determination of whether the Klamath facilities should be removed:

1. Will facilities removal advance restoration of the salmonid fisheries of the Klamath Basin

2. Is facilities removal in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and tribes

The economic analysis undertaken in support of the Secretarial Determination is narrowly focused on the specific issues and questions identified in the KHSA. In contrast, the analysis undertaken in the context of the prior FERC proceedings focused on the question of license renewal and the conditions to place on any license issued, including the analysis of fish passage and mandatory conditions (see the FERC *Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027).*

The analysis summarized in this document considers both facilities removal (as defined in section 1.4 of the KHSA) as well as aspects of the Klamath Basin Restoration Agreement (KBRA) because the KBRA is linked closely to advancing fish restoration and has impacts on local communities and tribes in the Basin.

In supporting the Secretarial Determination, the alternatives summarized in this Economics and Tribal Summary Technical Report are Alternative 1 – No Action, Alternative 2 – Full Facilities Removal of Four Dams, and Alternative 3 – Partial Facilities Removal of Four Dams. Alternatives evaluating fish passage are outside the KHSA and are thus not analyzed. Should the Secretary make a negative determination, a broader and more complicated set of alternatives would likely require additional analysis in the context of a re-started FERC proceeding. Additional analysis could include a review of the prior analysis of fish passage and other mandatory conditions, and updating as appropriate. A brief description of each alternative is provided in table ES-1. The alternatives were compared using the National Economic Development (NED) and Regional Economic Development (RED) accounts as defined in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, March 10, 1983 to facilitate evaluation and to display the economic effects of the alternatives. In addition, the Tribal Effects Analysis displays effects of the alternatives from the tribal perspective.

Table ES-1.—Alternatives analyzed

Alternative number	Alternative name	Description
1	No Action / No Project	Implement none of the action alternatives; Klamath Hydroelectric Project would continue current operations
2	Full Facilities Removal of Four Dams	Remove four dams and related facilities
3	Partial Facilities Removal of Four Dams	Remove main areas of four dams to allow a free-flowing river and volitional fish passage; related facilities and/or abutments may remain

NATIONAL ECONOMIC DEVELOPMENT (NED)

The Federal objective is to contribute to national economic development consistent with protecting the Nation's environment. The NED account measures the beneficial and adverse monetary effects of each alternative in terms of changes in the value of the national output of goods and services. A benefit-cost analysis (BCA) is conducted where the benefits of a proposed project are compared to its costs. Benefit-cost results are presented in terms of net benefits and benefit-cost ratios (BCR). Net benefits of a proposed action are estimated by subtracting total costs from total benefits. A BCR is estimated by dividing total benefits by total costs. If benefits exceed costs (resulting in positive net benefits or a BCR >1), the project is considered economically justified.

A range of potentially affected benefits associated with dam removal and KBRA activities were identified for this study. Benefits were analyzed for the following categories:

- Irrigated agriculture
- Commercial fishing
- Hydropower
- Ocean sport fishing
- In-river sport fishing
- Reservoir recreation
- Refuge recreation
- Whitewater recreation
- Non-use values
- Real estate

Benefits for hydropower, reservoir recreation, and whitewater recreation proved negative, implying that benefits for those categories under the proposed alternatives were less than those under the No Action Alternative. As a result, those benefit categories are presented under the cost section and referred to as

foregone benefits. Benefits and costs are inherently uncertain. These uncertainties arise from factors such as data and modeling limitations and uncertainties in future economic, sociodemographic, environmental, and biological conditions.

It is important to note that some potential benefits and costs could not be quantified for various reasons. As a result, these potential benefits and costs were not included in the numeric benefit-cost comparison. Failing to include benefits has the effect of understating estimated net benefits and benefit-cost ratios; the opposite effect occurs when costs are excluded. Elements of the following benefit categories were not included in the BCA:

- Tribal fisheries and cultural values (for area tribes, fish provide subsistence, ceremonial use, and cultural value that cannot be monetized; see chapter 3 for more details)
- In-river steelhead sport fishing (change in abundance not quantifiable)
- Redband trout sport fishing below and above Keno Dam (effort estimates incomplete)
- Refuge recreation (wildlife viewing activities not quantifiable)
- Real estate (not included as a separate analysis, partially reflected in some of the other values)

The total cost of each proposed alternative was divided into two primary components – project costs and the foregone benefits identified above. Project costs included KBRA restoration costs, facility removal costs, site mitigation costs, and operations, maintenance, and replacement (OM&R) costs.

For the NED BCA, the No Action Alternative was treated as the baseline from which the proposed alternatives were compared. An incremental analysis was conducted (based on available information) whereby the changes or increments in benefits and costs from the No Action Alternative were compared to calculate the net benefits and benefit-cost ratios for each of the proposed alternatives. The 50-year period of analysis began in year 2012 with the first KBRA activity and continued through 2061. All benefits and costs were estimated in 2012 dollars and discounted back to year 2012 using the 2011 Federal water resources planning rate of 4.125 percent.[1]

The benefits and costs shown in table ES-2 for each proposed alternative reflect the **change** from the No Action Alternative. As a result, a benefit-cost comparison is not shown for the No Action Alternative.

[1] Change in Discount Rate for Water Resources Planning. 75 FR 82066. (29 December 2010).

Table ES-2.—Preliminary benefit-cost comparison of proposed alternatives based on available data as of September 2011 (discounted present values, $ in millions of dollars, base year equals 2012)

	Full Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)	Partial Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)
Total Quantified Benefits:	Not available	Not available
Irrigated agriculture	29.9	29.9
Commercial fishing	134.5	134.5
Ocean sport fishing	52.8	52.8
In-river salmon sport fishing	1.8	1.8
Refuge recreation	4.3	4.3
Non-use values	Available December 2011	Available December 2011
***Unquantified* Benefits**		
Tribal Commercial fisheries	Sufficient data was not available to quantify these benefits. However, given that dam removal is anticipated to positively affect tribal commercial fisheries dependent resources, the net economic benefits associated with tribal commercial fisheries would also be positive.	
Tribal cultural values (including ceremonial and subsistence uses)	Applying a traditional economic framework to tribal cultural values is not appropriate. However, given that dam removal would restore, over time, fisheries that have important cultural significance for tribes in the Basin, effects to tribal cultural values would be expected to be positive and potentially large in magnitude.	
In-river steelhead and redband trout sport fishing	Sufficient data was not available to quantify these benefits. However, given that dam removal is anticipated to positively affect these in-river fisheries, the net economic benefits associated with these fisheries would also be positive.	
Refuge wildlife viewing	Sufficient data was not available to quantify these benefits. However, given that dam removal is anticipated to positively affect refuge recreation dependent resources, the net economic benefits associated with refuge wildlife viewing would also be positive.	

(Table continued on next page)

Table ES-2.—Preliminary benefit-cost comparison of proposed alternatives based on available data as of September 2011 (discounted present values, $ in millions of dollars, base year equals 2012)

	Full Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)	Partial Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)
Total Quantified Costs:	1,813.6	1,787.9
KBRA restoration	474.1	474.1
Facilities removal	129.1	98.0
Site mitigation	37.7	36.6
OM&R (cost savings)	-188.9	-182.4
Forgone hydropower benefits	1,320.1	1,320.1
Forgone reservoir recreation benefits	35.4	35.4
Forgone whitewater recreation benefits	6.1	6.1
***Unquantified* Costs**	—	—
Real estate values	Changes in real estate values are not quantified due to a lack of data. The extent to which these changes are positive or negative depends on the magnitude of property value changes, over time, for lands proximate to the reservoirs and to the restored river.	
Hydropower ancillary services	Explicit consideration of ancillary services is outside the scope of this analysis. An ancillary service is anything that supports the transmission of electricity from its generation site to the customer. Services may include load regulation, spinning reserve, non-spinning reserve, replacement reserve and voltage support. If these plants produce any ancillary services, their consideration could be expected to increase the foregone economic benefits reported here.	
Regional powerplant emissions	The hydropower analysis described in this document does not consider the effect, if any, of changing hydropower production levels on system-wide powerplant emissions or regional air quality.	
Given that the benefits associated with several important categories (tribal cultural values; tribal commercial fisheries; non-use values) are not quantified, it is not appropriate to calculate net benefits.		

REGIONAL ECONOMIC DEVELOPMENT (RED)

This account evaluates the impacts of each alternative on the economy of the affected region, with particular emphasis on income and employment measures. The affected region reflects the geographic area where these impacts are expected to occur. Impacts can be measured in both monetary and non-monetary terms. The RED analysis includes not only the initial or direct impact on the primary affected industries, but also the secondary impacts resulting from those industries providing inputs to the directly affected industries as well. This analysis also includes the changes in economic activity stemming from household spending of income earned by those employed in the sectors of the economy impacted either directly or indirectly. These secondary impacts are often referred to as "multiplier effects."

The modeling package used to assess the regional economic impacts stemming from the expenditures associated with each alternative was IMPLAN (IMpact analysis for PLANning). IMPLAN is an economic input-output modeling system that estimates the effects of economic changes in a defined analysis area.

A summary of estimated potential regional economic impacts by alternative is presented in table ES-3. In addition, for each category of regional economic impact, the economic region is defined by county, and the total economy of the defined region is summarized by employment (jobs), labor income, and output. The potential **total** regional economic impacts are presented for the No Action Alternative. Only the potential **changes** in regional economic impacts from the No Action Alternative are presented for the action alternatives.

It is important to note each category of regional impact was analyzed by alternative specific definitions, periods of occurrence, and other factors; therefore, the potential impacts must not be summed by alternative, by category, or by region.

Table ES-3.—Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.1	**Dam Decommissioning** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	None	Short-term impacts during the one year decommissioning. Approximately 1,400 jobs, $60 million in labor income, and $163 million in output estimated to stem from in region decommissioning expenditures	Short-term impacts during the one year decommissioning. Approximately 1,100 jobs, $48 million in labor income, and $132 million in output estimated to stem from in region decommissioning expenditures
2.2	**Operation and Maintenance** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	Regional economic impacts stemming from existing in region O&M expenditures were estimated to generate approximately 49 jobs and labor income and output of $2 million and $5 million respectively	No long-term annual O&M expenditures. Therefore the regional economy would lose the 49 jobs, $2 million of labor income, and $5 million output associated with the in region O&M expenditures for the No Action Alternative	Based on in region O&M expenditures approximately 47 jobs, $2 million in labor income, and $5 million in output would be lost to the regional economy compared to the No Action Alternative
2.3	**Mitigation** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	None	These would be temporary short-term impacts and vary year by year between 2018-2025 proportionate to actual in region expenditures. A total of approximately 220 jobs, $10 million in labor income, and $31 million in output between the years 2018-2025 were estimated to stem from the total in region mitigation expenditures	Same as the Full Facilities Removal of Four Dams Alternative

Table ES-3.—Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.4	**Irrigated Agriculture** **Economic Region:** Klamath County OR Siskiyou and Modoc Counties CA **Regional Economy:** Employment (Jobs): 52,141 Labor Income: $2,083 million Output: $5,497 million	Regional economic impacts stemming from irrigated agriculture were estimated to be equal in all years except for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008. Estimated regional economic impacts stemming from irrigated agriculture for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008.:	Regional economic impacts stemming from irrigated agriculture were estimated to be equal in all years except for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008. Estimated regional economic impacts stemming from the change in irrigated agriculture for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008. between the No Action Alternative and Alternative 2:	Same as the Full Facilities Removal of Four Dams Alternative
		2027 — Jobs 1,361 Labor Income $45 million Output $184 million	2027 — Jobs 112 Labor Income $2 million Output $13 million	
		2043 — Jobs 766 Labor Income $33 million Output $118 million	2043 — Jobs 695 Labor Income $11 million Output $84 million	
		2045 — Jobs 1,076 Labor Income $40 million Output $156 million	2045 — Jobs 397 Labor Income $7 million Output $41 million	
		2051 — Jobs 1,286 Labor Income $44 million Output $177 million	2051 — Jobs 187 Labor Income $4 million Output $20 million	
		2059 — Jobs 1,403 Labor Income $46 million Output $188 million	2059 — Jobs 70 Labor Income $2 million Output $9 million	

Table ES-3.—Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.5	**Commercial Fishing** **Economic Regions and Regional Economies:** • **San Francisco Management Area** (San Mateo, San Francisco, Marin and Sonoma Counties CA) Employment (Jobs): 3,060,366 Labor Income: $204,685 million Output: $599,164 million	Estimated regional economic impacts stemming from ocean commercial fishing: • **San Francisco Management Area** Jobs: 510 Labor Income: $6.10 million Output: $15.52 million	Estimated regional economic impacts stemming from the change in ocean commercial fishing between the No Action Alternative and Alternative 2: • **San Francisco Management Area** Jobs: 218 Labor Income: $2.56 million Output: $6.6 million	Same as the Full Facilities Removal of Four Dams Alternative.
	• **Fort Bragg Management Area**(Mendocino County CA) Employment (Jobs): 40,117 Labor Income: $1,731 million Output: $4,814 million	• **Fort Bragg Management Area** Jobs: 162 Labor Income: $2.45 million Output: $5.62 million	• **Fort Bragg Management Area** Jobs: 69 Labor Income: $1.05 million Output: $2.41 million	
	• **KMZ-CA** (Humboldt and Del Norte Counties CA) Employment (Jobs): 71,633 Labor Income: $2,983 million Output: $7,360 million	• **KMZ-CA** Jobs: 44 Labor Income: $0.19 million Output: $0.45 million	• **KMZ-CA** Jobs: 19 Labor Income: $0.07 million Output: $0.19 million	
	• **KMZ-OR** (Curry County OR) Employment (Jobs): 8,656 Labor Income: $311 million Output: $859 million	• **KMZ-OR** Jobs: 26 Labor Income: $0.15 million Output: $0.33 million	• **KMZ-OR** Jobs: 11 Labor Income: $0.06 million Output: $0.13 million	
	• **Central Oregon Management Area** (Coos, Douglas and Lane Counties OR) Employment (Jobs): 258,047 Labor Income: $10,170 million Output: $27,815 million	• **Central Oregon Management Area** Jobs: 319 Labor Income: $4.15 million Output: $9.55 million	• **Central Oregon Management Area** Jobs: 136 Labor Income: $1.74 million Output: $4.07 million	

Table ES-3.—Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.6	**In-River Sport Fishing** **Economic Region:** Klamath County OR Del Norte, Humboldt, and Siskiyou Counties CA **Regional Economy:** Employment (Jobs): 119,837 Labor Income: $4,911 million Output: $12,499 million	**Recreational Salmon Fishery** Regional economic impacts stemming from in river salmon fishing trip expenditures were estimated to create approximately 34 jobs and stimulate about $0.93 million of labor income and $2.01 million of output.	**Recreational Salmon Fishery** Regional economic impacts stemming from the change in river salmon fishing trip expenditures were estimated to create approximately three more jobs and stimulate increases of about $0.07 million of labor income and $0.15 million of output compared to the No Action Alternative.	**Recreational Salmon Fishery** Same as the Full Facilities Removal of Four Dams Alternative.
		Recreational Steelhead Fishery Regional economic impacts stemming from in-river steelhead fishing trip expenditures were estimated to create approximately 20 jobs and stimulate about $0.62 million of labor income and $1.31 million of output.	**Recreational Steelhead Fishery** The Coho/Steelhead Expert Panel Report and previous studies generally positive regarding the potential for increased distribution and abundance of steelhead. However, insufficient data precluded estimation of potential regional economic impacts associated with changes in steelhead fishing trip expenditures compared to the No Action Alternative.	**Recreational Steelhead Fishery** Same as the Full Facilities Removal of Four Dams Alternative.
		Recreational Redband Trout Fishery A popular guide fishery occurs on the lower Williamson. Given demand for guide trips is generally higher among non-resident than resident anglers, the proportion of trips by non-resident anglers is likely higher; however, data are lacking to verify this or quantify regional economic impacts associated with in-region guide fishing expenditures.	**Recreational Redband Trout Fishery** The Resident Fish Expert Panel concluded this alternative would result in increased abundance and distribution of redband trout in Upper Klamath Lake and its tributaries and a potential seven-fold increase in the trophy fishery in the Keno Reach. However, the potential regional economic impacts of this notable increase could not be quantified with available data.	**Recreational Redband Trout Fishery** Same as the Full Facilities Removal of Four Dams Alternative.

Table ES-3.—Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.7	**Ocean Sport Fishing** **Economic Regions and Regional Economies:** • **KMZ-OR – Curry County OR** Employment (Jobs): 8,656 Labor Income: $311 million Output: $859 million • **KMZ-CA – Humboldt and Del Norte Counties CA** Employment (Jobs): 71,633 Labor Income: $2,983 million Output: $7,360 million	• **KMZ-OR – Curry County OR** An estimated three jobs, $0.08 million of labor income, and $0.21 million in output were estimated to stem from in region ocean sport salmon fishing related expenditures	• **KMZ-OR – Curry County OR** Regional economic impacts stemming from the change in in-region ocean sport salmon fishing trip expenditures were estimated to be increases of approximately one job, $0.02 million in labor income, and $0.09 million in output compared to the No Action Alternative	Same as the Full Facilities Removal of Four Dams Alternative.
		• **KMZ-CA – Humboldt and Del Norte Counties CA** Approximately 13 jobs, $0.42 million of labor income, and $1.12 million of output were estimated to stem from in region ocean sport salmon fishing related expenditures	• **KMZ-CA – Humboldt and Del Norte Counties CA** Regional economic impacts stemming from the change in in-region ocean sport salmon fishing trip expenditures between the No Action Alternative and Alternative 2 were estimated to be approximately five more jobs, $0.18 million of labor income, and $0.48 million of output.	
2.8	**Refuge Recreation** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	Approximately 11 jobs stem from refuge hunting related expenditures and stimulate about $0.26 million of labor income and $0.62 million of output	The change in refuge hunting expenditures between the No Action Alternative and Alternative 2 was estimated to create 5 more jobs, increase labor income by $0.12 million, and output by $0.27 million compared to the No Action Alternative	Same as the Full Facilities Removal of Four Dams Alternative
2.9	**Reservoir Recreation** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	Approximately seven jobs stem from reservoir recreation related expenditures. Reservoir recreation related expenditures stimulate about $0.22 million of labor income and $0.54 million of output.	Four jobs would be lost with the change in reservoir recreation related expenditures between the No Action Alternative and Alternative 2. Labor income and output would decline by $0.13 million and $0.31 million respectively compared to the No Action alternative.	Same as the Full Facilities Removal of Four Dams Alternative

Table ES-3.—Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.10	**Whitewater Recreation** **Economic Region:** Klamath and Jackson counties OR Humboldt and Siskiyou counties CA **Regional Economy:** Employment (Jobs): 224,667 Labor Income:$8,682 million Output: $23,330 million	Jobs stemming from whitewater recreation expenditures made inside the region account for almost 56 jobs. Labor income and output produced by the in region whitewater expenditures account for $1.56 million and $4.31 million respectively.	Jobs stemming from whitewater recreation expenditures made inside the region would decline by 14 compared to the No Action Alternative; labor income and output would decline by $0.43 million and $0.89 million respectively.	Same as the Full Facilities Removal of Four Dams Alternative
2.11	**Klamath Basin Restoration Agreement (KBRA)** Information provided by CDM in separate standalone document entitled KBRA Appendix**.**	Information provided by CDM in separate standalone document entitled KBRA Appendix	Information provided by CDM in separate standalone document entitled KBRA Appendix	Information provided by CDM in separate standalone document entitled KBRA Appendix

TRIBAL EFFECTS ANALYSIS

This analysis focuses on fishing opportunities, related cultural and social practices, standard of living, and health for five of the six federally recognized tribes in the Klamath Basin (Klamath Tribes, Karuk Tribe, Resighini Rancheria, Yurok Tribe, Hoopa Valley Tribe) as they relate to the Secretarial Determination. The sixth tribe, the Quartz Valley Indian Community, is not expected to be directly affected by the outcome of the Secretarial Determination.

For the tribes of the Klamath Basin, fish are integral to a world view that emphasizes interconnectedness, balance, and mutual respect as guiding principles. The diversity, abundance, distribution, run timing and health of fish are important indicators of how well such balance is being maintained. The seasonal round of harvest provides sustained access to food that is synchronous with the cycles of nature. Fish are honored in rituals such as the First Salmon Ceremony and (for the Klamath Tribes) the Return of the C'waam, which traditionally precede the commencement of fishing for spring Chinook and suckers respectively. Fishing itself is a social and cultural activity – an opportunity to meet with family and friends; to engage in traditional fishing practices; to strengthen community bonds, demonstrate respect and promote food security by sharing fish with elders and others who are unable to fish; and to transmit these traditions to the next generation. Trade and barter occur both within and between tribes as a means of increasing access to fish and other valued goods, and cementing social relationships.

While fish has been central to the daily life and culture of the tribes, access to fish has declined due to reductions in abundance and distribution and loss of access to traditional fishing sites. These changes have affected the tribes' dietary habits and well-being – as well as their cultural, ritualistic and social lives. Despite these challenges, the tribes have been persistent in ensuring continuation of practices and values that have been a part of their world view for many centuries.

Sedimentation and water quality changes associated with dam removal may have adverse short term effects on fish stocks that inhabit areas below the dams. Over the longer term, dam removal and successful implementation of the Klamath Basin Restoration Agreement (KBRA) are expected to increase tribal harvest opportunities on the Klamath River. These actions are not expected to affect the productivity of Hupa fisheries (which depend on Trinity River stocks). Effects of dam removal and KBRA on Klamath River stocks (excluding the Trinity) can be summarized as follows:

- Steelhead is expected to increase in abundance and extend its distribution to areas currently under the reservoirs and upstream to Keno Dam; expansion upstream of Keno Dam is possible but not certain.

- Redband trout is expected to increase in abundance and distribution in Upper Klamath Lake and its tributaries and also below Keno Dam.

- Pacific lamprey harvest potential below Keno Dam is expected to increase from one to ten percent over the long term due to habitat improvement and recolonization of the reach between Iron Gate Dam and Keno Dam. Harvest potential above Keno Dam is possible but more uncertain.

- Sucker populations in the Upper Basin are expected to increase over the long term, although anything more than tribal ceremonial harvest would be unlikely until a sustained upward trend in the population is observed.

- The Southern Oregon Northern California Coast (SONCC) coho Evolutionarily Significant Unit (ESU) is listed as "threatened" under the Endangered Species Act (ESA). This ESU is comprised of coho populations both inside and outside the Klamath Basin. The action alternatives are expected to lead to an increase in the viability of Klamath River coho populations and advance the recovery of the ESU. However, since these alternatives do not include coho restoration outside the Klamath Basin, they alone will not create conditions that would warrant de-listing of the SONCC coho ESU throughout its range.

- Tribal harvest of spring and fall Chinook on the Klamath River is expected to increase by 50 percent on an average annual basis (from 31,127 fish to 46,682 fish) during 2012-61 under the action alternatives. This projection is subject to considerable uncertainty due to natural biological and environmental variability and other factors. Despite this uncertainty, tribal harvest is projected to be higher in 74 percent of years under the action alternatives relative to no action. In 2006, unusually low Klamath River fall Chinook abundance triggered major regulatory restrictions for all Chinook fisheries (including tribal fisheries). Such conditions are projected to occur in 80 percent fewer years under facilities removal.

  Fall-run Chinook salmon (consisting largely of hatchery fish) is currently a much larger component of tribal harvest than spring-run Chinook salmon, which is at low levels of abundance. This stock composition is likely to persist into the future under the no action alternative. A modest harvestable surplus of spring Chinook may become available under the action alternatives. This harvest opportunity would be beneficial to tribal fisheries, as spring-run Chinook salmon are highly desirable for their fat content and have the potential to temporally expand tribal harvest opportunities beyond the current season.

Tables ES-4 through ES-8 summarize potential effects of the Secretarial Determination as it affects tribal access to fishing opportunities, tribal cultural practices, economic well being, and tribal health. Each tribe is considered separately, in recognition of the individual ways in which each may be affected by the Secretarial Determination.

Table ES-4.—Effects of the No Action and action alternatives on the Klamath Tribes

Indicator	No Action	Change from No Action
Harvest opportunities:		
• Chinook	No access to spring or fall Chinook	Return of salmon to Upper Basin would be first time in almost a century. Interim fishing site below IGD would provide first Chinook harvest opportunity in almost a century.
• Sucker (mullet)	ESA listed, ceremonial only, no subsistence use since 1986	Continued ceremonial use, potential long-term subsistence use.
• Redband trout	Some subsistence	Increase in abundance and distribution, greater subsistence opportunity.
• Steelhead	No access	Re-introduction to Upper Basin.
Land base/ fishing access sites	Limited Tribal land ownership	Mazama Forest Project (KBRA Section 33.2) would increase access to traditional lands and expand opportunities to exercise fishing rights.
Engagement in resource monitoring and management	Active engagement in data collection, research, and management pertaining to aquatic resources, wildlife, and habitat.	Engagement would be expanded and supported by new funding for fisheries and conservation management (KBRA section 32.2).

Table ES-4.—Effects of the No Action and action alternatives on the Klamath Tribes

Indicator	No Action	Change from No Action
Cultural practices	First C'waam Ceremony held annually. No First Salmon Ceremony due to lack of access to spring Chinook. Loss of fishing opportunities over past century impairs ability to practice and transmit traditional harvest methods and values (sharing fish with elders) to younger generation.	Enhanced significance of First C'waam Ceremony associated with improvement in status of sucker populations. Return of spring Chinook would allow for revival of First Salmon Ceremony. Return of salmonids to Upper Basin and expedited water quality improvements would provide new opportunities to engage in traditional harvesting, ceremonial and cultural practices and teach those practices to younger generation. Mazama Forest Project (KBRA Section 32.2) would provide access to culturally important sites and land base for engagement in traditional practices.
Employment, income, standard of living	Employment provided by Klamath Tribes' Natural Resources Department. Subsistence fishery for redband trout provides modest contribution to standard of living.	Increased employment and income opportunities associated with funding for fisheries and conservation management, economic development study and Mazama Forest Project (KBRA Sections 32.2, 33.1, 33.2, 34). Increased subsistence fishing opportunities would improve standard of living, expand opportunities for trade and barter, and enhance food security for tribal members (particularly important for elders).
Health	Subsistence fishing limited to modest amounts of redband trout. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with interim fishing site (KBRA Section 34) and increased subsistence fishing opportunities.

Table ES-5.—Effects of the No Action and action alternatives on the Karuk Tribe

Indicator	No Action	Change from No Action
Harvest opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential adverse short-term effect due to sedimentation associated with dam removal. Some increase in spring and fall Chinook after dam removal. Spring Chinook particularly valued for high fat content and potential to extend salmon season.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status.
• Steelhead	Stable/declining abundance	Potential adverse short-term effect due to sedimentation associated with dam removal. Increased abundance and distribution after dam removal.
• Pacific lamprey	Very low abundance	One to ten percent increase in harvest potential.
• Sturgeon	Very low abundance	Limited documentation of potential effects.
• Eulachon	ESA-listed	Limited documentation of potential effects.
Engagement in resource monitoring and management	Active engagement in data collection, research and management pertaining to fish and wildlife, water quality, and habitat.	Engagement would be expanded and supported by new funding for fisheries and conservation management (KBRA section 32.2).

Table ES-5.—Effects of the No Action and action alternatives on the Karuk Tribe

Indicator	No Action	Change from No Action
Cultural practices	No First Salmon Ceremony as traditionally practiced in the spring. Participation in Piky'avish ceremonies (including ritual immersion of ceremonialists and daily feasting) and other cultural practices (e.g., basket weaving, medicinal plants) impaired by limited fish abundance and poor water quality. Limited fishing opportunities impair ability to practice and transmit traditional harvest methods and values (sharing fish with elders) to younger generation.	Return of spring Chinook would allow for revival of traditional First Salmon Ceremony in the spring. Increase in fish populations and expedited water quality improvements would enhance opportunities to engage in traditional harvesting, ceremonial and cultural practices and transmit those practices to younger generation.
Employment, income, standard of living	Employment provided by Karuk Tribe's Natural Resources Department.	Increased employment and income opportunities associated with funding for fisheries and conservation management and economic development study (KBRA Sections 32.2, 33.1, 33.2). Increased subsistence fishing opportunities would improve standard of living, expand opportunities for trade and barter, and enhance food security for tribal members (particularly important for elders).
Health	Subsistence fishing opportunities very limited in terms of quantity and length of season. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with enhanced subsistence fishing opportunities.

Table ES-6.—Effects of the No Action and action alternatives on the Resighini Rancheria

Indicator	No Action	Change from No Action
Harvest Opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential adverse short-term effect due to sedimentation associated with dam removal. Some increase in spring and fall Chinook after dam removal. Spring Chinook particularly valued for high fat content and potential to extend salmon season.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status.
• Pacific lamprey	Very low abundance	One to ten percent increase in harvest potential.
• Sturgeon	Very low abundance	Limited documentation of potential effects.
• Eulachon	ESA-listed	Limited documentation of potential effects.
Cultural practices	Active attendance at World Renewal Ceremonies held by Yurok Tribe and Hoopa Valley Tribe. Cultural practices (e.g., basket weaving, medicinal plants) impaired by poor water quality.	Return of spring Chinook would provide opportunity to attend revival of First Salmon Ceremony. Increase in fish populations and expedited water quality improvements would enhance opportunities to engage in traditional harvesting, ceremonial and cultural practices and transmit those practices to younger generation.
Employment, income, standard of living	Modest income provided by Resighini Rancheria's campground.	Increase in fishing opportunities may modestly increase campground usage.
Health	Subsistence fishing opportunities very limited. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with higher fish abundance.

Table ES-7.—Effects of the No Action and action alternatives on the Yurok Tribe

Indicator	No Action	Change from No Action
Harvest opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential adverse short-term effect due to sedimentation associated with dam removal. Potential 50 percent increase in overall tribal harvest (fall and spring Chinook), with absolute increase more modest for spring than fall run. Spring Chinook particularly valued for high fat content and potential to extend salmon season.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status
• Steelhead	Stable/declining abundance	Potential adverse short-term effect due to sedimentation associated with dam removal. Increased abundance and distribution some years after dam removal.
• Pacific lamprey	Very low abundance	One to ten percent increase in harvest potential.
• Sturgeon	Very low abundance	Limited documentation of potential effects.
• Eulachon	ESA-listed	Limited documentation of potential effects.
Engagement in resource monitoring and management	Active engagement in data collection, research and management pertaining to fish, wildlife, habitat and fisheries.	Engagement would be expanded and supported by new funding for fisheries and conservation management (KBRA section 32.2).
Cultural practices	No First Salmon Ceremony. Participation in ceremonies (e.g., World Renewal, Brush Dance, Flower Dance – including ritual immersion of ceremonialists and daily feasting) and other cultural practices (e.g., basket weaving, medicinal plants) impaired by limited fish abundance and poor water quality.	Return of spring Chinook would allow for revival of First Salmon Ceremony. Increase in fish populations and expedited water quality improvements would enhance opportunities to engage in traditional harvesting, ceremonial and cultural practices and transmit these practices to younger generation.

Table ES-7.—Effects of the No Action and action alternatives on the Yurok Tribe

Indicator	No Action	Change from No Action
Employment, income, standard of living	Employment provided by Yurok Tribal Fisheries Program and participation of tribal members in commercial and guide fisheries. Subsistence fishery contributes to standard of living.	Increased employment and income opportunities associated with funding for fisheries and conservation management and economic development study (KBRA Sections 32.2, 33.1, 33.2). Increased harvest opportunities would provide additional employment and income for commercial and guide fisheries. Increased subsistence fishing opportunities would improve standard of living, increase opportunities for trade and barter, and enhance food security for tribal members (particularly important for elders).
Health	Subsistence fishery provides limited but healthy source of sustenance. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with enhanced subsistence fishing opportunities.

Table ES-8.—Effects of the No Action and action alternatives on the Hoopa Valley Tribe

Indicator	No Action	Change from No Action
Harvest Opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential for modest adverse short-term effect due to sedimentation associated with dam removal. No change in productivity of Trinity River salmon. Potential reduction in incidence of fish kills below confluence with Trinity.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status
• Steelhead	Stable/declining abundance	Potential for modest adverse short-term effect due to sedimentation associated with dam removal. No change in productivity of Trinity River steelhead. Potential reduction in incidence of fish kills below confluence with Trinity.
• Pacific lamprey	Very low abundance	Little if any long-term change.
• Sturgeon	Very low abundance	No change.
• Eulachon	ESA-listed	No change.
Engagement in resource monitoring and management	Active engagement in data collection, research and management pertaining to fish, wildlife, habitat and fisheries.	No change.

Table ES-8.—Effects of the No Action and action alternatives on the Hoopa Valley Tribe

Indicator	No Action	Change from No Action
Cultural practices	No First Salmon Ceremony. Participation in ceremonies (e.g., World Renewal, Brush Dance, Flower Dance – including ritual immersion of ceremonialists and daily feasting) and other cultural practices (e.g., basket weaving, medicinal plants) impaired by limited fish abundance and poor water quality on the Trinity River.	No change in Trinity River water quality or associated cultural practices.
Employment, income, standard of living	Employment provided by Hoopa Valley Tribal Fisheries Program and participation of tribal members in commercial fishery. Subsistence fishery contributes to standard of living.	Little if any change in Trinity River fishing opportunities or associated employment.
Health	Subsistence fishery provides limited but healthy source of sustenance. Poverty constrains ability to replace fish with healthy food alternatives.	Little if any change in availability of Trinity River fish as healthy source of subsistence.

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Introduction

This Economics and Tribal Summary Technical Report summarizes the economics and tribal analyses. Section 3.3 of the Klamath Hydroelectric Settlement Agreement (KHSA) directs the Secretary to consider the following factors in his determination of whether the Klamath facilities should be removed:

1. Will facilities removal advance restoration of the salmonid fisheries of the Klamath Basin

2. Is facilities removal in the public interest, which includes but is not limited to consideration of potential impacts on affected local communities and tribes

The economic analysis undertaken in support of the Secretarial Determination is narrowly focused on the specific issues and questions identified in the KHSA. In contrast, the analysis undertaken in the context of the prior FERC proceedings focused on the question of license renewal and the conditions to place on any license issued, including the analysis of fish passage and mandatory conditions (see the FERC *Final Environmental Impact Statement for Relicensing of the Klamath Hydroelectric Project No. 2082-027).*

The analysis summarized in this document considers both facilities removal (as defined in section 1.4 of the KHSA) as well as aspects of the Klamath Basin Restoration Agreement (KBRA) because the KBRA is linked closely to advancing fish restoration and has impacts on local communities and tribes in the Basin.

In supporting the Secretarial Determination, the alternatives summarized in this Economics and Tribal Summary Technical Report are Alternative 1 – No Action, Alternative 2 – Full Facilities Removal of Four Dams, and Alternative 3 – Partial Facilities Removal of Four Dams. Alternatives evaluating fish passage are outside the KHSA and are thus not analyzed. Should the Secretary make a negative determination, a broader and more complicated set of alternatives would likely require additional analysis in the context of a re-started FERC proceeding. Additional analysis could include a review of the prior analysis of fish passage and other mandatory conditions, and updating as appropriate.

Chapter 1 − National Economic Development Benefit-Cost Analysis

The purpose of the National Economic Development Benefit-Cost Analysis (NED BCA) is to compare the benefits of a proposed project to its costs. The total costs of the project are subtracted from the total benefits to measure net benefits. If all benefits are available and measurable and the net benefits are positive, implying that benefits exceed costs, the project could be considered economically justified. In studies where multiple mutually exclusive alternatives are being considered, the alternative with the greatest positive net benefit would be preferred from strictly an economics perspective. Another way of displaying this benefit-cost comparison involves dividing total project benefits by total project costs, resulting in the benefit-cost ratio (BCR). A BCR greater than one is analogous to a positive net benefit in terms of economic justification.

For the NED BCA, the No Action Alternative was treated as the baseline from which the proposed alternatives were compared. An incremental analysis was conducted (based on available information) whereby the changes or increments in benefits and costs from the No Action Alternative were compared to calculate the net benefits and benefit- cost ratios for each of the proposed alternatives.

The proposed alternatives involve a combination of facility/dam removal and Klamath Basin Restoration Agreement (KBRA) activities. The period of analysis was set at 50 years from the point of the first KBRA activity (year 2012). Therefore, the period of analysis runs from 2012 through 2061.

Before comparisons can be made between costs and benefits, they must be converted to the same dollar year and the same point in time. For consistency, all benefits and costs were measured in 2012 dollars. Furthermore, since the benefits and costs were estimated to occur at different times across the 2012-2061 period of analysis, they were also discounted to year 2012 using the 2011 Federal water resources planning rate of 4.125 percent.[1]

Project analysis necessarily involves uncertainty. Uncertainty is almost always present when one evaluates the net economic benefits of projects or activities that extend into the future. Uncertainty regarding outcomes is typically addressed by calculating expected values. There are many causes of uncertainty. For example, agricultural production is influenced by prices, weather, and presence of pests, none of which is entirely predictable. In practice, uncertainty can be measured by the expected variability in outcomes.

[1] Change in Discount Rate for Water Resources Planning. 75 FR 82066. (29 December 2010).

It is useful to distinguish between uncertainty caused by unpredictability of future events and uncertainty caused by limitation on the precision of data. As a general matter, uncertainty should be recognized explicitly and factored into the NED analysis. Explicit recognition of uncertainty allows decisions to be considered in the context of the quality of the available information used to support a particular decision as well as often revealing factors that may have the greatest influence on the possible results from a project. Sensitivity analysis is the most frequently used method for analyzing uncertainty. In essence, sensitivity analysis measures how sensitive the result of a benefit-cost analysis is to a change in one of the variables.

Given the time and resources available to conduct the NED analysis, it was not feasible to conduct a comprehensive analysis of uncertainty. Given the 50-year period of analysis and the large number of exogenous factors that could change over this period the results presented in this analysis should be characterized as uncertain, but the best available at this point in time. While the uncertainty inherent in the analysis cannot be quantified, it is possible to summarize the major sources of uncertainty:

- *Hydrology*: Future hydrology would be expected to affect agricultural activities, hydropower production, fisheries, and recreation. The direction and magnitude of the impacts are difficult to evaluate. In general, additional surface water supplies would increase the benefits to most impacted resources. However, the timing the additional supplies would be a factor also. If the additional supplies occurred in a year when surface water was in relatively short supply, the differential between the action and no action alternative would likely diminish.

- *Crop prices and agricultural production input costs*: Crop prices and input costs would affect the agricultural benefits in the Basin. The direction and magnitude of the effects are difficult to evaluate. In general, input cost increases, all else equal, would reduce agricultural benefits. The effects of crop price changes would depend on the direction and magnitude of the changes. Higher crop prices, all else equal, would be expected to increase net agricultural revenues.

- *Hydropower*: The hydropower analysis is sensitive to hydrology, future electricity prices, and the extent to which future capital investments that would increase the efficiency at the existing facilities are undertaken. The higher future electricity prices are, the larger the foregone hydropower values would be. If future investments to increase efficiency are not undertaken, this would result in lower foregone hydropower values.

- *Fisheries*: Natural variability in biological and environmental parameters and uncertainty regarding future harvest management policies would impact fishery benefits. The magnitude of these changes is difficult to predict.

- *Capital and mitigation costs*: Costs are subject to changes in supply and prices of labor, materials, equipment. The direction and magnitude of the impact is difficult to predict. Shifts in the timing of when costs were incurred would also change the present value of the costs. All else equal, shifting capital costs closer to the present would increase the present value of these costs; shifting costs further into the future would decrease present values.

- *KBRA*: The timing, nature, extent, and success of the KBRA measures implemented could impact both costs and benefits. Shifting KBRA costs closer to the present would increase the present value of these costs; shifting costs further into the future would decrease present values.

- *Recreation values*: The following are issues that create uncertainty for the analysis of recreation values: (1) to the extent that acceptable whitewater boating flow conditions periodically occur on portions of the Upper Klamath River (UKR) after dam removal that allow for some trips to still be taken, the estimated loss of whitewater boating user days and economic value may be overstated, (2) reservoir recreation values are based on uncertain population and visitation projections, (3) because net benefit estimates were only estimated for hunting visits, values could be underestimated if there is a relationship between wildlife viewing trips and waterfowl numbers, and (4) use of a benefits transfer approach for estimates of consumer surplus values.

This chapter briefly describes the methodology, assumptions, and results associated with each benefit and cost component. Benefits associated with irrigated agriculture, hydropower, and reservoir recreation were provided by the Bureau of Reclamation (Reclamation). NOAA's National Marine Fisheries Service (NOAA Fisheries Service) provided benefits for commercial fishing, ocean sport fishing, and in-river sport fishing. Refuge recreation benefits were provided by the U.S. Fish and Wildlife Service (USFWS). Whitewater recreation benefits and benefit information for non-use values and real estate were provided by the U.S. Department of the Interior's (DOI) Office of Policy Analysis. KBRA restoration costs were obtained from the KBRA Appendix C-2 Budget of Implementation of Agreement. Study team engineers provided the facility removal costs, site mitigation costs, and operations, maintenance, and replacement (OM&R) costs. For more detail on the benefit-cost analysis (BCA) methodology, see the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011).

1.1 BENEFIT ANALYSES

A range of potentially affected benefits associated with dam removal and KBRA activities was identified for this study. Benefits were analyzed for the following categories:

- Irrigated agriculture
- Commercial fishing
- Hydropower
- Ocean sport fishing
- In-river sport fishing
- Reservoir recreation
- Refuge recreation
- Whitewater recreation
- Non-use values
- Real estate

Benefits for hydropower, reservoir recreation, and whitewater recreation proved negative, implying that benefits for those categories under the proposed alternatives were less than those under the No Action Alternative. As a result, those benefit categories are presented under "Section 1.2 – "Cost Analyses" and referred to as foregone benefits.

