RECLAMATION

Managing Water in the West

Economics Technical Report for the Yakima River Basin

A Component of
Yakima River Basin Water Storage Feasibility Study, Washington

Technical Series No. TS–YSS–23

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

January 2008

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

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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PREFACE

The Congress directed the Secretary of the Interior, acting through the Bureau of Reclamation, to conduct a feasibility study of options for additional water storage in the Yakima River basin. Section 214 of the Act of February 20, 2003 (Public Law 108-7), contains this authorization and includes the provision "… with emphasis on the feasibility of storage of Columbia River water in the potential Black Rock Reservoir and the benefit of additional storage to endangered and threatened fish, irrigated agriculture, and municipal water supply."

Reclamation initiated the Yakima River Basin Water Storage Feasibility Study (Storage Study) in May 2003. As guided by the authorization, the purpose of the Storage Study is to identify and examine the viability and acceptability of alternate projects by: (1) diversion of Columbia River water to a potential Black Rock reservoir for further water transfer to irrigation entities in the lower Yakima River basin as an exchange supply, thereby reducing irrigation demand on Yakima River water and improving Yakima Project stored water supplies; and (2) creation of additional water storage within the Yakima River basin. In considering the benefits to be achieved, study objectives are to modify Yakima Project flow management operations to improve the flow regime of the Yakima River system for fisheries, provide a more reliable supply for existing proratable water users, and provide water supply for future municipal demands.

State support for the Storage Study was provided in the 2003 Legislative session. The 2003 budget included appropriations for the Washington State Department of Ecology (Ecology) with the provision that the funds ". . . are provided solely for expenditure under a contract between the department of ecology and the United States bureau of reclamation for the development of plans, engineering, and financing reports and other preconstruction activities associated with the development of water storage projects in the Yakima river basin, consistent with the Yakima river basin water enhancement project, P.L. 103-434. The initial water storage feasibility study shall be for the Black Rock reservoir project." Since that initial legislation, the State of Washington has appropriated additional matching funds.

Storage Study alternatives were identified from previous studies by other entities and Reclamation, appraisal assessments by Reclamation in 2003 through 2006, and public input. Reclamation filed a Notice of Intent and Ecology filed a Determination of Significance to prepare a combined Planning Report and Environmental Impact Statement (PR/EIS) on December 29, 2006. A scoping process, including two public scoping meetings in January 2007 identified several

concepts to be considered in the Draft PR/EIS. Those concepts have been developed into “Joint” and “State” Alternatives.

The Joint Alternatives fall under the congressional authorization and the analyses are being cost-shared by Reclamation and Ecology. The State Alternatives are outside the congressional authorization, but within the authority of the state legislation, and will be analyzed by Ecology only. Analysis of all alternatives will be included in the Draft PR/EIS.

This technical document and others explain the analyses performed to determine how well the alternatives meet the goals of the Storage Study and the impacts of the alternatives on the environment. These documents will address such issues as hydrologic modeling, sediment modeling, temperature modeling, fish habitat modeling, and designs and costs. All technical documents will be referenced in the Draft PR/EIS and available for review.

CONTENTS

Chapter 1. INTRODUCTION

This technical report provides comprehensive analytical information on the range of economic analyses (e.g., benefit-cost, regional economic impact, cost allocation and repayment) developed for the Yakima River Basin Water Storage Feasibility Study (Storage Study). The economics discussion in the Draft Planning Report/Environmental Impact Statement (PR/EIS) reflects a summary of the information presented in this report.

Chapter 2. NATIONAL ECONOMIC DEVELOPMENT BENEFIT-COST ANALYSIS

This section describes the results of a National Economic Development (NED) benefit cost analysis (BCA) developed for the Storage Study's Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives.

The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, otherwise referred to as the P&Gs (U. S. Water Resources Council, 1983), represent the main set of guidelines for Federal water management agency economic analyses. The P&Gs describe two accounts to facilitate the evaluation of the economic effects of proposed alternative plans – the National Economic Development (NED) account and the Regional Economic Development (RED) account. According to the P&Gs, a primary distinction between an NED benefit-cost analysis and a RED regional economic impact analysis is geographic. The RED analysis focuses on economic impacts to the local region, whereas NED analysis focuses on economic benefits to the entire Nation. The RED evaluation recognizes the NED benefits accruing to the local region plus the transfers of income into the region. However, since the RED analysis focuses purely on the local region, it does not take into account potential offsetting effects occurring outside the region, as does the NED analysis. As a Federal agency, Reclamation must analyze the NED effects so as not to favor one area of the country over another. Reclamation also analyzes the RED effects to the local economy to provide specific information on the primary impact area. However, economic justification is determined for each alternative solely by the benefit-cost analysis and must be demonstrated on the basis of NED benefits exceeding NED costs.

In addition to the geographic differences between the analyses, the RED analysis includes not only the initial or direct impact on the primary affected industries (as does the NED analysis), but also the secondary or indirect effects on those industries providing inputs to the directly affected industries (referred to as the multiplier effect). This multiplier effect is not included in the NED analysis.