It should also be noted that some potential benefits and costs could not be quantified for various reasons. As a result, these potential benefits and costs were not included in the numeric benefit-cost comparison. Failing to include benefits has the effect of understating estimated net benefits and benefit-cost ratios; the opposite effect occurs when costs are excluded. Elements of the following benefit categories were not included in the BCA:

- Tribal fisheries and cultural values (for area tribes, fish provide subsistence, ceremonial use, and cultural value that cannot be monetized; see chapter 3 for more details)

- In-river steelhead sport fishing (change in abundance not quantifiable)

- Redband trout sport fishing below and above Keno Dam (effort estimates incomplete)

- Refuge recreation (wildlife viewing activities not quantifiable)

- Real estate (not included as a separate analysis, partially reflected in some of the other values)

1.1.1 Irrigated Agriculture

The objective of this analysis is to measure the NED agricultural benefits resulting from implementing elements of KBRA that impact Reclamation's Klamath Irrigation Project. The irrigable lands of the Klamath Project are in south-central Oregon and north-central California.

1.1.1.1 Methodology and Assumptions

The Irrigated Agriculture Economics Technical Report (Reclamation 2011a) and the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011b) discuss in detail the methodology and results of the irrigated agriculture analysis summarized here. The base year for this analysis is 2012, and the period of analysis is 2012 through 2061, a 50-year period. This analysis follows the criteria for measuring NED agricultural benefits defined in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, March 10, 1983 (P&Gs).

Two primary elements of the KBRA related to agriculture were addressed in the economic benefits analysis: (1) Reclamation Klamath Project hydrology and (2) on-farm pumping costs. Hydrology modeling drives the agricultural benefit analysis (Reclamation 2011c). The No Action Alternative hydrology uses the Biological Opinions (BO) under which the Klamath Project operates currently.[2] Alternative 2 hydrology modeling incorporated KBRA's criteria. Some of the elements incorporated into the hydrology assumptions include the "On-Project Water Users Program" presented in Section 15 of the KBRA and the "Drought Plan" discussed in Section 19.

The Klamath Basin Hydrologic and Economic model (KB_HEM) was used to estimate the on-farm response to a change in annual surface water deliveries and groundwater pumping based on the hydrology. The on-farm response was measured as a change in acres in production and cropping patterns on an annual time-step when the annual amount of surface water for irrigation changed.

Agricultural benefit values for each crop were applied to the cropping patterns measured by KB_HEM. These annual values were discounted over the 50-year period for each hydrologic trace to derive the agricultural benefit. The agricultural benefit values were developed using farm budget methodology.

[2] National Marine Fisheries Service BO *Operation of the Klamath Project between 2010 and 2018* dated March 15, 2010, and USFWS BO *Effects of the U.S. Bureau of Reclamation's Proposed 10-Year Operation Plan (April 1, 2008 – March 31, 2018)* dated April 2, 2008.

1.1.1.2 Results

1.1.1.2.1 Alternative 1 – No Action Alternative

The average annual benefit discounted over the 50-year analysis period under the No Action alternative is $1,578,876,000.

1.1.1.2.2 Alternative 2 – Full Facilities Removal of Four Dams

The difference between the average discounted benefit for Alternative 1 benefits and the average discounted benefit for Alternative 2 benefits is $29,890,000.

1.1.1.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Benefits for irrigated agriculture for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be expected to be the same as the Full Facilities Removal of Four Dams Alternative.

1.1.1.3 References

Reclamation, 2011a. U.S. Department of Interior, Bureau of Reclamation. 2011. Irrigated Agriculture Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

Reclamation, 2011b. U.S. Department of Interior, Bureau of Reclamation. 2011. Benefit Cost and Regional Economic Development Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

Reclamation, 2011c. U.S. Department of Interior, Bureau of Reclamation. 2011. Hydrology, Hydraulics and Sediment Transport Studies for the Secretary's Determination on Klamath River Dam Removal and Basin Restoration. Technical Report No. SRH-2011-02. Bureau of Reclamation, Technical Service Center, Denver, CO.

1.1.2 Commercial Fishing

1.1.2.1 Methodology and Assumptions

The economic analysis provided here summarizes the effects of the No Action and action alternatives on the commercial troll fishery. Further details regarding the methodologies, assumptions, and conclusions underlying this analysis are contained in the *Commercial Fishing Economics Technical Report* (NOAA 2011).

The particular salmon stocks influenced by the No Action and action alternatives are the Southern Oregon Northern California Coast (SONCC) coho Evolutionarily Significant Unit (ESU)[3] and Klamath River fall and spring Chinook. The ocean migratory range of SONCC coho and Klamath Chinook is largely limited to the area south of Cape Falcon, Oregon. The area south of Cape Falcon is divided into six management areas: Monterey, San Francisco, Fort Bragg, Klamath Management Zone (KMZ), Central Oregon, and Northern Oregon. For purposes of this analysis, the KMZ (which straddles the Oregon-California border) is divided at the border into two areas: KMZ-OR and KMZ-CA. Effects of the No Action and action alternatives on the troll fishery are differentiated among these seven areas.

The SONCC coho ESU is listed as 'threatened' under the Endangered Species Act (ESA). This ESU is comprised of 28 populations ranging from the Elk and Rogue Rivers in southern Oregon to the Eel River in northern California and includes the coho populations in the Klamath Basin (Williams et al. 2008). The action alternatives are expected to increase the viability of Klamath River coho populations (Dunne et al. 2011). However, since these alternatives do not include coho restoration outside the Klamath Basin, they alone will not create conditions that would warrant de-listing of the SONCC coho ESU throughout its range. Nevertheless, the action alternatives will increase the viability of coho populations in the Klamath Basin and advance the recovery of the SONCC coho ESU.

Evaluation of effects on fall and spring Chinook is based on results of two models – the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model (Hendrix 2011) and a habitat comparison model (Lindley and Davis 2011) – and conclusions of the Biological Subgroup (Hamilton et al. 2011) and an Expert Panel convened to evaluate the effects of the alternatives on Chinook salmon (Goodman et al. 2011).

[3] An Evolutionarily Significant Unit is a population or group of populations that is reproductively isolated and of substantial ecological/genetic importance to the species (Waples 1991).

The EDRRA model is a simulation model that provides 50-year projections of Klamath Chinook escapement and harvest under the No Action and action alternatives. The EDRRA harvest projections pertain to Klamath Basin Chinook and do not distinguish between spring and fall runs. Harvest is estimated for each simulated year on the basis of a new Klamath fall Chinook harvest control rule recommended by the Pacific Fishery Management Council (PFMC) to NMFS in June 2011. The model distributes total Klamath River Chinook harvest among fisheries as follows: 50.0% to tribal fisheries, 7.5% to the in-river recreational fishery (up to a maximum of 25,000 fish – with any surplus above 25,000 allocated to escapement), 34.0% to the ocean commercial fishery, and 8.5% to the ocean recreational fishery. The 50-50 tribal/non-tribal split is a "hard" allocation specified by the U.S. Department of the Interior (DOI 1993) on behalf of the Yurok and Hoopa Valley tribes. The distribution of the remaining 50.0 percent among the three non-tribal fisheries represents customary practice rather than mandatory conditions.

Due to certain assumptions underlying the EDRRA model (e.g., that ocean abundance is known without error), the absolute harvest projections provided by the model represent an idealized version of real world conditions. To anchor EDRRA projections to the real world, average annual troll harvest of Klamath Chinook during 2001-05 (35,778 fish) was used to characterize the No Action Alternative. The years 2001-05 were selected as the base period for the following reasons: Klamath River fall Chinook fell within a "normal" range of abundance during those years; abundance of Sacramento River fall Chinook (which is targeted along with Klamath River fall Chinook in the ocean fishery south of Cape Falcon) also fell within a "normal" range; constraints and policies that are likely to continue into the future – e.g., more conservative harvest policies established in the 1990s to protect weaker stocks (including two Chinook and three coho ESUs listed under the ESA), the 50-50 tribal/non-tribal harvest allocation – were well established by that time; and unusually depressed fishery conditions after 2005 made those years unsuited for base period characterization. Annual harvest under the action alternatives (51,082 fish) was estimated by scaling average 2001-05 harvest upward, based on the percent difference between the EDRRA's 50th percentile harvest projections for the No Action and action alternatives (+43%).

Area-specific estimates of troll harvest and revenue were estimated for each alternative as follows: (1) Total troll harvest projected under each alternative was distributed among management areas to reflect the distribution experienced during 2001-05 (data source: Michael O'Farrell, NMFS). (2) In San Francisco, Fort Bragg, KMZ-CA, KMZ-OR and Central Oregon, Klamath River fall Chinook is managed as a "constraining stock"; that is, the amount of Chinook harvest (all stocks) made available to the troll fishery depends on the allowable harvest of Klamath Chinook. To account for this phenomenon, Klamath Chinook harvest in each area was divided by an area-specific expansion factor – calculated

on the basis of 2001-05 data as the ratio of Klamath Chinook harvest to total Chinook harvest (data source: Michael O'Farrell, NMFS). For Monterey and Northern Oregon, Klamath Chinook is rarely a constraining stock. For these latter two areas, the expansion factor was set equal to 1.0. (3) The resulting Chinook harvest estimate (all stocks) for each area was converted from numbers of fish to pounds dressed weight, based on the 2001-05 average weight of 11.9 pounds per fish (data source: PFMC 2011). (4) Pounds were converted to gross revenue based on the 2004-05 average price of $3.59 per pound dressed weight (data source: PFMC 2011). (5) The economic value of the fishery is measured in terms of net revenue (gross revenue minus trip expenses) – estimated as 81.3 percent of gross revenue (source: Jerry Leonard, NMFS).

While the EDRRA model focuses on Chinook escapement and harvest of spring and fall runs combined, other studies and reports distinguish the alternatives more finely in terms of their effects on specific runs or areas: (1) According to the Biological Subgroup, the action alternatives are expected to provide habitat favorable to spring Chinook – e.g., additional coldwater tributaries and springs that provide thermal refugia (Hamilton et al. 2011). (2) The Lindley/Davis habitat model involved compilation of escapement and watershed attribute data for 77 fall and spring Chinook populations in various watersheds in Washington, Oregon, Idaho, and northern California and comparison of these attribute sets with the attributes of Upper Basin watersheds. Based on their analysis, the authors concluded that Upper Basin attributes fall well within the range of spring bearing watersheds and that viable populations of spring-run Chinook salmon in the upper Klamath would improve the sustainability of the ESU as a whole (Lindley and Davis 2011). (3) The Chinook Expert Panel concluded that "The Proposed Action offers greater potential for increased harvest and escapement of Klamath Chinook salmon than the Current Conditions" (Goodman et al., p 16). The Panel noted the potential for a "substantial increase" in Chinook abundance in the area between IGD and Keno Dam. The Panel indicated that the possibility of successful Chinook introduction above Keno Dam was potentially large but less certain and contingent on successful implementation of the KBRA and resolution of issues such as water quality and fish disease. The Panel also noted that the possibility of substantial positive effects from the proposed action was much lower for spring than fall Chinook (Goodman et al. 2011).

The quantitative projections provided in the economic analysis rely heavily on EDRRA model outputs, which do not differentiate between spring and fall Chinook. Actual harvest opportunities for a given fishery may deviate somewhat from the projections provided here – depending on the extent to which the harvestable surplus includes spring Chinook, as some fisheries have better access to spring Chinook than others. The Biological Subgroup, Lindley/Davis and Expert Panel results provide insights regarding effects of the action alternatives on spring Chinook. Given that these latter sources do not claim substantial increases in spring Chinook, the economic analysis distinguishes between fall

and spring Chinook by qualitatively considering what a modest share of spring Chinook in the harvestable surplus might mean for each fishery (including the troll fishery).

1.1.2.2 Results

1.1.2.2.1 Alternative 1 – No Action Alternative

Coho retention has been prohibited in the troll fishery south of Cape Falcon since 1993 to meet consultation standards for SONCC coho and three other coho ESUs listed under the ESA. This prohibition is expected to continue into the future under Alternative 1.

Average annual net revenue associated with total Chinook harvest (all stocks) attributable to Klamath Chinook availability under Alternative 1 is $17.057 million (table 1.1-1). In order to estimate the discounted stream of annual net revenues for the projection period 2012-61, the annual variability in troll harvest simulated by the EDRRA model was carried over to the net revenue projections by multiplying average annual net revenue ($17.057 million) by the ratio of median troll harvest in each simulated year to the mean of the median harvests projected by the EDRRA model for all simulated years under Alternative 1. The discounted stream of annual commercial fishing net revenues under the No Action Alternative equates to $375.3 million.

Table 1.1-1.—Projected annual net revenue in the troll fishery (all stocks) attributable to Klamath River Chinook availability under Alternative 1, by management area (2012 dollars)

Management area	Annual net revenue
Monterey	58,021
San Francisco	7,419,075
Fort Bragg	3,417,033
KMZ-CA	267,131
KMZ-OR	216,985
Central OR	5,566,658
Northern OR	111,946
Total	17,056,849

Fall Chinook (consisting largely of hatchery fish) is currently a much larger component of ocean troll harvest than spring Chinook, which is at low levels of abundance. This stock composition is likely to persist into the future under Alternative 1.

1.1.2.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Alternative 2 will improve the viability of coho populations in the Klamath Basin portion of the SONCC coho ESU. Alternative 2 will improve the viability of coho populations in the Klamath Basin portion of the SONCC coho ESU. However (for reasons discussed in Section 1.1.2.1) this alternative by itself is unlikely to lead to de-listing of the ESU as whole. Thus, under the action alternatives, coho retention will likely continue to be prohibited in the California and Oregon troll fisheries south of Cape Falcon.

Annual net revenue associated with total Chinook harvest (all stocks) attributable to Klamath Chinook availability under Alternative 2 is $24.353 million (table 1.1-2). The average annual increase in net revenue (all areas) under Alternative 2 relative to Alternative 1 is $7.296 million (+43%). The stream of incremental ocean commercial fishery benefits for Alternative 2 in excess of the No Action Alternative across the 2012 to 2061 period equates to a discounted present value of $134.5 million.

Annual net revenue associated with total Chinook harvest (all stocks) attributable to Klamath Chinook availability under Alternative 2 is $24.353 million (table 1.1-2). The average annual increase in net revenue (all areas) under Alternative 2 relative to Alternative 1 is $7.296 million (+43%). The stream of incremental ocean commercial fishery benefits for Alternative 2 in excess of the No Action Alternative across the 2012 to 2061 period equates to a discounted present value of $134.5 million.

Table 1.1-2.—Projected annual net revenue in the troll fishery (all stocks) attributable to Klamath River Chinook availability under Alternative 2, and increase in annual net revenue relative to Alternative 1, by management area (2012 dollars)

Management area	Annual net revenue	Difference from Alternative 1
Monterey	82,840	24,819
San Francisco	10,592,576	3.173,501
Fort Bragg	4,878,665	1,461,632
KMZ-CA	381,396	114,265
KMZ-OR	309,800	92,815
Central OR	7,947,790	2,381,138
Northern OR	159,831	47,885
Total	24,352,897	7,296,048

Additional insights provided by the EDRRA model regarding the effects of Alternative 2 relative to Alternative 1 are as follows:

- The 5th percentile harvest value for Alternative 2 is 57% lower than the 5th percentile value for Alternative 1, and the 95th percentile harvest value is 725% higher. That is, the posterior harvest distribution under Alternative 2 exhibits a high degree of overlap with the Alternative 1 harvest distribution.

- Despite the extent of overlap in the Alternative 1 and 2 harvest distributions, annual harvest is projected to be higher in 70% of years under Alternative 2 than Alternative 1.

- The harvest control rule incorporated into the EDRRA model limits the harvest rate to 10% or less when pre-harvest escapements fall below 30,500 adult natural spawners. Escapements this low would likely be accompanied by major regulatory restrictions and adverse economic conditions for the fishery. Such conditions are projected to occur in 66% fewer years under Alternative 2 than Alternative 1; the decline is even larger (-80%) when considering just the post-dam removal years 2021-61.

The Biological Subgroup expects the action alternatives to provide habitat favorable to spring Chinook. The Lindley/Davis model indicates some potential for modest harvest of spring Chinook. The Expert Panel considers that prospect to be much less certain for spring than fall Chinook. An increase in spring Chinook is more likely to be advantageous to in-river fisheries than the troll fishery, as (given the run timing of spring Chinook relative to the current troll season structure) a large portion of the spring run will have returned to the river by the time the troll season opens.

1.1.2.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Alternative 3 is intended to provide the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. Therefore, the effects of this alternative on Chinook and coho populations and the salmon troll fishery are expected to be the same as Alternative 2.

1.1.2.3 References

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1.1.3 In-River Sport Fishing

1.1.3.1 Methodology and Assumptions

In-river recreational fisheries potentially affected by the Secretarial Determination include existing fisheries for salmon, steelhead and redband trout, and the recreational sucker fishery, which has been closed since 1987. The economic analysis provided here summarizes the effects of the No action and action alternatives on these fisheries. Further details of the methodologies, assumptions, and conclusions underlying this analysis are contained in the *In-River Sport Fishing Economics Technical Report* (NOAA 2011).

1.1.3.1.1 Recreational Salmon Fishery

The particular salmon stocks influenced by the No Action and action alternatives are the SONCC coho ESU and Klamath River fall and spring Chinook.

The SONCC coho ESU is listed as 'threatened' under the Endangered Species Act (ESA). This ESU is comprised of 28 populations ranging from the Elk and Rogue Rivers in southern Oregon to the Eel River in northern California and includes the coho populations in the Klamath Basin (Williams et al. 2008). The action alternatives are expected to increase the viability of Klamath River coho populations (Dunne et al. 2011). However, since these alternatives do not include coho restoration outside the Klamath Basin, they alone will not create conditions that would warrant de-listing of the SONCC coho ESU throughout its range. Nevertheless, the action alternatives will increase the viability of coho populations in the Klamath Basin and advance the recovery of the SONCC coho ESU.

Evaluation of effects on fall and spring Chinook availability on the in-river Chinook fishery is based on results of two models – the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model (Hendrix 2011) and a habitat comparison model (Lindley and Davis 2011) – and conclusions of the Biological Subgroup (Hamilton et al. 2011) and an Expert Panel convened to evaluate the effects of the alternatives on Chinook salmon (Goodman et al. 2011).

The EDRRA model is a simulation model that provides 50-year projections of Klamath Chinook escapement and harvest under the No Action and action alternatives. The EDRRA harvest projections pertain to Klamath Basin Chinook and do not distinguish between spring and fall runs. Harvest is estimated for each simulated year on the basis of a new Klamath fall Chinook harvest control rule recommended by the Pacific Fishery Management Council (PFMC) to NMFS in June 2011. The model distributes total Klamath River Chinook harvest among fisheries as follows: 50.0% to tribal fisheries, 7.5% to the in-river recreational fishery (up to a maximum of 25,000 fish – with any surplus above 25,000

allocated to escapement), 34.0% to the ocean commercial fishery, and 8.5% to the ocean recreational fishery. The 50-50 tribal/non-tribal split is a "hard" allocation specified by the U.S. Department of the Interior (DOI 1993) on behalf of the Yurok and Hoopa Valley tribes. The distribution of the remaining 50.0 percent among the three non-tribal fisheries represents customary practice rather than mandatory conditions.

Due to certain assumptions underlying the EDRRA model (e.g., that ocean abundance is known without error), the absolute harvest projections provided by the model represent an idealized version of real world conditions. To anchor EDRRA projections to the real world, average annual in-river recreational harvest of adult fall Chinook on the Klamath River during 2001-05 (6,241 fish) was used to characterize the No Action Alternative. The years 2001-05 were selected as the base period for the following reasons: Klamath River fall Chinook fell within a 'normal' range of abundance during those years; constraints and policies that are likely to continue into the future – e.g., more conservative harvest policies established in the 1990s to protect weaker stocks (including the SONCC coho ESU), the 50-50 tribal/non-tribal harvest allocation – were well established by the early 2000s; and unusually depressed fishery conditions after 2005 made those years unsuited for base period characterization. In-river recreational harvest on the Trinity River is not included in the base period harvest and the harvest increases projected by the EDRRA model are not applied to the Trinity River, as beneficial effects of the action alternatives are expected to be felt on the Klamath and not the Trinity. Annual adult harvest on the Klamath River under the action alternatives (6,720 fish) was estimated by scaling average 2001-05 harvest upward, based on the percent difference between the EDRRA's 50th percentile harvest projections for the No Action and action alternatives (+8%).

The harvest projections for the No Action and action alternatives were converted from numbers of adult Chinook to angler days, based on the ratio of angler days to total adult harvest, estimated from Klamath River creel survey data collected by the California Department of Fish and Game (CDFG) (data source: Sara Borok, CDFG). Total net economic value was estimated by multiplying number of angler days by an estimate of net economic value per angler day of $66.74 –based on in-river salmon valuation estimates from the economics literature, converted to angler day equivalents (as needed), adjusted for inflation to 2012 dollars, and averaged across studies.

While the EDRRA model focuses on Chinook escapement and harvest of spring and fall runs combined, other studies and reports distinguish the alternatives more finely in terms of their effects on specific runs or areas: (1) According to the Biological Subgroup, the action alternatives are expected to provide habitat favorable to spring Chinook – e.g., additional coldwater tributaries and springs that provide thermal refugia (Hamilton et al. 2011). (2) The Lindley/Davis habitat

model involved compilation of escapement and watershed attribute data for 77 fall and spring Chinook populations in various watersheds in Washington, Oregon, Idaho, and northern California and comparison of these attribute sets with the attributes of Upper Basin watersheds. Based on their analysis, the authors concluded that Upper Basin attributes fall well within the range of spring bearing watersheds and that viable populations of spring-run Chinook salmon in the upper Klamath would improve the sustainability of the ESU as a whole (Lindley and Davis 2011). (3) The Chinook Expert Panel concluded that "The Proposed Action offers greater potential for increased harvest and escapement of Klamath Chinook salmon than the Current Conditions" (Goodman et al., p 16). The Panel noted the potential for a "substantial increase" in Chinook abundance in the area between IGD and Keno Dam. The Panel indicated that the possibility of successful Chinook introduction above Keno Dam was potentially large but less certain and contingent on successful implementation of the KBRA and resolution of issues such as water quality and fish disease. The Panel also noted that the possibility of substantial positive effects from the proposed action was much lower for spring than fall Chinook (Goodman et al. 2011).

The quantitative projections provided in the economic analysis are based on EDRRA model outputs, which do not differentiate between spring and fall Chinook. Actual harvest opportunities for a given fishery may deviate somewhat from the projections provided here, depending on the extent to which the harvestable surplus includes spring Chinook, as some fisheries have better access to spring Chinook than others. The Biological Subgroup, Lindley/Davis and Expert Panel results provide insights regarding effects of the action alternatives on spring Chinook. Given that these latter sources do not claim substantial increases in spring Chinook, the economic analysis distinguishes between fall and spring Chinook by qualitatively considering what a modest share of spring Chinook in the harvestable surplus might mean for each fishery (including the in-river sport fishery).

1.1.3.1.2 Recreational Steelhead Fishery

For the recreational steelhead fishery, analysis of the No Action Alternative is based on current fishery conditions, as little change in the status of steelhead is anticipated under that alternative. The number of angler days on the Klamath River and its tributaries (excluding the Trinity) during 2003-08 was estimated in consultation with CDFG on the basis of data collected in CDFG's Steelhead Fishing Report-Restoration Card Program (Jackson 2007). The Trinity River was excluded from this analysis, as steelhead fishing on the Trinity is not expected to differ between the No Action and action alternatives.

Total net economic value of the Klamath River steelhead fishery was estimated by multiplying number of angler days by an estimate of net economic per angler day of $83.15 – based on steelhead valuation estimates from the economics literature, converted to angler day equivalents (as needed), adjusted for inflation to 2012 dollars, and averaged across studies.

Due to data limitations, evaluation of the action alternatives is largely qualitative, with conclusions based on advice from an Expert Panel convened in December 2010 to evaluate the effects of the alternatives on steelhead and coho (Dunne et al. 2011).

1.1.3.1.3 Recreational Redband Trout Fishery

The recreational fishery for redband trout occurs in two locations: (1) above Keno Dam in Upper Klamath Lake and the lower Williamson and Wood Rivers and (2) below Keno Dam in the Keno Reach of the Klamath River. Effects of the No Action and action alternatives are considered separately for these two areas, based on conclusions of an Expert Panel convened in August 2010 to evaluate the effects of the No Action and action alternatives on resident fish (Buchanan et al. 2011).

Analysis of the No Action Alternative is based on current fishery conditions, as the Resident Fish Panel expected little change in the status of redband trout under that alternative. Information on current fishery conditions includes results of a creel survey conducted on Upper Klamath Lake by the Oregon Department of Fish and Wildlife (ODFW) and qualitative information regarding the fishery elsewhere. Due to data limitations, effects of the action alternatives are described in qualitative terms.

1.1.3.1.4 Recreational Sucker Fishery

A recreational snag fishery for Lost River and shortnose suckers existed in the early 1900s. The fishery peaked in the 1960s, but had declined precipitously by the 1980s. ODFW closed the fishery in 1987 (Markle and Cooperman 2001). Both Lost River and shortnose suckers were listed as “endangered” under the ESA in 1988, and recreational harvest opportunities have been nonexistent for over two decades. The Resident Fish Expert Panel included suckers in their evaluation (Buchanan et al. 2011). The qualitative analysis provided here reflects the Panel’s views on the prospects of recreational sucker harvest under the No Action and action alternatives.

1.1.3.2 Results

1.1.3.2.1 Alternative 1 – No Action Alternative

1.1.3.2.1.1 Recreational Salmon Fishery

Coho retention is prohibited in the Klamath River recreational fishery to address the consultation standard for SONCC coho. This prohibition is expected to continue into the future under Alternative 1.

For Alternative 1, the annual net economic value of the in-river recreational Chinook fishery is $1.648 million. In order to estimate the discounted stream of annual net economic values for the projection period 2012-61, the annual variability in in-river recreational harvest simulated by the EDRRA model was carried over to the net economic value projections by multiplying average annual net economic value ($1.648 million) by the ratio of median ocean recreational harvest in each simulated year to the mean of the median harvests projected by the EDRRA model for all simulated years under Alternative 1. The discounted stream of annual in-river salmon sport fishing values under the No Action Alternative equates to $36.4 million.

Fall Chinook (consisting largely of hatchery fish) is a much larger component of harvest in the fishery than spring Chinook, which is at low levels of abundance. This stock composition is likely to persist into the future under Alternative 1.

1.1.3.2.1.2 Recreational Steelhead Fishery

The Coho/Steelhead Expert Panel did not consider a change in the status of steelhead to be likely under the No Action Alternative (Dunne et al. 2011). Thus, Alternative 1 is characterized here in terms of existing conditions. Annual fishing activity under existing conditions is approximately 17,155 angler days (based on 2003-08 steelhead report card data) with an estimated annual economic value of $1.426 million – based on a net value per angler day derived from various steelhead valuation studies in the economics literature. The discounted stream of annual in-river steelhead sport fishing values under the No Action Alternative equates to $31.2 million.

An important component of the Klamath River steelhead fishery is the half-pounder fishery. Half pounders are immature steelhead (<16 inches) that migrate to the river while immature, then return to the ocean before again migrating to the river as adults (Jackson 2007). Half pounders are unique to northern California and southern Oregon. As indicated by Kesner and Barnhart (1972, p 218), “The fishery for half-pounders on the Klamath River is the most important of its type on the West Coast.” Data on the half-pounder fishery are sparse; steelhead report card holders are only required to provide catch data for steelhead that

are larger than 16 inches. This analysis does not cover the half-pounder fishery and, thus, underestimates steelhead fishing activity and value under Alternative 1.

1.1.3.2.1.3 Recreational Redband Trout Fishery

The Resident Fish Expert Panel expected the distribution and abundance of redband/rainbow trout to remain stable under the No Action Alternative (Buchanan et al. 2011). Thus, current fishery conditions provide a reasonable representation of fishing activity under this alternative.

The redband trout fishery is a renowned trophy fishery. Results of a creel survey conducted on Upper Klamath Lake (UKL) and Agency Lake during May 18 – September 30, 2009, indicate that 15,191 angler days (6,109 bank, 9,082 boat) occurred during the survey period (pers. comm. William Tinniswood, ODFW). According to Messmer and Smith (2007, p. 92), The tributary streams above Upper Klamath Lake "offer some of the best fly fishing in the United States"; however, quantitative estimates of effort and harvest for that area are not available. The fishery below Keno Dam is largely limited to the Keno Reach (Keno Dam to J.C. Boyle Dam), which redband trout also reach trophy size. Fishing activity below J.C. Boyle is likely modest, as hydropower operations make fishing conditions (fishable flows) during daylight hours unpredictable (pers. comm. William Tinniswood, ODFW). Quantitative estimates of effort and harvest are not available for the fishery below Keno Dam.

1.1.3.2.1.4 Recreational Sucker Fishery

The recreational sucker fishery has been closed since 1987 and the prospects of a future fishery are unlikely under the No Action Alternative. As noted by the Resident Fish Expert Panel, "With declining populations under the current conditions, there are no opportunities for tribal or recreational harvest" (Buchanan et al. 2011, p. 71).

1.1.3.2.2 Alternative 2 – Full Facilities Removal of Four Dams

1.1.3.2.2.1 Recreational Salmon Fishery

Alternative 2 will increase the viability of coho populations in the Klamath Basin portion of the SONCC coho ESU. However (for reasons cited in Section 1.1.2.1) this alternative by itself is unlikely to lead to de-listing of the ESU as a whole. Thus, the prohibition on coho retention in California's in-river recreational fishery will likely continue under this alternative.

Average annual net economic value of the Chinook recreational fishery is $1.774 million. The annual increase in net economic value under Alternative 2

relative to Alternative 1 is $126.4 thousand (+8%). The stream of incremental river sport fishery benefits for Alternative 2 in excess of the No Action Alternative across the 2012 to 2061 period equates to a discounted present value of $1.75 million.

Additional insights provided by the EDRRA model regarding the effects of Alternative 2 relative to Alternative 1 are as follows:

- The 5th percentile harvest value for Alternative 2 is 56% lower than the 5th percentile value for Alternative 1, and the 95th percentile harvest value is 1393% higher. That is, the posterior harvest distribution under Alternative 2 is positively skewed and exhibits a high degree of overlap with the Alternative 1 harvest distribution.

- Annual harvest is projected to be higher in 60% of years under Alternative 2 than Alternative 1.

- The harvest control rule incorporated into the EDRRA model limits the harvest rate to 10% or less when pre-harvest escapements fall below 30,500 adult natural spawners. Escapements this low would likely be accompanied by major regulatory restrictions and adverse economic conditions for the fishery. Such conditions are projected to occur in 66% fewer years under Alternative 2 than Alternative 1; the decline is even larger (-80%) when considering just the post-dam removal years 2021-61.

The Biological Subgroup expects the action alternatives to provide habitat favorable to spring Chinook. The Lindley/Davis model indicates some potential for modest harvest of spring Chinook. The Expert Panel considers that prospect to be much less certain for spring than fall Chinook. An increase in spring Chinook abundance is more likely to be advantageous to in-river than ocean fisheries, as (given the run timing of spring Chinook relative to the season structure for the ocean fisheries) a large portion of the spring run will have returned to the river by the time of the opening of the ocean fisheries. To the extent that spring Chinook numbers become sufficient to allow in-river recreational harvest, economic benefits can be expected, as spring Chinook are highly desirable for their fat content and have the potential to temporally expand recreational harvest opportunities beyond the current fall Chinook season.

1.1.3.2.2. Recreational Steelhead Fishery

According to the Coho/Steelhead Expert Panel, any adverse effects of dam removal activities on coho and steelhead will likely be short term. Over the longer term, the Panel concludes that Alternative 2 may lead to increases in the abundance and spatial distribution of steelhead, including successful colonization

of the Upper Basin. These conclusions are accompanied by a number of conditions including effective implementation of the Klamath Basin Restoration Agreement (KBRA) and successful fish passage through Keno Reservoir and Upper Klamath Lake (Dunne et al. 2011). The Biological Subgroup concluded that the action alternatives would lead to expansion of the steelhead fishery above Iron Gate Dam. The Subgroup also noted that Upper Basin habitat would be favorable to steelhead due to their ability to navigate steep gradients and spawn in small streams and their resistance to *C. Shasta* (Hamilton et al. 2011).

It is not possible to draw quantitative economic inferences from the Panel's conclusions (which are not quantified and subject to a number of caveats). However, Alternative 2 appears to provide notable potential to enhance the net economic value of the steelhead fishery from its discounted net present value of $31.2 million under Alternative 1.

1.1.3.2.2.3 Recreational Redband Trout Fishery

The Resident Fish Expert Panel predicts marked improvement in the redband trout fishery under Alternative 2. With regard to the fishery above Keno Dam, the Panel predicts an expansion in the distribution and abundance of large-sized trout in UKL and the lower Williamson and Wood Rivers. With regard to the fishery below Keno, the Panel concludes that short-term adverse impacts from dam removal would be outweighed by increases in the size and abundance of resident trout in the 43 miles between J.C. Boyle Reservoir and IGD and a potential seven-fold increase in the fishery (Buchanan et al. 2011).

While the Panel spoke favorably regarding improvement in fishery conditions above Keno, the qualitative nature of their evaluation and the lack of quantitative data on fishing activity in the tributaries make it infeasible to quantify the economic effects of such improvement. For the area below Keno, the Panel did quantify potential effects in terms of a potential seven-fold expansion relative to current conditions; however, lack of data on fishing effort below Keno makes it infeasible to draw quantitative inferences for that area. Nevertheless, even given the lack of quantitative information, it is likely that Alternative 2 would represent a major change from current conditions and a considerable increase in the value of the redband trout fishery.

1.1.3.2.2.4 Recreational Sucker Fishery

The prospects for restoration of the recreational sucker fishery appear quite limited under Alternative 2. As noted by the Resident Fish Expert Panel, "Under KBRA, populations are likely to increase beginning about 2022 based on increasing survival of larval and juvenile suckers and recruitment of new adult year classes. However, until population monitoring indicates an upward trend in the population over at least a decade with major recruitment events and multiple

age classes, harvest would reduce or negate population growth. Harvest other than ceremonial tribal harvest should only occur after a sustained population growth can be shown over a period of decades" (Buchanan et al. 2011, pp. 71-72).

1.1.3.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

1.1.3.2.3.1 Recreational Salmon Fishery

Alternative 3 provides the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. The effects of this alternative on salmon populations and salmon fisheries – including the in-river recreational fishery – are expected to be the same as Alternative 2.

1.1.3.2.3.2 Recreational Steelhead Fishery

Alternative 3 provides the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. The effects of this alternative on steelhead populations and the recreational steelhead fishery are expected to be the same as Alternative 2.

1.1.3.2.3.3 Recreational Redband Trout Fishery

Alternative 3 provides the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. The effects of this alternative on redband trout and the recreational redband fishery are expected to be the same as Alternative 2.

1.1.3.2.3.4 Recreational Sucker Fishery

Alternative 3 provides the same KBRA benefits as Alternative 2 and is thus expected to provide the same benefits to sucker populations. However, just as the recreational sucker fishery is unlikely to reopen under Alternative 2, it is equally unlikely to reopen under Alternative 3.

1.1.3.3 References

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1.1.4 Ocean Sport Fishing

The economic analysis provided here summarizes the effects of the No Action and action alternatives on the ocean recreational fishery. Further details regarding the methodologies, assumptions, and conclusions underlying this analysis are contained in the *Ocean Sport Fishing Economics Technical Report* (NOAA 2011).

1.1.4.1 Methodology and Assumptions

The particular salmon stocks influenced by the No Action and action alternatives are the SONCC coho ESU and Klamath River fall and spring Chinook. The ocean migratory range of SONCC coho and Klamath Chinook is largely limited to the area south of Cape Falcon, Oregon. The area south of Cape Falcon is divided into six management areas: Monterey, San Francisco, Fort Bragg, Klamath Management Zone (KMZ), Central Oregon, and Northern Oregon. For purposes of this analysis, the KMZ (which straddles the Oregon-California border) is divided at the border into two areas: KMZ-OR and KMZ-CA. Effects of the No Action and action alternatives on the ocean recreational fishery are differentiated among these seven areas.

The SONCC coho ESU is listed as 'threatened' under the ESA. This ESU is comprised of 28 populations ranging from the Elk and Rogue Rivers in southern Oregon to the Eel River in northern California and includes the coho populations in the Klamath Basin (Williams et al. 2008). The action alternatives are expected

to increase the viability of Klamath River coho populations (Dunne et al. 2011). However, since these alternatives do not include coho restoration outside the Klamath Basin, they alone will not create conditions that would warrant de-listing of the SONCC coho ESU throughout its range. Nevertheless, the action alternatives will increase the viability of coho populations in the Klamath Basin and advance the recovery of the SONCC coho ESU.

Evaluation of effects on fall and spring Chinook is based on results of two models – the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model (Hendrix 2011) and a habitat comparison model (Lindley and Davis 2011) – and conclusions of the Biological Subgroup (Hamilton et al. 2011) and an Expert Panel convened to evaluate the effects of the alternatives on Chinook salmon (Goodman et al. 2011).

The EDRRA model is a simulation model that provides 50-year projections of Klamath Chinook escapement and harvest under the No Action and action alternatives. The EDRRA harvest projections pertain to Klamath Basin Chinook and do not distinguish between spring and fall runs. Harvest is estimated for each simulated year on the basis of a new Klamath fall Chinook harvest control rule recommended by the Pacific Fishery Management Council (PFMC) to NMFS in June 2011. The model distributes total Klamath River Chinook harvest among fisheries as follows: 50.0% to tribal fisheries, 7.5% to the in-river recreational fishery (up to a maximum of 25,000 fish – with any surplus above 25,000 allocated to escapement), 34.0% to the ocean commercial fishery, and 8.5% to the ocean recreational fishery. The 50-50 tribal/non-tribal split is a "hard" allocation specified by the U.S. Department of the Interior (DOI 1993) on behalf of the Yurok and Hoopa Valley tribes. The distribution of the remaining 50.0 percent among the three non-tribal fisheries represents customary practice rather than mandatory conditions.

Due to certain assumptions underlying the EDRRA model (e.g., that ocean abundance is known without error), the absolute harvest projections provided by the model represent an idealized version of real world conditions. To anchor EDRRA projections to the real world, average annual ocean recreational harvest of Klamath Chinook during 2001-05 (4,255 fish) was used to characterize the No Action Alternative. The years 2001-05 were selected as the base period for the following reasons: Klamath River fall Chinook fell within a 'normal' range of abundance during those years; abundance of Sacramento River fall Chinook (which is targeted along with Klamath River fall Chinook in the ocean fishery south of Cape Falcon) also fell within a 'normal' range; constraints and policies that are likely to continue into the future – e.g., more conservative harvest policies established in the 1990s to protect weaker stocks (including two Chinook and three coho ESUs listed under the ESA), the 50-50 tribal/non-tribal harvest allocation – were well established by the early 2000s; and unusually depressed fishery conditions after 2005 made those years unsuited for base period

characterization. Annual Klamath Chinook harvest under the action alternatives (6,075 fish) was estimated by scaling average 2001-05 harvest upward, based on the percent difference between the EDRRA's 50th percentile harvest projections for the No Action and action alternatives (+43%).

Area-specific estimates of harvest and net economic value for each alternative were derived as follows: (1) Total ocean recreational harvest of Klamath River fall Chinook projected under each alternative was distributed among management areas to reflect the distribution experienced during 2001-05 (data source: Michael O'Farrell, NMFS). (2) In KMZ-CA and KMZ-OR, Klamath Chinook is managed as a "constraining stock"; that is, the amount of Chinook harvest (all stocks) made available to the recreational fishery depends on the allowable harvest of Klamath Chinook. To account for this phenomenon, Klamath Chinook harvest in each area was divided by an area-specific expansion factor – calculated on the basis of 2001-05 data as the ratio of Klamath Chinook harvest to total Chinook harvest (data source: Michael O'Farrell, NMFS). For all other areas (Monterey, San Francisco, Fort Bragg, Central Oregon, Northern Oregon), Klamath Chinook is rarely a constraining stock. For these latter areas, the expansion factor was set equal to 1.0. (3) The resulting Chinook harvest estimate (all stocks) for each area was converted from numbers of fish to angler days – based on area-specific estimates of the ratio of effort to harvest, calculated with 2001-05 data (data source: PFMC 2011). (4) Total net economic value was estimated by multiplying number of angler days associated with each area by net economic value per angler day – estimated at $152.37, based on a travel cost model estimated with data collected in a 2000 survey of recreational anglers sponsored by NMFS.

While the EDRRA model focuses on Chinook escapement and harvest of spring and fall runs combined, other studies and reports distinguish the alternatives more finely in terms of their effects on specific runs or areas. According to the Biological Subgroup, the action alternatives are expected to provide habitat favorable to spring Chinook – e.g., additional coldwater tributaries and springs that provide thermal refugia (Hamilton et al. 2011). The Lindley/Davis habitat model involved compilation of escapement and watershed attribute data for 77 fall and spring Chinook populations in various watersheds in Washington, Oregon, Idaho, and northern California and comparison of these attribute sets with the attributes of Upper Basin watersheds. Based on their analysis, the authors concluded that Upper Basin attributes fall well within the range of spring bearing watersheds and that viable populations of spring-run Chinook salmon in the upper Klamath would improve the sustainability of the ESU as a whole (Lindley and Davis 2011). The Chinook Expert Panel concluded that "The Proposed Action offers greater potential for increased harvest and escapement of Klamath Chinook salmon than the Current Conditions" (Goodman et al., p 16). The Panel noted the potential for a "substantial increase" in Chinook abundance in the area between IGD and Keno Dam. The Panel indicated that the possibility of successful Chinook introduction above Keno Dam was potentially large but

less certain and contingent on successful implementation of the KBRA and resolution of issues such as water quality and fish disease. The Panel also noted that the possibility of substantial positive effects from the proposed action was much lower for spring than fall Chinook (Goodman et al. 2011).

The quantitative projections provided in the economic analysis are based on EDRRA model outputs, which do not differentiate between spring and fall Chinook. Actual harvest opportunities for a given fishery may deviate somewhat from the projections provided here, depending on the extent to which the harvestable surplus includes spring Chinook, as some fisheries have better access to spring Chinook than others. The Biological Subgroup, Lindley/Davis and Expert Panel results provide insights regarding effects of the action alternatives on spring Chinook. Given that these latter sources do not claim substantial increases in spring Chinook, the economic analysis distinguishes between fall and spring Chinook by qualitatively considering what a modest share of spring Chinook in the harvestable surplus might mean for each fishery (including the ocean recreational fishery).