Finally, yet another difference between the analyses relates to the distinction between economic impacts and economic benefits. Economic impacts measure total economic activity within a given region using such indicators as output (sales or gross receipts), income, and employment. Economic impacts stem from

changes in expenditures within the region. Conversely, benefits measure economic welfare based on a net value concept. For consumers, economic welfare reflects the value of goods and services consumed above what is actually paid for them (willingness-to-pay in excess of cost - also referred to as consumer surplus). For producers or businesses, economic welfare can be estimated by gross revenues minus operating costs (profit). One way to visualize the difference between impacts and benefits is to consider how each reacts to increases in expenditures only. Regional economic impacts increase as in-region expenditures increase, whereas benefits (i.e., consumer surplus or profitability) tend to decrease as costs or expenditures increase.

While benefits and economic impacts often move in unison since they typically rise or fall with levels of production, there are many situations where changes in benefits and economic impacts diverge. This potential for divergence, combined with the need to consider both national and regional perspectives, and the fact that different user groups are often interested in different economic measures, creates a need for both NED and RED analyses.

2.1 NED BCA Results

BCA compares the present value of a proposed project's benefits to the present value of its costs. If benefits exceed costs, the project is considered economically justified. Since both benefits and costs can occur at various points throughout the study period, it is important to convert them to a common point in time (i.e., present value or future value). For this analysis, the costs and benefits were measured as of the start of the benefits period (which is equivalent to the end of the construction period). As a result, construction costs are converted to a "future value" and annual benefits and costs are converted or discounted to a "present value" as of the start of the benefits period. The study period or period of analysis was assumed to be 100 years as suggested by the P&Gs for this type of dam construction project. The interest rate used to convert costs and benefits to a common year was Reclamation's FY2007 planning rate of 4.875 percent.

Table 2-1 presents the results of the NED BCA for the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives. This table displays the total costs, total benefits, net benefits (i.e., total benefits minus total costs), and benefit-cost ratios (i.e., total benefits divided by total costs) for each alternative. Each piece of information is shown in both present value and annual equivalent terms. The annual equivalent estimate converts the present value figure to an average annual value over the 100-year study period. Details on the individual costs and benefits associated with each alternative can be found in the cost analysis and benefit analysis sections presented below.

The cost categories aggregated into total costs include: 1) up-front total construction costs including field costs, noncontract costs, and interest during construction (IDC); and 2) annual operations, maintenance, replacement, and energy (OMR&E) costs. The 100-year stream of annual OMR&E costs was discounted to a present value as of the start of the benefits period before being combined with the total construction costs. Each alternative includes at least two construction cost estimates, one with noncontract costs estimated at 20 percent of total field costs and another at 35 percent of total field costs. The Black Rock Alternative also includes construction cost estimates based on both a 10-year and a 15-year construction period, for a total of four cost estimates. This results in a total of eight benefit-cost estimates across the three alternatives.

The benefit categories aggregated into total benefits include: 1) agriculture; 2) municipal; 3) recreation (both at the proposed reservoirs and at existing reservoirs and rivers); 4) hydropower (Black Rock and Sunnyside powerplants plus lost hydropower benefits from Federal and non-Federal facilities, e.g., Priest Rapids powerplant); and 5) fisheries use values (commercial, sport, tribal subsistence). The 100-year stream of annual benefits was also discounted to a present value as of the start of the benefits period.

Table 2-1. Benefit-cost analysis summary (million $)

			Black Rock Alternative				Wymer Dam and Reservoir Alternative		Wymer Dam Plus Yakima River Pump Exchange Alternative	
		Construction Period:	**10 yrs**	**10 yrs**	**15 yrs**	**15 yrs**	**10 yrs**	**10 yrs**	**10 yrs**	**10 yrs**
	Value Option[1]	Cost Option[2]								
Total Costs	PV:	Noncontract Cost: 20%	6,117.5		6,741.6		1,262.0		5,350.3	
	Annual:		300.8		331.5		62.1		263.1	
	PV:	Noncontract Cost: 35%		6,739.5		7,546.6		1,417.7		5,926.8
	Annual:			331.4		371.1		69.7		291.4
Total Benefits	PV:		1,045.1	1,045.1	1,045.1	1,045.1	414.8	414.8	428.7	428.7
	Annual:		51.4	51.4	51.4	51.4	20.4	20.4	21.1	21.1
Net Benefits	PV:	Noncontract Cost: 20%	-5,072.4		-5,696.5		-847.2		-4,921.6	
	Annual:		-249.4		-280.1		-41.7		-242.0	
	PV:	Noncontract Cost: 35%		-5,694.4		-6,501.5		-1,002.9		-5,498.1
	Annual:			-280.0		-319.7		-49.3		-270.4
Benefit-Cost Ratios	PV & Annual	Noncontract Cost: 20%	0.17		0.16		0.33		0.08	
	PV & Annual	Noncontract Cost: 35%		0.16		0.14		0.29		0.07

[1]Value Options: Include present value (PV) and annual equivalent value (annual).

[2] Cost Options: For the Black Rock Alternative, there are four cost options based on different construction periods (10 and 15 years) and noncontract cost percentages (20% and 35%). For the Wymer Dam and Reservoir and Wymer Dam Plus Yakima River Pump Exchange Alternatives, there are only two cost options based on the different noncontract cost percentages (20% and 35%).