1.1.4.2 Results

1.1.4.2.1 Alternative 1 – No Action Alternative

Coho retention has been prohibited in California's recreational fishery since 1996 to meet the consultation standard for ESA-listed Central California Coast coho (listed in 1996); this prohibition also meets the consultation standard for SONCC coho (listed in 1997). In 1999, a mark-selective recreational coho fishery was established in Oregon with a marked coho quota and season limits to ensure that the fishery does not exceed maximum allowable exploitation rates for three ESA-listed coho ESUs – including SONCC coho (PFMC 2011). These California and Oregon regulations are expected to continue into the future under Alternative 1.

Annual net economic value associated with total Chinook harvest (all stocks) attributable to Klamath Chinook availability under Alternative 1 is $6.697 million (table 1.1-3).

In order to estimate the discounted stream of annual net economic values for the projection period 2012-61, the annual variability in ocean recreational harvest simulated by the EDRRA model was carried over to the net economic value projections by multiplying average annual net economic value ($6.697 million) by the ratio of median ocean recreational harvest in each simulated year to the mean of the median harvests projected by the EDRRA model for all simulated years under Alternative 1. The discounted stream of annual ocean sport fishing values under the No Action Alternative equates to $147.4 million.

Table 1.1-3.—Projected annual net economic value in the ocean recreational fishery (all stocks) attributable to Klamath River Chinook availability under Alternative 1, by management area (2012 dollars)

Management area	MED
Monterey	34,191
San Francisco	93,527
Fort Bragg	246,969
KMZ-CA	3,844,933
KMZ-OR	2,236,014
Central OR	150,429
Northern OR	91,340
Total	6,697,401

Fall Chinook (consisting largely of hatchery fish) is currently a much larger component of ocean recreational harvest than spring Chinook, which is at low levels of abundance. This stock composition is likely to persist into the future under Alternative 1.

1.1.4.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Alternative 2 will increase the viability of coho populations in the Klamath Basin portion of the SONCC coho ESU. However (for reasons discussed in Section 1.1.2.1), this alternative by itself is unlikely to lead to de-listing of the ESU as a whole. Thus, the prohibition on coho retention in California and the mark-selective coho regulations in Oregon will likely continue under Alternative 2.

Annual net economic value associated with total Chinook harvest (all stocks) attributable to Klamath Chinook availability under Alternative 2 is $9.562 million (table 1.1-4).

The average annual increase in net economic value (all areas) under Alternative 2 relative to Alternative 1 is $2.865 million (+43%) The stream of incremental ocean sport fishery benefits for Alternative 2 in excess of the No Action Alternative across the 2012 to 2061 period equates to a discounted present value of $52.8 million.

Table 1.1-4.—Projected annual net economic value in the ocean recreational fishery (all stocks) attributable to Klamath River Chinook availability under Alternative 2, and increase in annual net economic value relative to Alternative 1, by management area (2012 dollars)

Management Area	Annual net economic value	Difference from Alternative 1
Monterey	48,815	14,624
San Francisco	133,531	40,004
Fort Bragg	352,605	105,636
KMZ-CA	5,489,534	1,644,601
KMZ-OR	3,192,429	956,415
Central OR	214,772	64,343
Northern OR	130,409	39,069
Total	9,562,094	2,864,693

Additional insights provided by the EDRRA model regarding the effects of Alternative 2 relative to Alternative 1 are as follows:

- The 5th percentile harvest value for Alternative 2 is 57% lower than the 5th percentile value for Alternative 1, and the 95th percentile harvest value is 725% higher. That is, the posterior harvest distribution under Alternative 2 is positively skewed and exhibits a high degree of overlap with the Alternative 1 harvest distribution.

- Despite the extent of overlap in the Alternative 1 and 2 harvest distributions, annual harvest is projected to be higher in 70% of years under Alternative 2 than Alternative 1.

- The harvest control rule incorporated into the EDRRA model limits the harvest rate to 10% or less when pre-harvest escapements fall below 30,500 adult natural spawners. Escapements this low would likely be accompanied by major regulatory restrictions and adverse economic conditions for the fishery. Such conditions are projected to occur in 66% fewer years under Alternative 2 than Alternative 1; the decline is even larger (-80%) when considering just the post-dam removal years 2021-61.

The Biological Subgroup expects the action alternatives to provide habitat favorable to spring Chinook. The Lindley/Davis model indicates some potential for modest harvest of spring Chinook. The Expert Panel considers that prospect to be much less certain for spring than fall Chinook. An increase in spring Chinook is more likely to be advantageous to in-river fisheries than the ocean

recreational fishery, as (given the run timing of spring Chinook relative to the current ocean recreational season structure) a large portion of the spring run will have returned to the river by the time the season opens.

1.1.4.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Alternative 3 is intended to provide the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. Therefore, the effects of this alternative on Chinook and coho populations and the ocean recreational fishery are expected to be the same as Alternative 2.

1.1.4.3 References

Dunne, T. et al. April 25, 2011. Klamath River Expert Panel Final Report – Scientific Assessment of Two Dam Removal Alternatives on Coho Salmon and Steelhead. With the assistance of Atkins (formerly PBS&J), Portland, OR.

Goodman, D. et al. 2011. Klamath River Expert Panel Addendum to Final Report – Scientific Assessment of Two Dam Removal Alternatives on Chinook Salmon. With the assistance of Atkins (formerly) PBS&J, Portland, OR.

Hamilton, J. et al. 2011. Synthesis of the Effects to Fish Species of Two Management Scenarios for the Secretarial Determination on Removal of the Lower Four Dams on the Klamath River – Final Draft. Prepared by the Biological Subgroup (BSG) for the Secretarial Determination (SD) Regarding Potential Removal of the Lower Four Dams on the Klamath River.

Hendrix, N. 2011. Forecasting the response of Klamath Basin Chinook populations to dam removal and restoration of anadromy versus no action. R2 Resource Consultants Inc., Redmond, Washington. Review draft dated May 16, 2011.

Lindley, S. and H. Davis. 2011. Predicted Escapement of Chinook Salmon to Areas Above Iron Gate Dam Based on Geographic Attributes of Watersheds. Review draft dated May 16, 2011.

NOAA National Marine Fisheries Service. 2011. Ocean Sport Fishing Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon.

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Waples, R.S. 1991. Definition of "Species" Under the Endangered Species Act: Application to Pacific Salmon. NOAA Technical Memorandum NMFS F/NWC-194. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA.

Williams, T.H. et al. December 2008. Framework for Assessing Viability of Threatened Coho Salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit. NOAA-TM-NMFS-SWFSC-432.

1.1.5 Refuge Recreation

1.1.5.1 Methodology and Assumptions

To estimate net benefits of refuge recreation as measured by the additional value wildlife-watching refuge visitors experience above and beyond their actual expenditures associated with their visits, this analysis relied on information derived from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. This survey collected information from respondents concerning their surplus values associated with these recreational outdoor activities. For the purposes of this analysis, an average was computed using the reported results for California and Oregon. The Survey reported both a mean and a median estimate for each State, which were averaged and used as a lower and upper-bound to estimate baseline wildlife-watching economic surplus values. The median value for a state resident (in 2012 dollars) was $33.49 and the mean was $68.09. Out of state residents had a mean value of $107.16 and a median of $63.07.

To estimate the net economic benefits (economic surplus) for hunting trips this analysis relied on values used in the U.S. Fish and Wildlife Service's *Economic Analysis of the Migratory Bird Hunting Regulations for the 2008-2009 Season*. A different source was used for deriving these estimates because the National Survey did not collect any consumer surplus information for waterfowl hunting activities. The consumer surplus value per day of recreational waterfowl hunting along the Pacific flyway was estimated to range between $45.44 and $62.75 per day (2012 dollars).

Net benefit estimates for each of the three alternatives were only estimated for hunting visits as no significant relationship could be identified between reported wildlife-viewing trips and waterfowl numbers. Additional detail can be found in the Refuge Recreation Economics Technical Report (Maillett 2011).

1.1.5.2 Results

1.1.5.2.1 Alternative 1 – No Action Alternative

Under the No Action Alternative, the economic surplus associated with waterfowl hunting activities during a normal water year was estimated to range between $351,720 and $485,708. The midpoint of this range or $418,714 was used as the annual waterfowl hunting benefit within the benefit-cost analysis. The discounted stream of annual waterfowl hunting benefits for the No Action Alternative from 2012 to 2061 totals to $9.2 million. These estimates reflect a total estimate of 112,458 waterfowl, on average, during the hunting season and an estimated 7,740 hunting trips taken in response to the relative abundance of birds because a statistical relationship could not be detected between the number of waterfowl and reported wildlife watching trips, a net benefit estimate could not be estimated for waterfowl viewing trips.

1.1.5.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Under Alternative 2, the economic surplus associated with waterfowl hunting activities during a normal water year was estimated to range between $516,867 and $713,769 annually. As compared to the No Action Alternative, this represents a difference of $165,147 to $228,061 per year in economic benefit for hunters. The midpoint of this range or $196,604 was used as the annual waterfowl hunting benefit within the benefit-cost analysis. The discounted stream of incremental annual waterfowl hunting benefits for Alternative 2 in excess of the No Action Alternative from 2012 to 2061 totals to $4.3 million. Again, no estimate was derived for wildlife viewing activities because of the lack of a detectable relationship between waterfowl numbers and reported visits.

1.1.5.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Under Alternative 3, the economic surplus associated with waterfowl hunting activities during a normal water year was assumed to be the same as Alternative 2. Thus, the difference in per year in economic benefit for hunters as compared to the No Action Alternative would be the same as Alternative 2. Again, no estimate would be derived for wildlife viewing activities because of the lack of a detectable relationship between waterfowl numbers and reported visits.

1.1.5.3 References

Maillett, Edward, U.S. Fish and Wildlife Service, Division of Economics. Refuge Recreation Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. 2011.

Mauser, Dave and Tim Mayer, U.S. Fish and Wildlife Service, Effects of the Klamath Basin Restoration Agreement on Lower Klamath, Tule Lake, and Upper Klamath National Wildlife Refuges, 2010.

U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation.

U.S. Fish and Wildlife Service, Division of Economics, Economic Analysis of the Migratory Bird Hunting Regulations for the 2008-2009 Season, April 2008.

1.1.6 Non-Use Values

1.1.6.1 Methodology and Assumptions

Other sections of this document focused on human uses. These uses include fishing, whitewater boating, reservoir recreation, and hydropower. This section presents information on the methods used to evaluate non-use values.

Individual consumers use their incomes to purchase marketed goods and combine these marketed goods with time, human knowledge, and available non-marketed goods to produce a particular quality of life. In these terms, it is clear that an individual's perception of well-being is determined by the interaction of the individual's preferences and the available marketed and non-marketed goods. It is also clear that consideration of only the value of marketed goods could overlook important impacts of various alternatives if the alternatives affect nonmarket goods about which individuals care.

The factors that give rise to non-use values could include the following:

- Desire to preserve the functioning of specific ecosystems
- Desire to preserve the natural ecosystem to maintain the option for future use
- Feeling of environmental responsibility or altruism towards plants and animals

The literature on non-use values emphasizes the uniqueness or specialness of the resource in question and the irreversibility of the loss or injury.

Stated preference techniques must be used to evaluate the changes in non use values. These techniques typically involve surveying the public. DOI designed, pre-tested, pilot tested, and implemented a stated preference survey in order to evaluate the non-use benefits that would accrue to society from fish habitat and river ecosystem improvements in the Klamath River. The survey asked individuals to value two different scenarios for ecosystem restoration subsequent to dam removal. The scenarios differed in the extent to which fish populations would increase and how extinction risks might change, compared to the no action alternative. The survey is a nationwide survey, with oversampling within the Klamath Basin. Additional information on the sampling frame, survey content, response rates, etc., will be provided at a later date.

1.1.6.2 Results

1.1.6.2.1 Alternative 1 – No Action Alternative

The no action alternative is the baseline against which changes in non-use values will be evaluated.

1.1.6.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Until data from the stated preference survey has been collected, compiled, and analyzed, no additional information is available on the magnitude of estimated non-use values associated with dam removal.

1.1.6.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Until data from the stated preference survey has been collected, compiled, and analyzed, no additional information is available on the magnitude of estimated non-use values associated with dam removal.

1.1.7 Real Estate

1.1.7.1 Methodology and Assumptions

Another issue to consider is the effect dam removal might have on property values in the region. In concept, the value of the environmental amenities in the region are capitalized into property values, and changes in property values could serve as a measure of the benefits associated with the environmental improvements resulting from dam removal. Positive and negative property value changes might be anticipated, depending on property-specific factors.

An analysis of the value of environmental improvements based on property value changes could rely on a benefits transfer approach and look toward property value changes that occurred in other areas where dams may have been removed. Another approach could look at market transactions in the impacted region, comparing parcels whose values might be anticipated to change as a result of dam removal to parcels with characteristics similar to those currently present on parcels that do not have lake view, frontage, etc. This analysis would seek to compare the value of properties, for example, with reservoir views and/or frontage, to properties in the region lacking these characteristics. Information would also be needed on the extent to which some the value of some parcels might appreciate over time due to the improved environmental amenities. In areas with thin real estate markets, sufficient information may not be readily available to undertake a statistical analysis focused on evaluating the change in property values associated with the change in environmental quality resulting from dam removal.

An approach that seeks to estimate the value of environmental improvements by using property value information is an alternative to an approach that might rely on estimating the net economic benefits associated with specific resources, such as recreation water quality, or agriculture. Thus, including information on property value changes, as well as net economic benefit information, could result in double counting.

The literature on the extent to which dam removal impacts property values is limited, but some studies have found that adjacent property values either remained constant or decreased initially, but subsequently regained their value. The extent to which results from these studies can be generalized to other areas is uncertain.

The economic analysis in this report relied on estimating the net economic benefits associated with the various resources. While property value information could, in concept, have been used to estimate economic benefits (at least for some resources), sufficient information on property values and potential value changes was not readily available.

1.1.7.2 Results

1.1.7.2.1 Alternative 1 – No Action Alternative

Under this alternative, real estate values would not be expected to change, all else equal.

1.1.7.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Sufficient data are not available to conduct a statistical analysis of the changes in property values associated with environmental quality changes.

1.1.7.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Sufficient data are not available to conduct a statistical analysis of the changes in property values associated with environmental quality changes.

1.2 COST ANALYSES

The total cost of each proposed alternative was broken down into two primary components – project costs and foregone benefits.

Project costs include KBRA restoration costs, facility removal costs, site mitigation costs, and operations, maintenance, and replacement (OM&R) costs. KBRA habitat restoration costs are estimated to occur in the first 15 years of the period of analysis from 2012-2026. Facility removal costs, which occur during the single year de-construction period for each alternative (year 2020), include field costs related to construction contracts and noncontract costs related to engineering design, permitting, construction management, etc. Environmental and cultural resources site mitigation costs were spread across an 8-year period (2018-2025) both before and after dam removal. Finally, OM&R costs occur annually across the 50-year period of analysis. Since some OM&R costs would no longer be incurred under the proposed dam removal alternatives, the eliminated OM&R costs would reflect a cost savings. Under the Partial Facilities Removal of Four Dams Alternative, an additional cost associated with maintaining the facilities left in place would be required.

Several benefit categories (hydropower, reservoir recreation, and whitewater recreation) resulted in negative benefits since the benefits under the proposed dam removal alternatives were less than under the No Action Alternative. These foregone benefit categories are presented here under project costs as opposed to in the benefit section.

1.2.1 Project Costs

As noted above, project costs include KBRA restoration, facility removal, site mitigation, and OM&R costs.

1.2.1.1 KBRA Restoration Costs

While the KBRA program is referred to as restoration costs, it actually includes a wide range of activities including fisheries (restoration, reintroduction and monitoring), water resources (interim flow and lake level program, on and off

project water plans, energy efficiency), regulatory assurances (Keno Reservoir screening), county funding, and tribal funding (fisheries management, conservation, forestry). The fisheries (51%) and water resources (35%) components reflect the largest share of KBRA costs.

1.2.1.1.1 Methodology and Assumptions

Annual KBRA costs from 2012 through 2026 were obtained from the Klamath Basin Restoration Agreement for the Sustainability of Public and Trust Resources and Affected Communities (February 18, 2010), Appendix C-2 Revised, Budget of Implementation of Agreement. Since these costs were presented in 2007 dollars, they were escalated to 2012 dollars using the gross domestic product implicit price deflator (IPD) to be consistent with the other costs and benefits included in this report.

1.2.1.1.2 Results

Results are presented for each of the alternatives under consideration.

1.2.1.1.2.1 Alternative 1 – No Action Alternative

Certain KBRA costs were assumed to occur under agency base funding regardless of whether the proposed alternatives were accepted or not. As a result, these costs would be incurred under the No Action Alternative. Table 1.2-1 presents the KBRA oriented costs by year for the No Action Alternative. This stream of KBRA costs under the No Action Alternative totals to $258.5 million and equates to a present value of $199.1 million.

1.2.1.1.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Total KBRA costs measured in 2007 and 2012 dollars for years 2012-2026 under the Full Facilities Removal of Four Dams Alternative are shown in table 1.2-2.

The difference in KBRA costs between Alternative 2 and the No Action Alternative reflect the incremental KBRA costs used in the NED BCA. This stream of incremental KBRA costs associated with Alternative 2 was discounted to year 2012 resulting in an estimate of $474.1 million.

1.2.1.1.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

The KBRA costs under the Partial Facilities Removal of Four Dams Alternative would be the same as under the Full Facilities Removal of Four Dams Alternative.

Table 1.2-1.—KBRA costs by year – Alternative 1 (Millions $)

Year	Total costs (2012 $)
2012	15.862
2013	15.410
2014	15.396
2015	19.003
2016	20.195
2017	20.101
2018	20.447
2019	20.573
2020	20.773
2021	16.439
2022	14.853
2023	14.853
2024	14.853
2025	14.853
2026	14.853
Total:	**258.466**
Discounted:	**199.101**

Table 1.2-2.—KBRA costs by year – Alternative 2 (Millions $)

Year	Total costs (2007 $)	Total costs (2012 $)	Incremental costs as compared to the No Action Alternative (2012 $)
2012	24.2	25.2	9.4
2013	62.1	66.1	50.7
2014	60.4	65.1	49.7
2015	57.4	62.0	43.0
2016	61.8	66.7	46.5
2017	61.8	66.7	46.6
2018	77.7	84.1	63.6
2019	104.4	113.1	92.5
2020	93.9	101.6	80.8
2021	43.5	46.9	30.5
2022	34.2	37.0	22.1
2023	31.9	34.2	19.4
2024	30.4	32.6	17.8
2025	28.4	30.6	15.7
2026	26.5	28.5	13.6
Total:	**798.5**	**860.4**	**601.9**
Discounted:			**474.1**

1.2.1.2 Facility Removal Costs

Facility removal costs include the costs to remove dams, powerhouses, penstocks, etc., as well as the costs of sediment removal and road improvements.

1.2.1.2.1 Methodology and Assumptions

Facility removal costs were assumed to occur in year 2020 and include field costs related to construction contracts and noncontract costs related to engineering design, permitting, construction management, etc. Facility removal costs were estimated by study team cost engineers for J.C. Boyle, Copco 1, Copco 2, and Iron Gate Reservoirs. The costs of maintaining access to the river to provide water supply for the town of Yreka, CA was also included. While the full facility removal cost was estimated by Reclamation cost engineers in 2020 dollars to match the year of dam de-construction, to be consistent which the other costs and benefits included in the BCA, the facility removal costs were converted to 2012 dollars. In addition, because the environmental and cultural resources site mitigation costs, which were initially included in the facility removal cost estimates, were assumed to occur across an 8-year period (2018-2025) as opposed to all in year 2020, the mitigation costs were extracted from the facility removal cost estimates and treated separately within the BCA.

1.2.1.2.2 Results

Results are presented for each of the alternatives under consideration.

1.2.1.2.2.1 Alternative 1 – No Action Alternative

No facility removal costs would be associated with the No Action Alternative.

1.2.1.2.2.2 Alternative 2 – Full Facilities Removal of Four Dams

For comparison purposes, table 1.2-3 presents the construction and mitigation costs for the Full Facilities Removal of Four Dams Alternative by facility in both 2020 and 2012 dollars. As would be expected, the costs estimated in 2012 dollars are significantly less than those estimated in 2020 dollars. The year 2020 facility removal cost estimate in 2012 dollars for this alternative totaled $178.4 million. For use in the NED BCA, this cost was discounted to year 2012 resulting in an estimate of $129.1 million.

Table 1.2-3.—Full removal costs by facility

Cost element	Dollar year	J.C. Boyle (Millions $)	Copco 1 (Millions $)	Copco 2 (Millions $)	Iron Gate (Millions $)	Yreka Water Supply (Millions $)	Total (Millions $)
Facility removal and mitigation	2020	59.0	105.0	24.0	98.0	5.6	291.6
Facility removal	2012	36.0	65.0	15.0	59.0	3.4	178.4
Mitigation	2012	10.5	18.9	4.3	17.2	1.0	51.9
Facility removal and mitigation	2012	46.5	83.9	19.3	76.2	4.4	230.3

1.2.1.2.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

For comparison purposes, table 1.2-4 presents the construction and mitigation costs for the Partial Facilities Removal of Four Dams Alternative by facility in both 2020 and 2012 dollars. As would be expected, the costs estimated in 2012 dollars are significantly less than those estimated in 2020 dollars. The year 2020 facility removal cost estimate in 2012 dollars for this alternative totaled $135.4 million. For use in the NED BCA, this cost was discounted to year 2012 resulting in an estimate of $98.0 million.

Table 1.2-4.—Partial removal costs by facility

Cost element	Dollar year	J.C. Boyle (Millions $)	Copco 1 (Millions $)	Copco 2 (Millions $)	Iron Gate (Millions $)	Yreka Water Supply (Millions $)	Total (Millions $)
Facility removal and mitigation	2020	41.0	79.0	12.0	97.0	5.6	234.6
Facility removal	2012	24.0	46.0	7.0	55.0	3.4	135.4
Mitigation	2012	9.0	17.1	2.6	20.7	1.0	50.4
Facility removal and mitigation	2012	33.0	63.1	9.6	75.7	4.4	185.8

1.2.1.3 Site Mitigation Costs

Site mitigation costs represent the costs to mitigate environmental and cultural resources.

1.2.1.3.1 Methodology and Assumptions

Mitigation costs were extracted from the overall construction and mitigation cost estimate and treated as a separate cost component because the mitigation costs were assumed to be incurred from 2018-2025 as opposed to all in one year.

Total mitigation costs by alternative and facility were obtained from study team cost engineers. The sequence of years over which particular mitigation cost elements were expected to be incurred were also provided by study team cost engineers. Each mitigation cost element was spread equally across the number of years identified for that element.

1.2.1.3.2 Results

1.2.1.3.2.1 Alternative 1 – No Action Alternative

No mitigation costs are associated with the No Action Alternative.

1.2.1.3.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Table 1.2-5 presents annual mitigation costs for the Full Facilities Removal of Four Dams Alternative by facility in 2012 dollars. For use in the NED BCA, this stream of costs was discounted to year 2012 resulting in an estimate of $37.7 million.

Table 1.2-5.—Full removal mitigation costs by facility and year (2012 $)

Year	J.C. Boyle	Copco 1	Copco 2	Iron Gate	Yreka water supply	Total
2018	1,770,000	0	0	2,420,000	0	4,190,000
2019	2,080,000	4,200,000	3,340,000	5,400,000	0	15,020,000
2020	3,250,000	10,000,000	960,000	5,020,000	1,000,000	20,230,000
2021	2,290,000	4,700,000	0	2,790,000	0	9,780,000
2022	280,000	0	0	390,000	0	670,000
2023	280,000	0	0	390,000	0	670,000
2024	280,000	0	0	390,000	0	670,000
2025	280,000	0	0	390,000	0	670,000
					Total:	51,900,000
					Discounted:	37,729,000

1.2.1.3.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

Table 1.2-6 presents annual mitigation costs for the Partial Facilities Removal of Four Dams Alternative by facility in 2012 dollars. For use in the NED BCA, this stream of costs was discounted to year 2012 resulting in an estimate of $36.6 million.

Table 1.2-6.—Partial removal mitigation costs by facility and year (2012 $)

Year	J.C. Boyle	Copco 1	Copco 2	Iron Gate	Yreka water supply	Total
2018	1,520,000	0	0	2,910,000	0	4,430,000
2019	1,790,000	3,800,000	2,020,000	6,500,000	0	14,110,000
2020	2,780,000	9,050,000	580,000	6,040,000	1,000,000	19,450,000
2021	1,970,000	4,250,000	0	3,360,000	0	9,580,000
2022	240,000	0	0	470,000	0	710,000
2023	240,000	0	0	470,000	0	710,000
2024	240,000	0	0	470,000	0	710,000
2025	240,000	0	0	470,000	0	710,000
					Total:	50,410,000
					Discounted:	36,629,000

1.2.1.4 Operations, Maintenance, and Replacement (OM&R) Costs

OM&R costs reflect the annual costs to operate and maintain the facilities, as well as the costs to conduct periodic replacements of specific features.

1.2.1.4.1 Methodology and Assumptions

Annual OM&R costs were estimated across the 50-year period of analysis for each alternative and facility by study team cost engineers. The difference in annual OM&R costs between the No Action Alternative and facility removal alternatives were used to reflect the annual OM&R costs for each proposed alternative. In addition to the standard OM&R cost analysis, for the Partial Facilities Removal of Four Dams Alternative, cost estimates were developed to maintain the facilities left in place.

1.2.1.4.2 Results

1.2.1.4.2.1 Alternative 1 – No Action Alternative

Annual OM&R costs would occur every year under the No Action Alternative. These costs were estimated to average $9.34 million and range from a high of

$31.98 million to a low of $4.37 million. The discounted stream of annual OM&R costs across the 2012-2061 period equates to $219.4 million.

1.2.1.4.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Annual OM&R costs would only occur for the first 8 years of the period of analysis (2012-2019). The OM&R costs for these first 8 years were estimated to be less than those under the No Action Alternative because it was assumed replacement costs would be forgone given the impending facilities removal. Upon removal of the facilities in year 2020, OM&R costs would no longer be incurred implying zero OM&R costs under this alternative for years 2020-2061. As a result, the change in annual OM&R costs under the Full Facilities Removal of Four Dams Alternative as compared to the No Action Alternative was negative implying annual OM&R cost savings for this alternative. The annual OM&R cost savings averaged $8.64 million and ranged from a high of $31.98 million to a low of zero. For use in the NED BCA, this stream of cost savings was discounted to year 2012 resulting in a cost savings estimate of $188.9 million.

1.2.1.4.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

The annual OM&R cost differential between the Partial Facilities Removal of Four Dams Alternative and the No Action Alternative is the same as described above under the Full Facilities Removal of Four Dams Alternative ($188.9 million discounted to year 2012). In addition to the standard OM&R cost analysis, a further maintenance cost element was required for the facilities remaining in place. Annual and periodic costs to maintain the facilities left in place were developed by study team cost engineers. The cost engineers discounted their costs to year 2021, the start of the post de-construction maintenance period, providing an estimate of $9.35 million. Since this estimate was measured in year 2021, it was discounted back to year 2012 resulting in an estimate of $6.5 million. For use in the NED BCA, these discounted cost savings and additional maintenance costs were combined resulting in a net cost savings of $182.4 million.

1.2.2 Annual Foregone Benefits

This cost section displays the foregone benefits. Foregone benefits are associated with benefit categories where the benefits under the No Action Alternative are greater than those under the proposed facility removal alternatives. Instead of presenting these foregone benefits as negative benefits within the benefits section, they are presented as a cost within this cost section. Foregone benefits were estimated for hydropower, reservoir recreation, and whitewater recreation.

1.2.2.1 Foregone Hydropower Benefits

1.2.2.1.1 Methodology and Assumptions

The removal of four hydropower plants on the Klamath River (J.C. Boyle, Copco 1, Copco 2, and Iron Gate) is being considered as one component of a larger plan to restore aquatic habitat in the Klamath River Basin. In aggregate, these four plants have an installed generation capacity of approximately 163 megawatts (MW).

The Hydropower Economics Technical Report (Reclamation 2011) discusses in detail the methodology and results of the hydropower economic benefit analysis summarized here. By design, the analysis was limited to the hydropower economic benefits provided by the four Klamath River hydropower plants and assessed how these benefits would change with dam removal. The economic analysis conforms to the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (U.S. Water Resources Council 1983). The base year for this analysis is 2012, and the period of analysis is January 1, 2012 through December 31, 2061, a 50-year period.

Underlying the analysis were 49 modeled hydrologic sequences or traces, each of which is 50 years in length. These modeled sequences were employed for both Alternative 1 – No Action and Alternative 2 - Full Facilities Removal of Four Dams in order to capture the effects of hydrologic variability. The No Action Alternative hydrology characterizes the management of the Klamath River Basin under the National Marine Fisheries Service (2010) and Fish and Wildlife Service (2008) Biological Opinions. The hydrology for the Full Facilities Removal of Four Dams Alternative reflects the expected operation of the Klamath River Basin under the Klamath Hydroelectric Settlement Agreement (KHSA 2010) and the Klamath Basin Restoration Agreement (KBRA 2010).

The Klamath Dam Removal Model, a RiverWare based model of the four Klamath River hydropower plants was used to simulate daily plant operations, which were aggregated to a monthly time-step for purpose of this analysis. Monthly on-peak and off-peak generation at these plants was evaluated using monthly forecast prices for the California Oregon Border electrical interchange, developed by the Northwest Power and Conservation Council.

1.2.2.1.2 Results

1.2.2.1.2.1 Alternative 1 – No Action Alternative

With the No Action Alterative, the four Klamath River hydropower plants would generate an average of 895,846.9 megawatthours of electricity annually. Dependable capacity, a measure of the maximum generation capability available on a reliable basis, was estimated to be 55.9 MW in summer and 66.6 MW in

winter, using the 90 percent exceedence method. The output from these four plants was estimated to have a mean present economic value of $ 1,609,310,821 (2012 dollars) over the 50-year analysis period.

1.2.2.1.2.2 Alternative 2 – Full Facilities Removal of Four Dams

Under the Full Facilities Removal of Four Dams Alternative, the four Klamath River hydropower plants were expected to operate normally during the period 2012 through 2019 (8 years). Dam removal was assumed to occur instantaneously at one minute past midnight on January 1, 2020 and the production of electrical energy and capacity at the four hydropower plants was expected to be zero from January 1, 2020 through the end of 2061 (42-years). For this alternative, the estimated mean present value of hydropower economic benefits was approximately $ 289,223,758 (2012$), over the 50-year analysis period. Relative to the no action case, this represents a mean reduction in economic benefits of $ 1,320,087,063 (2012$) a loss of approximately 82.03 percent.

1.2.2.1.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

With partial removal of all four dams, the assumption was made that the production of electrical energy and capacity at the four hydropower plants would be the same as with the full facilities removal of four dams. As a result, the reduction in economic benefits of Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be the same as under the Full Facilities Removal of Four Dams Alternative.

1.2.2.1.3 References

Bureau of Reclamation. 2011. U.S. Department of the Interior, Bureau of Reclamation. 2011. Hydropower Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

Klamath Basin Restoration Agreement (KBRA). 2010. Klamath Basin Restoration Agreement for the Sustainability of Public and Trust Resources and Affected Communities. February 18, 2010. Available at: http://klamathrestoration.gov

Klamath Hydroelectric Settlement Agreement (KHSA). 2010. Klamath Hydroelectric Settlement Agreement. February 18, 2010. Available at: http://klamathrestoration.gov

U.S. Water Resources Council. 1983. Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. Washington, D.C.: U.S. Government Printing Office.

1.2.2.2 Foregone Reservoir Recreation Benefits

Of the four reservoirs impacted by this study, significant recreation activity currently occurs at only three: J.C. Boyle, Copco 1, and Iron Gate. For various reasons, Copco 2 does not generate significant recreation activity. Therefore, the reservoir recreation analysis focuses exclusively on J.C. Boyle, Copco 1, and Iron Gate Reservoirs.

1.2.2.2.1 Methodology and Assumptions

The Reservoir Recreation Economics Technical Report (Reclamation 2011) discusses the methodology and results of the reservoir recreation analysis in detail. To summarize, average recreation economic values per visit calculated for each reservoir were applied to annual estimates of visitation at each reservoir for each alternative (Alternative 1 - No Action, Alternative 2 - Full Facilities Removal of Four Dams, and Alternative 3 - Partial Facilities Removal of Four Dams) to develop annual estimates of alternative specific reservoir recreation value. Since dam removal is anticipated to begin in year 2020, reservoir recreation values were estimated annually from 2020 through the end of the analysis period in 2061. Changes in annual reservoir recreation value for the proposed alternatives were estimated by comparing annual values for each proposed alternative to those of the No Action Alternative. These changes in recreation value associated with the proposed alternatives represent the reservoir recreation benefit. Since the overall study period actually begins in 2012, these annual changes in recreation value/benefit for the proposed alternatives were discounted back to 2012 using the current 2011 Federal water project planning rate of 4.125 percent.

The information used to develop the projected visitation estimates at each reservoir relies heavily upon a recreation survey and report developed as part of the Federal Energy Regulatory Commission (FERC) relicensing effort (PacifiCorp, 2004). The survey, conducted back in 2002, was used to gather information for estimating visitation at each reservoir. Forecasts of regional population growth and trends in regional recreation visitation were used to develop visitation growth rates which were employed to project visitation at each reservoir through year 2061. Changes in recreation visitation at each reservoir for the proposed alternatives as compared to the No Action Alternative were adjusted to account for possible site substitution. As described in the Reservoir Recreation Economics Technical Report (Reclamation 2011), a visitation-based five-county market area (Klamath OR, Jackson OR, Josephine OR, Siskiyou CA, Shasta CA)

was defined for reservoir recreation. Recreators from inside and outside the market area were treated differently in terms of their site substitution potential. Recreators from outside the market area were assumed not to substitute. Conversely, only a small portion of within market area recreators was assumed not to substitute. The non-substituting portion was based on recreators who indicated each reservoir to be their favorite site.

Recreation economic values per visit at each reservoir were developed based on information obtained from a nationwide review of recreation valuation studies (Loomis 2005). Values by activity for the Pacific Coast Region (WA, OR, CA) were selected from the Loomis (2005) study. A weighted average value per visit was calculated for each reservoir based on visitation percentages by activity obtained from the PacifiCorp survey combined with the Loomis (2005) values per visit. To be consistent with the other benefit and costs estimates, the estimates of value per visit at each reservoir in 2005 dollars were indexed up to 2012 dollars using the Consumer Price Index for the Western United States.

1.2.2.2.2 Results

1.2.2.2.2.1 Alternative 1 – No Action Alternative

Total visitation in year 2002 (year of the PacifiCorp recreation survey) at the three reservoirs (J.C. Boyle, Copco 1, and Iron Gate) was estimated in the PacifiCorp recreation report at 95,470 recreation days. Projecting into the future using PacifiCorp's annual activity specific growth rates, results in an estimated 112,900 days in 2020 and 167,500 days in 2061 across the three reservoirs. Aggregating visitation across all three reservoirs for years 2020 to 2061 totals over 5.8 million recreation days.

Applying the weighted average recreation economic values per visit for each reservoir to the estimates of recreation visitation at each reservoir and discounting the annual value estimates back to year 2012 results in a total discounted reservoir recreation economic value of $99.5 million across all three reservoirs under the No Action Alternative.

A significant blue-green algae problem exists at Copco 1 and Iron Gate Reservoirs (but not J.C. Boyle Reservoir) sufficient to warrant health advisories related to water ingestion or contact. These advisories suggest avoiding use of water for cooking and washing as well as avoiding the consumption of fish. While these advisories have been in place for several years, no data exist as to their impact on recreation visitation primarily due to the lack of recreational data collection at these sites. Should these algae problems continue across the 50-year period of analysis for this study, a significant percentage of visitation at Copco 1 and Iron Gate Reservoirs may be lost. This could significantly reduce the baseline level of recreation visitation and value under the No Action Alternative. However, the algae problem is unlikely to expand into J.C. Boyle Reservoir due

to manner in which water flushes through the reservoir. At this point, the impact of the blue-green algae problem on visitation is unknown, so attempting to provide algae adjusted visitation estimates is speculative. For purposes of the reservoir recreation analysis, the No Action Alternative includes recreation visitation at Copco 1, Iron Gate, and J.C. Boyle Reservoirs. Total visitation at Copco 1, Iron Gate, and J.C. Boyle Reservoirs across the 50-year period of analysis was estimated at 5.81 million recreation days, and total discounted recreation value was estimated at $99.5 million.

1.2.2.2.2.2 Alternative 2 – Full Facilities Removal of Four Dams

The reservoir recreation analysis is a with versus without reservoir analysis. The No Action Alternative assumes the reservoirs would remain in place. The Full Facilities Removal Alternative assumes the dams would be removed and reservoirs would be lost. As a result, pursuing the Full Facilities Removal Alternative would imply a loss in reservoir recreation visitation and value as compared to the No Action Alternative.

Adjusting for site substitution, whereby a significant portion of potentially lost Copco 1, Iron Gate, and J.C. Boyle recreation visitations would substitute to other lakes and reservoirs in the area (for further discussion on substitution see Reservoir Recreation Economics Technical Report [Reclamation 2011]), total with substitution reservoir recreation losses for the Full Facilities Removal Alternative measured as a change from the No Action Alternative were estimated at 2.03 million recreation days and $35.4 million in discounted economic value.

1.2.2.2.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

With partial removal of all four dams, the assumption was made that the reservoirs would be lost. As a result, the losses in reservoir recreation visitation and value for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be the same as under the Full Facilities Removal of Four Dams Alternative.

1.2.2.2.3 References

Bureau of Reclamation. 2011. U.S. Department of the Interior, Bureau of Reclamation. 2011. Reservoir Recreation Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

Loomis, John. 2005. Updated Outdoor Recreation Use Values On National Forests And Other Public Lands. Gen. Tech. Rep. PNW-GTR-658. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p. http://www.fs.fed.us/ pnw/ pubs/pnw_gtr658.pdf

PacifiCorp. February 2004. Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082.

1.2.2.3 Foregone Whitewater Recreation Benefits

1.2.2.3.1 Methodology and Assumptions

The Whitewater Boating Recreation Economics Technical Report (DOI 2011) discusses in detail the methodology and results of the whitewater boating recreation economic analysis summarized here. In general, an estimate of average recreation economic value (i.e., consumer surplus) per whitewater boating user day was applied to annual estimates of user days for the Klamath River for each alternative (Alternative 1 – No Action, Alternative 2 – Full Facilities Removal of Four Dams, and Alternative 3 – Partial Facilities Removal of Four Dams) to develop annual estimates of the economic value of whitewater boating specific to each alternative. Whitewater boating recreation is broadly split into activity that occurs on the Upper Klamath River (UKR) and Lower Klamath River (LKR), where for the purposes of this analysis the UKR is defined as the section of the Klamath River upstream of IGD and the LKR is defined as the stretch downstream of IGD.

Annual estimates of whitewater boating recreation values cover the period of analysis 2012 through 2061. Changes in annual whitewater boating recreation value for the proposed alternatives were estimated by comparing the annual values for each proposed alternative to those of the No Action Alternative. However, since dam removal is anticipated to begin in year 2020, changes in whitewater boating recreation values were not anticipated to begin until 2020 and would continue through 2061. The changes in whitewater boating recreation value associated with the proposed alternatives represent the whitewater boating recreation benefits. The annual changes in recreation values for the proposed alternatives were discounted back to 2012 using the current 2011 Federal water project planning rate of 4.125 percent.

The annual estimates of whitewater boating user days relied upon several sources. A user day is defined as one user engaging in whitewater boating for any part of a day (e.g., three people taking a two day whitewater boating trip would equate to six user days – 3 users x 2 days = 6 user days). The primary sources of information were Bureau of Land Management (BLM) and U.S. Forest Service (USFS) whitewater boating trip card data files. BLM is in charge of management of the portion of the UKR that is primarily associated with whitewater boating

recreation (Hell's Corner reach) and the USFS has management responsibilities along significant portions of the LKR. Commercial whitewater boating outfitters must obtain a permit from BLM or USFS to provide commercial trips on the sections of the Klamath River that are under BLM or USFS management. When trips are taken, the commercial outfitters are required to submit a trip card that supplies information about the trip they are providing (e.g., number of people taking the trip, length of trip, put-in location, and take-out location). The same trip card data was relied upon to generate estimates of whitewater boating user days as part of the FERC Relicensing (PacifiCorp, 2004) and in Klamath National Forest River Management Report (2009). These data sources were combined to develop an estimate of whitewater boating user days for the UKR and LKR between 1994 and 2009. These historical estimates were used to project use over the period of analysis, 2012 through 2061. Analysis conducted for PacifiCorp's FERC Relicensing assumed a "slight increase" in annual whitewater boating user days when projecting use into the future. However, a similar assumption was not made for this analysis because the estimates of the historical use observed between 2003 and 2009 did not demonstrate this type of upward trend. Furthermore, while the estimates of historical whitewater boating use show that use in more recent years has been lower than the historical average for both the UKR and LKR, the lower use levels exhibited by the data in recent years also do not necessarily imply a long term trend of decreased use. Several factors can contribute to the level of whitewater boating use in a particular year such as, the condition of the economy, weather, and water available in the river. Therefore, to estimate a range of potential annual whitewater boating activity, a 95 percent confidence interval was computed using the sixteen years of historical data available. It was assumed that this would provide a reasonable approximation of the range of potential of use that could be observed in any given year when considering the multitude of factors that can affect the annual level of use. Separate ranges were computed for the UKR and LKR, where the resulting estimates were summed to arrive at the estimate for the entire Klamath River. To the extent that the historical estimates do not capture all whitewater boating activity along the Klamath River, the overall level of whitewater boating use on the UKR and LKR will be underestimated.