2.1.1 Black Rock Alternative

Four benefit-cost scenarios are presented in Table 2-1 for the Black Rock Alternative. Although the total benefits are the same for each of the four scenarios, the costs vary, since they were developed using both a 20-percent and a 35-percent noncontract cost component as well as 10- and 15-year construction periods. Across these four scenarios, the estimated benefits for the Black Rock Alternative cover from 14 to 17 percent of total project costs. This implies negative net benefits or uncovered costs ranging from $5.1 billion to $6.5 billion. Based on the results of this benefit-cost analysis, this alternative is not economically justified.

2.1.2 Wymer Dam and Reservoir Alternative

As presented in Table 2-1, two benefit-cost scenarios are provided for the Wymer Dam and Reservoir Alternative. Although the total benefits are the same for each scenario, the costs vary, since they were estimated using both a 20-percent and 35-percent noncontract cost component. For the Wymer Dam and Reservoir Alternative, estimated benefits cover from 29 to 33 percent of total project costs. This implies negative net benefits or uncovered costs ranging from $847.2 million to $1,002.9 million. Based on the results of this benefit-cost analysis, this alternative is not economically justified.

2.1.3 Wymer Dam Plus Yakima River Pump Exchange Alternative

As presented in Table 2-1. Benefit-cost analysis summary (million $), two benefit-cost scenarios are provided for the Wymer Dam Plus Yakima River Pump Exchange Alternative. Although the total benefits are the same for each scenario, the costs vary, since they were estimated using both a 20-percent and 35-percent noncontract cost component. For the Wymer Dam Plus Yakima River Pump Exchange Alternative, estimated benefits cover from 7 to 8 percent of total project costs. This implies negative net benefits or uncovered costs ranging from $4.9 billion to $5.5 billion. Based on the results of this benefit-cost analysis, this alternative is not economically justified.

2.2 Cost Analysis

The cost analysis for each alternative is broken down into two subsections: (1) up-front construction costs including interest during construction (IDC); and 2) annual operations, maintenance, replacement, and energy (OMR&E) costs.

2.2.1 Black Rock Alternative

The appraisal-level construction costs for the Black Rock Alternative, as obtained from the December 2004 *Appraisal Assessment of the Black Rock Alternative*, were indexed to April 2007 dollars via Reclamation cost engineers. As shown in table Table 2-2, total field costs were estimated at $3.274 billion. Noncontract costs were estimated at either 20 or 35 percent of the total field cost ($654.8 or $1,145.9 million). Summing these costs result in a total construction cost (before IDC) of either $3.929 or $4.420 billion.

There was discussion at the start of the Storage Study about how to estimate noncontract costs. Noncontract costs are for preparation of design data gathering, final designs, construction management, and environmental activities. It was decided to display the 20 and 35 percent noncontract costs to indicate the expected range of these noncontract costs. The Draft PR/EIS uses the 35 percent noncontract cost estimate.

Table 2-2. Up-front construction costs and annual OMR&E costs by alternative

	Black Rock Alternative				Wymer Dam and Reservoir Alternative		Wymer Dam Plus Yakima River Pump Exchange Alternative	
Plan #	n/a	n/a	n/a	n/a	n/a	n/a	2	2
Construction Period	10	10	15	15	10	10	10	10
Noncontract Percentage	20	35	20	35	20	35	20	35
I. Up-Front Construction Costs (million $)								
Field	3,274.0	3,274.0	3,274.0	3,274.0	780.0	780.0	2,980.0	2,980.0
Noncontract	654.8	1,145.9	654.8	1,145.9	156.0	273.0	596.0	1,043.0
IDC	965.0	1,095.9	1,589.1	1,903.0	265.4	304.1	1,001.1	1,130.6
Total	4,893.8	5,515.8	5,517.9	6,322.9	1,201.4	1,357.1	4,577.1	5,153.6
II. Annual Operations, Maintenance, Replacement, and Energy (OMR&E) Costs (million $)								
OM&R	10.17	10.17	10.17	10.17	1.08	1.08	18.20	18.20
Energy	50.0	50.0	50.0	50.0	1.90	1.90	19.82	19.82
Total	60.17	60.17	60.17	60.17	2.98	2.98	38.02	38.02
Present Value of 100 Years of OMR&E Costs	1,223.7	1,223.7	1,223.7	1,223.7	60.6	60.6	773.1	773.1
III. Total Cost (millions $)								
Construction Plus OMR&E	6,117.5	6,739.5	6,741.6	7,546.6	1,262.0	1,417.7	5,350.3	5,926.8

For the Black Rock Alternative, based on annual construction cost estimates provided by Reclamation cost engineers, IDC was calculated using both a 10-year and a 15-year construction period and ranged from $965.0 million to $1.903 billion (see Table 2-3, Table 2-4, Table 2-5, and Table 2-6). The IDC calculation charges the project for the cost of Federal Government borrowing through use of the planning interest rate of 4.875 percent, which results in converting all construction costs to a common point in time for comparison to project benefits. The total construction cost plus IDC ranges from $4.894 to $6.323 billion.

The construction period of 10 and 15 years were selected for analysis in estimating interest during construction costs due to the uncertainty of having funding available to complete a project the size of Black Rock in 10 years. To

show how the total project costs could change with an extension of construction period, both time periods are shown. The Draft PR/EIS uses the 10-year construction period.