The value per whitewater boating user day is based on the estimate of the average value per visitor day for whitewater boating utilized in an analysis conducted for PacifiCorp's FERC Relicensing (see Appendix 4B – Recreation Value Assessment, Final Technical Report, Klamath Hydroelectric Project, Socioeconomics Resources. FERC Project No. 2082). Separate values for the UKR and LKR were derived due to the difference in whitewater boating experiences for the two segments of the river, where the per user day values were $122 (2003 dollars) for the UKR and $48 (2003 dollars) for the LKR. Adjusting each value to 2012 dollars, the base year for the analysis, results in a value per user day applied for this analysis of $149 for the UKR and $58 for the LKR.

1.2.2.3.2 Results

1.2.2.3.2.1 Alternative 1 – No Action Alternative

Whitewater boating use projected for the period of analysis (2012 – 2061) for the UKR was estimated to vary annually between 3,871 and 4,958 total user days with an average of 4,414 user days. For the LKR, total annual user days were estimated to vary between 13,493 and 15,290 with an average of 14,392. Over the entire period of analysis, total user days for the UKR were estimated to be between 193,537 and 247,875 user days and between 674,674 and 764,487 user days for the LKR. This represents between 868,211 and 1,012,362 whitewater boating user days for the entire Klamath River.

The estimates of whitewater boating recreation values for the UKR ($149) and LKR ($58) were applied to the annual estimates of whitewater boating user days and discounted back to 2012 to arrive at an estimate of total discounted economic value for whitewater boating on the Klamath River of $29.8 to $35.6 million (midpoint estimate of $32.7 million) under the No Action Alternative. Individually for the UKR and LKR, the economic value of whitewater boating under the No Action Alternative was estimated to be $12.6 to $16.2 million (midpoint estimate of $14.4 million) and $17.1 to $19.4 million (midpoint estimate of $18.3 million), respectively.

1.2.2.3.2.2 Alternative 2 – Full Facilities Removal of Four Dams

In general, the whitewater boating economic analysis for the Full Facilities Removal Alternative can be described as comparing the economic value of whitewater boating activity that would occur if the dams remained in place to the economic value of whitewater boating activity that would occur without the dams. Under the No Action Alternative the four dams would remain in place and whitewater boating activity would not be affected. Under the Full Facilities Removal of Four Dams Alternative, whitewater boating activity on the UKR would be affected beginning in 2020 because of the dependence of water releases from the J.C. Boyle Dam to provide sufficient and predictable flows, primarily for whitewater boating along the Hell's Corner reach. In addition to the dependence upon the operations of J.C. Boyle Powerhouse upstream, the timing and duration of the releases are also critical for commercial operators so they can offer their clients reasonable trip itineraries (FERC 2007). Analysis of predicted hydrology modeling shows that the average number days with acceptable flows for whitewater boating on the Hell's Corner reach are estimated to decline by 47.3 percent during the five month period from May through September (months when the majority of whitewater boating activity occurs annually) and decline by 29.5, 36.4, and 88.2 percent in June, July and August, respectively, relative to the No Action Alternative. The combination of the decline in the number of days with acceptable flows, particularly during the three months when most of the use is observed (June, July, and August), and the lack of consistency and predictability of days with acceptable flows could make it more challenging for

outfitters to continue offering trips for this reach of the Upper Klamath River in the future. Therefore, it is assumed whitewater boating activity on the Upper Klamath River would be significantly negatively affected under the Full Facilities Removal of Four Dams Alternative. It is assumed that the level of whitewater boating activity on the LKR would not affected in any measurable way because sufficient flows for whitewater boating are not dependent on water releases from any of the four dams that would be removed. Additionally, analysis of the predicted hydrology for the Klamath River under the No Action Alternative and Full Facilities Removal of Four Dams Alternative shows the average number of days with acceptable flows for whitewater boating on the LKR would not change in any measurable way. Based on these assumptions, the total discounted loss in economic value associated with whitewater boating recreation for the Full Facilities Removal of Four Dams Alternative measured as a change from the No Action Alternative was estimated to be $5.4 to $6.9 million, with an associated loss of 101.8 to 130.3 thousand user days. The midpoint estimate of $6.1 million for the total discounted loss in economic value for whitewater boating was used in the NED BCA. For additional details, see the Whitewater Boating Recreation Economics Technical Report (DOI 2011).

1.2.2.3.2.3 Alternative 3 – Partial Facilities Removal of Four Dams

The Partial Facilities Removal of Four Dams Alternative is assumed to result in flow conditions on the Klamath River for whitewater boating that are similar to the Full Facilities Removal of Four Dams Alternative. As such, the losses in whitewater boating recreation visitation and value for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative are assumed to be the same as under the Full Facilities Removal of Four Dams Alternative.

1.2.2.3.3 References

U.S. Department of the Interior (DOI). 2011. Whitewater Boating Recreation Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon.

Johnson, Rebecca L. and Eric Moore. 1993. Tourism Impact Estimation. Annals of Tourism Research, v20(2): 279-286.

PacifiCorp. February 2004. Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082.

PacifiCorp. February 2004. Final Technical Report, Klamath Hydroelectric Project, Socioeconomics Resources. FERC Project No. 2082.

Payne, Dave. 2009. Klamath National Forest River Management Report.

1.3 NATIONAL ECONOMIC DEVELOPMENT BENEFIT-COST ANALYSIS RESULTS

As noted in the introduction of this chapter, the purpose of a NED BCA is to compare a proposed project's benefits to its costs. Total costs are subtracted from the total benefits to measure net benefits. If the net benefits of a project alternative are positive, then the alternative could be considered economically justified. When multiple mutually exclusive alternatives are being considered, the alternative with the greatest positive net benefit would be preferred from strictly an economics perspective. Quantified project benefits and costs, can be displayed using a benefit-cost ratio (BCR) where total project benefits are divided by total project costs. A BCR greater than one is analogous to a positive net benefit in terms of economic justification. However, if all project benefits are not quantified it may not be possible to determine if an alternative has net benefits or if the BCR exceeds one.

Table 1.3-1 describes all benefits and costs presented above – including those that were quantified as of September 2011 and those that were not. Benefits and costs are not shown for the No Action Alternative but instead characterized in terms of the change of each proposed alternative from the No Action Alternative. To allow direct comparison of quantified benefits and costs, all such quantified effects are estimated in 2012 dollars and discounted back to year 2012. Benefits and costs that are not quantified include non-use values (which will be quantified pending analysis of data being collected in a non-use valuation survey), other benefits and costs that could not be quantified due to lack of data, and tribal cultural values which are not amenable to quantification using standard economic methods.

Economic values are typically estimated on the basis of models that relate individual choice to well-defined goods and services which consumers consider in terms of price, the availability of substitutes, and their ability to pay (income). From a tribal perspective, however, resources such as fish are inseparable from other components of the ecosystem, provide individual values that are indistinguishable from communal values, are viewed as unique and not amenable to substitution at any price, and generate 'demand' that has no relationship to income. The sustainability of fisheries is indicative not only of harvest opportunity; it is emblematic of the extent to which the world is 'in balance'. Fisheries are also important for maintaining cultural and social cohesion. Thus for instance, subsistence fishing provides not only food but also the opportunity to practice and demonstrate to the younger generation important aspects of the culture – including fishing methods, resource stewardship, and the obligation to provide food for the elderly. Tribal ceremonies demonstrate the integral role of fish to tribal identity and honor not only the fish but also the ecosystem of which they are a part. Even tribal commercial fishing, which provides economic

benefits, is more than a commercial enterprise; during the fishing season, tribal members who live on and off the reservation gather in fish camps along the river and renew their social ties. Given the limited ability of standard economic methodologies to capture the expansive and integral value of fish to tribal members, it was not considered appropriate to monetize tribal resource effects.

Table 1.3-1.—Preliminary benefit-cost comparison of proposed alternatives based on available data as of September 2011 (discounted present values, $ in millions of dollars, base year equals 2012)

	Full Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)	**Partial Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)**
Total Quantified Benefits:	Not available	Not available
Irrigated agriculture	29.9	29.9
Commercial fishing	134.5	134.5
Ocean sport fishing	52.8	52.8
In-river salmon sport fishing	1.8	1.8
Refuge recreation	4.3	4.3
Non-use values	Available December 2011	Available December 2011
***Unquantified* Benefits**		
Tribal Commercial fisheries	Sufficient data was not available to quantify these benefits. However, given that dam removal is anticipated to positively affect tribal commercial fisheries dependent resources, the net economic benefits associated with tribal commercial fisheries would also be positive.	
Tribal cultural values (including ceremonial and subsistence uses)	Applying a traditional economic framework to tribal cultural values is not appropriate. However, given that dam removal would restore, over time, fisheries that have important cultural significance for tribes in the Basin, effects to tribal cultural values would be expected to be positive and potentially large in magnitude.	
In-river steelhead and redband trout sport fishing	Sufficient data was not available to quantify these benefits. However, given that dam removal is anticipated to positively affect these in-river fisheries, the net economic benefits associated with these fisheries would also be positive.	
Refuge wildlife viewing	Sufficient data was not available to quantify these benefits. However, given that dam removal is anticipated to positively affect refuge recreation dependent resources, the net economic benefits associated with refuge wildlife viewing would also be positive.	

(Table continued on next page)

Table 1.3-1.—Preliminary benefit-cost comparison of proposed alternatives based on available data as of September 2011 (discounted present values, $ in millions of dollars, base year equals 2012)

	Full Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)	Partial Facilities Removal of Four Dams Alternative ($ millions) (2012 dollars) (Incremental changes from No Action Alternative)
Total Quantified Costs:	1,813.6	1,787.9
KBRA restoration	474.1	474.1
Facilities removal	129.1	98.0
Site mitigation	37.7	36.6
OM&R (cost savings)	-188.9	-182.4
Forgone hydropower benefits	1,320.1	1,320.1
Forgone reservoir recreation benefits	35.4	35.4
Forgone whitewater recreation benefits	6.1	6.1
***Unquantified* Costs**	—	—
Real estate values	Changes in real estate values are not quantified due to a lack of data. The extent to which these changes are positive or negative depends on the magnitude of property value changes, over time, for lands proximate to the reservoirs and to the restored river.	
Hydropower ancillary services	Explicit consideration of ancillary services is outside the scope of this analysis. An ancillary service is anything that supports the transmission of electricity from its generation site to the customer. Services may include load regulation, spinning reserve, non-spinning reserve, replacement reserve and voltage support. If these plants produce any ancillary services, their consideration could be expected to increase the foregone economic benefits reported here.	
Regional powerplant emissions	The hydropower analysis described in this document does not consider the effect, if any, of changing hydropower production levels on system-wide powerplant emissions or regional air quality.	
Given that the benefits associated with several important categories (tribal cultural values; tribal commercial fisheries; non-use values) are not quantified, it is not appropriate to calculate net benefits.		

Chapter 2 – Regional Economic Development Impact Analysis

This chapter presents estimates of the regional economic impacts resulting from changes in expenditures associated with:

- Dam decommissioning
- Operation and maintenance
- Mitigation
- Irrigated agriculture
- Commercial fishing
- In-river sport fishing
- Ocean sport fishing
- Refuge recreation
- Reservoir recreation
- Whitewater recreation
- Klamath Basin Restoration Agreement (KBRA)

The RED account measures the effect of the alternatives on the region's local economy, while the NED account compares the alternatives from a national perspective. The RED analysis includes not only the initial or direct impact on the primary affected industries, but also the secondary impacts resulting from those industries providing inputs to the directly affected industries as well. This analysis also includes the changes in economic activity stemming from household spending of income earned by those employed in the sectors of the economy impacted either directly or indirectly. These secondary impacts are often referred to as "multiplier effects."

The NED economic benefits are not used directly in the RED analysis; only the physical inputs are carried over from the NED analysis. For example, changes in agricultural water supply may result in a change in crop acreages, which subsequently results in a change in gross farm income. The change in gross farm income reflects the direct economic impact in the RED analysis which, after being run through the regional economic model, generates the secondary, or multiplier, effects. The NED benefits analysis uses net farm income as defined by the P&Gs as the estimate of agricultural benefits used to compare alternatives from a national perspective.

This chapter describes potential regional economic impacts associated with implementation of the alternatives to several regions based on economic activities for example dam decommissioning expenditures. Socioeconomic impacts were measured as changes in regional employment, income, and output (sales) associated with implementation of the action alternatives compared to those associated with implementation of the No Action Alternative.

Changes in expenditures associated with Dam Decommissioning, Operation and Maintenance, Mitigation, Irrigated Agriculture, and Reservoir Recreation were provided by the Bureau of Reclamation (Reclamation). NOAA's National Marine Fisheries Service (NOAA Fisheries) provided changes in expenditures for In-River Sport Fishing and Ocean Sport Fishing and the Commercial Fishing impact analysis. Changes in refuge recreation expenditures were provided by the U.S. Fish and Wildlife Service (USFWS). The Department of the Interior's Office of Policy Analysis provided changes in whitewater recreation expenditures. CDM provided the impact analysis of expenditures associated with the Klamath Basin Restoration Agreement (KBRA) in a separate standalone document entitled KBRA Appendix.

METHODOLOGY AND ASSUMPTIONS

The modeling package used to assess the regional economic impacts stemming from the expenditures associated with each alternative was IMPLAN (IMpact analysis for PLANning). IMPLAN is an economic input-output modeling system that estimates the effects of economic changes in a defined analysis area.

IMPLAN is a static model that estimates impacts for a snapshot in time when the impacts are expected to occur, based on the makeup of the economy at the time of the underlying IMPLAN data. IMPLAN measures the initial impact to the economy but does not consider long-term adjustments as labor and capital move into alternative uses. This approach is used to compare the alternatives. Realistically, the structure of the economy will adapt and change; therefore, the IMPLAN results can only be used to compare relative changes between the No Action Alternative and the action alternatives and cannot be used to predict or forecast future employment, labor income, or output (sales).

Input-output models measure commodity flows from producers to intermediate and final consumers. Purchases for final use (final demand) drive the model. Industries produce goods and services for final demand and purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the analysis area (imports and value added) stop the cycle. These indirect and induced effects (the effects of household spending) can be mathematically derived using a set of multipliers. The multipliers describe the change in output for each regional industry caused by a 1-dollar change in final demand.

This analysis used 2009 IMPLAN data for the counties which encompass the Study Areas. IMPLAN data files for the analysis area are compiled from a variety of sources including the U.S. Bureau of Economic Analysis, the U.S. Bureau of Labor, and the U.S. Census Bureau.

RESULTS

A summary of estimated potential regional economic impacts by alternative is presented in the following table. In addition, for each category of regional economic impact, the economic region is defined by county and the total economy of the defined region is summarized by employment (jobs), labor income, and output. The potential **total** regional economic impacts are presented for the No Action Alternative. Only the potential **changes** in regional economic impacts from the No Action Alternative are presented for the action alternatives.

It is important to note each category of regional impact was analyzed by alternative specific definitions, periods of occurrence, and other factors; therefore, the potential impacts must not be summed by alternative, by category, or by region.

Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.1	**Dam Decommissioning** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	None	Short-term impacts during the one year decommissioning. Approximately 1,400 jobs, $60 million in labor income, and $163 million in output estimated to stem from in region decommissioning expenditures	Short-term impacts during the one year decommissioning. Approximately 1,100 jobs, $48 million in labor income, and $132 million in output estimated to stem from in region decommissioning expenditures
2.2	**Operation and Maintenance** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	Regional economic impacts stemming from existing in region O&M expenditures were estimated to generate approximately 49 jobs and labor income and output of $2 million and $5 million respectively	No long-term annual O&M expenditures. Therefore the regional economy would lose the 49 jobs, $2 million of labor income, and $5 million output associated with the in region O&M expenditures for the No Action Alternative	Based on in region O&M expenditures approximately 47 jobs, $2 million in labor income, and $5 million in output would be lost to the regional economy compared to the No Action Alternative
2.3	**Mitigation** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	None	These would be temporary short-term impacts and vary year by year between 2018-2025 proportionate to actual in region expenditures. A total of approximately 220 jobs, $10 million in labor income, and $31 million in output between the years 2018-2025 were estimated to stem from the total in region mitigation expenditures	Same as the Full Facilities Removal of Four Dams Alternative

Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.4	**Irrigated Agriculture** **Economic Region:** Klamath County OR Siskiyou and Modoc Counties CA **Regional Economy:** Employment (Jobs): 52,141 Labor Income: $2,083 million Output: $5,497 million	Regional economic impacts stemming from irrigated agriculture were estimated to be equal in all years except for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008. Estimated regional economic impacts stemming from irrigated agriculture for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008.:	Regional economic impacts stemming from irrigated agriculture were estimated to be equal in all years except for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008. Estimated regional economic impacts stemming from the change in irrigated agriculture for the years in the hydrologic model that correspond with the drought years of 1975, 1992, 1994, 2001, and 2008. between the No Action Alternative and Alternative 2:	Same as the Full Facilities Removal of Four Dams Alternative
		2027 — Jobs 1,361 Labor Income $45 million Output $184 million	2027 — Jobs 112 Labor Income $2 million Output $13 million	
		2043 — Jobs 766 Labor Income $33 million Output $118 million	2043 — Jobs 695 Labor Income $11 million Output $84 million	
		2045 — Jobs 1,076 Labor Income $40 million Output $156 million	2045 — Jobs 397 Labor Income $7 million Output $41 million	
		2051 — Jobs 1,286 Labor Income $44 million Output $177 million	2051 — Jobs 187 Labor Income $4 million Output $20 million	
		2059 — Jobs 1,403 Labor Income $46 million Output $188 million	2059 — Jobs 70 Labor Income $2 million Output $9 million	

Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.5	**Commercial Fishing** **Economic Regions and Regional Economies:** • **San Francisco Management Area** (San Mateo, San Francisco, Marin and Sonoma Counties CA) Employment (Jobs): 3,060,366 Labor Income: $204,685 million Output: $599,164 million	Estimated regional economic impacts stemming from ocean commercial fishing: • **San Francisco Management Area** Jobs: 510 Labor Income: $6.10 million Output: $15.52 million	Estimated regional economic impacts stemming from the change in ocean commercial fishing between the No Action Alternative and Alternative 2: • **San Francisco Management Area** Jobs: 218 Labor Income: $2.56 million Output: $6.6 million	Same as the Full Facilities Removal of Four Dams Alternative.
	• **Fort Bragg Management Area**(Mendocino County CA) Employment (Jobs): 40,117 Labor Income: $1,731 million Output: $4,814 million	• **Fort Bragg Management Area** Jobs: 162 Labor Income: $2.45 million Output: $5.62 million	• **Fort Bragg Management Area** Jobs: 69 Labor Income: $1.05 million Output: $2.41 million	
	• **KMZ-CA** (Humboldt and Del Norte Counties CA) Employment (Jobs): 71,633 Labor Income: $2,983 million Output: $7,360 million	• **KMZ-CA** Jobs: 44 Labor Income: $0.19 million Output: $0.45 million	• **KMZ-CA** Jobs: 19 Labor Income: $0.07 million Output: $0.19 million	
	• **KMZ-OR** (Curry County OR) Employment (Jobs): 8,656 Labor Income: $311 million Output: $859 million	• **KMZ-OR** Jobs: 26 Labor Income: $0.15 million Output: $0.33 million	• **KMZ-OR** Jobs: 11 Labor Income: $0.06 million Output: $0.13 million	
	• **Central Oregon Management Area** (Coos, Douglas and Lane Counties OR) Employment (Jobs): 258,047 Labor Income: $10,170 million Output: $27,815 million	• **Central Oregon Management Area** Jobs: 319 Labor Income: $4.15 million Output: $9.55 million	• **Central Oregon Management Area** Jobs: 136 Labor Income: $1.74 million Output: $4.07 million	

Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.6	**In-River Sport Fishing** **Economic Region:** Klamath County OR Del Norte, Humboldt, and Siskiyou Counties CA **Regional Economy:** Employment (Jobs): 119,837 Labor Income: $4,911 million Output: $12,499 million	**Recreational Salmon Fishery** Regional economic impacts stemming from in river salmon fishing trip expenditures were estimated to create approximately 34 jobs and stimulate about $0.93 million of labor income and $2.01 million of output.	**Recreational Salmon Fishery** Regional economic impacts stemming from the change in river salmon fishing trip expenditures were estimated to create approximately three more jobs and stimulate increases of about $0.07 million of labor income and $0.15 million of output compared to the No Action Alternative.	**Recreational Salmon Fishery** Same as the Full Facilities Removal of Four Dams Alternative.
		Recreational Steelhead Fishery Regional economic impacts stemming from in-river steelhead fishing trip expenditures were estimated to create approximately 20 jobs and stimulate about $0.62 million of labor income and $1.31 million of output.	**Recreational Steelhead Fishery** The Coho/Steelhead Expert Panel Report and previous studies generally positive regarding the potential for increased distribution and abundance of steelhead. However, insufficient data precluded estimation of potential regional economic impacts associated with changes in steelhead fishing trip expenditures compared to the No Action Alternative.	**Recreational Steelhead Fishery** Same as the Full Facilities Removal of Four Dams Alternative.
		Recreational Redband Trout Fishery A popular guide fishery occurs on the lower Williamson. Given demand for guide trips is generally higher among non-resident than resident anglers, the proportion of trips by non-resident anglers is likely higher; however, data are lacking to verify this or quantify regional economic impacts associated with in-region guide fishing expenditures.	**Recreational Redband Trout Fishery** The Resident Fish Expert Panel concluded this alternative would result in increased abundance and distribution of redband trout in Upper Klamath Lake and its tributaries and a potential seven-fold increase in the trophy fishery in the Keno Reach. However, the potential regional economic impacts of this notable increase could not be quantified with available data.	**Recreational Redband Trout Fishery** Same as the Full Facilities Removal of Four Dams Alternative.

Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.7	**Ocean Sport Fishing** **Economic Regions and Regional Economies:** • **KMZ-OR – Curry County OR** Employment (Jobs): 8,656 Labor Income: $311 million Output: $859 million • **KMZ-CA – Humboldt and Del Norte Counties CA** Employment (Jobs): 71,633 Labor Income: $2,983 million Output: $7,360 million	• **KMZ-OR – Curry County OR** An estimated three jobs, $0.08 million of labor income, and $0.21 million in output were estimated to stem from in region ocean sport salmon fishing related expenditures	• **KMZ-OR – Curry County OR** Regional economic impacts stemming from the change in in-region ocean sport salmon fishing trip expenditures were estimated to be increases of approximately one job, $0.02 million in labor income, and $0.09 million in output compared to the No Action Alternative	Same as the Full Facilities Removal of Four Dams Alternative.
		• **KMZ-CA – Humboldt and Del Norte Counties CA** Approximately 13 jobs, $0.42 million of labor income, and $1.12 million of output were estimated to stem from in region ocean sport salmon fishing related expenditures	• **KMZ-CA – Humboldt and Del Norte Counties CA** Regional economic impacts stemming from the change in in-region ocean sport salmon fishing trip expenditures between the No Action Alternative and Alternative 2 were estimated to be approximately five more jobs, $0.18 million of labor income, and $0.48 million of output.	
2.8	**Refuge Recreation** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	Approximately 11 jobs stem from refuge hunting related expenditures and stimulate about $0.26 million of labor income and $0.62 million of output	The change in refuge hunting expenditures between the No Action Alternative and Alternative 2 was estimated to create 5 more jobs, increase labor income by $0.12 million, and output by $0.27 million compared to the No Action Alternative	Same as the Full Facilities Removal of Four Dams Alternative
2.9	**Reservoir Recreation** **Economic Region:** Klamath County OR Siskiyou County CA **Regional Economy:** Employment (Jobs): 48,204 Labor Income: $1,928 million Output: $5,139 million	Approximately seven jobs stem from reservoir recreation related expenditures. Reservoir recreation related expenditures stimulate about $0.22 million of labor income and $0.54 million of output.	Four jobs would be lost with the change in reservoir recreation related expenditures between the No Action Alternative and Alternative 2. Labor income and output would decline by $0.13 million and $0.31 million respectively compared to the No Action alternative.	Same as the Full Facilities Removal of Four Dams Alternative

Regional Economic Development impact analysis summary table

	Category	Alternative 1 - No Action	Alternative 2 - Full Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)	Alternative 3 - Partial Facilities Removal of Four Dams (Incremental changes from Alternative 1) (2012 dollars)
2.10	**Whitewater Recreation** **Economic Region:** Klamath and Jackson counties OR Humboldt and Siskiyou counties CA **Regional Economy:** Employment (Jobs): 224,667 Labor Income:$8,682 million Output: $23,330 million	Jobs stemming from whitewater recreation expenditures made inside the region account for almost 56 jobs. Labor income and output produced by the in region whitewater expenditures account for $1.56 million and $4.31 million respectively.	Jobs stemming from whitewater recreation expenditures made inside the region would decline by 14 compared to the No Action Alternative; labor income and output would decline by $0.43 million and $0.89 million respectively.	Same as the Full Facilities Removal of Four Dams Alternative
2.11	**Klamath Basin Restoration Agreement (KBRA)** Information provided by CDM in separate standalone document entitled KBRA Appendix**.**	Information provided by CDM in separate standalone document entitled KBRA Appendix	Information provided by CDM in separate standalone document entitled KBRA Appendix	Information provided by CDM in separate standalone document entitled KBRA Appendix

2.1 DAM DECOMMISSIONING

2.1.1 Analysis Region

The economic region used in the regional economic impact analysis of dam decommissioning costs is based on the location of the impacted dams. J.C. Boyle dam is located in Klamath County Oregon while Copco 1, Copco 2, and Iron Gate dams are in Siskiyou County California. Figure 2.1-1 shows a map of the two-county analysis region.

Table 2.1-1 shows the employment, labor income, and output associated with the two-county area aggregated into eight industry sector classifications. Employment measures the number of jobs related to each industry sector of the regional economy. In the analysis area the service sector generates the largest number of jobs with 44 percent of total regional employment. The government sector ranks second with 21 percent of total regional employment. Trade sector employment ranks third making up 14 percent of total regional employment.

Table 2.1-1.—Summary of the regional economy for Klamath and Siskiyou Counties

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	**Jobs**	**Percent of total**	**$ million**	**Percent of total**	**$ million**	**Percent of total**
Agriculture	3,232	6.7	107.8	5.6	497.3	9.7
Mining	84	0.2	3.2	0.2	15.7	0.3
Construction	2,174	4.5	90.1	4.7	242.8	4.7
Manufacturing	2,621	5.4	135.7	7.0	703.6	13.7
TIPU	1,920	4.0	109.3	5.7	394.6	7.7
Trade	6,886	14.3	220.5	11.4	455.4	8.9
Service	21,197	44.0	722.0	37.4	2,131.2	41.5
Government	10,091	20.9	539.8	28.0	697.9	13.6
Total	**48,204**		**1,928.3**		**5,138.7**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

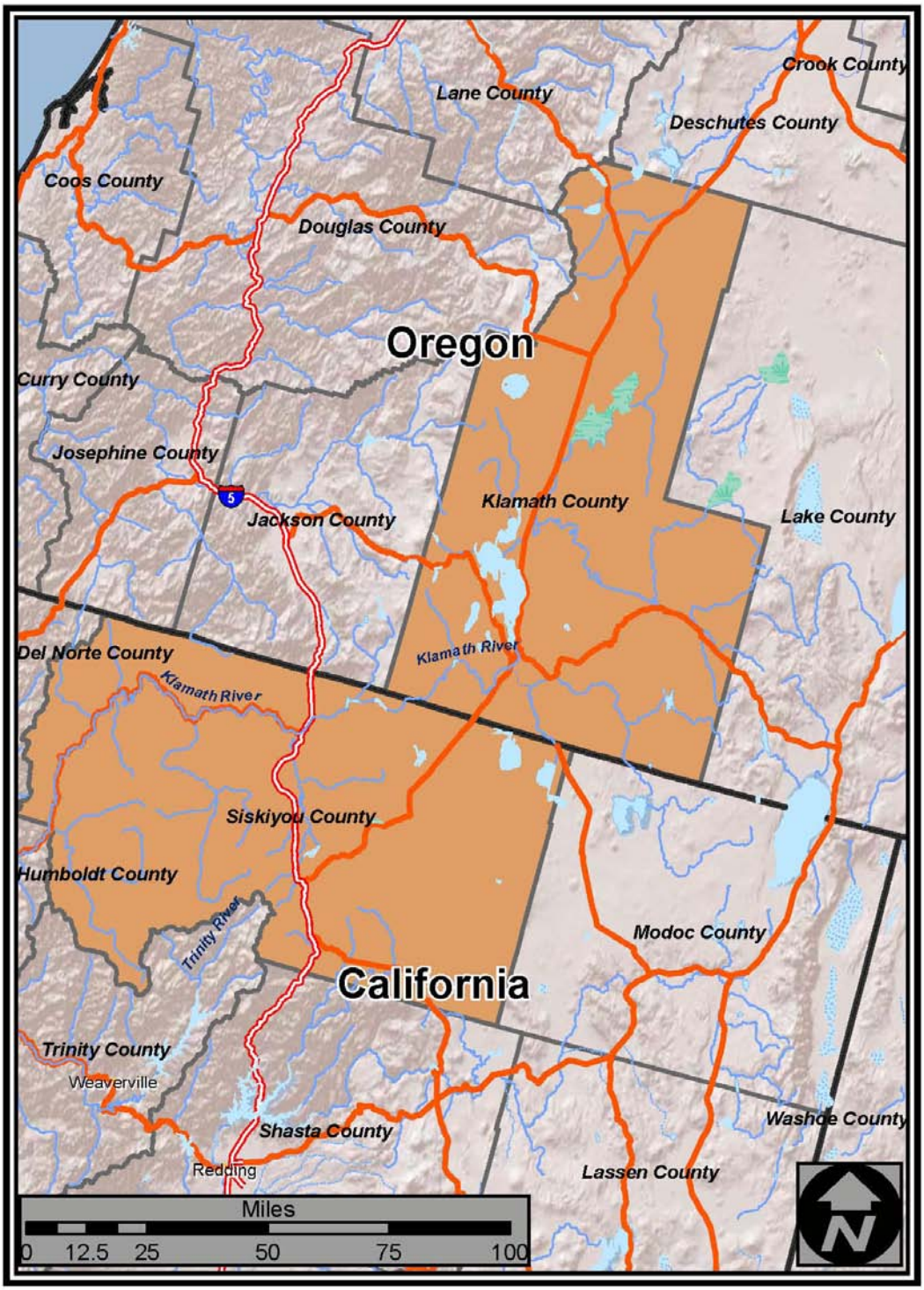

Figure 2.1-1.—Dam decommissioning regional economic impact analysis area.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sector ranks second with 28 percent of total regional labor income. Ranking third is the trade sector at 11 percent of total regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area with 42 percent of the total output. The manufacturing and government sectors rank second in total industry output at 14 percent. Ranking third is the agricultural sector which makes up ten percent of total industry output.

2.1.2 Methodology and Assumptions

The dam decommissioning costs were divided into expenditures that would be made inside and outside the analysis area. The expenditures assumed to be spent inside the analysis area are the basis for estimating employment, labor income, and output impacts stemming from dam decommissioning. Dam decommissioning expenditures made outside the analysis area are considered "leakages" that would have no impact on the local economy.

Reclamation's engineers allocated the costs associated with the major dam decommissioning activities to within-region expenditures according to the percentages shown in table 2.1-2. These percentages apply to both the Full Facilities Removal of Four Dams and Partial Facilities Removal of Four Dams alternatives. Dam decommissioning costs assumed to be spent within the analysis area are described in more detail in the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011).

The analysis assumed the onsite construction workforce would be hired from within the analysis area or would commute to the area from nearby communities. Money from outside the analysis area spent on goods and services within the analysis area contributes to regional economic impacts. Money that originates from within the analysis area is much less likely to generate regional economic impacts because it represents a redistribution of income and output.

Table 2.1-2.—Allocations of dam decommissioning costs by construction activity within the analysis area

Construction activity	Percentage of in-region expenditures				
	J.C. Boyle Dam	Iron Gate Dam	Copco 1 Dam	Copco 2 Dam	Yreka Pipeline
Diversion and care	90	55	55	90	
Dam removal	90	90	60	90	
Powerhouse/switchyard/ transmission line removal	80	80	80	80	
Penstock removal	80	80	80	80	
Reservoir vegetative restoration	90	90	90	–	
Road improvements	90	90	90	–	
Recreational facilities removal	90	85	90	-	
Mobilization	90	90	90	60	
Dam A modifications	–	–	–	–	50
Dam B modifications	–	–	–	–	50
Pipe crossing	–	–	–	–	40

2.1.3 Results

2.1.3.1 Alternative 1 – No Action

No dam decommissioning related regional economic impacts are anticipated because no dams are identified to be decommissioned under this alternative.

2.1.3.2 Alternative 2 – Full Facilities Removal of Four Dams

Dam decommissioning expenditures spent within the analysis area were estimated at $109,626,163. The within region expenditures would positively impact regional employment, labor income, and output as shown in table 2.1-3. These impacts would be short-term during the dam decommissioning which was assumed to last one year and to occur in the year 2020. Approximately 1,400 jobs were estimated by IMPLAN based on the in region Full Facilities Removal expenditures. IMPLAN estimated about $60 million in labor income and $163 million in output. The regional economy supports approximately 48,000 jobs, labor income of $1,928 million, and output of approximately $5,139 million.

Table 2.1-3.—Regional economic impacts stemming from dam decommissioning expenditures for Alternative 2

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	945	41.49	114.33
Indirect effect	216	9.13	22.23
Induced effect	262	9.08	26.76
Total effect	**1423**	**59.70**	**163.32**

[1] Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.1.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

Expenditures associated with the Partial Facilities Removal of Four Dams Alternative spent within the analysis area were estimated at $84,680,177. The within region expenditures would positively impact employment, labor income, and output as shown in table 2.1-4. These would be short-term impacts during the dam decommissioning which was assumed to last one year and occur in the year 2020. Approximately 1,100 jobs were estimated by IMPLAN based on the in region expenditures for this alternative. IMPLAN estimated $48 million in labor income and $132 million in output. The regional economy supports approximately 48,000 jobs, labor income of $1,928 million, and output of approximately $5,139 million.

Table 2.1-4.—Regional economic impacts stemming from dam decommissioning expenditures for Alternative 3

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	763	33.55	92.66
Indirect effect	168	7.24	17.69
Induced effect	207	7.32	21.49
Total effect	**1,138**	**48.11**	**131.84**

[1] Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.1.4 References

IMPLAN (Minnesota IMPLAN Group, Inc.), 2010. User's Guide, IMPLAN Version 3.0. Stillwater, Minnesota.

Reclamation, 2011a. U.S. Department of the Interior, Bureau of Reclamation. 2011. Benefit Cost and Regional Economic Development Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

2.2 OPERATION AND MAINTENANCE

2.2.1 Analysis Region

The economic region used in the regional economic impact analysis of annual operation and maintenance (O&M) expenditures is based on the location of the impacted dams. J.C. Boyle Dam is located in Klamath County Oregon while Copco 1, Copco 2, and Iron Gate dams are in Siskiyou County California. A map of the analysis region is shown in figure 2.2-1.

Table 2.1-1 shows the employment, labor income, and output associated with the two-county area aggregated into eight industry sector classifications. Employment measures the number of jobs related to each of the industry sectors of the regional economy. In the analysis area, activities related to the service sector generate the largest number of jobs, with 44 percent of total regional employment. The government sector ranks second in terms of overall number of jobs in the analysis area, with 21 percent of total regional employment. Trade related employment ranks third making up 14 percent of total regional employment.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sector ranks second with 28 percent of the total regional labor income. Ranking third is the trade sector at 11 percent of the total regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area with 42 percent of the total output. The manufacturing and government sectors rank second in total industry output at 14 percent. Ranking third is the agricultural sector which makes up 10 percent of total industry output.

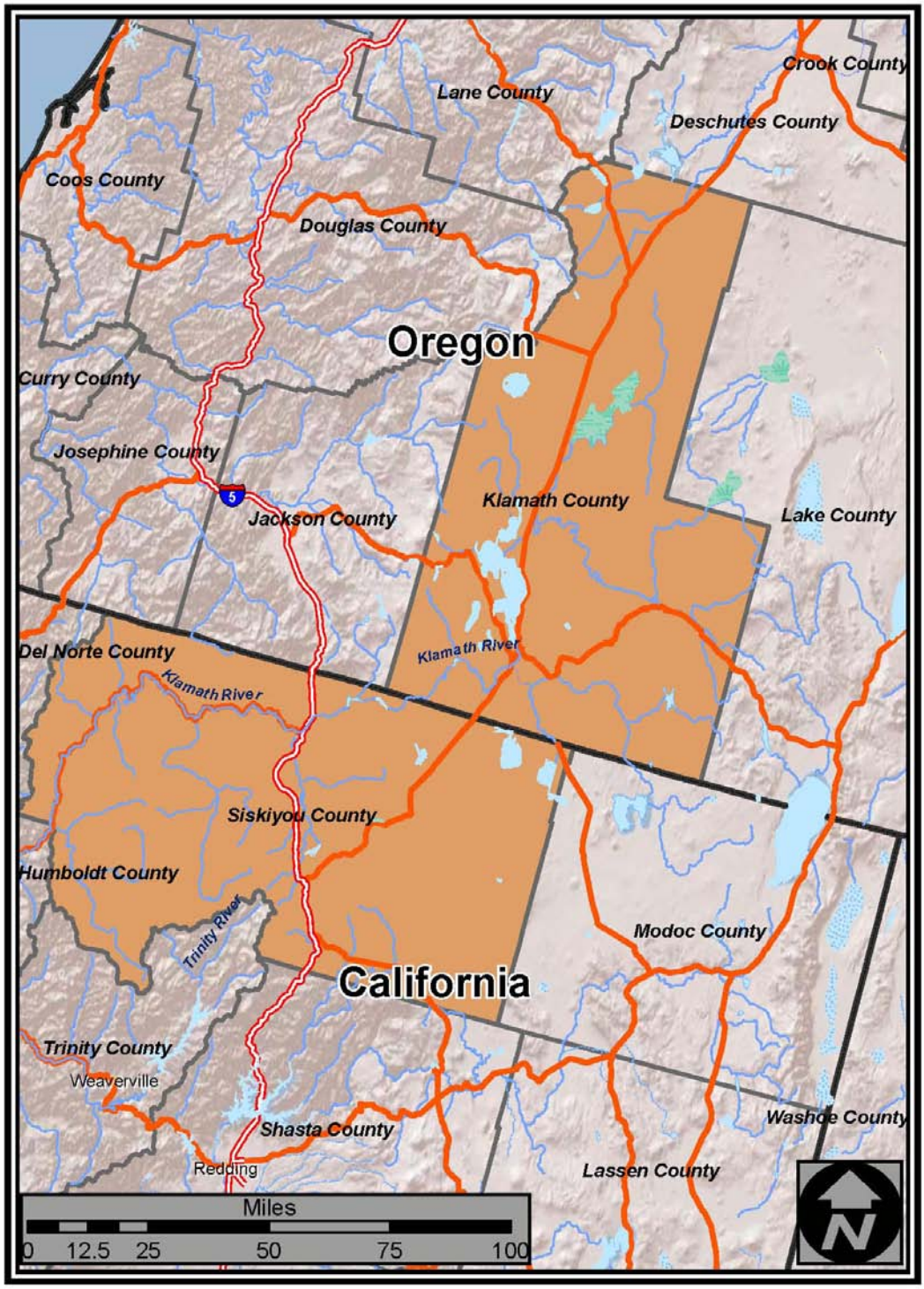

Figure 2.2-1.—Operation and maintenance regional economic impact analysis area.

Table 2.2-1.—Summary of the regional economy for Klamath and Siskiyou Counties

	Employment[1]		Labor Income[2]		Output[3]	
Industry sector	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	3,232	6.7	107.8	5.6	497.3	9.7
Mining	84	0.2	3.2	0.2	15.7	0.3
Construction	2,174	4.5	90.1	4.7	242.8	4.7
Manufacturing	2,621	5.4	135.7	7.0	703.6	13.7
TIPU	1,920	4.0	109.3	5.7	394.6	7.7
Trade	6,886	14.3	220.5	11.4	455.4	8.9
Service	21,197	44.0	722.0	37.4	2,131.2	41.5
Government	10,091	20.9	539.8	28.0	697.9	13.6
Total	**48,204**		**1,928.3**		**5,138.7**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.2.2 Methodology and Assumptions

Annual O&M expenditures for each alternative are summarized in the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011). O&M expenditures made inside the analysis area would generate positive economic impacts to the regional economy. Based on estimates from Reclamation engineers, it was assumed that 80 percent of the O&M expenditures would be made inside the two-county area. Annual O&M expenditures would continue to accrue for the existing structures between 2012 and 2020 the year of the dam removal. However, this analysis measures annual O&M impacts after dam removal in year 2020.

Like the dam commissioning expenditures, O&M expenditures made inside the study area associated with each alternative were placed into categories related to the sectors of the economy and run through IMPLAN to estimate impacts to the regional economy. This analysis does not quantify the impacts resulting from periodic replacement costs given they are spread out over the entire period of analysis.

2.2.3 Results

2.2.3.1 Alternative 1 – No Action

Annual O&M expenditures required to continue the operation of the existing dams would result in positive long-term economic impacts. Within region O&M expenditures were estimated at $3,500,000. Table 2.2-2 summarizes the regional impacts stemming from annual O&M expenditures. Existing O&M expenditures were estimated by IMPLAN to generate approximately 49 jobs. Labor income and output were estimated at $2.05 million and $5.19 million respectively. The regional economy supports approximately 48,000 jobs with labor income of $1,928 million and output of approximately $5,139 million.

Table 2.2-2.—Regional economic impacts stemming from O&M expenditures for the No Action Alternative

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	34.0	1.48	3.65
Indirect effect	6.4	0.26	0.63
Induced effect	8.7	0.31	0.90
Total effect	**49.2**	**2.05**	**5.19**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.2.3.2 Alternative 2 – Full Facilities Removal of Four Dams

The Full Facilities Removal of Four Dams Alternative would not require long term annual O&M expenditures. Therefore the regional economy would lose the 49 jobs, $2.05 million of labor income, and $5.19 million output associated with the O&M expenditures for the No Action Alternative. These results (losses) are presented in table 2.2-3. The regional economy supports approximately 48,000 jobs and the associated labor income and output of $1,928 million and $5,139 million respectively.