The operations, maintenance, replacement, and energy (OMR&E) costs occur on an annual basis. To calculate a present value, these annual costs were assumed to occur each year of the 100-year study period. The annual operations, maintenance, and replacement costs were estimated at $10.17 million ($206.8 million in present value) and the annual energy costs at $50 million ($1.017 billion in present value), for a total annual OMR&E cost of $60.17 million ($1.224 billion in present value).

Total project cost, representing the sum of total construction cost plus the present value of the 100-year stream of annual OMR&E costs, ranges from $6.1 to $7.5 billion, depending on the cost option.

Table 2-3. Interest During Construction for the Black Rock Alternative ($) (10-year construction period; 20% contingencies; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	100,000,000	50,000,000	0	0	0	50,000,000	2,437,500
2	228,700,000	114,350,000	100,000,000	0	2,437,500	216,787,500	10,568,391
3	392,400,000	196,200,000	328,700,000	0	13,005,891	537,905,891	26,222,912
4	387,400,000	193,700,000	721,100,000	0	39,228,803	954,028,803	46,508,904
5	551,100,000	275,550,000	1,108,500,000	0	85,737,707	1,469,787,707	71,652,151
6	551,100,000	275,550,000	1,659,600,000	0	157,389,858	2,092,539,858	102,011,318
7	551,100,000	275,550,000	2,210,700,000	0	259,401,176	2,745,651,176	133,850,495
8	387,400,000	193,700,000	2,761,800,000	0	393,251,671	3,348,751,671	163,251,644
9	387,400,000	193,700,000	3,149,200,000	0	556,503,314	3,899,403,314	190,095,912
10	392,200,000	196,100,000	3,536,600,000	3,928,800,000	746,599,226	4,479,299,226	218,365,837
11	0	0	3,928,800,000	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
	3,928,800,000						964,965,063

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	3,928,800,000
IDC:	964,965,063
	4,893,765,063
Factor:	0.049171225
	240,632,421
Annual OM&R:	10,170,000
Annual Energy Costs:	50,000,000
Total Annual Cost:	300,802,421

Table 2-4. Interest During Construction for the Black Rock Alternative ($) (10-year construction period; 35% contingencies; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	125,000,000	62,500,000	0	0	0	62,500,000	3,046,875
2	283,700,000	141,850,000	125,000,000	0	3,046,875	269,896,875	13,157,473
3	447,400,000	223,700,000	408,700,000	0	16,204,348	648,604,348	31,619,462
4	437,400,000	218,700,000	856,100,000	0	47,823,810	1,122,623,810	54,727,911
5	601,100,000	300,550,000	1,293,500,000	0	102,551,720	1,696,601,720	82,709,334
6	601,100,000	300,550,000	1,894,600,000	0	185,261,054	2,380,411,054	116,045,039
7	601,100,000	300,550,000	2,495,700,000	0	301,306,093	3,097,556,093	151,005,860
8	437,400,000	218,700,000	3,096,800,000	0	452,311,953	3,767,811,953	183,680,833
9	437,400,000	218,700,000	3,534,200,000	0	635,992,785	4,388,892,785	213,958,523
10	448,300,000	224,150,000	3,971,600,000	4,419,900,000	849,951,309	5,045,701,309	245,977,939
11	0	0	4,419,900,000	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
	4,419,900,000						1,095,929,247

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	4,419,900,000
IDC:	1,095,929,247
	5,515,829,247
Factor:	0.049171225
	271,220,078
Annual OM&R:	10,170,000
Annual Energy Costs:	50,000,000
Total Annual Cost:	331,390,078

Table 2-5. Interest During Construction for the Black Rock Alternative ($) (15 year construction period; 20% contingencies; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	60,000,000	30,000,000	0	0	0	30,000,000	1,462,500
2	60,000,000	30,000,000	60,000,000	0	1,462,500	91,462,500	4,458,797
3	223,700,000	111,850,000	120,000,000	0	5,921,297	237,771,297	11,591,351
4	223,700,000	111,850,000	343,700,000	0	17,512,648	473,062,648	23,061,804
5	223,700,000	111,850,000	567,400,000	0	40,574,452	719,824,452	35,091,442
6	387,400,000	193,700,000	791,100,000	0	75,665,894	1,060,465,894	51,697,712
7	357,400,000	178,700,000	1,178,500,000	0	127,363,606	1,484,563,606	72,372,476
8	357,400,000	178,700,000	1,535,900,000	0	199,736,082	1,914,336,082	93,323,884
9	357,400,000	178,700,000	1,893,300,000	0	293,059,966	2,365,059,966	115,296,673
10	357,400,000	178,700,000	2,250,700,000	0	408,356,639	2,837,756,639	138,340,636
11	357,400,000	178,700,000	2,608,100,000	0	546,697,275	3,333,497,275	162,507,992
12	357,400,000	178,700,000	2,965,500,000	0	709,205,267	3,853,405,267	187,853,507
13	193,700,000	96,850,000	3,322,900,000	0	897,058,774	4,316,808,774	210,444,428
14	193,700,000	96,850,000	3,516,600,000	0	1,107,503,202	4,720,953,202	230,146,469
15	218,500,000	109,250,000	3,710,300,000	3,928,800,000	1,337,649,671	5,157,199,671	251,413,484
16	0	0	3,928,800,000	0	0	0	0
	3,928,800,000						1,589,063,155

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	3,928,800,000
IDC:	1,589,063,155
	5,517,863,155
Factor:	0.049171225
	271,320,088
Annual OM&R:	10,170,000
Annual Energy Costs:	50,000,000
Total Annual Cost:	331,490,088

Table 2-6. Interest During Construction for the Black Rock Alternative ($) (15 year construction period; 35% contingencies; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	125,000,000	62,500,000	0	0	0	62,500,000	3,046,875
2	120,000,000	60,000,000	125,000,000	0	3,046,875	188,046,875	9,167,285
3	283,700,000	141,850,000	245,000,000	0	12,214,160	399,064,160	19,454,378
4	283,700,000	141,850,000	528,700,000	0	31,668,538	702,218,538	34,233,154
5	273,700,000	136,850,000	812,400,000	0	65,901,692	1,015,151,692	49,488,645
6	437,400,000	218,700,000	1,086,100,000	0	115,390,337	1,420,190,337	69,234,279
7	437,400,000	218,700,000	1,523,500,000	0	184,624,616	1,926,824,616	93,932,700
8	357,400,000	178,700,000	1,960,900,000	0	278,557,316	2,418,157,316	117,885,169
9	357,400,000	178,700,000	2,318,300,000	0	396,442,485	2,893,442,485	141,055,321
10	357,400,000	178,700,000	2,675,700,000	0	537,497,806	3,391,897,806	165,355,018
11	357,400,000	178,700,000	3,033,100,000	0	702,852,824	3,914,652,824	190,839,325
12	357,400,000	178,700,000	3,390,500,000	0	893,692,149	4,462,892,149	217,565,992
13	193,700,000	96,850,000	3,747,900,000	0	1,111,258,141	4,956,008,141	241,605,397
14	193,700,000	96,850,000	3,941,600,000	0	1,352,863,538	5,391,313,538	262,826,535
15	284,600,000	142,300,000	4,135,300,000	4,419,900,000	1,615,690,073	5,893,290,073	287,297,891
16	0	0	4,419,900,000	0	0	0	0
	4,419,900,000						1,902,987,964

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	4,419,900,000
IDC:	1,902,987,964
	6,322,887,964
Factor:	0.049171225
	310,904,144
Annual OM&R:	10,170,000
Annual Energy Costs:	50,000,000
Total Annual Cost:	371,074,144

2.2.2 Wymer Dam and Reservoir Alternative:

The appraisal-level construction costs for the Wymer Dam and Reservoir Alternative as obtained from the *Wymer Appraisal Assessment* (Reclamation, 2007) were indexed to April 2007 dollars by Reclamation cost engineers. As shown in Table 2-2, total field costs were estimated at $780 million. Noncontract costs were estimated at either 20 or 35 percent of the total field cost ($156.0 or $273.0 million). Summing these costs results in a total construction cost (before IDC) of either $936.0 million or $1.053 billion.

For the Wymer Dam and Reservoir Alternative, based on annual construction cost estimates provided by Reclamation cost engineers, IDC was calculated using only a 10 year construction period and were estimated at either $265.4 or $304.1 million (see Table 2-7 and Table 2-8). The total construction cost plus IDC were estimated at either $1.201 or $1.357 billion.

The operations, maintenance, replacement, and energy (OMR&E) costs occur on an annual basis. To calculate a present value, the annual costs were assumed to occur each year of the 100-year study period. The annual operations, maintenance, and replacement (OM&R) costs were estimated at $1.08 million ($21.96 million in present value) and the annual energy costs at $1.9 million ($38.64 million in present value), for a total annual OMR&E cost of $2.98 million ($60.6 million in present value).

Total project cost, representing the sum of total construction cost plus the present value of the 100-year stream of annual OMR&E costs, ranges from $1.3 to $1.4 billion, depending on the cost option.

Table 2-7. Interest During Construction for the Wymer Dam and Reservoir Alternative ($) (10 year construction period, 20% noncontract costs; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	30,000,000	15,000,000	0	0	0	15,000,000	731,250
2	98,000,000	49,000,000	30,000,000	0	731,250	79,731,250	3,886,898
3	137,000,000	68,500,000	128,000,000	0	4,618,148	201,118,148	9,804,510
4	127,000,000	63,500,000	265,000,000	0	14,422,658	342,922,658	16,717,480
5	127,000,000	63,500,000	392,000,000	0	31,140,138	486,640,138	23,723,707
6	88,000,000	44,000,000	519,000,000	0	54,863,844	617,863,844	30,120,862
7	88,000,000	44,000,000	607,000,000	0	84,984,707	735,984,707	35,879,254
8	88,000,000	44,000,000	695,000,000	0	120,863,961	859,863,961	41,918,368
9	88,000,000	44,000,000	783,000,000	0	162,782,329	989,782,329	48,251,889
10	65,000,000	32,500,000	871,000,000	936,000,000	211,034,218	1,114,534,218	54,333,543
11	0	0	936,000,000	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
	936,000,000						265,367,761