2.2.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

Annual O&M expenditures for the Partial Facilities Removal of Four Dams Alternative were estimated at $129,000. These annual O&M expenditures partially

Table 2.2-3.—Regional economic impacts stemming from changes in O&M expenditures between the No Action Alternative and Alternative 2

Impact type	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	-34.0		-1.48		-3.65	
Indirect effect	-6.4		-0.26		-0.63	
Induced effect	-8.7		-0.31		-0.90	
Total effect	**-49.2**	**-100**	**-2.05**	**-100**	**-5.19**	**-100**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

offset the lost No Action O&M expenditures. However under the Partial Facilities Removal of Four Dams Alternative annual O&M expenditures are estimated to result in a long term loss to the regional economy compared to the No Action Alternative. Approximately 47 jobs are lost to the regional economy under this alternative compared to the No Action Alternative. Labor income and output were estimated to decline by $1.98 million and $5 million respectively (table 2.2-4). The regional economy supports approximately 48,000 jobs. Labor income and output for the region are about $1,928 million and $5,139 million respectively.

Table 2.2-4.—Regional economic impacts stemming from changes in O&M expenditures between the No Action Alternative and Alternative 3

Impact type	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions	Percent change from No Action (2012 $)
Direct effect	-32.7		-1.43		-3.52	
Indirect effect	-6.2		-0.25		-0.61	
Induced effect	-8.4		-0.30		-0.87	
Total effect	**-47.4**	**-96**	**-1.98**	**-96**	**-5.00**	**-96**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.2.4 References

IMPLAN (Minnesota IMPLAN Group, Inc.), 2010. User's Guide, IMPLAN Version 3.0. Stillwater, Minnesota.

Reclamation, 2011. U.S. Department of the Interior, Bureau of Reclamation. 2011. Benefit Cost and Regional Economic Development Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

2.3 MITIGATION

2.3.1 Analysis Region

The economic region used in the regional economic impact analysis of mitigation costs associated with dam decommissioning is based on the location of the impacted dams. J.C. Boyle dam is located in Klamath County Oregon while Copco 1, Copco 2, and Iron Gate dams are in Siskiyou County California. A map of the two-county analysis region is shown in figure 2.3-1.

Table 2.3-1 shows the employment, labor income, and output associated with the two-county area aggregated into eight industry sector classifications. Employment measures the number of jobs related to each industry sector of the regional economy. In the analysis area the service sector generates the largest number of jobs with 44 percent of total regional employment. The government sector ranks second with 21 percent of total regional employment. Trade sector employment ranks third making up 14 percent of total regional employment.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sector ranks second with 28 percent of total regional labor income. Ranking third is the trade sector at 11 percent of total regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area with 42 percent of the total output. The manufacturing and government sectors rank second in total industry output at 14 percent. Ranking third is the agricultural sector which makes up 10 percent of total industry output.

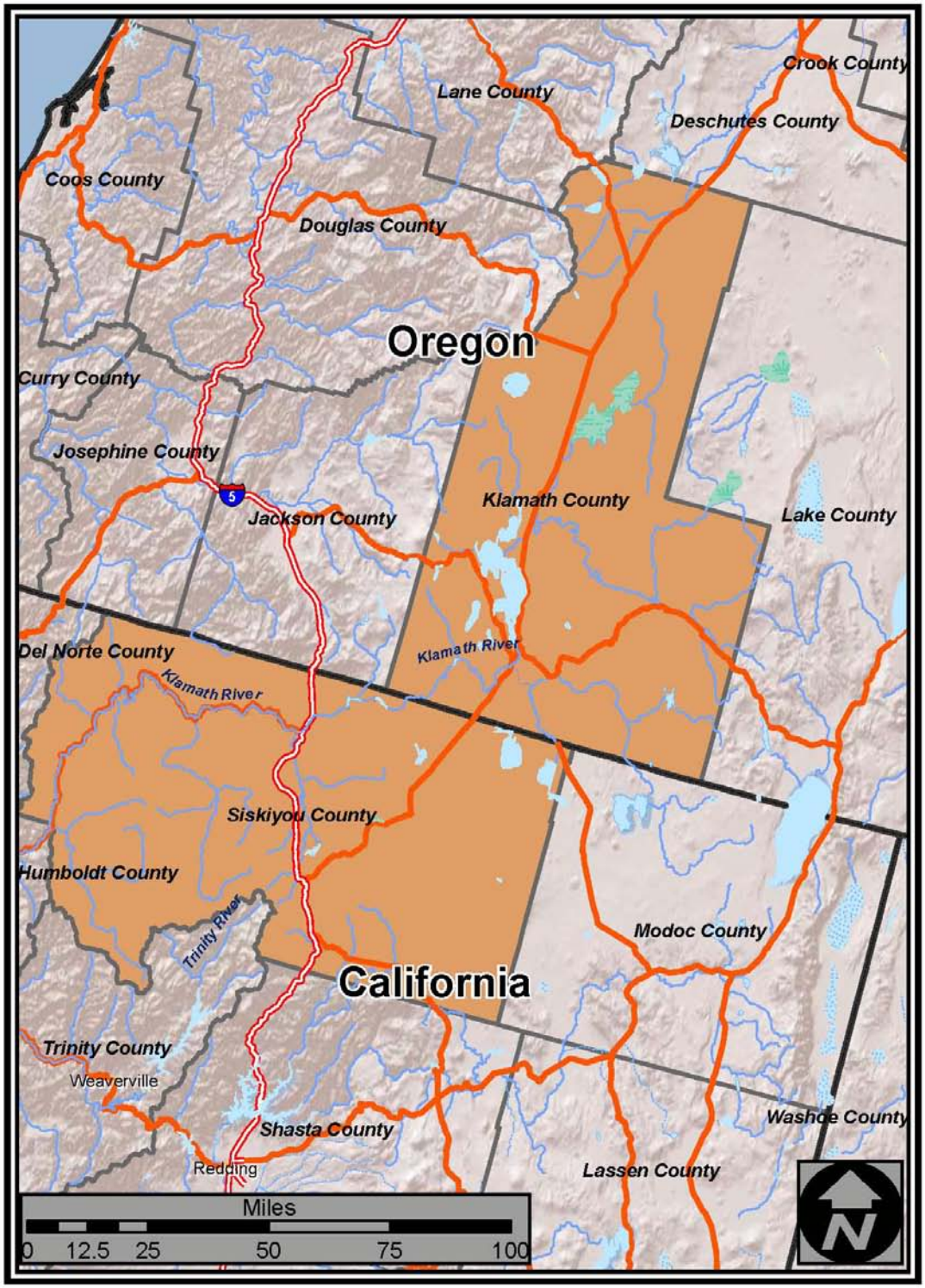

Figure 2.3-1.—Mitigation regional economic analysis impact area.

2.3-1.—Summary of the regional economy for Klamath and Siskiyou Counties

Industry sector	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	3,232	6.7	107.8	5.6	497.3	9.7
Mining	84	0.2	3.2	0.2	15.7	0.3
Construction	2,174	4.5	90.1	4.7	242.8	4.7
Manufacturing	2,621	5.4	135.7	7.0	703.6	13.7
TIPU	1,920	4.0	109.3	5.7	394.6	7.7
Trade	6,886	14.3	220.5	11.4	455.4	8.9
Service	21,197	44.0	722.0	37.4	2,131.2	41.5
Government	10,091	20.9	539.8	28.0	697.9	13.6
Total	**48,204**		**1,928.3**		**5,138.7**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.3.2 Methodology and Assumptions

The dam decommissioning mitigation costs were divided into expenditures that would be made inside the analysis area. The expenditures assumed to be spent inside the analysis area were input into IMPLAN to estimate employment, labor income, and output stemming from dam decommissioning mitigation. Dam mitigation expenditures made outside the analysis area were considered "leakages" and would have no impact on the local economy.

The costs associated with the major dam mitigation activities were allocated to within-region expenditures according to the percentages shown in table 2.3-2. These percentages would apply to both the Full Facilities Removal of Four Dams and Partial Facilities Removal of Four Dams Alternatives. Dam mitigation costs assumed to be spent within the analysis area are described in more detail in the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011).

Like the dam decommissioning analysis, the onsite mitigation workforce was assumed to be hired from within the analysis area or would commute to the area from nearby communities. Money from outside the analysis area spent on goods and services within the analysis area contributes to regional economic impacts, while money that originates from within the analysis area is much less likely to

Table 2.3-2.—In region allocation of dam mitigation costs by activity within the analysis area

Construction activity	In region percentage
Freshwater mussel relocation	80
Trap and haul, tributaries	40
Sucker rescue	40
Wetlands impacts	10
Impacts on special status bats	80
Flood proofing structures	50
Deepen/replace groundwater wells	50
Modify water intakes	80
Energy conservation plan	20
Sediment monitoring plan	10
Cultural resources	30
Fencing reservoir lands	50
Recreation facilities	50
Bridge and culvert construction	50

generate regional economic impacts because spending from sources within the analysis area represents a redistribution of income and output. The regional economic impacts associated with dam mitigation costs would be spread over the 2018-2025 period and would vary year-by-year proportionate to actual expenditures.

2.3.3 Results

2.3.3.1 Alternative 1 – No Action

No dam decommissioning mitigation was identified for this alternative thus there would be no mitigation related regional economic impacts.

2.3.3.2 Alternative 2 – Full Facilities Removal of Four Dams

Dam mitigation expenditures spent within the analysis area were estimated at $19,487,125. The within region expenditures would positively impact regional employment, labor income, and output as shown in table 2.3-3. These would be temporary short-term impacts while mitigation activities were being conducted.

These impacts would vary year by year from 2018-2025 proportionate to actual expenditures. A total of approximately 220 jobs, $10 million in labor income, and $31 million in output between the years 2018-2025 were estimated by IMPLAN to stem from the total in region mitigation expenditures for Alternative 2. The regional economy supports approximately 48,000 jobs, labor income of $1,928 million, and output of approximately $5,139 million.

Table 2.3-3.—Regional economic impacts stemming from expenditures for mitigation associated with dam decommissioning for Alternative 2

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	123.9	6.31	20.18
Indirect effect	51.6	2.21	6.32
Induced effect	41.9	1.49	4.36
Total effect	**217.5**	**10.01**	**30.86**

[1] Employment is measured in number of jobs. Construction-related employment estimates include the in-field workforce plus all additional jobs generated by project construction expenditures, e.g., in retail, services, manufacturing, and other related sectors throughout the economy.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.3.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

The regional economic impacts related to dam decommissioning mitigation for the Partial Facilities Removal of Four Dams Alternative were assumed to be the same as Alternative 2.

2.3.4 References

IMPLAN (Minnesota IMPLAN Group, Inc.), 2010. User's Guide, IMPLAN Version 3.0. Stillwater, Minnesota.

Reclamation, 2011. U.S. Department of the Interior, Bureau of Reclamation. 2011. Benefit Cost and Regional Economic Development Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

2.4 IRRIGATED AGRICULTURE

2.4.1 Analysis Region

The economic region used in the irrigated agriculture regional economic impact analysis is based on the location of lands receiving irrigation water from Reclamation's Klamath Project and off-project lands. These lands are located in Klamath County Oregon and Siskiyou and Modoc Counties California. A map of the analysis region is shown in figure 2.4-1.

Table 2.4-1 shows the employment, labor income, and output associated with the three county analysis region aggregated into eight industry classifications. Employment measures the number of jobs related to each sector of the regional economy. In the analysis area the service sector generates the largest number of jobs with 43 percent of total regional employment. The government sector ranks second in overall number of jobs with 22 percent of total regional employment. Trade sector employment ranks third making up 13.9 percent of total regional employment. The agriculture and fishing sector ranks fourth in employment at 7.3 percent of total regional employment.

Table 2.4-1.—Summary of the regional economy for Siskiyou and Modoc Counties, California and Klamath County Oregon

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture and fishing	3,803	7.3	124.2	6.0	560.9	10.2
Mining	85	0.2	3.3	0.2	16.1	0.3
Construction	2,358	4.5	99.3	4.8	265.5	4.8
Manufacturing	2,629	5.0	135.9	6.5	706.1	12.8
TIPU	2,122	4.1	118.1	5.7	426.3	7.8
Trade	7,272	13.9	237.7	11.4	491.6	8.9
Service	22,421	43.0	752.2	36.1	2,245.1	40.8
Government	11,452	22.0	611.8	29.4	785.7	14.3
Total	**52,141**		**2,082.6**		**5,497.2**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

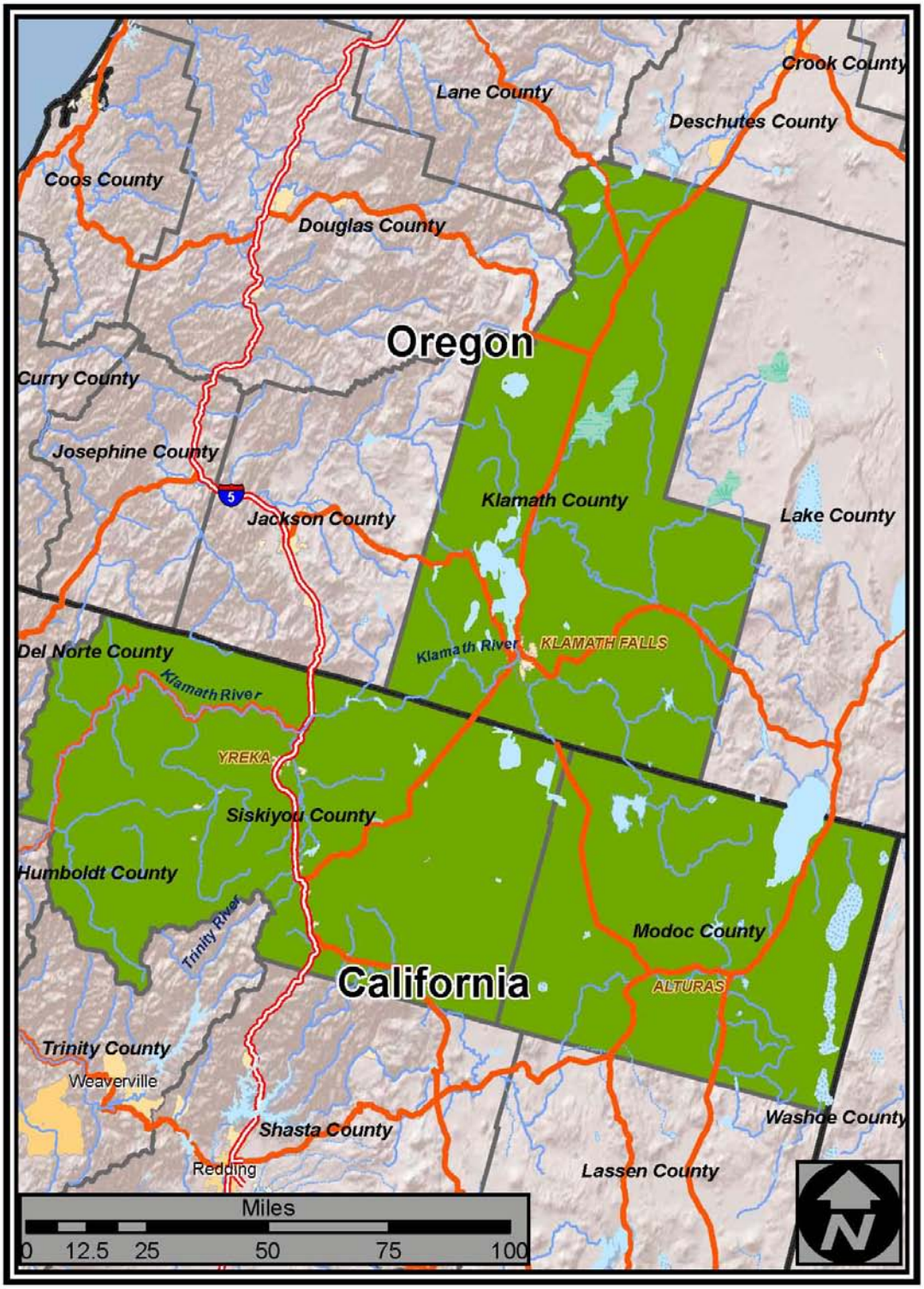

Figure 2.4-1.—Irrigated agriculture regional economic impact analysis area.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 36.1 percent of the total regional labor income. The government sector ranks second with 29.4 percent of the total regional labor income. Ranking third are the sectors related to trade, at 11.4 percent of the total regional labor income. The agriculture and fishing sector ranks fifth and contributes 6.0 percent of the regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area with 40.8 percent of total regional output. The government sector ranks second in total industry output at 14.3 percent. Ranking third is the trade sector which makes up 12.8 percent of total industry output. Agriculture and fishing rank fourth in output with 10.2 percent.

2.4.2 Methodology and Assumptions

The Irrigated Agriculture Economics Technical Report (Reclamation 2011a) and the Benefit Cost and Regional Economic Development Technical Report (Reclamation 2011b) discuss in detail the methodology and results of the irrigated agriculture analysis summarized here. Several elements of the KBRA related to agriculture were addressed in the regional economic analysis. The KBRA elements generally relate to Reclamation Klamath Project hydrology, on farm pumping costs, and water acquisitions. The specific KBRA elements addressed and the methodology and assumptions used in the analysis are discussed below. It should be noted that because the regional impacts associated with these elements occur at different times, the results cannot be added to derive a total regional economic impact.

2.4.2.1 Reclamation Klamath Project Hydrology

The hydrology modeling drives the agricultural regional analysis (Reclamation 2011c). The No Action Alternative hydrology uses the Biological Opinions (BO) under which the Klamath Project operates currently[1]. Alternative 2 hydrology modeling incorporated KBRA's criteria. Some of the elements incorporated into the hydrology assumptions include the "On-Project Water Users Program" presented in Section 15 of the KBRA and the "Drought Plan" discussed in Section 19.

[1] National Marine Fisheries Service BO *Operation of the Klamath Project between 2010 and 2018* dated March 15, 2010, and U.S. Fish and Wildlife Service BO *Effects of the U.S. Bureau of Reclamation's Proposed 10-Year Operation Plan (April 1, 2008 – March 31, 2018)* dated April 2, 2008.

The hydrology assumptions drive the irrigated agricultural model, Klamath Basin Hydro-Economics model (KB_HEM). KB_HEM was used to evaluate impacts to Reclamation's Klamath Project irrigators for each of the alternatives based on the hydrology. KB_HEM measures changes to cropping patterns and gross farm revenue. Gross farm revenue was used in IMPLAN to measure the regional impacts for both the no action and action alternatives.

2.4.2.2 On Farm Pumping Costs

Several KBRA elements pertain to power and affordable electricity for both the Klamath Reclamation project and off-project irrigators. KB_HEM was used to evaluate the current pumping rates for lands irrigated within Reclamation's Klamath Project under the No Action Alternative compared to the estimate of the reduced cost of electricity and subsequently the cost of pumping groundwater. Using the information provided by KB_HEM, IMPLAN was used to measure the regional impacts stemming from changes in pumping costs for the alternatives. KBRA does not provide enough information to quantify the impacts stemming from power rates to off-project irrigators so these impacts are described in qualitative terms.

2.4.2.3 Water Acquisitions

Also evaluated using IMPLAN were programs described in KBRA which introduce water acquisition programs like the Water Use Retirement Program, the Off-Project Reliance Program, and Interim flow and Lake Level Program. These programs introduce the voluntary sale of water right or short term voluntary water leasing.

The regional economic impact of water right transfers or short term water leases are measured in two stages. Measured in the first stage are the regional economic impacts stemming from the reduction in irrigated agricultural production that stems directly from water right transfer or lease. In the second stage, the regional economic impact of the water transfer compensation or lease payment to growers is estimated. These payments will tend to compensate, to some degree, the impacts from reduced irrigated crop production. The net regional economic impact is the sum of the stage one and stage two effects.

2.4.3 Results

2.4.3.1 Alternative 1 – No Action

2.4.3.1.1 Reclamation Klamath Project Hydrology

Gross farm revenue is equal in all years under the No Action Alternative and Alternative 2 except for the five drought years 2027, 2043, 2045, 2051, and 2059 as illustrated in figure 2.4-2. These years simulated in the hydrology model correspond to the years 1975, 1992, 1994, 2001, and 2008 in the historical period of record. The gross farm revenue, as measured by KB_HEM, decreases in the drought years. Table 2.4-2 shows the gross farm revenue by IMPLAN sector for these drought years.

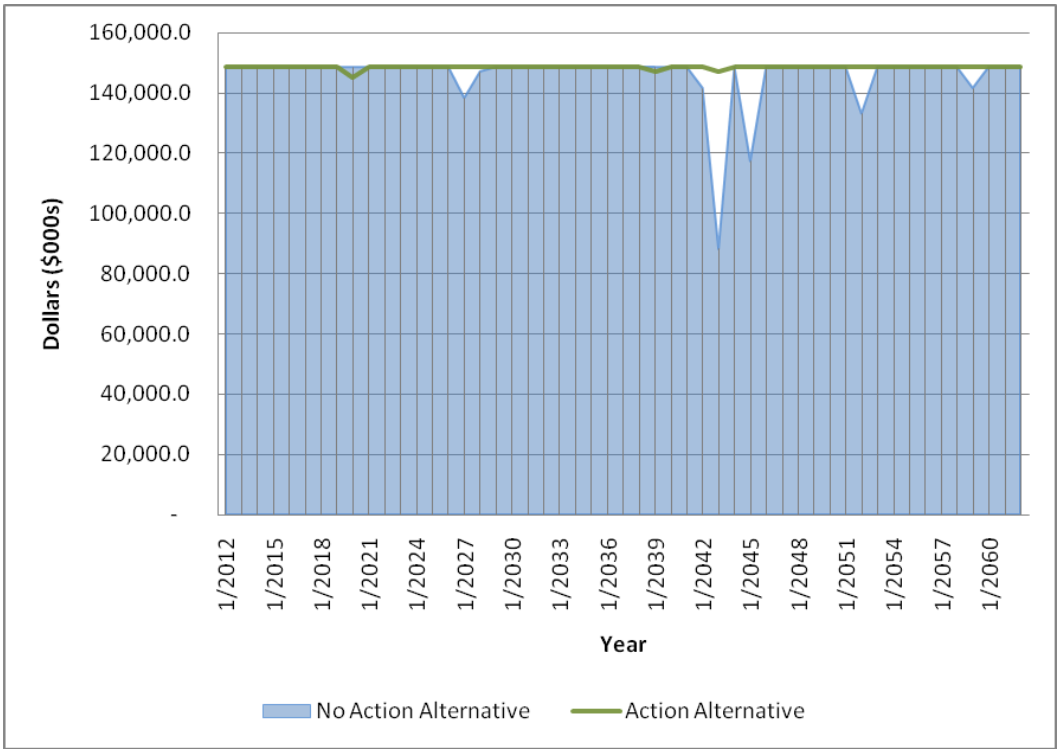

Figure 2.4-2.—Gross farm revenue for the No Action Alternative and action alternatives for the 50-year analysis period.

The gross farm revenue shown in table 2.4-2 was used in IMPLAN to estimate the potential regional impacts stemming from on farm production in the drought years. These results are summarized in table 2.4-3. The three-county region supports a total of approximately 52,000 jobs, $2,082.6 in labor income, and $5,497 million in output by comparison.

2.4.3.1.2 On Farm Pumping Costs

The full tariff rates were used for the No Action Alternative (Reclamation 2011a).

Table 2.4-2.—Gross farm revenue estimated for drought years by IMPLAN crop sectors for the No Action Alternative

IMPLAN crop sectors	Gross farm revenue for drought years ($/1,000)				
	2027	2043	2045	2052	2059
Grains	19,189.3	4,518.8	11,462.3	17,077.6	20,300.2
Vegetables	60,674.6	55,965.8	58,561.6	60,127.0	60,790.8
All other (hay and pasture)	58,387.0	27,640.3	47,250.1	55,815.4	60,456.8
Total	**138,250.9**	**88,124.9**	**117,274.0**	**133,020.0**	**141,547.8**

Source: KB_HEM estimated gross farm revenue by IMPLAN crop sectors.

Table 2.4-3.—Regional impacts stemming from irrigated agriculture for the drought years under the No Action Alternative

Drought years	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
2027	1,361	45.20	183.56
2043	766	33.21	118.30
2045	1,076	40.24	156.34
2051	1,286	43.97	176.78
2059	1,403	45.94	187.84

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.4.3.1.3 Water Acquisitions

The Klamath Water and Power Association (KWAPA) currently manages the Water Use Mitigation Plan. This plan is similar to a water leasing mitigation program in which farmers are paid to idle land in exchange for the use of the water to reduce on project demand. This is a pilot project whose authorization ends in 2012; therefore it was assumed this program will not continue under the No Action Alternative.

2.4.3.2 Alternative 2 – Full Facilities Removal of Four Dams

2.4.3.2.1 Reclamation Klamath Project Hydrology

Gross farm revenue was equal in all years under No Action Alternative and Alternative 2 except for five drought years 2027, 2043, 2045, 2051, and 2059 which correspond to the years 1975, 1992, 1994, 2001, and 2008 in the historical period of record. Under Alternative 2 gross farm revenue increases compared to the No Action Alternative during these drought years. Gross farm revenue under Alternative 2 is shown in table 2.4-4. The change in gross farm revenue with Alternative 2 compared to the No Action Alternative in these drought years is shown in table 2.4-5.

Table 2.4-4.—Gross farm revenue estimated for drought years by IMPLAN crop sectors for Alternative 2

IMPLAN crop sectors	Gross farm revenue for drought years ($/1,000)				
	2027	2043	2045	2052	2059
Grains	21,856.5	21,663.9	21,856.5	21,856.5	21,856.5
Vegetables	60,993.3	60,966.1	60,993.3	60,993.3	60,993.3
All other (hay and pasture)	65,687.6	64,438.7	65,687.6	65,687.6	65,687.6
Total	**148,537.4**	**147,068.7**	**148,537.4**	**148,537.4**	**148,537.4**

Source: KB_HEM estimated gross farm revenue by IMPLAN crop sectors.

Table 2.4-5.—Change in gross farm revenue for drought years by IMPLAN crop sector with Alternative 2 compared to the No Action Alternative

IMPLAN crop sectors	Gross farm revenue for drought years ($/1,000)				
	2027	2043	2045	2052	2059
Grains	2,667.2	17,145.1	10,394.2	4,778.8	1,556.2
Vegetables	318.8	5,000.3	2,431.7	866.3	202.6
All other (hay and pasture)	7,300.6	36,798.4	18,437.5	9,872.2	5,230.8
Total	**10,286.5**	**58,943.8**	**31,263.4**	**15,517.4**	**6,989.6**

Source: KB_HEM estimated gross farm revenue by IMPLAN crop sectors.

The regional impacts stemming from a change in gross farm revenue with Alternative 2 compared to the No Action Alternative are shown in table 2.4-6. Compared to the No Action Alternative, regional employment, labor income, and output increase with Alternative 2 in the five drought years.

Table 2.4-6.—Regional economic impacts stemming from the change in gross farm revenue for the drought years between the No Action Alternative and Alternative 2

	Employment[1]		Labor Income[2]		Output[3]	
Year	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
2027	112	8.2	2.33	5.2	13	7.3
2043	695	90.6	11.22	33.8	84	71.4
3045	397	36.9	7.29	18.1	41	26.0
2051	187	14.5	3.56	8.1	20	11.4
2059	70	5.0	1.60	3.5	9	4.8

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.4.3.2.2 On Farm Pumping Costs

Regional employment, labor income, and output are equal to the No Action Alternative in all non-drought years in the period of record. The regional impacts are the same in all non-drought years due to groundwater substitution. Irrigators are pumping more groundwater in Alternative 2 compared to No Action Alternative and therefore are paying more for electricity under Alternative 2 even with a decrease in electricity rates assumed in Alternative 2 (Reclamation 2011a). The average annual cost of pumping groundwater in the 50 year period of record is equal to $178,000 per year.

Because farmers are paying more for electricity to pump groundwater under Alternative 2 household income is reduced by the additional money spent to pump groundwater. This reduced household income has a relatively small negative impact on the regional economy. Table 2.4-7 shows the relatively small regional impacts as result of increased pumping costs.

2.4.3.2.3 Water Acquisitions – Permanent Voluntary Water Right Sales

The water acquisition programs like the Water Use Retirement (WURP) and the Off-Project Reliance programs described in KBRA may also result in a negative regional impact. WURP will be implemented to generate on an average annual basis an additional 30,000 acre-feet of inflow to Upper Klamath Lake." The KBRA states that WURP will provide for increased streamflow and inflow into Upper Klamath Lake through voluntary retirement of water rights or water uses. The KBRA states that "acquisition of water rights or uses to achieve the WURP

purpose will be compensated, as applicable, through market mechanisms based upon values mutually agreed to by purchaser and seller, as informed by appraisals."

Table 2.4-7.—Net regional economic impacts as a result of increased pumping costs for Alternative 2 compared to the No Action Alternative

Impact type	Employment[1] (Jobs)	Labor Income[2] (Dollars) (2012 $)	Output[3] (Dollars) (2012 $)
Direct effect	0	0	0
Indirect effect	0	0	0
Induced effect	-1.1	-40,907	-120,933
Total effect	**-1.1**	**-40,907**	**-120,933**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

Water right transfers proposed as part of WURP could impact the regional economy in several ways. First the land once irrigated with the surface water right will continue to be irrigated but with groundwater or some or all of the land will be converted to either dryland production or fallow. If the water is replaced by groundwater the economy is only impacted by the loss of household income associated with the increased dryland pumping electricity costs. If all or part of the land is converted to dryland and/or fallow the losses to economy stem from the gross revenue produced on this land.

The second aspect of WURP that potentially impacts the regional economy is the compensation for the water right. Water right holder, or the growers, will be compensated for the value of the water right. However, no compensation is paid to those in the regional economy who do not own the water right but are affected by the grower's activities. Farm workers, agribusiness firms such as fertilizer and chemical dealers, wholesale and agricultural service providers are examples of those who do not receive compensation but will be impacted by the water right sale.

The land currently being irrigated by the water rights proposed to be acquired under the WURP program are located off project in the Sprague River sub-basin; the Sycan River; the Williamson River sub-basin; and the Wood River sub-basin.

This land is mostly used to grow irrigated pasture to support local livestock operations.

The combined impact of the lost irrigated pasture production and the associated livestock forward linkage stemming from the 30,000 acre-foot water right sale proposed under the WURP program are presented in table 2.4-8. However, it should be noted that a portion of these impacts are offset from household induced impacts resulting from household wages that are spent as a result of the compensation made to the water right holder.

Table 2.4-8.—Regional impacts stemming from lost agricultural production associated with the WURP program

Impact type	Employment[1] (Jobs)	Labor Income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	19.3	0.41	3.99
Indirect effect	11.2	0.32	1.49
Induced effect	3.6	0.13	0.37
Total effect	34.1	0.86	5.85

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

More information is needed to measure the direct effect of household spending of payments for water purchases proposed in the KBRA. The direct household spending is determined after accounting for debt retirement and leakages related to outside investments, household savings, and household tax payments. It is unknown how much to account for debt retirement and leakages. It can be assumed that a small amount of the regional impacts shown in table 2.4-8 will be offset by household spending (Howe and Goemans 2003).

2.4.3.2.4 Water Acquisitions – Short Term Water Leasing

Other programs in KBRA, like the Off-Project Reliance Program and the Interim Flow and Lake Level Program, suggest the use of water lease programs in drought years. Water lease programs are short term programs that may have negative impacts to the regional economy during water short years. The programs allow farmers to sell or lease their water for fisheries programs on a short term basis when sufficient water is unavailable for fish. The regional economy is impacted by the loss in gross farm revenue generated on the land idled by farmers who

voluntarily lease water. Some of these regional impacts are offset by household induced impacts when farmers spend a portion of the compensation in the local area. Since the KBRA does not specify what crops are being idled is not possible to use IMPLAN to measure these impacts.

2.4.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

The regional economic impacts for irrigated agriculture for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be expected to be the same as the Full Facilities Removal of Four Dams Alternative.

2.4.4 References

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2.5 COMMERCIAL FISHING

2.5.1 Economic Activities and Analysis Regions

The particular salmon stocks influenced by the no action and action alternatives are the Southern Oregon Northern California Coast (SONCC) coho Evolutionarily Significant Unit (ESU), which is listed as 'threatened' under the Endangered Species Act (ESA), and Klamath River fall and spring Chinook. The ocean migratory range of SONCC coho and Klamath Chinook is largely limited to the area south of Cape Falcon, Oregon. The area south of Cape Falcon is divided into six management areas: Monterey, San Francisco, Fort Bragg, Klamath Management Zone (KMZ), Central Oregon, and Northern Oregon. For purposes of this analysis, the KMZ (which straddles the Oregon-California border) is divided at the border into two areas: KMZ-OR and KMZ-CA.

The basis for the regional economic analysis are the annual gross revenues projected for each area under each alternative. Five of the seven management areas account for 99% of total gross revenue attributable to the availability of Klamath River Chinook under the No Action and action alternatives. Thus the regional economic analysis focuses on those five areas: San Francisco (San Mateo, San Francisco, Marin and Sonoma Counties), Fort Bragg (Mendocino County), KMZ-CA (Humboldt and Del Norte Counties), KMZ-OR (Curry County) and Central Oregon (Coos, Douglas and Lane Counties) (figure 2.5-1).

Tables 2.5-1 to -5 show the employment, labor income, and output associated with the fisheries management areas aggregated into eight industry sector classifications. Employment measures the number of jobs related to each of the industry sectors of the regional economy. Labor income is the sum of employee compensation and proprietor income. Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy.

2.5.1.1 San Francisco Management Area (San Mateo, San Francisco, Marin, and Sonoma Counties CA)

Table 2.5-1 shows employment, labor income, and output in the San Francisco Management analysis area. This region is the largest area in terms of economic activity as it includes the Bay Area cities. The service sector generates the largest number of jobs, with 63 percent of total regional employment. The trade sector ranks second with 12 percent of total regional employment. Government-related employment ranks third making up 11 percent of total regional employment.

The service sector generates the largest portion of labor income in the analysis area at 59 percent of the total regional labor income. The government sectors ranks second with 14 percent of the total regional labor income. The trade sector ranks third with 9 percent of the total regional labor income.

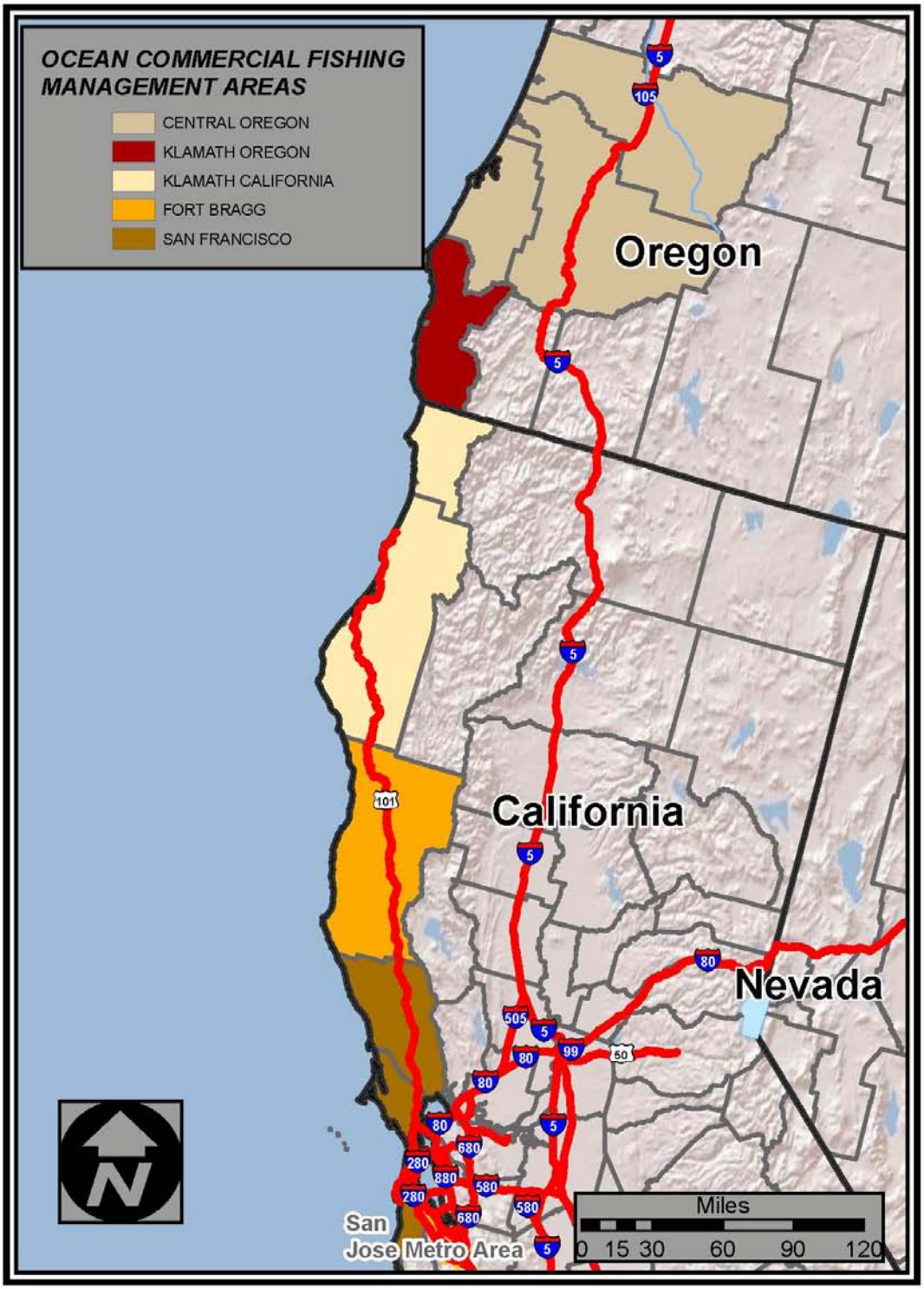

Figure 2.5-1.—Commercial fishing regional economic impact analysis area.

Table 2.5-1.—Summary of the regional economy for San Francisco Management Area (San Mateo, San Francisco, Marin, and Sonoma Counties CA)

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	10,400.70	0.34	570.53	0.28	1,536.15	0.26
Mining	2,682.60	0.09	404.25	0.20	1,529.34	0.26
Construction	153,734.40	5.02	11,116.50	5.43	23,970.50	4.00
Manufacturing	149,052.60	4.87	17,552.96	8.58	151,443.53	25.28
TIPU	98,914.50	3.23	6,843.29	3.34	24,426.35	4.08
Trade	372,966.90	12.19	19,026.25	9.30	42,067.56	7.02
Service	1,933,854.40	63.19	121,200.87	59.21	318,440.96	53.15
Government	338,759.50	11.07	27,970.63	13.67	35,749.56	5.97
Total	**3,060,365.60**		**204,685.28**		**599,163.95**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

The service sector produces the greatest level of output in the analysis area with 53 percent of the total output. The manufacturing sector ranks second in total industry output at 25 percent. Ranking third is the trade sector which makes up 7 percent of total industry output.

2.5.1.2 Fort Bragg Management Area (Mendocino County CA)

Table 2.5-2 shows employment, labor income, and output in the Fort Bragg Management Area. The service sector generates the largest number of jobs with 45 percent of total regional employment. The government sector ranks second with 19 percent of total regional employment. Trade sector employment ranks third making up 16 percent of total regional employment.

Thirty eight percent of the total regional labor income is generated by the service sector. The government sector ranks second with 24 percent of the total regional labor income. The trade sector ranks third with 14 percent of the total regional labor income.

Table 2.5-2.—Summary of the regional economy for the Fort Bragg Management Area (Mendocino County CA)

Industry sector	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	2,339.00	5.83	118.11	6.82	312.39	6.49
Mining	66.40	0.17	1.80	0.10	9.14	0.19
Construction	2,233.40	5.57	115.93	6.70	281.60	5.85
Manufacturing	2,449.30	6.11	128.21	7.41	808.43	16.79
TIPU	1,093.30	2.73	58.26	3.37	346.44	7.20
Trade	6,303.50	15.71	250.07	14.45	520.20	10.81
Service	18,190.10	45.34	649.96	37.55	1,970.63	40.94
Government	7,442.30	18.55	408.64	23.61	564.71	11.73
Total	**40,117.20**		**1,730.98**		**4,813.53**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

The service sector produces the greatest level of output in the analysis area with 41 percent of the total output. The manufacturing sector ranks second in total industry output at 17 percent. Ranking third is the government sector which makes up 12 percent of total industry output.

2.5.1.3 KMZ-CA (Humboldt and Del Norte Counties CA)

Table 2.5-3 shows employment, labor income, and output in the KMZ-CA. The service sector generates the largest number of jobs with 45 percent of total regional employment. The trade sector ranks second with 25 percent of total regional employment. Government related employment ranks third making up 15 percent of total regional employment.

The service related sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sectors ranks second with 32 percent of the total regional labor income. The trade sector ranks third with 13 percent of the total regional labor income.

Table 2.5-3.—Summary of the regional economy for the KMZ-CA (Humboldt and Del Norte Counties CA)

Industry sector	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	2,481.20	3.46	111.27	3.73	413.34	5.62
Mining	43.40	0.06	2.37	0.08	7.38	0.10
Construction	3,671.90	5.13	192.04	6.44	464.58	6.31
Manufacturing	2,464.80	3.44	126.28	4.23	798.32	10.85
TIPU	1,967.00	2.75	105.77	3.55	365.00	4.96
Trade	10,585.50	14.78	380.59	12.76	777.07	10.56
Service	32,461.50	45.32	1,113.71	37.34	3,327.87	45.21
Government	17,958.10	25.07	950.47	31.87	1,206.59	16.39
Total	**71,633.40**		**2,982.50**		**7,360.17**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

The service sector produces the greatest level of output in the analysis area with 45 percent of the total output. The government sector ranks second in total industry output at 16 percent. Ranking third are the trade and manufacturing sectors each with about 11 percent of total industry output.

2.5.1.4 KMZ-OR (Curry County OR)

Table 2.5-4 shows employment, labor income, and output in the KMZ-OR. The service sector generates the largest number of jobs with 45 percent of total regional employment. The government sector ranks with 16 percent of total regional employment. Trade sector employment ranks third making up 15 percent of total regional employment.