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	936,000,000
IDC:	265,367,761
	1,201,367,761
Factor:	0.049171225
	59,072,724
Annual OM&R:	1,080,000
Annual Energy Costs:	1,900,000
Total Annual Cost:	62,052,724

Table 2-8. Interest During Construction for the Wymer Dam and Reservoir Alternative ($) (10 year construction period, 35% noncontract costs; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	50,000,000	25,000,000	0	0	0	25,000,000	1,218,750
2	118,000,000	59,000,000	50,000,000	0	1,218,750	110,218,750	5,373,164
3	147,000,000	73,500,000	168,000,000	0	6,591,914	248,091,914	12,094,481
4	137,000,000	68,500,000	315,000,000	0	18,686,395	402,186,395	19,606,587
5	137,000,000	68,500,000	452,000,000	0	38,292,982	558,792,982	27,241,158
6	98,000,000	49,000,000	589,000,000	0	65,534,139	703,534,139	34,297,289
7	98,000,000	49,000,000	687,000,000	0	99,831,429	835,831,429	40,746,782
8	98,000,000	49,000,000	785,000,000	0	140,578,211	974,578,211	47,510,688
9	98,000,000	49,000,000	883,000,000	0	188,088,899	1,120,088,899	54,604,334
10	72,000,000	36,000,000	981,000,000	1,053,000,000	242,693,233	1,259,693,233	61,410,045
11	0	0	1,053,000,000	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
	1,053,000,000						304,103,278

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	1,053,000,000
IDC:	304,103,278
	1,357,103,278
Factor:	0.049171225
	66,730,430
Annual OM&R:	1,080,000
Annual Energy Costs:	1,900,000
Total Annual Cost:	69,710,430

2.2.3 Wymer Dam Plus Yakima River Pump Exchange Alternative

The appraisal-level construction costs for the Wymer Dam Plus Yakima River Pump Exchange Alternative as obtained from the *Wymer Appraisal Assessment* were indexed to April 2007 dollars by Reclamation cost engineers. Two different plans were initially developed (Plan 1 and Plan 2). The lower cost plan, Plan 2, was selected for use in this analysis.

For Plan 2, total field costs were estimated at $2.98 billion. Noncontract costs were estimated at both 20 and 35 percent of the total field cost ($596.0 million and $1.043 billion). Summing these costs results in a total construction cost (before IDC) of either $3.576 or $4.023 billion.

For the Wymer Dam Plus Yakima River Pump Exchange Alternative, based on annual construction cost estimates provided by Reclamation cost engineers, IDC was calculated using only a 10 year construction period and was estimated at either $1.001 or $1.131 billion (see Table 2-9 and Table 2-10). For Plan 2, the total construction cost plus IDC was estimated at either $4.577 or $5.154 billion.

The OMR&E costs occur on an annual basis. To calculate a present value, the annual costs were assumed to occur each year of the 100-year study period. The annual OM&R costs were estimated at $18.198 million ($370.1 million in present value) and the annual energy costs at $19.815 million ($403.0 million in present value) for a total annual OMR&E cost of $38.013 million ($773.1 million in present value).

Total project cost, representing the sum of total construction cost plus the present value of the 100-year stream of annual OMR&E costs, ranges from $5.4 to $5.9 billion, depending on the cost option.

Table 2-9. Interest During Construction for the Wymer Dam Plus Yakima River Pump Exchange Alternative, Plan 2 ($) (10 year construction period, 20% noncontract costs; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	70,000,000	35,000,000	0	0	0	35,000,000	1,706,250
2	368,000,000	184,000,000	70,000,000	0	1,706,250	255,706,250	12,465,680
3	517,000,000	258,500,000	438,000,000	0	14,171,930	710,671,930	34,645,257
4	507,000,000	253,500,000	955,000,000	0	48,817,186	1,257,317,186	61,294,213
5	497,000,000	248,500,000	1,462,000,000	0	110,111,399	1,820,611,399	88,754,806
6	348,000,000	174,000,000	1,959,000,000	0	198,866,205	2,331,866,205	113,678,477
7	348,000,000	174,000,000	2,307,000,000	0	312,544,682	2,793,544,682	136,185,303
8	348,000,000	174,000,000	2,655,000,000	0	448,729,986	3,277,729,986	159,789,337
9	358,000,000	179,000,000	3,003,000,000	0	608,519,322	3,790,519,322	184,787,817
10	215,000,000	107,500,000	3,361,000,000	3,576,000,000	793,307,139	4,261,807,139	207,763,098
11	0	0	3,576,000,000	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
	3,576,000,000						1,001,070,237

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	3,576,000,000
IDC:	1,001,070,237
	4,577,070,237
Factor:	0.049171225
	225,060,148
Annual OM&R:	18,198,000
Annual Energy Costs:	19,815,000
Total Annual Cost:	263,073,148

Table 2-10. Interest During Construction for the Wymer Dam Plus Yakima River Pump Exchange Alternative, Plan 2 ($) (10 year construction period; 35% noncontract costs; 0.04875 interest rate)

Year	Annual expense	½ current expense	All previous years	Plant in service	All previous interest	Interest bearing amount	IDC method compound interest
0	0	0	0	0	0	0	0
1	120,000,000	60,000,000	0	0	0	60,000,000	2,925,000
2	408,000,000	204,000,000	120,000,000	0	2,925,000	326,925,000	15,937,594
3	557,000,000	278,500,000	528,000,000	0	18,862,594	825,362,594	40,236,426
4	557,000,000	278,500,000	1,085,000,000	0	59,099,020	1,422,599,020	69,351,702
5	557,000,000	278,500,000	1,642,000,000	0	128,450,722	2,048,950,722	99,886,348
6	398,000,000	199,000,000	2,199,000,000	0	228,337,070	2,626,337,070	128,033,932
7	388,000,000	194,000,000	2,597,000,000	0	356,371,002	3,147,371,002	153,434,336
8	388,000,000	194,000,000	2,985,000,000	0	509,805,339	3,688,805,339	179,829,260
9	388,000,000	194,000,000	3,373,000,000	0	689,634,599	4,256,634,599	207,510,937
10	262,000,000	131,000,000	3,761,000,000	4,023,000,000	897,145,536	4,789,145,536	233,470,845
11	0	0	4,023,000,000	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0
	4,023,000,000						1,130,616,381

Annual Equivalent Costs

Annual Equivalent Period: 100 years

Construction:	4,023,000,000
IDC:	1,130,616,381
	5,153,616,381
Factor:	0.049171225
	253,409,628
Annual OM&R:	18,198,000
Annual Energy Costs:	19,815,000
Total Annual Cost:	291,422,628

2.3 Benefit Estimation

This section estimates economic benefits for the following areas: (1) agriculture; (2) municipal; (3) recreation; (4) hydropower; and (5) fisheries.

As noted in the introduction to the NED BCA section, to the extent possible, these analyses follow the criteria for measuring NED benefits defined in the P&Gs. A P&G analysis of NED benefits is a "with versus without" project comparison. Comparisons were therefore made between the "with project" Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives and the "without project" No Action Alternative.

Instead of measuring all the costs and benefits associated with the No Action Alternative and action alternatives separately, and then subtracting the No Action Alternative effects from the action alternative effects to estimate the overall net effect of each action alternative, an incremental analysis was performed. An incremental analysis focuses from the onset on the change in costs and benefits for each action alternative over the No Action Alternative. For each action alternative, the changes in costs and benefits are summed to measure the overall net effect. This focus upon the sum of the change in costs and benefits for each action alternative as compared to the No Action Alternative provides the same net result as if one analyzed each alternative separately and then subtracted the No Action Alternative results from the results of each of the Action Alternatives. By focusing on the incremental changes of each action alternative over the No Action Alternative, the analysis does not present the results for the No Action Alternative.

2.3.1 Agricultural Benefits

Agricultural benefits for each alternative are realized only in drought years when the proration level is less than 70 percent. The Black Rock Alternative replaces part of the annual Yakima River water deliveries for Roza and Sunnyside Irrigation Districts used for irrigated agriculture with Columbia River water. This Columbia River water exchange provides enough water so all Yakima River basin entities with proratable irrigation entitlements will receive a proratable water supply of not less than 70 percent of their entitlements in dry years.

The Wymer Dam and Reservoir and the Wymer Dam Plus Yakima River Pump Exchange Alternatives provide the same amount of agricultural benefits. The Wymer Dam acts as a reregulation reservoir to store irrigation water released from Cle Elum Reservoir in the winter. These releases provide instream flows for

fish habitat purposes. The water stored in Wymer is then released for irrigation later in the year. This operation is the same for Wymer Dam and for Wymer Dam Plus the Yakima Pump Exchange Alternatives. The Wymer Dam Plus the Yakima Pump Exchange Alternative is the Wymer Dam with a pumping plant below the mouth of the Yakima River to pump irrigation water upstream to the Roza and Sunnyside Irrigation Districts. This pump exchange only pumps the amount of water that those districts would divert from the Yakima River based on the hydrologic conditions in the basin. If there is prorationing for Roza, then the pump exchange would only pump the water that Roza is entitled to based on the prorationing rules. This does not provide more agricultural benefits, but does provide instream flow benefits from the point of diversion to the mouth of the Yakima River. More detail is available in the Draft PR/EIS.

2.3.1.1 Methodology

The agricultural benefits are based on (1) the cropping pattern for both with and without the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives, (2) the benefit unit value per acre for each crop, and (3) the probability of occurrence of dry years, below a 70-percent proration.

Reclamation's Yakima Agricultural Impact (YAI) model measures the cropping pattern for the alternatives, including the No Action Alternative, based on the hydrologic conditions. The benefit unit values, calculated in a previous study, were applied to the cropping patterns, incremental to the No Action Alternative and, finally, the probability of a dry year occurring was applied to estimate the NED agricultural benefits for the alternatives. An example is provided below to illustrate how these components are used to derive agricultural benefits. Following the example, the YAI model, the benefit unit values, and the probability of a dry-year occurrence are discussed.

2.3.1.1.1 Example

The following is an example of how the agricultural benefits were derived for the Yakima Storage Study.