The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sectors ranks second with 22 percent of the total regional labor income. The trade sector ranks third with 12 percent of the total regional labor income.

Table 2.5-4.—Summary of the regional economy for the KMZ-OR (Curry County OR)

Industry sector	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	676.00	7.81	20.60	6.61	53.21	6.20
Mining	25.40	0.29	1.26	0.41	4.39	0.51
Construction	673.10	7.78	21.94	7.04	67.28	7.84
Manufacturing	611.10	7.06	33.42	10.73	130.97	15.25
TIPU	179.80	2.08	11.33	3.64	43.17	5.03
Trade	1,252.40	14.47	38.04	12.21	74.43	8.67
Service	3,884.70	44.88	114.81	36.86	393.11	45.79
Government	1,354.00	15.64	70.07	22.50	91.97	10.71
Total	**8,656.40**		**311.47**		**858.51**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

The service sector produces the greatest level of output in the analysis area with 46 percent of the total output. The manufacturing sector ranks second in total industry output at 15 percent. Ranking third is the government sector which makes up 11 percent of total industry output.

2.5.1.5 Central Oregon Management Area (Coos, Douglas, and Lane Counties OR)

Table 2.5-5 shows employment, labor income, and output in the Central Oregon Management Area. The service sector generates the largest number of jobs with 51 percent of total regional employment. The government sector ranks second with 17 percent of total regional employment. Trade sector employment ranks third making up 15 percent of total regional employment.

The service sector generates the largest portion of labor income in the analysis area at 43 percent of the total regional labor income. The government sectors ranks second with 23 percent of the total regional labor income. The trade sector ranks third with 12 percent of the total regional labor income.

Table 2.5-5.—Summary of the regional economy for the Central Oregon Management Area (Coos, Douglas, and Lane Counties OR)

Industry sector	Employment[1]		Labor income[2]		Output[3]	
	Jobs	Percent of total	$ million	Percent of total	$ million	Percent of total
Agriculture	8,717.70	3.38	273.06	2.68	865.38	3.11
Mining	448.50	0.17	23.57	0.23	92.68	0.33
Construction	12,681.20	4.91	547.94	5.39	1,451.52	5.22
Manufacturing	17,715.90	6.87	1,012.13	9.95	5,480.22	19.70
TIPU	6,726.20	2.61	332.09	3.27	1,070.39	3.85
Trade	37,814.90	14.65	1,259.06	12.38	2,657.42	9.55
Service	130,484.40	50.57	4,415.17	43.41	13,062.44	46.96
Government	43,458.70	16.84	2,307.17	22.69	3,134.82	11.27
Total	**258,047.40**		**10,170.18**		**27,814.88**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

The service sector produces the greatest level of output in the analysis area, with 47 percent of the total output. The manufacturing sector ranks second in total industry output at 20 percent. Ranking third is the government sector which makes up 11 percent of total industry output.

2.5.2 Methodology and Assumptions

Estimation of regional economic impacts is based on the assumption that salmon troll revenues are spent in the management area where the landings occur. The estimates of gross revenue used in this analysis are based on relative projections of Klamath Chinook harvest provided by the Evaluation of Dam Removal and Restoration of Anadromy model (Hendrix 2011), scaled to fishery conditions during 2001-05. These projections of Klamath Chinook harvest and associated estimates of total Chinook harvest (all stocks) and gross revenue by management area are identical to and derived in the same manner as the 50th percentile harvest and gross revenue estimates described in the benefit-cost analysis (section 1.1.2). Additional information regarding the methodologies, assumptions and conclusions underlying these derivations are contained in section 1.1.2.1 and the *Commercial Fishing Economics Technical Report* (NOAA 2011). The gross

revenue estimates by management area were used in IMPLAN to estimate employment, labor income, and output stemming commercial fishing.

2.5.3 Results

2.5.3.1 Alternative 1 – No Action

Annual gross revenue projected for each of the five areas under Alternative 1 is described in table 2.5-6. Revenues range from $266.9 thousand in KMZ-OR to $9.126 million in San Francisco.

Table 2.5-6.—Estimated annual ex-vessel revenue distributed among management areas according to where the landings occur – Alternative 1

Management area	Revenue (2012 dollars)
San Francisco	9,125,553
Fort Bragg	4,202,992
KMZ-CA	328,574
KMZ-OR	266,894
Central Oregon	6,847,058

Tables 2.5-7 through -11 show the regional economic impacts stemming from ocean commercial fishing under the No Action Alternative. Employment ranges from 26-510 jobs. Labor income ranges from $0.15 million to $6.10 million. Output ranges from $0.32 million to $15.52 million. The total employment in these management areas ranges from 3.06 million jobs in the San Francisco Management Area to 8,656 jobs in the KMZ-OR. Total labor income ranges from $204,685 million in the San Francisco Management Area to $311 million in the KMZ-OR. Total output ranges from $600,000 million in the San Francisco Management Area to $859 million in the KMZ-OR.

2.5.3.1.1 San Francisco Management Area

Table 2.5-7.—San Francisco Management Area regional economic impacts stemming from ocean commercial fishing under No Action

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	480	4.27	9.13
Indirect effect	8	0.56	2.70
Induced effect	22	1.27	3.69
Total effect	**510**	**6.10**	**15.52**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.1.2 Fort Bragg Management Area

Table 2.5-8.—Fort Bragg Management Area regional economic impacts stemming from ocean commercial fishing under No Action

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	150.0	1.98	4.20
Indirect effect	1.4	0.07	0.18
Induced effect	10.6	0.40	1.24
Total effect	**162**	**2.45**	**5.62**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.1.3 KMZ-CA

Table 2.5-9.—KMZ-CA regional economic impacts stemming from ocean commercial fishing under No Action

Impact type	Employment[1] (Jobs)	Labor Income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	43.0	0.15	0.33
Indirect effect	.1	0.01	0.02
Induced effect	0.9	0.03	0.10
Total effect	**44**	**0.19**	**0.45**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.1.4 KMZ-OR

Table 2.5-10.—KMZ-OR regional economic impacts stemming from ocean commercial fishing under No Action

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	25.0	0.13	0.27
Indirect effect	0.1	0.00	0.01
Induced effect	0.5	0.02	0.05
Total effect	**26**	**0.15**	**0.33**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.1.5 Central Oregon Management Area

Table 2.5-11.—Central Oregon Management Area regional economic impacts stemming from ocean commercial fishing under No Action

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	293.0	3.21	6.85
Indirect effect	4.1	0.17	0.46
Induced effect	21.8	0.77	2.24
Total effect	**319**	**4.15**	**9.55**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.2 Alternative 2 – Full Facilities Removal of Four Dams

Annual gross revenue projected for each of the five areas under Alternative 2 is described in Table 2.5-12. Regional economic impacts associated with Alternative 2 are estimated on the basis of the difference in revenue between Alternative 1 and Alternative 2, as described in Table 2.5-13. These differences range from $114 thousand in KMZ-OR to $3.903 million in San Francisco.

Table 2.5-12.—Estimated annual ex-vessel revenue distributed among management areas according to where the landings occur – Alternative 2

Management area	Revenue (2012 dollars)
San Francisco	13,028,998
Fort Bragg	6,000,817
KMZ-CA	469,121
KMZ-OR	381,058
Central Oregon	9,775,879

Table 2.5-13.—Estimated change in annual ex-vessel revenue between Alternative 1 and Alternative 2, distributed among management areas according to where the landings occur

Management area	Change in Revenue (2012 dollars)
San Francisco	3,903,445
Fort Bragg	1,797,825
KMZ-CA	140,547
KMZ-OR	114,164
Central Oregon	2,928,821

Regional economic impacts stemming from the change in ocean commercial fishing revenue between the No Action Alternative and Alternative 2 are presented in tables 2.5-14 through -18. Additional employment impacts range from 11 to 218 jobs compared to No Action. Labor income increases between $0.06 million to $2.56 million compared to No Action. Output increases from $0.13 million to $6.6 million. The total employment in these management areas ranges from 3.06 million jobs in the San Francisco Management Area to 8,656 jobs in the KMZ-OR. Total labor income ranges from $204,685 million in the San Francisco Management Area to $311 million in the KMZ-OR. Total output ranges from $600,000 million in the San Francisco Management Area to $859 million in the KMZ-OR.

2.5.3.2.1 San Francisco Management Area

Table 2.5-14.—San Francisco Management Area regional economic impacts stemming from the change in ocean commercial fishing revenue between the No Action Alternative and Alternative 2

	Employment[1]		Labor Income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	205.0		1.79		3.90	
Indirect effect	3.5		0.24		1.15	
Induced effect	9.3		0.53		1.55	
Total effect	**218**	**42.7**	**2.56**	**42.0**	**6.6**	**42.6**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.2.2 Fort Bragg Management Area

Table 2.5-15.—Fort Bragg Management Area regional economic impacts stemming from the change in ocean commercial fishing revenue between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	64.0		0.85		1.80	
Indirect effect	0.5		0.03		0.08	
Induced effect	4.5		0.17		0.53	
Total effect	**69**	**42.7**	**1.05**	**42.8**	**2.41**	**42.8**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.2.3 KMZ-CA

Table 2.5-16.—KMZ-CA regional economic impacts stemming from the change in ocean commercial fishing revenue between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	18.0		0.06		0.14	
Indirect effect	0.1		0.00		0.01	
Induced effect	0.4		0.01		0.04	
Total effect	**19**	**41.7**	**0.07**	**42.0**	**0.19**	**42.6**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.2.4 KMZ-OR

Table 2.5-17.—KMZ-OR regional economic impacts stemming from the change in ocean commercial fishing revenue between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	**Jobs**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**
Direct effect	11.0		0.05		0.11	
Indirect effect	0.0		0.00		0.00	
Induced effect	0.2		0.01		0.02	
Total effect	**11**	**43.8**	**0.06**	**42.8**	**0.13**	**42.8**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.2.5 Central Oregon Management Area

Table 2.5-18.—Central Oregon Management Area regional economic impacts stemming from the change in ocean commercial fishing revenue between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	**Jobs**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**
Direct effect	125.0		1.35		2.93	
Indirect effect	1.8		0.07		0.20	
Induced effect	9.1		0.32		0.94	
Total effect	**136**	**42.6**	**1.74**	**42.0**	**4.07**	**42.6**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.5.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

Alternative 3 is intended to provide the same habitat conditions as Alternative 2 (i.e., fish passage unencumbered by dams and a free-flowing river) as well as benefits of the KBRA. Therefore the effects of this alternative on salmon populations and the salmon troll fishery are expected to be the same as Alternative 2. Thus, regional economic impacts for Alternative 3 compared to the No Action Alternative would be expected to be the same as Alternative 2.

2.5.4 References

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Pacific Fishery Management Council, 2011. *Review of 2010 Ocean Salmon Fisheries*. Pacific Fishery Management Council. Portland, Oregon.

2.6 IN-RIVER SPORT FISHING

2.6.1 Analysis Regions

The economic region used in the regional economic impact analysis for in-river recreational fisheries includes Del Norte, Humboldt and Siskiyou counties in California and Klamath County in Oregon (figure 2.6-1). The three California counties cover the current location of the in-river salmon and steelhead fisheries; the Oregon county (Klamath) covers the area above the dams where salmon and steelhead could potentially recolonize under the action alternative. The economic analysis provided here summarizes the regional economic impacts of the No Action Alternative as it relates to the salmon and steelhead fisheries. Regional impacts of the action alternatives are also provided the salmon fishery but could not be estimated for the steelhead fishery due to data limitations; steelhead fishery impacts are instead discussed qualitatively.

The redband trout fishery occurs in two of the counties in the impact analysis area – Siskiyou and Klamath. However, lack of redband effort estimates for the tributaries above Upper Klamath Lake and for the fishery below Keno Dam preclude quantitative consideration of the regional economic impacts of this fishery. Those impacts are instead discussed qualitatively. The recreational sucker fishery is not considered in the regional analysis, as that fishery closed in 1987 and is unlikely to re-open under the No Action and action alternatives.

Table 2.6-1 shows the employment, labor income, and output associated with the four county area aggregated into the eight industry sector classifications. Employment measures the number of jobs related to each of the industry sectors of the regional economy. In the analysis area, activities related to the service sector generate the largest number of jobs, with 45 percent of total regional employment. The government sector ranks second with 23 percent of total regional employment. Trade sector employment ranks third making up 15 percent of total regional employment.

Table 2.6-1.—Summary of the regional economy for Del Norte, Humboldt, and Siskiyou Counties in California and Klamath County, OR

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	**Jobs**	**Percent of total**	**$ million**	**Percent of total**	**$ million**	**Percent of total**
Agriculture	5,713.10	4.77	219.03	4.46	910.68	7.29
Mining	127.10	0.11	5.58	0.11	23.06	0.18
Construction	5,845.40	4.88	282.12	5.74	707.41	5.66
Manufacturing	5,085.80	4.24	261.96	5.33	1,501.95	12.02
TIPU	3,887.40	3.24	215.09	4.38	759.63	6.08
Trade	17,471.10	14.58	601.06	12.24	1,232.50	9.86
Service	53,658.70	44.78	1,835.74	37.38	5,459.12	43.68
Government	28,048.70	23.41	1,490.23	30.35	1,904.47	15.24
Total	**119,837.10**		**4,910.81**		**12,498.83**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

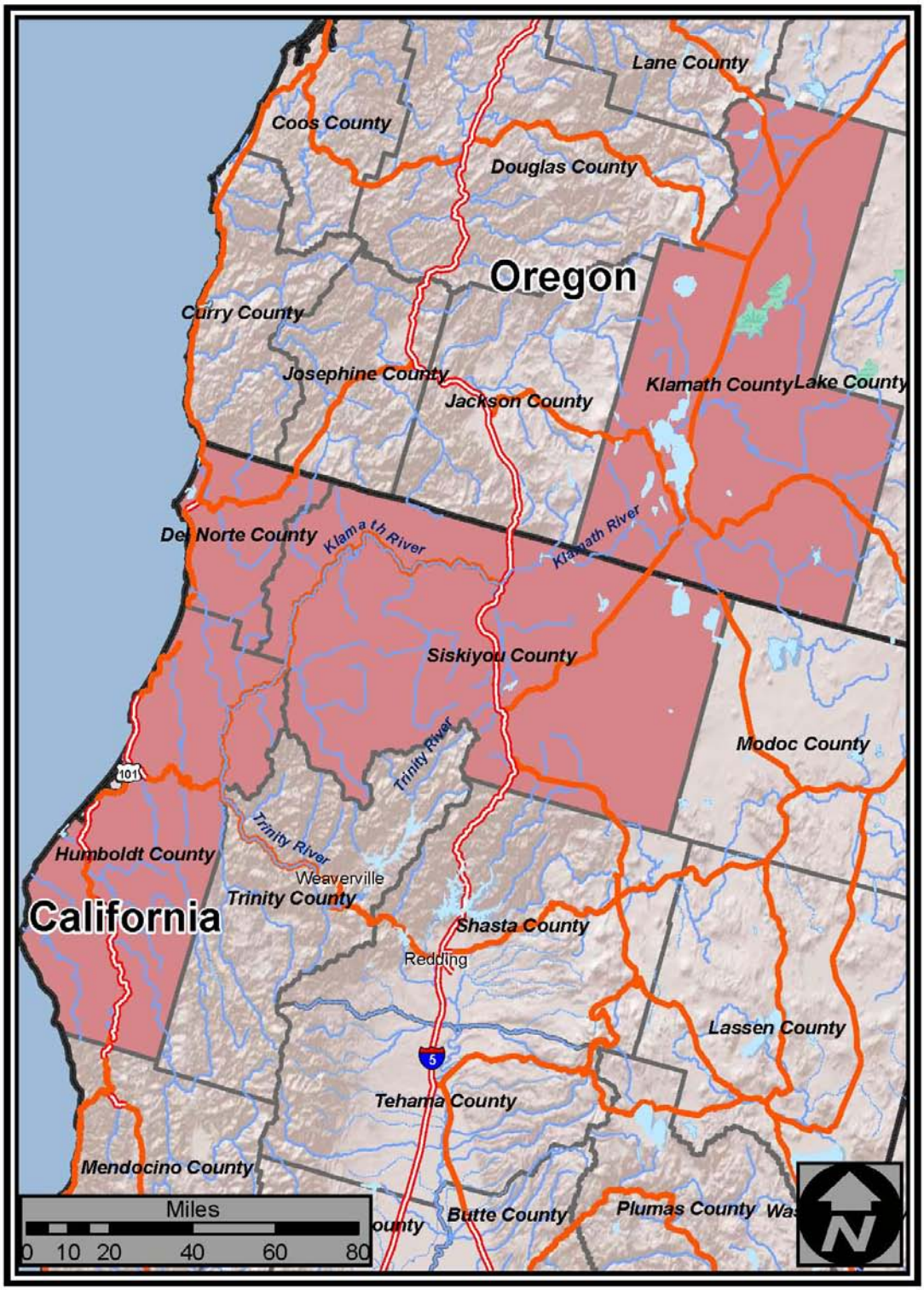

Figure 2.6-1.—In-river sport fishing regional economic impact analysis area.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sector ranks second with 30 percent of the total regional labor income. Ranking third are the sectors related to trade, at 12 percent of the total regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area, with 44 percent of the total output. The government sector ranks second in total industry output at 15 percent. Ranking third is the trade sector which makes up 12 percent of total industry output.

2.6.2 Methodology and Assumptions

For purposes of the regional economic impact analysis, fishing effort is distinguished according to whether it is attributable to anglers who reside inside or outside the four-county economic impact area. Expenditures in the impact area by resident and nonresident anglers generate economic activity measured in terms of employment, labor income and industry output. A basic assumption underlying this analysis is that any increase in expenditures by resident anglers associated with expanded fishing opportunities would be accommodated by reducing expenditures on other locally purchased goods and services – with no net change in local economic activity. For nonresident anglers, however, increases in regional fishing expenditures would be accommodated by diverting money that they would otherwise spend in their area of residence. Thus, the economic impact analysis focuses on nonresident angler expenditures, which represent 'new money' that stimulates the regional economy. Total within region direct expenditures were run through IMPLAN to estimate changes in regional economic impacts.

2.6.2.1 Recreational Salmon Fishery

Estimates of nonresident angler expenditures for the in-river salmon fishery are based on relative projections of Klamath Chinook harvest provided by the Evaluation of Dam Removal and Restoration of Anadromy model (Hendrix 2011), scaled to fishery conditions during 2001-05. The harvest projections and associated estimates of fishing effort (angler days) are identical to and derived in the same manner as the 50th percentile harvest and effort estimates used in the benefit-cost analysis (section 1.1.3.1.1).

To estimate nonresident angler expenditures, the proportion of angler days attributable to nonresident anglers was calculated on the basis of location-of-residence data collected in the Klamath River creel survey conducted by the California Department of Fish and Game (CDFG) (Borok 2009). Location of residence is reported in the creel survey as the first three digits of the angler's zip code of residence. Each three-digit location corresponds to a Sectional Center Facility (SCF) of the U.S. Postal Service – a processing and distribution center that serves zip code destinations beginning with those three digits. For purposes of this analysis, anglers identified with SCF 955 and SCF 960 are defined as resident anglers. Because these SCFs extend beyond the boundaries of the four-county regional economic impact area, the analysis provided here likely understates expenditures by nonresident anglers and their contribution to the regional economy.

Nonresident expenditures were estimated by multiplying nonresident angler days by average nonresident expenditures per angler day – the latter derived from data collected in a 2004 economic survey of California salmon and steelhead anglers conducted by NMFS. Average expenditures per angler day by nonresident anglers (for lodging, food, gasoline, fishing gear, private boat fuel, and guide services) is $105.02 (in 2012 dollars). Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in section 1.1.3.1.1 and the *In-River Sport Fishing Economics Technical Report* (NOAA 2011).

2.6.2.2 Recreational Steelhead Fishery

Economic impacts of the No Action Alternative on the in-river steelhead fishery were analyzed on the basis of current fishery conditions, as little change in the status of steelhead is anticipated under that alternative. Estimation of regional impacts for the action alternatives was precluded due to data limitations; instead those effects are expressed in qualitative terms.

The No Action Alternative is characterized in terms of average annual 2003-08 steelhead fishing effort on the Klamath River, estimated from CDFG steelhead report card data. The steelhead effort estimate underlying the regional impact analysis is identical to and derived in the same manner as the effort estimate used in the benefit-cost analysis (section 1.1.3.1.2). A number of additional steps were taken to estimate nonresident angler expenditures, as follows: Report card data on city/state of residence were used to estimate the proportion of total effort attributable to nonresident anglers. Annual nonresident expenditures were then estimated by multiplying nonresident effort by average nonresident expenditures per angler day (for lodging, food, gasoline, fishing gear, boat fuel, guide fees). This latter estimate – $105.98 (2012 dollars) – is based on data from a 2004 economic survey of in-river salmon and steelhead anglers sponsored by NMFS.

Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in section 1.1.3.1.2 and the *In-River Sport Fishing Economics Technical Report* (NOAA 2011).

Half-pounders are an important component of the steelhead fishery (Hopelain 1998). However, half-pounder catch is not included on steelhead report cards (Jackson 2007), and data for this fishery from other sources is sparse. Thus the regional impacts estimated for the No Action Alternative should be viewed as conservative.

2.6.2.3 Recreational Redband Trout Fishery

The recreational redband trout fishery is a well-known trophy fishery. Major fishing sites include Upper Klamath Lake, the lower Williamson and Wood Rivers, and the Keno Reach of the Klamath River. Effort estimates for Upper Klamath Lake and Agency Lake are available from a statistical creel conducted by ODFW in 2009. However similar estimates are not available for the lower Williamson and Wood Rivers or for the Keno Reach – making it difficult to infer how much is spent on this fishery. Regional economic impacts of this fishery are qualitatively assessed, based on the growth and enhancement of this fishery anticipated by the Resident Fish Expert Panel under the action alternatives. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in section 1.1.3.2.1.3 and the *In-River Sport Fishing Economics Technical Report* (NOAA 2011).

2.6.3 Results

2.6.3.1 Alternative 1 – No Action

2.6.3.1.1 Recreational Salmon Fishery

Annual salmon fishing effort on the Klamath River is estimated at 24,683 angler days under the No Action Alternative. The portion of this effort attributable to nonresident anglers is 15,822 angler days. Annual expenditures in the regional impact area by nonresident anglers is estimated at $1.662 million (2012 dollars).

As indicated in section 2.6.2.1, due to the use of three-digit zip codes to distinguish resident and nonresident anglers, this estimate of nonresident expenditures should be viewed as conservative.

Table 2.6-2 shows the regional impacts stemming from in river salmon fishing trip expenditures for the No Action Alternative. Approximately 34 jobs stem from in river salmon fishing related expenditures in the four county area. The four-county region supports almost 120,000 jobs. In river salmon fishing trip expenditures stimulate about $0.93 million of labor income and $2.01 million

of output. The overall region supports $4,900 million in labor income $12,500 million in output.

Table 2.6-2.—Regional impacts stemming from in-river salmon fishing expenditures with the No Action Alternative

Impact type	Employment[1] (Jobs)	Labor Income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	27.7	0.69	1.28
Indirect effect	2.3	0.09	0.28
Induced effect	4.2	0.15	0.45
Total effect	**34.2**	**0.93**	**2.01**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.6.3.1.2 Recreational Steelhead Fishery

The No Action Alternative is characterized in terms of recent steelhead fishing activity. Based on steelhead report card data, steelhead effort on the Klamath River averaged 17,155 angler days during 2003-08, of which 11,103 were attributable to nonresident anglers. Annual expenditures by nonresidents in the regional impact area are estimated at $1.177 million.

As indicated in section 2.6.2.2, steelhead report cards do not cover the half-pounder fishery. Thus, the regional impacts of this fishery under the No Action Alternative are understated.

Table 2.6-3 shows the estimated regional impacts stemming from in-river steelhead fishing trip expenditures for the No Action Alternative. Approximately 20 jobs were estimated to stem from in-river steelhead fishing related expenditures in the four county area. The four-county region supports almost 120,000 jobs. In-river steelhead fishing trip expenditures were estimated to stimulate about $0.62 million of labor income and $1.31 million of output. The overall region supports $4,900 million in labor income and $12,500 million in output.

Table 2.6-3.—Regional impacts stemming from in-river steelhead fishing expenditures with the No Action Alternative

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	15.6	0.46	0.83
Indirect effect	1.5	0.06	0.18
Induced effect	2.8	0.10	0.30
Total effect	**19.9**	**0.62**	**1.31**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.6.3.1.3 Recreational Redband Trout Fishery

The redband trout fishery is a renowned trophy fishery. According to results of a creel survey conducted during May-September 2009, fishing effort on Upper Klamath Lake totaled 15,191 angler days during that period (pers. comm. William Tinniswood, ODFW). County-of-residence data collected as part of the survey indicate that 24% of this effort was by nonresident anglers. Effort estimates for other major fishing sites (lower Williamson and Wood Rivers, Keno Reach of the Klamath River) are not available. A popular guide fishery occurs on the lower Williamson. Given that demand for guide trips is generally higher among nonresident than resident anglers, the proportion of trips by nonresident anglers is likely higher on the Williamson than in Upper Klamath Lake; however, data are lacking to verify this.

2.6.3.2 Alternative 2 – Full Facilities Removal of Four Dams

2.6.3.2.1 Recreational Salmon Fishery

Annual salmon fishing effort on the Klamath River is estimated at 26,578 angler days under Alternative 2. The portion of this effort attributable to nonresident anglers is 17,036 angler days. Expenditures in the regional impact area by nonresident anglers is estimated at $1.789 million (2012 dollars). The annual increase in nonresident expenditures under Alternative 2 relative to Alternative is $127.5 thousand.

As indicated in section 2.6.2.1, due to the use of three-digit zip codes to distinguish resident and nonresident anglers, this estimate of nonresident expenditures should be viewed as conservative.

Alternative 2 was estimated to create approximately three more jobs compared to the No Action Alternative in a region that supports almost 120,000 jobs. Table 2.6-4 shows that labor income increases by $0.07 million compared to the No Action Alternative, and output increases $0.15 million compared to the No Action Alternative. The overall region supports $4,900 million in labor income and $12,500 million in output.

Table 2.6-4.—Regional impacts stemming from the change in in-river salmon fishing trip expenditures between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	2.2		0.05		0.10	
Indirect effect	0.2		0.01		0.02	
Induced effect	0.3		0.01		0.03	
Total effect	**2.6**	**7.6**	**0.07**	**7.7**	**0.15**	**7.7**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.6.3.2.2 Recreational Steelhead Fishery

The Coho/Steelhead Expert Panel was generally positive regarding the potential for increased distribution and abundance of steelhead under Alternative 2 – assuming successful implementation of the Klamath Basin Restoration Agreement (Dunne *et al*. 2011). The Biological Subgroup for the Secretarial Determination concluded that Alternative 2 would result in increased numbers of steelhead spawners and provide conditions conducive to establishment of a steelhead fishery above Iron Gate Dam (Hamilton *et al*. 2010). However, because these changes were not quantified, it is not possible to quantify the effects of Alternative 2 on the steelhead fishery. However, expansion of that fishery would likely generate additional expenditures and additional jobs and income in the regional economy.

2.6.3.2.3 Recreational Redband Trout Fishery

The Resident Fish Expert Panel concluded that Alternative 2 would result in increased abundance and distribution of redband trout in Upper Klamath Lake and its tributaries and a potential seven-fold expansion of the fishery below Keno Dam (Buchanan *et al*. 2011). The effects of this increase could not be quantified with available data but would likely yield notable economic impacts, given the size of the potential increase in the fishery noted by the Expert Panel.

2.6.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

2.6.3.3.1 Recreational Salmon Fishery

Alternative 3 provides the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. The effects of this alternative on salmon populations and salmon fisheries – including the in-river recreational fishery – are expected to be the same as Alternative 2.

2.6.3.3.2 Recreational Steelhead Fishery

Alternative 3 provides the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. The effects of this alternative on steelhead populations and the recreational steelhead fishery are expected to be the same as Alternative 2.

2.6.3.3.3 Recreational Redband Trout Fishery

Alternative 3 provides the same habitat conditions as Alternative 2 – i.e., fish passage unencumbered by dams and a free-flowing river, as well as benefits of the KBRA. The effects of this alternative on redband trout and the recreational redband fishery are expected to be the same as Alternative 2.

2.6.4 References

Borok, S. 2009. Task 5 – Angler Creel Surveys in the Lower Klamath River. In: Sinnen, W. *et al*. *Annual Report – Trinity River Basin Salmon and Steelhead Monitoring Project, 2006-2007 Season*. State of California, The Resources Agency, Department of Fish and Game.

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NOAA Fisheries Service. 2011. *In-River Sport Fishing Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon.*

2.7 OCEAN SPORT FISHING

2.7.1 Economic Activities and Analysis Regions

The particular salmon stocks influenced by the No action and action alternatives are the Southern Oregon Northern California Coast (SONCC) coho Evolutionarily Significant Unit (ESU), which is listed as 'threatened' under the Endangered Species Act (ESA), and Klamath River fall and spring Chinook. The ocean migratory range of SONCC coho and Klamath Chinook is largely limited to the area south of Cape Falcon, Oregon. The area south of Cape Falcon is divided into six management areas: Monterey, San Francisco, Fort Bragg, Klamath Management Zone (KMZ), Central Oregon, and Northern Oregon. For purposes of this analysis, the KMZ (which straddles the Oregon-California border) is divided at the border into two areas: KMZ-OR and KMZ-CA.

The basis for the regional economic analysis are the annual nonresident fishing effort and expenditures projected for each area under each alternative. Two of the seven management areas account for 91% of total fishing effort attributable to the availability of Klamath River Chinook under the No Action and action alternatives. Thus the regional economic analysis focuses on those two areas: KMZ-CA (Humboldt and Del Norte Counties) and KMZ-OR (Curry County).

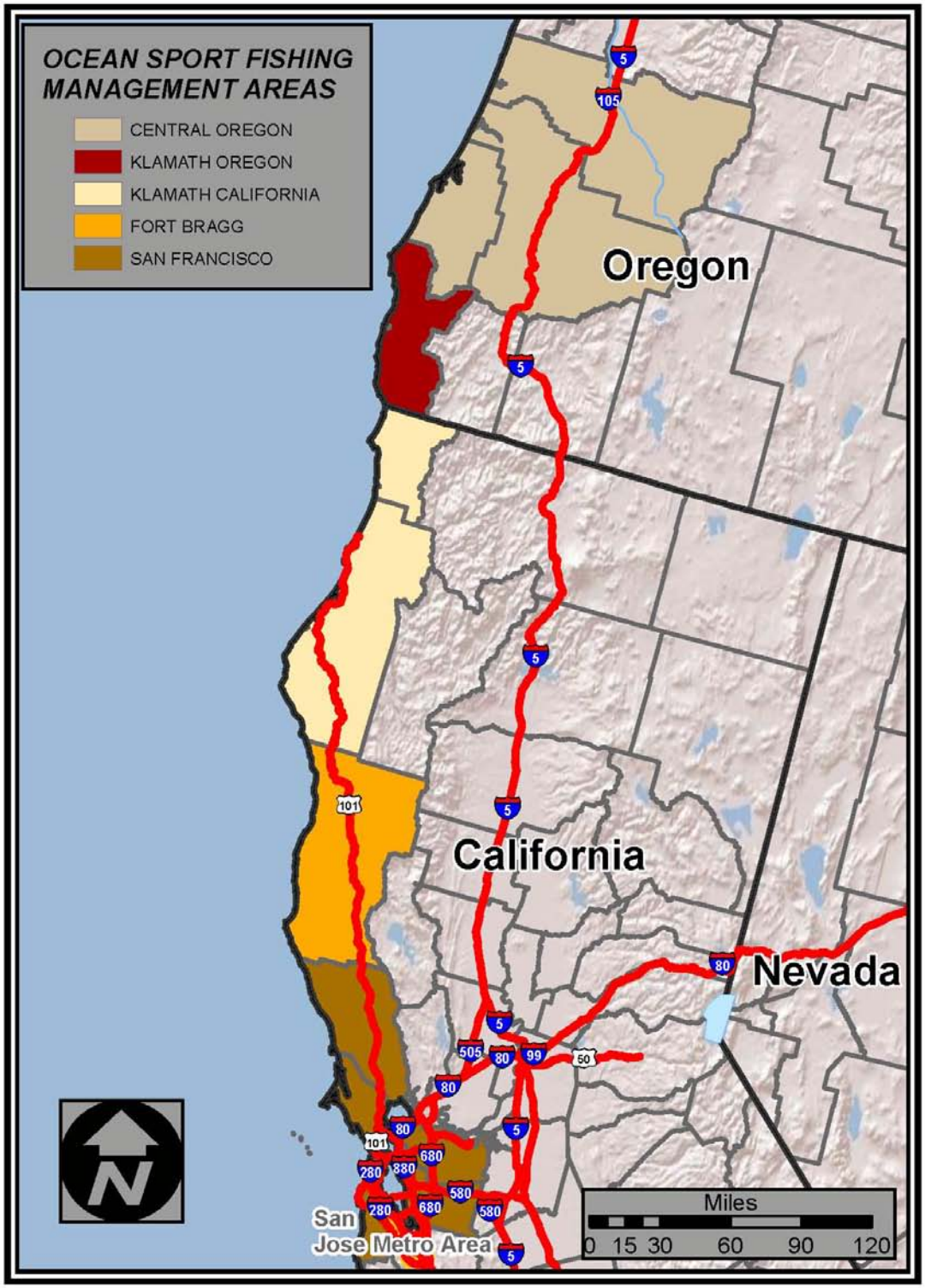

Figure 2.7-1.—Ocean sport fishing regional economic impact analysis area.

Tables 2.7-1 and -2 show the employment, labor income, and output associated with KMZ-CA and KMZ-OR aggregated into eight industry sector classifications. Employment measures the number of jobs related to each industry sector of the regional economy. Labor income is the sum of employee compensation and proprietor income. Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy.

Table 2.7-1.—Summary of the regional economy for the KMZ-CA (Humboldt and Del Norte Counties, CA)

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	**Jobs**	**Percent of total**	**$ million**	**Percent of total**	**$ million**	**Percent of total**
Agriculture	2,481.20	3.46	111.27	3.73	413.34	5.62
Mining	43.40	0.06	2.37	0.08	7.38	0.10
Construction	3,671.90	5.13	192.04	6.44	464.58	6.31
Manufacturing	2,464.80	3.44	126.28	4.23	798.32	10.85
TIPU	1,967.00	2.75	105.77	3.55	365.00	4.96
Trade	10,585.50	14.78	380.59	12.76	777.07	10.56
Service	32,461.50	45.32	1,113.71	37.34	3,327.87	45.21
Government	17,958.10	25.07	950.47	31.87	1,206.59	16.39
Total	71,633.40		**2,982.50**		**7,360.17**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

Table 2.7-2.—Summary of the regional economy for the KMZ-OR (Curry County, OR)

	Employment[1]		Labor Income[2]		Output[3c]	
Industry sector	**Jobs**	**Percent of total**	**$ million**	**Percent of total**	**$ million**	**Percent of total**
Agriculture	676.00	7.81	20.60	6.61	53.21	6.20
Mining	25.40	0.29	1.26	0.41	4.39	0.51
Construction	673.10	7.78	21.94	7.04	67.28	7.84
Manufacturing	611.10	7.06	33.42	10.73	130.97	15.25
TIPU	179.80	2.08	11.33	3.64	43.17	5.03
Trade	1,252.40	14.47	38.04	12.21	74.43	8.67
Service	3,884.70	44.88	114.81	36.86	393.11	45.79
Government	1,354.00	15.64	70.07	22.50	91.97	10.71
Total	8,656.40		311.47		858.51	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

Table 2.7-1 shows employment, labor income, and output in the KMZ-CA. The service sector generates the largest number of jobs with 45 percent of total regional employment. The trade sector ranks second with 25 percent of total regional employment. Government sector employment ranks third making up 15 percent of total regional employment.

The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sectors ranks second with 32 percent of the total regional labor income. The trade sector ranks third with 13 percent of the total regional labor income.

The service sector produces the greatest level of output in the analysis area with 45 percent of the total output. The government sector ranks second in total industry output at 16 percent. Ranking third is the trade sector which makes up 11 percent of total industry output.

Table 2.7-2 shows employment, labor income, and output in the KMZ-OR. The service sector generates the largest number of jobs with 45 percent of total regional employment. The government sector ranks second with 16 percent of total regional employment. Trade sector employment ranks third making up 15 percent of total regional employment.

The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sector ranks second with 22 percent of the total regional labor income. The trade sector ranks third with 12 percent of the total regional labor income.

The service sector produces the greatest level of output in the analysis area with 46 percent of the total output. The manufacturing sector ranks second in total industry output at 15 percent. Ranking third is the government sector which makes up 11 percent of total industry output.

2.7.2 Methodology and Assumptions

For purposes of analyzing regional impacts , fishing effort is distinguished according to whether it is attributable to anglers who reside inside or outside the management area fished. Expenditures within the area by resident and nonresident anglers generate economic activity measured in terms of industry output, labor income and employment. A basic assumption underlying this analysis is that any increase in expenditures by resident anglers associated with expanded fishing opportunities would be accommodated by reducing expenditures on other locally purchased goods and services – with no net change in local economic activity. For nonresident anglers, however, increases in local expenditures associated with increases in local fishing opportunities would be

accomplished by diverting money that they would otherwise spend in their area of residence. Thus the economic impact analysis focuses on nonresident angler expenditures, which represent 'new money' whose injection serves to stimulate the local economy.

The estimates of nonresident angler expenditures used in this analysis are based on relative projections of Klamath Chinook harvest provided by the Evaluation of Dam Removal and Restoration of Anadromy model (Hendrix 2011), scaled to fishery conditions during 2001-05. These harvest projections and the associated estimates of fishing effort (angler days) by management area are identical to and derived in the same manner as the 50th percentile harvest and effort estimates used in the benefit-cost analysis (section 1.1.2.1).

The following steps were taken to estimate nonresident angler expenditures associated with the angler day projections cited above: Angler days by fishing mode (party/charter, private boat) was estimated for each area by multiplying effort in each area by the proportion of effort attributable to each mode, estimated using 2001-05 fishery data (Pacific Fishery Management Council 2011). Zip code of residence data collected in ocean recreational creel surveys conducted by the California Department of Fish and Game (CDFG) and Oregon Department of Fish and Wildlife (ODFW) were used to estimate the proportion of effort in each mode and area attributable to nonresident anglers. Nonresident expenditures for each area and mode were then estimated by multiplying nonresident angler days by average nonresident expenditures per angler day – with the latter estimates derived from data collected in a 2000 economic survey of saltwater anglers conducted by NMFS. Average expenditures per angler day by nonresident anglers (for lodging, food, gasoline, fishing gear, party/charter boat fees, private boat fuel, equipment rental, access fees, and bait/ice) were estimated separately for each mode – $200,02 for party/charter mode and $54.66 for private boat mode (in 2012 dollars). Total within region direct expenditures were run through IMPLAN to estimate changes in regional economic impacts. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in section 1.1.4.1 and the *Ocean Sport Fishing Economics Technical Report* (NOAA 2011).

2.7.3 Results

2.7.3.1 Alternative 1 – No Action

Annual salmon fishing effort (in total and by nonresident anglers) and nonresident angler expenditures projected for Alternative 1 are described in table 2.7-3. Annual nonresident expenditures total $981.5 thousand in KMZ-CA and $223.5 thousand in KMZ-OR.

Table 2.7-3.—Estimated total annual recreational salmon effort, nonresident effort, and nonresident expenditures by fishing mode and management area for Alternative 1 – No Action

Management area	Angler days (Total)		Angler days (Nonresident)		Expenditures (Nonresident [2012 dollars])	
	Party/charter	Private	Party/charter	Private	Party/charter	Private
KMZ-CA	1,665	23,569	1,538	11,926	313,644	667,856
KMZ-OR	382	14,293	197	3,273	40,174	183,288

Table 2.7-4 and -5 show the estimated regional impacts stemming from ocean sport fishing trip expenditures for the No Action Alternative for KMZ-CA and KMZ-OR respectively. In KMZ-CA approximately 13 jobs were estimated to stem from ocean sport salmon fishing related expenditures. In KMZ-OR an estimated 2.9 jobs were associated with ocean sport salmon fishing. The KMZ-CA and KMZ-OR support almost 71,633 and 8,656 jobs respectively. Ocean sport salmon fishing trip expenditures were estimated to stimulate about $0.42 million of labor income in KMZ-CA and $0.08 million in KMZ-OR. Output related to ocean sport fishing was estimated at $1.12 million in KMZ-CA and $0.21 million in KMZ-OR. The overall economy in KMZ-CA supports $2,982.50 million in labor income and $7,360.17 million in output. KMZ-OR's economy supports $311.47 million in income and $858.51 million in output.

Table 2.7-4.—Estimated regional impacts stemming from ocean sport salmon fishing expenditures in the KMZ-CA from the No Action Alternative

Impact type	Employment[1] jobs	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	9.4	0.28	0.71
Indirect effect	1.5	0.06	0.19
Induced effect	2.0	0.07	0.22
Total effect	12.9	0.42	1.12

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

Table 2.7-5.—Estimated regional impacts stemming from ocean sport salmon fishing expenditures in the KMZ-OR from the No Action Alternative

Impact type	Employment[1] jobs	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	2.3	0.06	0.15
Indirect effect	0.3	0.01	0.03
Induced effect	0.3	0.01	0.03
Total effect	2.9	0.08	0.21

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.7.3.2 Alternative 2 – Full Facilities Removal of Four Dams

Annual salmon fishing effort (in total and by nonresident anglers) and nonresident angler expenditures projected for Alternative 2 are described in table 2.7-6. Annual nonresident expenditures total $1.402 million in KMZ-CA and $319.0 thousand in KMZ-OR. The annual increase in nonresident expenditures under Alternative 2 relative to Alternative 1 is $420.0 thousand for KMZ-CA and $95.5 thousand for KMZ-OR.

Table 2.7-6.—Estimated total annual recreational salmon effort, nonresident effort, and nonresident expenditures by fishing mode and management area – Alternative 2

Management area	Angler days total		Angler days nonresident		Expenditures nonresident (2012 dollars)	
	Party/charter	Private	Party/charter	Private	Party/charter	Private
KMZ-CA	2,378	33,650	2,197	17,027	448,034	953,512
KMZ-OR	545	20,407	281	4,673	57,304	261,688

Alternative 2 was estimated to create approximately five more jobs compared to the No Action Alternative in KMZ-CA as shown in table 2.7-7. The KMZ-CA economy supports almost 71,633 jobs. Labor income was estimated to increase by $0.18 million compared to the No Action Alternative. Output was estimated to increase $0.48 million compared to the No Action Alternative. The overall the KMZ-CA economy supports $2,982.50 million in labor income and $7,360.17 million in output.

Table 2.7-7.—Estimated regional impacts stemming from the change in ocean sport salmon fishing trip expenditures in the KMZ-CA between the No Action Alternative and Alternative 2

	Employment[1]		Labor Income[2]		Output[3]	
Impact type	**Jobs**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**
Direct effect	4.0		0.12		0.30	
Indirect effect	0.7		0.03		0.08	
Induced effect	0.8		0.03		0.09	
Total effect	**5.5**	**42.3**	**0.18**	**42.8**	**0.48**	**42.8**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

As shown in table 2.7-8 for KMZ-OR Alternative 2 was estimated to create approximately one more job compared to the No Action Alternative in a region that supports 8,656 total jobs. Alternative 2 was estimated to generate increases of $0.02 million in labor income and $0.09 million in output. KMZ-OR economy supports $311.47 million in labor income and $858.15 million of output.

Table 2.7-8.—Regional impacts stemming from the change in ocean sport salmon fishing trip expenditures in the KMZ-OR between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	**Jobs**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**	**$ millions (2012 $)**	**Percent change from No Action**
Direct effect	1		0.02		0.07	
Indirect effect	0.1		0.00		0.01	
Induced effect	0.1		0.00		0.01	
Total effect	**1.2**	**41.4**	**0.02**	**42.7**	**0.09**	**42.7**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.7.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

Alternative 3 is intended to provide the same habitat conditions as Alternative 2 (i.e., fish passage unencumbered by dams and a free-flowing river) as well as benefits of the KBRA. Therefore the effects of this alternative on fish populations and fisheries are expected to be the same as Alternative 2. Thus, regional economic impacts for Alternative 3 compared to the No Action Alternative would be expected to be the same as Alternative 2 (tables 2.7-7 and 2.7-8).

2.7.4 References

Hendrix, N2011. *Forecasting the response of Klamath Basin Chinook populations to dam removal and restoration of anadromy versus no action*. R2 Resource Consultants Inc., Redmond, Washington. Review draft dated May 16, 2011.

NOAA, National Marine Fisheries Service. 2011. *Ocean Sport Fishing Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon.*

Pacific Fishery Management Council. 2011. *Review of 2010 Ocean Salmon Fisheries*. Pacific Fishery Management Council. Portland, Oregon.

2.8 REFUGE RECREATION

2.8.1 Analysis Region

The economic region used in the refuge recreation regional economic impact analysis is based on the locations of the Lower Klamath Lake and Tule Lake National Wildlife Refuges. These two refuges sit along the border of Oregon and California in Siskiyou County (California) and Klamath County (Oregon). While a small portion of Tule Lake Refuge also lies within Modoc County, California, expenditures are most likely to take place either in Klamath Falls Oregon (Klamath County) or Tule Lake California (Siskiyou County). A map of the analysis region is shown in figure 2.8-1.

Table 2.8-1 shows the employment, labor income, and output associated with the two-county area aggregated into eight industry sector classifications. Employment measures the number of jobs related to each industry sector of the regional economy. In the analysis area activities related to the service sector generate the largest number of jobs with 44 percent of total regional employment.

Table 2.8-1.—Summary of the regional economy for Klamath and Siskiyou Counties

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	**Jobs**	**Percent of total**	**$ million**	**Percent of total**	**$ million**	**Percent of total**
Agriculture	3,232	6.7	$107.8	5.6	$497.3	9.7
Mining	84	0.2	$3.2	0.2	$15.7	0.3
Construction	2,174	4.5	$90.1	4.7	$242.8	4.7
Manufacturing	2,621	5.4	$135.7	7.0	$703.6	13.7
TIPU	1,920	4.0	$109.3	5.7	$394.6	7.7
Trade	6,886	14.3	$220.5	11.4	$455.4	8.9
Service	21,197	44.0	$722.0	37.4	$2,131.2	41.5
Government	10,091	20.9	$539.8	28.0	$697.9	13.6
Total	**48,204**		**$1,928.3**		**$5,138.7**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

The government sector ranks second in terms of overall number of jobs in the analysis area with 21 percent of total regional employment. Trade related employment ranks third making up 14 percent of total regional employment.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sector ranks second with 28 percent of the total regional labor income. Ranking third is the trade sector at 11 percent of the total regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area with 42 percent of the total output. The manufacturing and government sectors rank second in total industry output at 14 percent. Ranking third is the agricultural sector, which makes up 10 percent of total industry output.

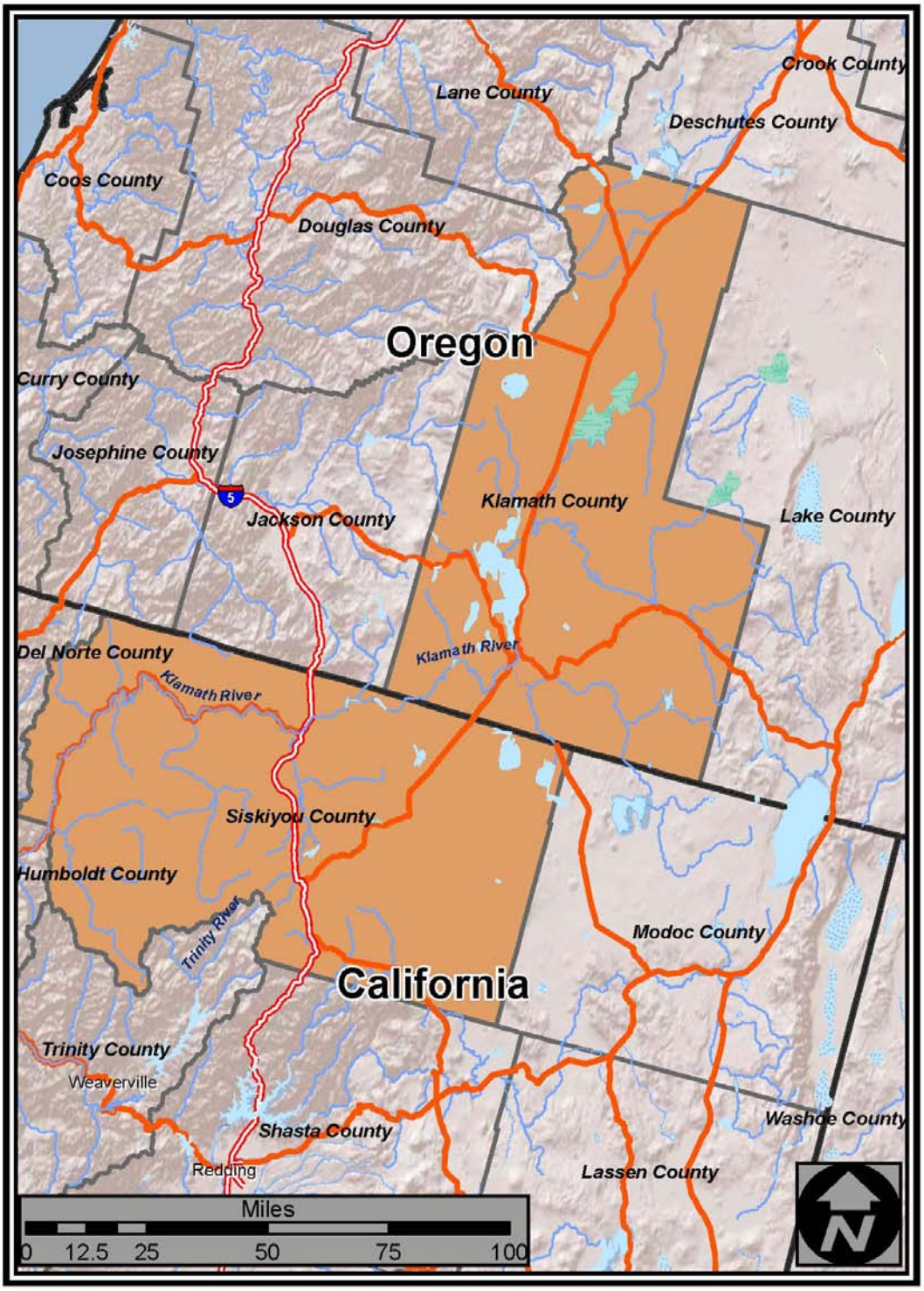

Figure 2.8-1.—Refuge recreation regional economic impact analysis area.

2.8.2 Methodology and Assumptions

The Refuge Recreation Economics Technical Report (Maillett 2011) discusses in greater detail the methodology followed and the results derived associated with the direct economic contribution to the local area associated with the economic expenditures of nonlocal refuge visitors. Visitors target the refuge primarily for one of two recreational purposes: wildlife viewing or waterfowl hunting. Expenditures associated with visitation include lodging, food and beverages, transportation, and equipment. Expenditure data was obtained from the National Survey of Fishing, Hunting, and Wildlife-Associated Recreation and prorated based on the amount of time a typical visitor spends on the Refuge engaging in either activity. Expenditures were prorated so as not to over-estimate the total economic contribution of the Refuge to the regional economy as most visitation to the Refuge lasts for no more than one-half a day. In 2009, the two refuges reported a combined total of 96,300 wildlife watching visits and 10,526 hunting visits. In general, visitation to the Refuges has been declining over the past decade.

To estimate the effects of the alternatives, the analysis looked for relationships between visitation and waterfowl counts under the premise that visitors come to the Refuges either to view or harvest waterfowl and that a positive correlation exists between visitor numbers and waterfowl numbers. The results of this analysis found a reasonable relationship existed between hunting visits and waterfowl numbers but could not detect any significant relationship between wildlife watching visits and waterfowl counts.

2.8.3 Results

2.8.3.1 Alternative 1 – No Action

The Refuge Recreation Economics Technical Report (Maillett 2011) discusses in greater detail the relationship discovered between hunting visits and waterfowl numbers. This relationship was compared to the estimated number of waterfowl associated with Alternative 1, which was estimated in a separate USFWS report (Mayer and Mauser 2010). Only economic impacts associated with hunting visits were estimated because no discernable relationship could be identified for wildlife watching visits. The Mayer and Mauser report estimates the number of waterfowl based on wetted acres. Under an average water year scenario, Mayer and Mauser estimate an average of 112,458 waterfowl, which based on the relationship established in the Technical Report translates into an estimated 7,740 hunting trips with a total expenditure of $611,444.

Table 2.8-2 shows the regional impacts stemming from refuge hunting trip expenditures for the No Action Alternative. Approximately 11 jobs stem from refuge hunting related expenditures. The region supports almost 48,000 jobs. Refuge hunting trip expenditures stimulate about $0.26 million of labor income and $0.62 million of output. The overall region supports $1,928 million in labor income and $5,139 million in output.

Table 2.8-2.—Regional impacts stemming from refuge hunting expenditures with the No Action Alternative

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	9.2	0.20	0.45
Indirect effect	0.5	0.02	0.06
Induced effect	1.1	0.04	0.11
Total effect	**10.8**	**0.26**	**0.62**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.8.3.2 Alternative 2 – Full Facilities Removal of Four Dams

Following the same methodology described in section 2.8.3.1, it was estimated that there would be an additional 193,830 waterfowl and 3,634 hunting trips under Alternative 2. The addition of these trips would result in a total of $287,099 in direct expenditures within the local economies.

Alternative 2 was estimated to create 5 more jobs, increase labor income by $0.11 million, and output by $0.27 million compared to the No Action Alternative. The regional economy supports almost 48,000 jobs, $1,928 million in labor income, and $5,139 million in output as shown in table 2.8-3.

Table 2.8-3.—Regional impacts stemming from the change in refuge hunting expenditures between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	4.3		0.09		0.19	
Indirect effect	0.2		0.01		0.03	
Induced effect	0.5		0.02		0.05	
Total effect	**5.0**	**47.2**	**0.11**	**47.0**	**0.27**	**47.0**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.8.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

The impacts for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be the same as under the Full Facilities Removal of Four Dams Alternative.

2.8.4 References

2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, U.S. Fish and Wildlife Service.

IMPLAN (Minnesota IMPLAN Group, Inc.), 2010. User's Guide, IMPLAN Version 3.0. Stillwater, Minnesota.

Maillett, Edward, U.S. Fish and Wildlife Service, Division of Economics. Refuge Recreation Economics Technical Report 2011.

Mauser, Dave and Tim Mayer, U.S. Fish and Wildlife Service, Effects of the Klamath Basin Restoration Agreement on Lower Klamath, Tule Lake, and Upper Klamath National Wildlife Refuges. 2010.

2.9 RESERVOIR RECREATION

2.9.1 Analysis Region

The economic region used in the reservoir recreation regional economic impact analysis is based on the location of the impacted reservoirs. Significant recreation activity occurs at J.C. Boyle, Copco 1, and Iron Gate Reservoirs. For various reasons, Copco Reservoir 2 does not generate significant recreation activity. Therefore, the reservoir recreation regional analysis focuses exclusively on J.C. Boyle reservoir which is located in Klamath County, Oregon, and Copco 1 and Iron Gate reservoirs which are located in Siskiyou County, California. A map of the analysis region is shown in figure 2.9-1.

Table 2.9-1 shows the employment, labor income, and output associated with the two-county area aggregated into eight industry sector classifications. Employment measures the number of jobs related to each sector of the regional economy. In the analysis area, activities related to the service sector generate the largest number of jobs, with 44 percent of total regional employment. The government sector ranks second in terms of overall number of jobs in the analysis area, with 21 percent of total regional employment. Trade related employment ranks third making up 14 percent of total regional employment.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 37 percent of the total regional labor income. The government sectors ranks second with 28 percent of the total regional labor income. Ranking third is trade at 11 percent of the total regional labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area with 42 percent of the total output. The manufacturing and government sectors rank second in total industry output at 14 percent. Ranking third is the agricultural sector which makes up ten percent of total industry output.

2.9.2 Methodology and Assumptions

The Reservoir Recreation Economics Technical Report (Reclamation 2011) discusses in detail the methodology and results of the reservoir recreation regional economic impact analysis summarized here. The basic premise of the analysis is that nonlocal recreators visiting the three reservoirs (J.C. Boyle, Copco 1, and Iron Gate) spend money in the region purchasing gas, food and drink, lodging,

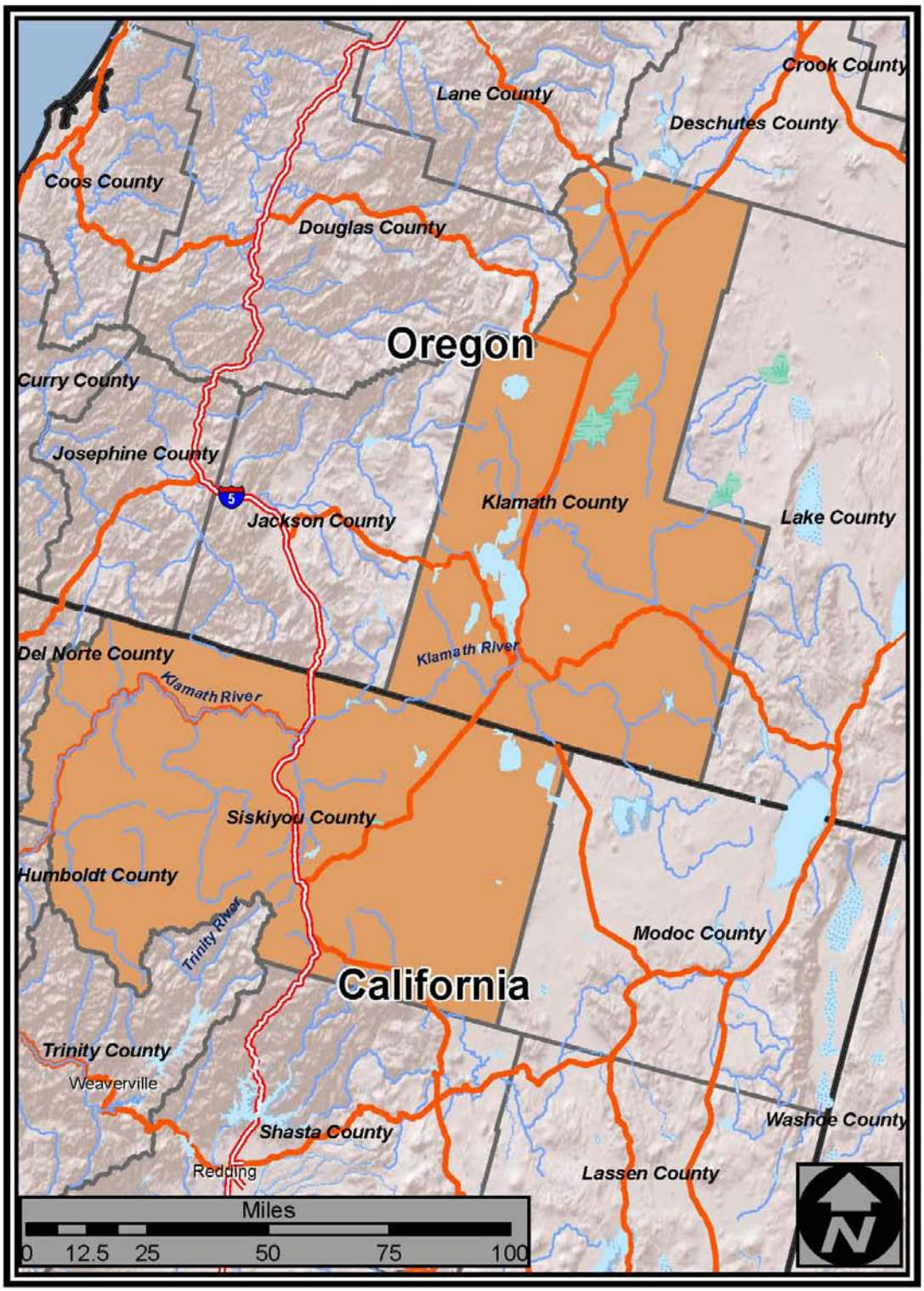

Figure 2.9-1.—Reservoir recreation regional economic impact analysis area.

Table 2.9-1.—Summary of the regional economy for Klamath and Siskiyou Counties

	Employment[1]		Labor income[2]		Output[3]	
Industry sectors	Jobs	Percent of total	Millions $	Percent of total	Millions $	Percent of total
Agriculture	3,232	6.7	107.8	5.6	497.3	9.7
Mining	84	0.2	3.2	0.2	15.7	0.3
Construction	2,174	4.5	90.1	4.7	242.8	4.7
Manufacturing	2,621	5.4	135.7	7.0	703.6	13.7
TIPU	1,920	4.0	109.3	5.7	394.6	7.7
Trade	6,886	14.3	220.5	11.4	455.4	8.9
Service	21,197	44.0	722.0	37.4	2,131.2	41.5
Government	10,091	20.9	539.8	28.0	697.9	13.6
Total	**48,204**		**1,928.3**		**5,138.7**	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

guide services, and other items. These expenditures generate economic activity measured in terms of total industry output, labor income, and employment within the two-county economic region.

To develop estimates of the average annual within region reservoir recreation expenditures for each alternative, annual estimates of nonlocal recreator visitation were applied to estimates of within region reservoir recreation expenditures per visit.

Average annual estimates of nonlocal recreator visitation for each alternative were developed based on the visitation projections derived for the National Economic Development benefit-cost analysis (NED BCA) (see NED reservoir recreation benefit methodology section of the Reservoir Recreation Economics Technical Report). The primary differences in the visitation estimates used in the regional analysis versus the NED BCA relates to variation in the site substitution method and the fact that the regional analysis focuses on nonlocal recreators. Substitution differences result because the two-county economic region used in the regional analysis is somewhat smaller than the five county market area used in the NED BCA. The regional analysis focuses on within region expenditures by nonlocal recreators (nonresidents of the two-county region) because this represents an increase in expenditures within the region. It was assumed that within region recreation expenditures made by residents of the region may not result in increased expenditures because those expenditures could represent a transfer from other within region purchases.

Within region reservoir recreation expenditures per visit were obtained from the recreation survey presented in the PacifiCorp (2004) report. The expenditure information was gathered by expenditure category (accommodations, food, gas, supplies, guide fees, etc.). Various adjustments (e.g., group trip to individual trip, trip to day, original dollars to 2012 dollars) were made to convert the expenditures into an average of $15.35 per visit (recreation day). Changes in average annual within region nonlocal recreator expenditures for each proposed alternative as compared to the No Action Alternative were run through the IMPLAN Model to estimate regional economic impacts associated with each proposed alternative.

2.9.3 Results

2.9.3.1 Alternative 1 – No Action

A significant blue green algae problem exists at Copco 1 and Iron Gate reservoirs. Health advisories have been posted at these reservoirs for the past several years. These advisories suggest avoiding use of the water for cooking and washing as well as avoiding the consumption of fish. While these advisories have been in place for several years, no data exists as to their on their impact on recreation visitation. Should the algae problems continue across the 50-year period of analysis for this study, a significant percentage of visitation at these two reservoirs may be lost. This could significantly reduce the baseline level of recreation visitation under the No Action Alternative. At this point, the impact of the blue-green algae problem on visitation is unknown so attempting to provide algae adjusted visitation estimates is deemed speculative. However, algae is not found nor is anticipated at J.C. Boyle Reservoir because of the way water flushes through the reservoir. Average annual nonlocal recreator visitation, within region expenditures, and estimates of regional economic activity under the No Action Alternative are based on recreation at Copco 1, Iron Gate, and J.C. Boyle Reservoirs. Average annual nonlocal recreator visitation, as discussed in the Reservoir Recreation Technical Report, was estimated at 71,584 visits. Average annual non local expenditures equal $1,098,821.

Table 2.9-2 displays estimates of reservoir recreation based regional economic impacts for the No Action Alternative. Seven jobs stem from reservoir recreation related expenditures in a region that supports almost 48,000 jobs. Recreation expenditures stimulate about $0.22 million of labor income and $0.54 million of output. The overall regions supports $1,928 million in labor income $5,139 million in output.

Table 2.9-2.—Regional impacts stemming from reservoir recreation expenditures with the No Action Alternative

Impact type	Employment[1] (Jobs)	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	5.4	0.17	0.38
Indirect effect	0.5	0.02	0.06
Induced effect	0.9	0.03	0.10
Total effect	**6.8**	**0.22**	**0.54**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.9.3.2 Alternative 2 – Full Facilities Removal of Four Dams

The reservoir recreation regional analysis is a with versus without reservoir analysis. Under the No Action Alternative, Copco 1, Iron Gate, J.C. Boyle Reservoirs would remain in place whereas under the Full Facilities Removal of Four Dams Alternative, these three reservoirs are assumed lost. Therefore, the proposed removal of Copco 1, Iron Gate J.C. Boyle dams would result in losses in reservoir recreation visitation, expenditures, and regional economic activity within the two-county region as compared to the No Action Alternative. Note that the losses in regional economic activity estimated for the Full Facilities Removal of Four Dams Alternative are less than those presented under the No Action Alternative due to the influence of site substitution (i.e., a portion of the regional economic activity associated with the No Action Alternative would substitute to other sites in the region thereby dampening the effect of the lost reservoir). The change in average annual visitation between the Alternative 2 and the No Action Alternative were estimated at 40,901 visits. The change in average annual expenditures between Alternative 2 and the No Action Alternative was estimated at $627,838.

Table 2.9-3 displays estimates of the changes in regional economic activity associated with the change in reservoir recreation expenditures between the Full Facilities Removal of Four Dams Alternative and the No Action Alternative. Four jobs are lost with the change in recreation expenditures between the No Action Alternative and Alternative 2. Labor income declines by $0.13 million compared to the No Action Alternative in a regional economy that supports $1,928 million in labor income as shown in table 2.9-1. Output declines $0.31 million compared to the No Action Alternative. The overall economy generates 5,139 million in output.

Table 2.9-3.—Regional impacts stemming from the changes in reservoir recreation expenditures between the No Action Alternative and Alternative 2

	Employment[1]		Labor Income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	-3.1		-0.10		-0.22	
Indirect effect	0.3		-0.01		-0.03	
Induced effect	-0.5		-0.02		-0.06	
Total effect	**-3.9**	**-57.4**	-0.13	**-59.1**	**-0.31**	**-56.9**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.9.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

With partial removal of all four dams, the assumption was made that the reservoirs would be lost. As a result, the losses in reservoir recreation visitation, expenditures, and regional economic activity for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative would be the same as under the Full Facilities Removal of Four Dams Alternative.

2.9.4 References

PacifiCorp. February 2004. Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082.

Bureau of Reclamation. 2011. Reservoir Recreation Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon. Bureau of Reclamation, Technical Service Center, Denver, CO.

2.10 WHITEWATER RECREATION

2.10.1 Analysis Region

The economic region used in the whitewater boating recreation regional economic impact analysis is based on the location of whitewater boating activity that occurs on the Klamath River. Whitewater boating recreation is broadly split into activity

that occurs on the Upper Klamath River (UKR) and Lower Klamath River (LKR), where for the purposes of this analysis, the UKR is defined as the section of the Klamath River upstream of IGD and the LKR is defined as the stretch downstream of IGD. The regional economic impact analysis for whitewater boating activity that occurs on the UKR focuses on Klamath and Jackson Counties in Oregon, while the analysis for activity on the LKR focuses on Siskiyou and Humboldt Counties in California. The whitewater boating regional economic impact analysis region is Klamath and Jackson counties in Oregon and Humboldt and Siskiyou counties in California. A map of the analysis area is shown in figure 2.10-1.

Table 2.10-1 shows the employment, labor income, and output associated with the four county area aggregated into eight industry sector classifications. Employment measures the number of jobs related to each sector of the regional economy. In the analysis area activities related to the service sector generate the largest number of jobs with 48 percent of total regional employment. The trade sector ranks second in terms of overall number of jobs in the analysis area, with 17 percent of total regional employment. Government related employment ranks third making up 16 percent of total regional employment.

Table 2.10-1.—Summary of the overall regional economy for Klamath, Jackson, Humboldt, and Siskiyou Counties

	Employment[1]		Labor income[2]		Output[3]	
Industry sector	**Jobs**	**Percent of total**	**$ million**	**Percent of total**	**$ million**	**Percent of total**
Agriculture	8,336.60	3.7	306.80	3.5	1,078.18	4.6
Mining	324.7	0.1	12.47	0.1	54.79	0.2
Construction	16,545.40	7.4	632.86	7.3	1,782.00	7.6
Manufacturing	10,603.90	4.7	540.76	6.2	3,225.89	13.8
TIPU	7,746.00	3.4	411.93	4.7	1,400.27	6.0
Trade	37,272.60	16.6	1,187.90	13.7	2,591.26	11.1
Service	108,382.20	48.2	3,642.63	42.0	10,690.44	45.8
Government	35,455.70	15.8	1,946.49	22.4	2,507.61	10.7
Total	224,667.20		8,681.84		23,330.45	

Source: 2009 IMPLAN data.
[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

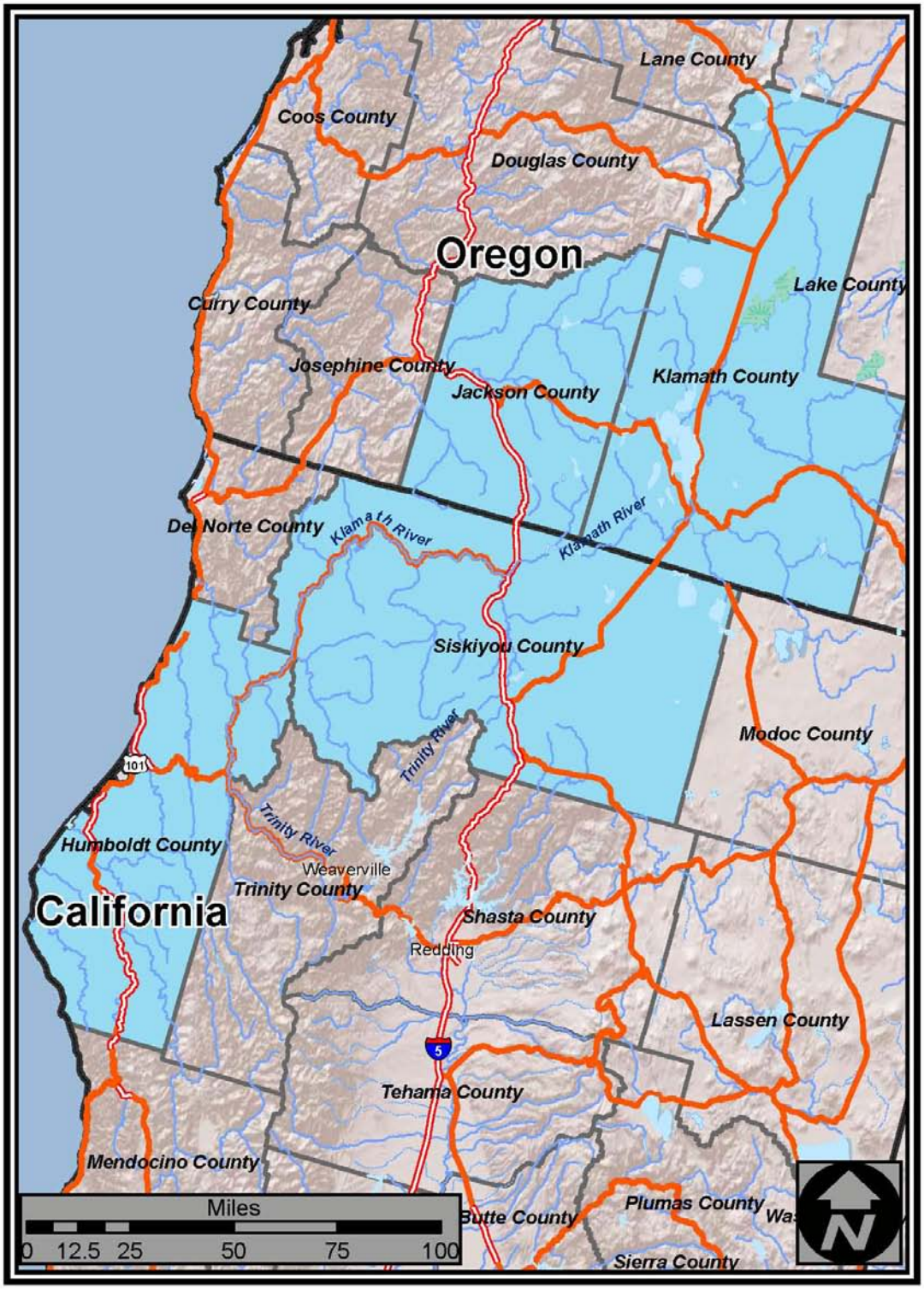

Figure 2.10-1.—Whitewater recreation regional economic impact analysis area.

Labor income is the sum of employee compensation and proprietor income. The service sector generates the largest portion of labor income in the analysis area at 42 percent of the total regional labor income. The government sector ranks second with 22 percent of the total labor income. Ranking third is trade at 14 percent of the total labor income.

Industry output or sales represent the value of goods and services produced by businesses within a sector of the economy. The service sector produces the greatest level of output in the analysis area, with 46 percent of the total output. The manufacturing sector ranks second in total industry output at 14 percent. Ranking third are trade and government each with 14 percent of total industry output.

2.10.2 Methodology and Assumptions

The Whitewater Boating Recreation Economics Technical Report (U.S. Department of the Interior 2011) discusses in detail the methodology and results of the whitewater boating recreation regional economic impact analysis summarized here. In general, individuals visiting the Klamath River to engage in whitewater boating recreation spend money in the region purchasing gas, food and drink, lodging, guide services, and other items. The expenditures associated with these trips generate economic activity measured in terms of total industry output, labor income, and employment within the four county economic region defined for this analysis.

The estimate of average annual total direct expenditures for whitewater boating was derived by combining estimates for expenditures per user day and estimates for the number of whitewater boating user days. However, for the local regional economy it matters where the expenditures come from. If the expenditures are from users located outside of the local region (i.e., non-local users), it generates increased economic activity in the local region and would be considered a loss to the local economy if it did not occur. If the expenditures are from users within the local region (i.e., local users), their expenditures may or may not generate increased economic activity in the local region. Whether expenditures from local users results in increased economic activity within the local region depends on whether the local users would have engaged in a substitute activity outside of the local region if the primary activity were not available (e.g., the local user would engage in whitewater boating on another river outside of the local area if the Klamath River was not available or if the local users substitute some other activity inside the region). Expenditures from local users associated with whitewater boating activity that would not have occurred within the local area if the Klamath River was not available would be considered an increase in local economic activity. However, the expenditure of money by local users for a substitute activity that occurs within local area if the Klamath River was not

available does not result in an increase economic activity. Therefore, these expenditures would not be considered a loss to the local economy.

The Whitewater Boating Recreation Economics Technical Report (U.S. .Department of the Interior 2011) provides the estimate of the average annual number of whitewater boating user days for the UKR and LKR, where total number of user days are differentiated by local vs. nonlocal user days and commercial vs. private user days. The percentage of total use that is associated with local and non-local users was based on survey results in Johnson and Moore (1993) that found 78 percent of total whitewater boating activity on the UKR is by non-local users. This same percentage was assumed to apply for activity on the LKR. The number of local user days was further adjusted to account for those local users that would have engaged in a substitute activity outside of the local area if the Klamath River was not available. Following Johnson and Moore (1993), it was assumed that 11 percent of the local user days would have been substituted to an activity outside of the local region if the Klamath River was not available. As such, expenditures associated with these user days represent increased economic activity to the local region and should be included in the estimation of total direct expenditures. The expenditures associated with the other 89 percent of local user days would have still occurred in the local area if the Klamath River was not available and therefore, do not represent an increase in economic activity to the local region and should not be included.

Expenditures per user day are differentiated by private and commercial users. Commercial use is associated with the use of whitewater boating outfitter for the trip, while private use are those trips taken without an outfitter. Significant portions of the Klamath River require commercial whitewater boating outfitters to obtain a permit from Bureau of Land Management (BLM) for use on the UKR and from the U.S. Forest Service (USFS) for use on the LKR. Separate estimates of outfitter fees per user day were developed for the UKR and LKR from on an analysis of outfitters fees charged by outfitters permitted to provide trips on the UKR and LKR and the number of trips of different lengths (i.e., number of days). The primary difference between total expenditures per user day for private and commercial use is the exclusion of outfitter guide fees for private user days. The estimates of expenditures per user day for expenditures other than outfitter fees (e.g., accommodations, food, gas, supplies, and shuttle services) are based on Johnson and Moore (1993) inflated to 2012 dollars. For the UKR, the average expenditures per user day for private and commercial use are $176 and $333, respectively. For the LKR, average expenditures per user day are $176 and $306 for private and commercial use, respectively. Changes in average annual within region direct expenditures associated with whitewater boating recreation for each proposed alternative as compared to the No Action Alternative were run through IMPLAN to estimate changes in regional economic impacts.

2.10.3 Results

2.10.3.1 Alternative 1 – No Action

Regional economic activity under the No Action Alternative is based on the average annual whitewater boating use and local region expenditures per user day for the UKR and LKR. Total average annual visitation for the Klamath River was estimated at 18,806 user days, where the associated within region expenditures were estimated at $4,235,718 for the No Action Alternative.

Table 2.10-2 displays estimates of whitewater boating recreation regional economic impacts for the No Action Alternative. Jobs stemming from No Action whitewater recreation expenditures made inside the region account for almost 56 jobs. As table 2.10-1 shows, this region is estimated to have approximately 225,000 total jobs. Labor income and output produced by the in region whitewater expenditures account for $1.56 million and $4.31 million respectively. The overall region economy's labor income and output is estimated at $8,682 million and $23,330 million respectively.

Table 2-10.2.—Regional impacts stemming from whitewater recreation expenditures with the No Action Alternative

Impact type	Employment[1] jobs	Labor income[2] ($ millions) (2012 $)	Output[3] ($ millions) (2012 $)
Direct effect	41	1.04	2.78
Indirect effect	7	0.24	0.72
Induced effect	8	0.28	0.81
Total effect	**56**	**1.56**	**4.31**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.10.3.2 Alternative 2 – Full Facilities Removal of Four Dams

In general, the whitewater boating recreation regional economic analysis for the Full Facilities Removal Alternative can be described as comparing the regional economic impacts from whitewater boating activity that would occur if the dams remained in place to whitewater boating activity that would occur without the dams. Under the Full Facilities Removal of Four Dams Alternative, whitewater boating activity on the UKR would be affected beginning in 2020 because of the

dependence of water releases from the J.C. Boyle Dam to provide sufficient and predictable flows, primarily for whitewater boating along the Hell's Corner reach. In addition to the dependence upon the operations of J.C. Boyle Powerhouse upstream, the timing and duration of the releases are also critical for commercial operators so they can offer their clients reasonable trip itineraries (FERC 2007). Analysis of predicted hydrology modeling shows that the average number days with acceptable flows for whitewater boating on the Hell's Corner reach are estimated to decline by 47.3 percent during the five month period from May through September (months when the majority of whitewater boating activity occurs annually) and decline by 29.5, 36.4, and 88.2 percent in June, July and August, respectively, relative to the No Action Alternative. The combination of the decline in the number of days with acceptable flows, particularly during the three months when most of the use is observed (June, July, and August), and the lack of consistency and predictability of days with acceptable flows could make it more challenging for outfitters to continue offering trips for this reach of the Upper Klamath River in the future. Therefore, it is assumed whitewater boating activity on the Upper Klamath River would be significantly negatively affected under the Full Facilities Removal of Four Dams Alternative. It is assumed that the level of whitewater boating activity on the LKR would not affected in any measurable way because sufficient flows for whitewater boating are not dependent on water releases from any of the four dams that would be removed. Furthermore, analysis of the predicted hydrology for the Klamath River under the No Action Alternative and Full Facilities Removal of Four Dams Alternative shows the average number of days with acceptable flows for whitewater boating on the LKR would not change in any measurable way. The loss of whitewater boating activity on the UKR (primarily the Hell's Corner Reach of the UKR) would result in losses in expenditures and regional economic activity in the local region as compared to the No Action Alternative, where these annual losses would begin in 2020.

The difference in average annual user days between the Full Facilities Removal of Four Dams alternative and the No Action Alternative was estimated at 2,763 user days. The difference in average annual lost expenditures between the Full Facilities Removal of Four Dams Alternative and the No Action Alternative was estimated as $715,903.

Table 2.10-3 displays estimates of the changes in whitewater boating recreation regional economic activity for the Full Facilities Removal of Four Dams Alternative compared to the No Action Alternative. Employment would decline by 14 jobs compared to the No Action Alternative with the implementation of the Full Facilities Removal of Four Dams Alternative. As table 2.10-1 shows, this region is estimated to have approximately 225,000 total jobs. Labor income and output would decline by $0.43 million and $0.89 million, respectively. The overall economy's labor income and output is estimated at $8,682 million and $23,330 million, respectively.

Table 2.10-3.—Regional impacts stemming from changes in whitewater recreation expenditures between the No Action Alternative and Alternative 2

	Employment[1]		Labor income[2]		Output[3]	
Impact type	Jobs	Percent change from No Action	$ millions (2012 $)	Percent change from No Action	$ millions (2012 $)	Percent change from No Action
Direct effect	-11		-0.31		-0.54	
Indirect effect	-1		-0.04		-0.13	
Induced effect	-2		-0.08		-0.22	
Total effect	**-14**	**-25.2**	**-0.43**	**-27.6**	**-0.89**	**-20.6**

[1] Employment is measured in number of jobs.
[2] Income is the dollar value of total payroll (including benefits) for each industry in the analysis area plus income received by self-employed individuals located within the analysis area.
[3] Output represents the dollar value of industry production.

2.10.3.3 Alternative 3 – Partial Facilities Removal of Four Dams

The Partial Facilities Removal of Four Dams Alternative is assumed to result in conditions on the Klamath River for whitewater boating that are similar to the Full Facilities Removal of Four Dams Alternative. As such, the losses in whitewater boating recreation visitation, expenditures, and regional economic activity for the Partial Facilities Removal of Four Dams Alternative as compared to the No Action Alternative are assumed to be the same as under the Full Facilities Removal of Four Dams Alternative.

2.10.4 References

U.S. Department of the Interior, 2011. Whitewater Boating Recreation Economics Technical Report for the Secretarial Determination on Whether to Remove Four Dams on the Klamath River in California and Oregon.

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PacifiCorp, 2004. Final Technical Report, Klamath Hydroelectric Project, Recreation Resources. FERC Project No. 2082. February 2004.

2.11 KLAMATH BASIN RESTORATION AGREEMENT (KBRA)

Provided by CDM in separate standalone document entitled KBRA Appendix.

Chapter 3 – Tribal Effects Analysis

This analysis focuses on fishing opportunities, related cultural and social practices, standard of living, and health for five of the six federally recognized tribes in the Klamath Basin (Klamath Tribes, Karuk Tribe, Resighini Rancheria, Yurok Tribe, Hoopa Valley Tribe) as they relate to the Secretarial Determination. The sixth tribe, the Quartz Valley Indian Community, is not expected to be directly affected by the outcome of the Secretarial Determination.

For the tribes of the Klamath Basin, fish are integral to a world view that emphasizes interconnectedness, balance, and mutual respect as guiding principles. The diversity, abundance, distribution, run timing and health of fish are important indicators of how well such balance is being maintained. The seasonal round of harvest provides sustained access to food that is synchronous with the cycles of nature. Fish are honored in rituals such as the First Salmon Ceremony and (for the Klamath Tribes) the Return of the C'waam, which traditionally precede the commencement of fishing for spring Chinook and suckers respectively. Fishing itself is a social and cultural activity – an opportunity to meet with family and friends; to engage in traditional fishing practices; to strengthen community bonds, demonstrate respect and promote food security by sharing fish with elders and others who are unable to fish; and to transmit these traditions to the next generation. Trade and barter occur both within and between tribes as a means of increasing access to fish and other valued goods, and cementing social relationships.

While fish has been central to the daily life and culture of the tribes, access to fish has declined due to reductions in abundance and distribution and loss of access to traditional fishing sites. These changes have affected the tribes' dietary habits and well-being – as well as their cultural, ritualistic and social lives. Despite these challenges, the tribes have been persistent in ensuring continuation of practices and values that have been a part of their world view for many centuries.

Sedimentation and water quality changes associated with dam removal may have adverse short term effects on fish stocks that inhabit areas below the dams (Close *et al*. 2010, Dunne *et al*. 2011, Goodman *et al*. 2011). Over the longer term, dam removal and successful implementation of the Klamath Basin Restoration Agreement (KBRA) are expected to increase tribal harvest opportunities on the Klamath River. These actions are not expected to affect the productivity of Hupa fisheries (which depend on Trinity River stocks). Effects of dam removal and KBRA on Klamath River stocks (excluding the Trinity) can be summarized as follows:

- Steelhead is expected to increase in abundance and extend its distribution to areas currently under the reservoirs and upstream to Keno Dam; expansion upstream of Keno Dam is possible but not certain (Dunne *et al*. 2011). The Biological Subgroup also expects the action alternatives to lead to expansion of the steelhead fishery above Iron Gate Dam. The Subgroup notes that Upper Basin habitat would be more favorable to steelhead than other anadromous species, due to the ability of steelhead to navigate steep gradients and spawn in small streams and their resistance to *C. Shasta* (Hamilton et al. 2011).

- Redband trout is expected to increase in abundance and distribution in Upper Klamath Lake and its tributaries and also below Keno Dam (Buchanan *et al*. 2011).

- Pacific lamprey harvest potential below Keno Dam is expected to increase from one to ten percent over the long term due to habitat improvement and recolonization of the reach between Iron Gate Dam and Keno Dam. Harvest potential above Keno Dam is possible but more uncertain (Close *et al*. 2010).

- Sucker populations in the Upper Basin are expected to increase over the long term, although anything more than tribal ceremonial harvest would be unlikely until a sustained upward trend in the population is observed (Buchanan *et al*. 2011).

- The Southern Oregon Northern California Coast (SONCC) coho Evolutionarily Significant Unit (ESU)[1] is listed under the Endangered Species Act (ESA). This ESU is comprised of 28 populations ranging from the Elk and Rogue Rivers in southern Oregon to the Eel River in northern California, and includes the coho populations in the Klamath Basin (Williams et al. 2008). The action alternatives are expected to lead to an increase in the viability of Klamath River coho populations (Dunne *et al*. 2011). However, since these alternatives do not include coho restoration outside the Klamath Basin, they alone will not create conditions that would warrant de-listing of the SONCC coho ESU throughout its range. Nevertheless, the action alternatives will increase the viability of coho populations in the Klamath Basin and advance the recovery of the ESU.

[1] An Evolutionarily Significant Unit is a population or group of populations that is reproductively isolated and of substantial ecological/genetic importance to the species (Waples 1991).

- Evaluation of effects on fall and spring Chinook is based on results of two models – the Evaluation of Dam Removal and Restoration of Anadromy (EDRRA) model (Hendrix 2011), and a habitat model (Lindley and Davis 2011) – and conclusions of the Biological Subgroup (Hamilton *et al*. 2011) and an Expert Panel convened to evaluate the effects of the alternatives on Chinook (Goodman *et al*. 2011).

  The EDRRA model is a simulation model that provides 50-year projections of Klamath Chinook escapement and harvest under the No Action and action alternatives. The EDRRA harvest projections pertain to Klamath Basin Chinook and do not distinguish between spring and fall runs. Harvest is estimated for each simulated year on the basis of a new Klamath fall Chinook harvest control rule recommended by the Pacific Fishery Management Council (PFMC) to NMFS in June 2011. The model distributes total Klamath Basin Chinook harvest among fisheries as follows: 50.0 percent to tribal fisheries, 7.5 percent to the in-river recreational fishery (up to a maximum of 25,000 fish – with any surplus above 25,000 allocated to escapement), 34.0 percent to the ocean commercial fishery, and 8.5 percent to the ocean recreational fishery. The 50-50 tribal/non-tribal split is a "'hard" allocation specified by the U.S. Department of the Interior Solicitor's Office (DOI 1993) on behalf of the Yurok and Hoopa Valley tribes. The distribution of the remaining 50.0 percent among the three non-tribal fisheries represents customary practice rather than mandatory conditions.

  The absolute harvest projections provided by the EDRRA model reflect an idealized version of real world conditions (Hendrix 2011); thus model results are best considered in terms of relative rather than absolute differences between alternatives. To anchor EDRRA projections to the real world, average annual 2001-05 harvest of fall and spring Chinook by Yurok tribal members (31,127 fish) was used to characterize tribal harvest on the Klamath River under the No Action Alternative; Yurok harvest represents the vast majority of Klamath River tribal harvest (excluding the Trinity). The years 2001-05 were selected as the base period for the following reasons: Klamath River fall Chinook fell within a 'moderate' range of abundances during those years and fishery regulations that reflect the influence of the 50-50 tribal/non-tribal harvest allocation and the listing of SONCC coho were well established by that time; unusually depressed fishery conditions after 2005 made those years unsuited for base period characterization. Harvest by Hupa tribal members is not included in the base period harvest and the harvest increases projected by the EDRRA model are not applied to Hupa harvests, as beneficial effects of the action alternatives are expected to be felt on the Klamath and not the Trinity River. Annual tribal harvest on the Klamath River under the action alternatives (46,682 fish) was estimated by scaling average 2001-05

harvest upward, based on the percent difference between the EDRRA's 50th percentile harvest projections for the No Action and action alternatives (+50 percent).

The 5th percentile harvest value for the action alternatives projected by the EDRRA model is 60 percent lower than the 5th percentile value for the No Action Alternative, and the 95th percentile harvest value is 886 percent higher. That is, the posterior harvest distribution under the action alternatives is positively skewed and exhibits a high degree of overlap with the harvest distribution for the No Action Alternative. Despite this overlap, annual harvest is projected to be higher in 70 percent of years under the action alternatives. The harvest control rule incorporated into the EDRRA model limits the harvest rate to 10 percent or less when pre-harvest escapements fall below 30,500 adult natural spawners. Escapements this low would likely be highly adverse to all salmon fisheries (including tribal fisheries). Such conditions are projected to occur in 66 percent fewer years under the action alternatives; the decline is even larger (-80 percent) when considering just the post-dam removal years 2021-61.

While the EDRRA model focuses on Chinook escapement and harvest of spring and fall runs combined, other studies and reports distinguish the alternatives more finely in terms of their effects on specific runs or areas: (1) According to the Biological Subgroup, the action alternatives are expected to provide habitat favorable to spring Chinook – e.g., additional coldwater tributaries and springs that provide thermal refugia (Hamilton et al. 2011). (2) The Lindley/Davis habitat model involved compilation of escapement and watershed attribute data for 77 fall and spring Chinook populations in various watersheds in Washington, Oregon, Idaho, and northern California and comparison of these attribute sets with the attributes of Upper Basin watersheds. Based on their analysis, the authors concluded that Upper Basin attributes fall well within the range of spring bearing watersheds and that viable populations of spring-run Chinook salmon in the upper Klamath would improve the sustainability of the ESU as a whole (Lindley and Davis 2011). (3) The Chinook Expert Panel concluded that "The Proposed Action offers greater potential for increased harvest and escapement of Klamath Chinook salmon than the Current Conditions" (Goodman et al., p 16). The Panel noted the potential for a "substantial increase" in Chinook abundance in the area between IGD and Keno Dam. The Panel indicated that the possibility of successful Chinook introduction above Keno Dam was potentially large but less certain and contingent on successful implementation of the KBRA and resolution of issues such as water quality and fish disease. The Panel also noted that the possibility of substantial positive effects from the proposed action was much lower for spring than fall Chinook (Goodman et al. 2011).

> The quantitative projections provided in the economic analysis are based on EDRRA model outputs, which do not differentiate between spring and fall Chinook. The Biological Subgroup, Lindley/Davis and Expert Panel results provide insights regarding effects of the action alternatives on spring Chinook. Given that these latter sources do not claim substantial increases in spring Chinook, the socioeconomic analysis distinguishes between fall and spring Chinook by qualitatively considering what a modest share of spring Chinook in the harvestable surplus might mean for tribal fisheries.

This chapter summarizes potential effects of the Secretarial Determination as it affects tribal access to fishing opportunities, tribal cultural practices, economic well being, and tribal health. Each tribe is considered separately, in recognition of the individual ways in which each may be affected by the Secretarial Determination.

3.1 KLAMATH TRIBES

This section describes historical and recent use of Klamath River water, fish and other resources by the Klamath Tribes and potential effects of the Secretarial Determination on future harvest opportunities, engagement in resource monitoring and management, cultural practices, standard of living, and health. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in the *Klamath Tribes Fishery Socioeconomics Technical Report* (National Oceanic and Atmospheric Administration [NOAA] 2011c).

The Klamath Tribes consist of three historically separate tribes: the Klamath Tribe, the Modoc Tribe, and the Yahooskin band of Snake Indians. The Klamath Tribes currently own approximately 600 acres in Klamath County, Oregon. Tribal enrollment was 3,579 in 2005 (Bureau of Indian Affairs [BIA] 2005). The unemployment rate (defined as the percentage of adults who are available for work but unemployed, regardless of whether or not they have recently looked for work) was 21 percent in 2005 (BIA 2005). Per capita income of Indians residing in Chiloquin, Oregon (predominantly members of the Klamath Tribes) and Indians residing in Klamath County (including but not limited to Klamath Tribes members) in 1999 was $8,646 and $10,457 respectively – both lower than per capita income of the general population of Klamath County ($16,719). The percent of the population below the poverty level follows a similar pattern: 40 percent of Indians in Chiloquin, 40 percent of Indians in Klamath County, and 17 percent of the general Klamath County population (U.S. Census 2000).

The Klamath Tribes once occupied large areas of the Upper Klamath Basin – including Upper Klamath Lake, Klamath Marsh and the Williamson River. The

Tribes historically engaged in a seasonal round of harvest that included suckers (mullet), trout, and spring and fall Chinook. Fishing was often a large-scale affair, as large numbers of salmon and mullet spawned in the Upper Basin at roughly the same times and locations and were followed by trout who consumed the spawn of both species (Deur 2011). Fish were dried during the summer and fall in preparation for the harsh winter months; winter settlements were located near traditional fishing sites to facilitate detection of the return of spring Chinook and timely replenishment of depleted food supplies (Deur 2003, Lane and Lane 1981).

3.1.1 Alternative 1 – No Action Alternative

The decline in spring run Chinook began prior to construction of Copco 1 Dam due to factors such as mining and unregulated cannery operations at the river mouth (Snyder 1931). Construction of Copco 1 Dam eliminated much of the spawning and rearing habitat for the spring run (Hamilton *et al*. 2010). For the Klamath Tribes, access to both fall and spring Chinook ceased completely with the construct of Copco 1. The abrupt loss of this important food source necessitated rapid changes in dietary habits and livelihoods. Adaptive strategies included intensified harvest of less desired species (mullet, trout, deer), diversion of fishing effort to other areas (e.g., upper Rogue River), and attempts to obtain salmon through barter arrangements. Out-of-area fishing and barter proved to be untenable as a regular practice – due to the distances traveled, the relatively small amounts of salmon obtained, and the need to meet obligations closer to home. Moreover, salmon obtained elsewhere did not have the same cultural significance as salmon harvested by tribal members on their own fishing grounds. After almost a century without salmon, first salmon ceremonies have ceased and been replaced by ceremonies focused on other species or prayers for the return of salmon. Efforts by the Klamath Tribes to educate the younger generations regarding the cultural and social importance of salmon are challenged by the lack of direct experience with salmon in their daily lives (Deur 2011).

Lost River (c'waam) and shortnose (qapdo) suckers were also important sources of sustenance and became increasingly so after the loss of salmon harvest opportunities. Suckers were also harvested in non-tribal recreational and commercial fisheries. Studies conducted by the Klamath Tribes, Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service in the early 1980s revealed the poor status of these populations. The Klamath Tribes drastically curtailed their sucker fishery in 1985 and closed it entirely in 1986 (Markle and Cooperman 2001). In 1988, Lost River and shortnose suckers were listed as 'endangered' under the ESA. Every spring the Klamath Tribes release two c'waam raised in their Aquatic Research Center into the river as part of their Return of the C'waam Ceremony. Such rituals are directed toward recovery of a species and fishery that has been lost over the past 25 years.

The only fish species currently available to the Klamath Tribes is redband trout. Klamath Tribal regulations allow subsistence harvest of trout – five fish per day on the Williamson River and up to ten fish per day in other areas. For the Klamath Tribes, the return of salmonids to the Upper Basin and the recovery of suckers are long-awaited events that would provide healthy, economical sources of sustenance and food security, provide greater access to and protection of trust resources, and allow more meaningful expression and transmission of cultural values: "The return of sustainable salmon populations even below a harvestable threshold is seen by some as a correction of some of the cultural and spiritual losses associated with the extirpation of anadromous salmonids from the upper Klamath Basin. However, the restoration of a robust fishery in the Klamath Basin is widely believed to have potentially restorative functions that will reverse some (though not all) of the adverse cultural, social, and economic impacts of salmon extirpation over the last century" (Deur 2011, p. 48).

3.1.2 Alternative 2 – Full Facilities Removal of Four Dams

As described above, tribal harvest opportunities for Chinook salmon, suckers, steelhead and redband trout are expected to increase in varying degrees under Alternative 2. Dam removal and KBRA are also expected to expedite attainment of Total Maximum Daily Loads (TMDLs) being developed for the Klamath Basin.

The return of Chinook to the Upper Basin (even in small numbers) would have great cultural significance for the Klamath Tribes, who have not experienced Chinook in the Upper Basin for almost a century. Spring Chinook is of particular importance, as it would allow for the revival of the First Salmon Ceremony. Should spring Chinook become sufficiently abundant to support subsistence, it would also lengthen the duration of the seasonal round for salmon. Opportunities for subsistence harvest of suckers (which has not occurred since 1986) and redband trout are also likely to increase over the long term.

Cultural benefits to be derived from this increased access to fish would include greater social and cultural cohesion associated with harvesting activities and associated ceremonies, greater opportunity to transmit cultural values and practices to the younger generation, and greater ability to provide food security, care for elders in the community, and engage in trade and barter. Poverty and rural isolation have constrained the ability of tribal members to replace fish with healthy food alternatives. Improved fishing opportunities would increase opportunities for healthy food consumption.

The KBRA provides a number of benefits to the Klamath Tribes, including: (1) funding for fish habitat restoration and development and administration of fishery reintroduction and monitoring programs; (2) funding for long-term economic revitalization; (3) funding to facilitate acquisition of the Mazama Forest Project, which lies within the historical territories of the Klamath Tribes; and (4) establishment of an interim fishing site below Iron Gate Dam (IGD) (KBRA Part VII, pp 170-171). These provisions would be significant steps toward enhancing economic self-sufficiency and self-determination, enabling the Klamath Tribes to more fully engage in fishery and habitat management, and allowing for greater cultural expression related to the harvest of fish.

Table 3.1-1.—Effects of the No Action and action alternatives on the Klamath Tribes

Indicator	No Action	Change from No Action
Harvest opportunities:		
• Chinook	No access to spring or fall Chinook	Return of salmon to Upper Basin would be first time in almost a century. Interim fishing site below IGD would provide first Chinook harvest opportunity in almost a century.
• Sucker (mullet)	ESA listed, ceremonial only, no subsistence use since 1986	Continued ceremonial use, potential long-term subsistence use.
• Redband trout	Some subsistence	Increase in abundance and distribution, greater subsistence opportunity.
• Steelhead	No access	Re-introduction to Upper Basin.
Land base/ fishing access sites	Limited Tribal land ownership	Mazama Forest Project (KBRA Section 33.2) would increase access to traditional lands and expand opportunities to exercise fishing rights.
Engagement in resource monitoring and management	Active engagement in data collection, research, and management pertaining to aquatic resources, wildlife, and habitat.	Engagement would be expanded and supported by new funding for fisheries and conservation management (KBRA section 32.2).

Table 3.1-1.—Effects of the No Action and action alternatives on the Klamath Tribes

Indicator	No Action	Change from No Action
Cultural practices	First C'waam Ceremony held annually. No First Salmon Ceremony due to lack of access to spring Chinook. Loss of fishing opportunities over past century impairs ability to practice and transmit traditional harvest methods and values (sharing fish with elders) to younger generation.	Enhanced significance of First C'waam Ceremony associated with improvement in status of sucker populations. Return of spring Chinook would allow for revival of First Salmon Ceremony. Return of salmonids to Upper Basin and expedited water quality improvements would provide new opportunities to engage in traditional harvesting, ceremonial and cultural practices and teach those practices to younger generation. Mazama Forest Project (KBRA Section 32.2) would provide access to culturally important sites and land base for engagement in traditional practices.
Employment, income, standard of living	Employment provided by Klamath Tribes' Natural Resources Department. Subsistence fishery for redband trout provides modest contribution to standard of living.	Increased employment and income opportunities associated with funding for fisheries and conservation management, economic development study and Mazama Forest Project (KBRA Sections 32.2, 33.1, 33.2, 34). Increased subsistence fishing opportunities would improve standard of living, expand opportunities for trade and barter, and enhance food security for tribal members (particularly important for elders).
Health	Subsistence fishing limited to modest amounts of redband trout. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with interim fishing site (KBRA Section 34) and increased subsistence fishing opportunities.

3.2 KARUK TRIBE

This section describes historical and recent use of Klamath River water, fish and other resources by the Karuk Tribe and potential effects of the Secretarial Determination on future harvest opportunities, engagement in resource monitoring and management, cultural practices, standard of living, and health. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in the *Karuk Tribe Fishery Socioeconomics Technical Report* (NOAA 2011b).

The Karuk Tribe currently owns 652 acres in trust status, and maintains offices in Orleans (Humboldt County) and Happy Camp and Yreka (Siskiyou County). Tribal enrollment was 3,427 in 2005. The unemployment rate (defined as the percentage of adults who are available for work but unemployed, regardless of whether or not they have recently looked for work) was 63 percent in 2005 (BIA 2005). Per capita income of Indians residing on the Karuk Reservation and off-Reservation trust lands and Indians residing in Siskiyou County (including but not limited to Karuk tribal members) in 1999 was $4,938 and $8,305 respectively – both lower than per capita income of the general population of Siskiyou County ($17,570). The percent of the population below the poverty level follows a similar pattern: 54 percent of Indians on the Karuk Reservation and off-Reservation trust lands, 32 percent of Indians in Siskiyou County, and 19 percent of the general Siskiyou County population (U.S. Census 2000).

The historical homeland of the Karuk Tribe covered 1.4 million acres and included more than 100 villages along the Klamath and Salmon Rivers. The seasonal round of harvest included two runs of Chinook, two runs of lamprey, three runs of steelhead trout, coho, sturgeon, eulachon, mussels and crayfish. The right to fish at particular sites was subject to common rules and understandings regarding use and sharing of sites.

The Karuk Tribe is known as the 'Fix the World People' due to their central role in the annual *Piky'avish* or World Renewal Ceremonies. *Piky'avish* traditionally began with the First Salmon Ceremony in the spring followed by additional ceremonies in the summer and fall. The First Salmon Ceremony, which marked the arrival of spring Chinook, was conducted below the mouth of the Salmon River. The ceremony signaled the end of the winter steelhead season and the beginning of the salmon season. The Karuk Tribe traded with tribes in other areas. Fish (particularly salmon) was an important and valuable commodity for trade (Karuk Tribe undated).

3.2.1 Alternative 1 – No Action Alternative

The Karuk Tribe does not have federally recognized fishing rights. However, the California Fish and Game Commission allows members of the Tribe to fish with traditional hand-held dip nets at their indigenous fishing site at Ishi Pishi Falls. Karuk tribal fishing is bound by California sport fishing regulations, including bag and possession limits. The seasonal round at Ishi Pishi is much diminished and consists mostly of fall Chinook, available in modest numbers and for a very limited period. The First Salmon Ceremony has not been practiced in traditional form in the spring for decades, due to the dramatic decline in spring Chinook. Lamprey have also declined in abundance to such an extent that traditional family eeling spots are no longer used (Lewis 2009). Quantities of fish harvested are not sufficient to meet subsistence needs, engage in trade and barter, or even provide adequately for tribal elders.

The Karuk Tribe's Natural Resources Department is actively engaged in data collection, research and management pertaining to fish and wildlife, water quality, and habitat. The Karuk Tribe participates in the posting of health warnings along the river in the summer that advise people to avoid contact with the water and ingestion of fish livers and to thoroughly wash fish before consumption. The Tribe's concerns extend not only to finfish but also to freshwater mussels, crayfish and food plants that contribute to their diet (Norgaard 2005). Water quality also affects cultural practices, as the Piky'avish ceremonies (which require some participants to ritually immerse themselves in the river) extend into the summer months, when water quality is at its worst. Other tribal activities (e.g., basket making, use of medicinal plants) also involve contact with the river. Basket makers wade in the river to collect basket materials such as willows and cottonwood, wash the materials in the river, and strip the willows with their teeth. Medicinal plants are often washed in the river and some water is consumed along with the plants (Karuk Tribe undated, Gates and Novell 2011).

3.2.2 Alternative 2 – Full Facilities Removal of Four Dams

As described above, tribal harvest opportunities for Chinook, Pacific lamprey and steelhead are expected to increase in varying degrees under Alternative 2. Dam removal and KBRA are also expected to expedite attainment of TMDLs being developed for the Klamath Basin.

Fish population effects will provide greater opportunities for the Karuk Tribe to engage in subsistence fishing and associated cultural practices (e.g., sharing fish with elders, transmitting values to the next generation, trade and barter). Spring Chinook is of particular importance, as it could lead to revival of the traditional

First Salmon Ceremony in the spring. Also, spring Chinook are highly desirable for their fat content and would provide quality benefits to the subsistence fishery and lengthen the duration of the seasonal round for salmon. Poverty and rural isolation have constrained the ability of tribal members to replace fish with healthy food alternatives. Improved fishing opportunities would increase opportunities for healthy food consumption.

The KBRA provides the Karuk Tribe with funding for fishery and habitat management and restoration, administration of fishery programs, and long-term economic revitalization (KBRA Part VII, p 170). These provisions would enhance economic self-sufficiency and self-determination and allow the Karuk Tribe to more fully engage in fishery and habitat management.

Table 3.2-1.—Effects of the No Action and action alternatives on the Karuk Tribe

Indicator	No Action	Change from No Action
Harvest opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential adverse short-term effect due to sedimentation associated with dam removal. Some increase in spring and fall Chinook after dam removal. Spring Chinook particularly valued for high fat content and potential to extend salmon season.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status.
• Steelhead	Stable/declining abundance	Potential adverse short-term effect due to sedimentation associated with dam removal. Increased abundance and distribution after dam removal.
• Pacific lamprey	Very low abundance	One to ten percent increase in harvest potential.
• Sturgeon	Very low abundance	Limited documentation of potential effects.
• Eulachon	ESA-listed	Limited documentation of potential effects.

Table 3.2-1.—Effects of the No Action and action alternatives on the Karuk Tribe

Indicator	No Action	Change from No Action
Engagement in resource monitoring and management	Active engagement in data collection, research and management pertaining to fish and wildlife, water quality, and habitat.	Engagement would be expanded and supported by new funding for fisheries and conservation management (KBRA section 32.2).
Cultural practices	No First Salmon Ceremony as traditionally practiced in the spring. Participation in Piky'avish ceremonies (including ritual immersion of ceremonialists and daily feasting) and other cultural practices (e.g., basket weaving, medicinal plants) impaired by limited fish abundance and poor water quality. Limited fishing opportunities impair ability to practice and transmit traditional harvest methods and values (sharing fish with elders) to younger generation.	Return of spring Chinook would allow for revival of traditional First Salmon Ceremony in the spring. Increase in fish populations and expedited water quality improvements would enhance opportunities to engage in traditional harvesting, ceremonial and cultural practices and transmit those practices to younger generation.
Employment, income, standard of living	Employment provided by Karuk Tribe's Natural Resources Department.	Increased employment and income opportunities associated with funding for fisheries and conservation management and economic development study (KBRA Sections 32.2, 33.1, 33.2). Increased subsistence fishing opportunities would improve standard of living, expand opportunities for trade and barter, and enhance food security for tribal members (particularly important for elders).
Health	Subsistence fishing opportunities very limited in terms of quantity and length of season. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with enhanced subsistence fishing opportunities.

3.3 RESIGHINI RANCHERIA

This section describes historical and recent use of Klamath River water, fish and other resources by the Resighini Rancheria and potential effects of the Secretarial Determination on future harvest opportunities, engagement in resource monitoring and management, cultural practices, standard of living, and health. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in the *Resighini Rancheria Fishery Socioeconomics Technical Report* (NOAA 2011d).

The Resighini Rancheria is a 239-acre reservation located near the mouth of the Klamath River and surrounded by the larger Yurok Reservation. Tribal enrollment was 111 in 2005. The unemployment rate (defined as the percentage of adults who are available for work but unemployed, regardless of whether or not they have recently looked for work) was 60 percent in 2005 (BIA 2005). Per capita income of Resighini Rancheria residents and Indians residing in Del Norte County (including but not limited to Resighini Rancheria members) in 1999 was $6,925 and $9,638 respectively – both lower than per capita income of the general population of Del Norte County ($14,573) (U.S. Census 2000).

Although the Resighini are Yurok Indians, they are governmentally separate from the Yurok Tribe. Their seasonal round of fishing historically included Chinook and coho salmon, Pacific lamprey, steelhead, green sturgeon, and Pacific eulachon (candlefish). The Resighini do not have tribal fishing rights but retain a strong affinity to fishing and other cultural practices such as basket weaving and use of medicinal plants. Resighini members regularly participate in World Renewal ceremonies hosted by neighboring tribes.

3.3.1 Alternative 1 – No Action Alternative

Today sturgeon is rarely seen on the Klamath River, coho and eulachon have been listed as ‘threatened’ under the Endangered Species Act, and Pacific lamprey and spring Chinook are at very low levels of abundance. The declines in fish abundances have impacted the modest fishing opportunities available to the Resighini Rancheria.

Poor water quality at certain times of year affects the quantity and quality of basket materials and also exposes basket makers (who wade in the river and also strip willows and other materials with their teeth) to adverse water conditions. Gathering and use of medicinal plants is also adversely affected by poor water quality.

3.3.2 Alternative 2 – Full Facilities Removal of Four Dams

As described above, tribal harvest opportunities for Chinook, Pacific lamprey and steelhead are expected to increase in varying degrees under Alternative 2. Dam removal and KBRA are also expected to expedite attainment of TMDLs being developed for the Klamath Basin.

Alternative 2 may yield benefits to Resighini Rancheria members in terms of improved access to salmonids and other fish (through fishing and trade and barter). Poverty and rural isolation have constrained the ability of tribal members to replace fish with healthy food alternatives. Improved fishing opportunities would increase opportunities for healthy food consumption. Also, given their current dedication to attending ceremonies, it is likely that the Resighini would welcome a revival of the First Salmon Ceremony that may accompany improvements in the status of spring Chinook.

Table 3.3-1.—Effects of the No Action and action alternatives on the Resighini Rancheria

Indicator	No Action	Change from No Action
Harvest Opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential adverse short-term effect due to sedimentation associated with dam removal. Some increase in spring and fall Chinook after dam removal. Spring Chinook particularly valued for high fat content and potential to extend salmon season.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status.
• Pacific lamprey	Very low abundance	One to ten percent increase in harvest potential.
• Sturgeon	Very low abundance	Limited documentation of potential effects.
• Eulachon	ESA-listed	Limited documentation of potential effects.

Table 3.3-1.—Effects of the No Action and action alternatives on the Resighini Rancheria

Indicator	No Action	Change from No Action
Cultural practices	Active attendance at World Renewal Ceremonies held by Yurok Tribe and Hoopa Valley Tribe. Cultural practices (e.g., basket weaving, medicinal plants) impaired by poor water quality.	Return of spring Chinook would provide opportunity to attend revival of First Salmon Ceremony. Increase in fish populations and expedited water quality improvements would enhance opportunities to engage in traditional harvesting, ceremonial and cultural practices and transmit those practices to younger generation.
Employment, income, standard of living	Modest income provided by Resighini Rancheria's campground.	Increase in fishing opportunities may modestly increase campground usage.
Health	Subsistence fishing opportunities very limited. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with higher fish abundance.

3.4 YUROK TRIBE

This section describes historical and recent use of Klamath River water, fish and other resources by the Yurok Tribe and potential effects of the Secretarial Determination on future harvest opportunities, engagement in resource monitoring and management, cultural practices, standard of living, and health. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in the *Yurok Tribe Fishery Socioeconomics Technical Report* (NOAA 2011e).

The Yurok Tribe is the largest tribe in California; tribal enrollment was 4,912 in 2005. The unemployment rate (defined as the percentage of adults who are available for work but unemployed, regardless of whether or not they have recently looked for work) was 74 percent in 2005 (BIA 2005). Per capita income of Indians residing on the Yurok Reservation and Indians residing in Del Norte County (including but not limited to Yurok tribal members) in 1999 was $6,839 and $9,638 respectively – both lower than per capita income of the

general population of Del Norte County ($14,573). The percent of the population below the poverty level follows a similar pattern: 40 percent of Indians on the Yurok Reservation, 26 percent of Indians in Del Norte County, and 20 percent of the general Del Norte County population (U.S. Census 2000).

The Yurok Reservation extends about one mile on each side of the Klamath River from the mouth of the river to 44 miles upstream. The location of the reservation gives the Yuroks first access to anadromous species returning to the Klamath Basin. The seasonal round of fishing included Chinook and coho salmon, Pacific lamprey, steelhead, green sturgeon, and Pacific eulachon (candlefish). Historical abundances of fish enabled the Yuroks to engage in extensive trade and barter with neighboring tribes.

An important ritual was the First Salmon Ceremony – to honor and ensure the return of spring Chinook to the river. Following the Ceremony, the Yuroks constructed a fish dam at Cappell (33 miles from the river mouth) – an elaborate structure that included ten panels constructed by ten groups of men and described as "the greatest mechanical undertaking of the tribes in question" (Kroeber 1971, p. 469). Weir gates were kept open during much of the fishing season to ensure adequate passage of salmon for harvest by upstream tribes and escapement to spawning areas. The right to fish at particular sites was subject to common rules and understandings regarding use and sharing of sites (Sloan 2011, USFWS 1999).

Although the First Salmon Ceremony has not been practiced for decades, other cultural practices – including ceremonies that have been revived over the past decade (World Renewal Ceremonies, Brush Dance, Flower Dance), basket weaving, use of medicinal plants, and hygienic and ritualistic bathing in the river – are important aspects of Yurok life.

3.4.1 Alternative 1 – No Action Alternative

Today candlefish and sturgeon are rarely seen on the Klamath River, coho has been listed as 'threatened' under the Endangered Species Act, and Pacific lamprey and spring Chinook are at very low levels of abundance.

The traditional rights of certain families or family members to fish at particular locations and the sharing of fish with elders are still honored practices among the Yurok. Even the commercial fishery is not strictly commercial; it is also an occasion for tribal members (including those who live off the Reservation) to gather in 'fish camps' along the river and renew their social and cultural ties. The decline in fish abundances, however, has impaired the ability of tribal members to meet their subsistence needs and engage in trade and barter. With the decline of

spring Chinook, the First Salmon Ceremony and the Cappell weir have not been practiced for many decades. Water quality problems interfere with fishing operations by causing algae to become entangled in fishing nets.

The Yurok Tribe hosts the World Renewal Ceremonies – which include the Deerskin Dance and Jump Dance - every other year in the Lower Basin in rotation with the Hoopa Valley Tribe. When fish harvest is low, the Yurok Tribe must supplement the harvest with sources off the reservation to meet their obligation to share salmon and other food with ceremonial participants and attendees (USFWS et al. 1999, Gates and Novell 2011). The World Renewal Ceremonies, Brush Dance and Flower Dance involve the use of basket materials that grow along the river and immersion of some ceremonialists in the river. Poor water quality at certain times of year affects the quantity and quality of basket materials and also exposes basket makers (who wade in the river and also strip willows and other materials with their teeth) and ceremonialists (who engage in ritual immersion) to adverse water conditions. Gathering and use of medicinal plants is also adversely affected by poor water quality.

The Yurok Tribe has a Harvest Management Plan (HMP) that serves as the basis for regulation, monitoring and enforcement of their commercial, subsistence and recreational guide fisheries. Under the HMP, commercial fishing is disallowed for all species except fall Chinook – and only in years where fall Chinook abundance is sufficient to support commercial as well as subsistence harvest (Williams 2010, Yurok Tribe 2010). A Yurok tribal biologist serves on the Pacific Fishery Management Council's Salmon Technical Team, provides tribal harvest and biological data that help determine the status of stocks, and advises the Council on scientific and regulatory matters.

3.4.2 Alternative 2 – Full Facilities Removal of Four Dams

As described above, tribal harvest opportunities for Chinook, Pacific lamprey and steelhead are expected to increase in varying degrees under Alternative 2. Dam removal and KBRA are also expected to expedite attainment of TMDLs being developed for the Klamath Basin.

Fish population effects will provide greater opportunities for the Yurok Tribe to engage in subsistence and commercial fishing and associated cultural practices (e.g., sharing of fish with elders, transmitting values to the next generation, trade and barter). Spring Chinook is of particular importance and would allow for revival of the First Salmon Ceremony. Also, spring Chinook are highly desirable for their fat content and would provide quality benefits to the subsistence and commercial fisheries and lengthen the duration of the seasonal round for salmon. The tribal guide fishery would benefit and also bring additional money into the

community. Poverty and rural isolation have constrained the ability of tribal members to replace fish with healthy food alternatives. Improved fishing opportunities would increase opportunities for healthy food consumption.

The KBRA provides the Yurok Tribe with funding for fishery and habitat management and restoration, administration of fishery programs, and long-term economic revitalization (KBRA Part VII, p 170). These provisions would enhance economic self-sufficiency and self-determination and allow the Yurok Tribe to expand their existing capabilities in fishery and habitat management.

Table 3.4-1.—Effects of the No Action and action alternatives on the Yurok Tribe

Indicator	No Action	Change from No Action
Harvest opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential adverse short-term effect due to sedimentation associated with dam removal. Potential 50 percent increase in overall tribal harvest (fall and spring Chinook), with absolute increase more modest for spring than fall run. Spring Chinook particularly valued for high fat content and potential to extend salmon season.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status
• Steelhead	Stable/declining abundance	Potential adverse short-term effect due to sedimentation associated with dam removal. Increased abundance and distribution some years after dam removal.
• Pacific lamprey	Very low abundance	One to ten percent increase in harvest potential.
• Sturgeon	Very low abundance	Limited documentation of potential effects.
• Eulachon	ESA-listed	Limited documentation of potential effects.
Engagement in resource monitoring and management	Active engagement in data collection, research and management pertaining to fish, wildlife, habitat and fisheries.	Engagement would be expanded and supported by new funding for fisheries and conservation management (KBRA section 32.2).

Table 3.4-1.—Effects of the No Action and action alternatives on the Yurok Tribe

Indicator	No Action	Change from No Action
Cultural practices	No First Salmon Ceremony. Participation in ceremonies (e.g., World Renewal, Brush Dance, Flower Dance – including ritual immersion of ceremonialists and daily feasting) and other cultural practices (e.g., basket weaving, medicinal plants) impaired by limited fish abundance and poor water quality.	Return of spring Chinook would allow for revival of First Salmon Ceremony. Increase in fish populations and expedited water quality improvements would enhance opportunities to engage in traditional harvesting, ceremonial and cultural practices and transmit these practices to younger generation.
Employment, income, standard of living	Employment provided by Yurok Tribal Fisheries Program and participation of tribal members in commercial and guide fisheries. Subsistence fishery contributes to standard of living.	Increased employment and income opportunities associated with funding for fisheries and conservation management and economic development study (KBRA Sections 32.2, 33.1, 33.2). Increased harvest opportunities would provide additional employment and income for commercial and guide fisheries. Increased subsistence fishing opportunities would improve standard of living, increase opportunities for trade and barter, and enhance food security for tribal members (particularly important for elders).
Health	Subsistence fishery provides limited but healthy source of sustenance. Poverty constrains ability to replace fish with healthy food alternatives.	Greater opportunity for healthy food consumption associated with enhanced subsistence fishing opportunities.

3.5 HOOPA VALLEY TRIBE

This section describes historical and recent use of Klamath River water, fish and other resources by the Hoopa Valley Tribe and potential effects of the Secretarial Determination on future harvest opportunities, engagement in resource monitoring and management, cultural practices, standard of living, and health. Further details regarding the methodologies, assumptions and conclusions underlying this analysis are contained in the *Hoopa Valley Tribe Fishery Socioeconomics Technical Report* (NOAA 2011a).

The Hoopa Valley Tribe is located on the Trinity River. Their 90,000-acre reservation – also known as the 'Hoopa Square' – is the largest in California. Tribal enrollment was 1,893 in 2005. The unemployment rate (defined as the percentage of adults who are available for work but unemployed, regardless of whether or not they have recently looked for work) was 40 percent in 2005 (BIA 2005). Per capita income of Indians residing on the Hoopa Valley Reservation and Indians residing in Humboldt County (including but not limited to Hoopa Valley tribal members) in 1999 was $9,757 and $11,532 respectively – both lower than per capita income of the general population of Humboldt County ($17,203). The percent of the population below the poverty level follows a similar pattern: 34 percent of Indians on the Hoopa Valley Reservation, 31 percent of Indians in Humboldt County, and 20 percent of the general Humboldt County population (U.S. Census 2000).

The Hupa people historically relied on a seasonal round of fishing that focused largely on salmon but also included steelhead, Pacific lamprey, sturgeon, and Pacific eulachon (candlefish). The Hupa harvest these species for ceremonial, subsistence and/or commercial use.

The Hoopa Valley Tribe's Fisheries Department manages its fisheries and participates in a number of fish and fishery monitoring activities on the Reservation. A Hoopa Valley tribal biologist serves on the Pacific Fishery Management Council's Salmon Technical Team, provides tribal harvest and biological data that help determine the status of stocks, and advises the Council on scientific and regulatory matters.

3.5.1 Alternative 1 – No Action Alternative

The decline in fish abundances on the Trinity River has impaired the ability of Hoopa tribal members to meet their subsistence needs and utilize fish for trade and barter. The Hupa incorporate traditional cultural understandings and ceremonies into their everyday life, including fish harvesting (USFWS 1999). Due to the decline of spring Chinook, they have not had a First Salmon Ceremony

in decades. However, they are active participants in the World Renewal Ceremonies, which they host every other year in the Lower Basin in rotation with the Yurok. When fish harvest is low, the Hupa must supplement the harvest with sources off the reservation to meet their obligation to share salmon and other food with ceremonial participants and attendees (USFWS et al. 1999, Gates and Novell 2011).

Ceremonial and cultural practices affected by Trinity River water quality include ritual immersion of some ceremonial participants in the river, basket making (which requires basket makers to wade in the river and also strip willows and other materials with their teeth), and gathering and use of medicinal plants.

3.5.2 Alternative 2 – Full Facilities Removal of Four Dams

Demand for water exports from the Klamath and Trinity Rivers originates from two separate sources: the Klamath Project in the case of the Klamath River, and the Central Valley Project's Trinity River Division in the case of the Trinity River. Anadromous fish that return to the Trinity River are generally distinct from fish that return to the Klamath, although Trinity fish must first pass through 42 miles of the Klamath River before reaching the Trinity. Trinity River fish migrating through the lower Klamath may experience short term adverse effects from sedimentation associated with dam removal, although such effects are expected to be diminished in the lower reaches of the river (Reclamation 2011). Over the longer term, water quality improvements on the Klamath River may improve survival of anadromous Trinity River fish to the extent that they reduce the incidence of fish kills in the lower river similar to what occurred in 2002 (CDFG 2004). However, Trinity River stocks are not likely to experience any change in productivity, as the beneficiaries of Alternative 2 are stocks that return to the Klamath rather than the Trinity.

Table 3.5-1.—Effects of the No Action and action alternatives on the Hoopa Valley Tribe

Indicator	No Action	Change from No Action
Harvest Opportunities:		
• Chinook	Very low abundance of spring Chinook, moderate abundance of hatchery-dominated fall Chinook	Potential for modest adverse short-term effect due to sedimentation associated with dam removal. No change in productivity of Trinity River salmon. Potential reduction in incidence of fish kills below confluence with Trinity.
• Coho	ESA-listed	Improved viability of Klamath Basin coho but no change in listing status
• Steelhead	Stable/declining abundance	Potential for modest adverse short-term effect due to sedimentation associated with dam removal. No change in productivity of Trinity River steelhead. Potential reduction in incidence of fish kills below confluence with Trinity.
• Pacific lamprey	Very low abundance	Little if any long-term change.
• Sturgeon	Very low abundance	No change.
• Eulachon	ESA-listed	No change.
Engagement in resource monitoring and management	Active engagement in data collection, research and management pertaining to fish, wildlife, habitat and fisheries.	No change.

Table 3.5-1.—Effects of the No Action and action alternatives on the Hoopa Valley Tribe

Indicator	No Action	Change from No Action
Cultural practices	No First Salmon Ceremony. Participation in ceremonies (e.g., World Renewal, Brush Dance, Flower Dance – including ritual immersion of ceremonialists and daily feasting) and other cultural practices (e.g., basket weaving, medicinal plants) impaired by limited fish abundance and poor water quality on the Trinity River.	No change in Trinity River water quality or associated cultural practices.
Employment, income, standard of living	Employment provided by Hoopa Valley Tribal Fisheries Program and participation of tribal members in commercial fishery. Subsistence fishery contributes to standard of living.	Little if any change in Trinity River fishing opportunities or associated employment.
Health	Subsistence fishery provides limited but healthy source of sustenance. Poverty constrains ability to replace fish with healthy food alternatives.	Little if any change in availability of Trinity River fish as healthy source of subsistence.

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