The hypothetic district (District Z) grows apples, cherries, and wine grapes. In hypothetical water year X, under the No Action (without project) alternative, as shown in row 2 of Table 2-11, District Z is able to grow 25 acres of apples, 12 acres of cherries, and 12 acres of wine grapes. With the proposed project (row 1 Table 2-11), during the water year X, District Z is able to grow 50 acres of apples, 25 acres of cherries, and 25 acres of wine grapes. Therefore, the project, as shown in row 3 of Table 2-11, enables District Z to grow 25 more acres of apples, 13 more acres of cherries, and 13 more acres of wine grapes in Year X than if the

project had not been implemented. This information is calculated for the Yakima storage alternatives by the YAI model.

The benefit unit values for apples, cherries, and wine grapes for this example are shown in row 4 of Table 2-11. These are applied to the incremental acres (the acres that the project enables District Z to produce during water year X) as shown in row 5 of Table 2-11.

Because dry years do not occur annually, a probability of a dry-year occurrence is applied to row 5. In this example, the probability of a dry year occurring is .04. The probability, .04, is computed by dividing 1 by 25 (years in the period of record). The annual benefits are shown in row 7, which is the probability of dry-year occurrence times row 5 (the incremental acres times Benefit Unit Values). These annual benefits are summed across the crops grown for District Z for the water year to estimate a benefit value for water year X in the example (row 8). The present value of the annual benefit is shown in row 9.

Table 2-11. Example of Agricultural Benefit Derivation

Row		Year	Apples	Cherries	Wine
1	Action (with project) (acres)	X	50	25	25
2	No Action Alternative (without project) (acres)	X	25	12	12
3	Incremental acres	X	25	13	13
4	Benefit unit values (per acre)		$1,015	$367	$1,100
5	Incremental acres times unit values	X	$25,375	$4,771	$14,300
6	Probability of a dry year (1/25)		0.04		
7	Annual benefits by crop	X	$1,015	$191	$572
8	Total annual benefits for District Z	X	$1,778		
9	Present value	X	$36,160		

2.3.1.1.2 Yakima Agricultural Production Model

The YAI model, developed by the Technical Service Center (TSC) Economics Group, estimates the crop acreages for (1) the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives and (2) the dry years without the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives.

The YAI model is a positive mathematical programming model, which simulates crop production. The modeling framework allows the model to respond in a manner consistent with grower behaviors. The model first replicates the

Agricultural producers maximize profit subject to physical (water supply) and economic constraints (prices, production costs). The YAI model utilized in this study attempts to capture farmer's decisions on a regional level. As economic constraints and/or physical constraints change, the model estimates the optimal mix of crops that maximize profit.

The data inputs for the YAI model are discussed below.

Irrigated Acres and Crop Data

Information on prices, yields, acres, and production costs were not available for all the crops grown in the study area; therefore, the model relies on information for representative crops. The representative crops included in the YAI model are shown in Table 2-12.

Table 2-12. Representative crops included in the YAI model

Representative Crop	Crops Included
Asparagus	Asparagus
Cherries	Cherries, Apricots, and Peaches
Pears	Pears
Alfalfa (flood irrigated)	Pasture, and Alfalfa (flood irrigated)
Alfalfa (center-pivot irrigated)	Alfalfa
Apples	Apples
Silage	Silage
Hops	Hops
Concord Grapes	Concord Grapes
Wine Grapes	Wine Grapes
Sweet Corn	Processed Sweet Corn and Fresh Sweet Corn
Potato	Potato
Timothy Hay	Other Hay
Wheat	Spring Wheat, Winter Wheat, Corn Grain, Oats, and Barley
Mint	Peppermint and Spearmint

The YAI model estimates the changes in crop acreages for 7 irrigation districts based on the available water supply. The decision to include these districts in the YAI model is based on the availability of Reclamation Crop Reports. The average (2002-2004) district acreages for those districts included are shown in Table 2-13.

Table 2-13. Crop acres by district

Crop	Roza	Kittitas	Tieton	Wapato	Sunny-side	Union Gap	Yakima Valley Canal
Asparagus	1,919				3,672		
Cherries	4,354		1,175	1,847	3,986	678	
Pears	2,154		2,350	822	642	669	300
Pasture	7,450	23,648	150	13,278	44,110	107	
Alfalfa (flood irrigated)		5,714					
Alfalfa (center-pivot irrigated)	3,373		3,650	30,638	9,731	14	250
Apple	22,731	985	19,975	11,651	4,910	996	800
Silage	3,599			2,414	7,927		
Hop	4,789			9,199	8,140		
Concord	9,051			4,804	11,512		
Wine Grapes	9,687				1,174	65	
Sweet Corn				12,328			
Potato				1,506			
Timothy Hay		21,480					
Wheat	1,449	4,137		19,324	1,903		
Mint	578			5,294	1,537		

Source: *Reclamation Crop and Water Data , 2002-2004.*

The agricultural model relies on county-level yield statistics. Prices were collected on a statewide basis. Data for prices and yields are obtained from the Washington State Agricultural Statistics for 2002-2004 for all crops except apples and grapes. These data are compiled by the Washington Agricultural Statistics Service. The average crop prices and yields used in the YAI model are summarized in Table 2-14 and Table 2-15.

Table 2-14. Average Crop Prices (2002-2004)

Crop	Unit	Roza	Kittitas	Tieton	Wapato	Sunny-side	Union Gap	Yakima Valley Canal
Asparagus	cwt	74.90				74.90		
Cherries	tons	1,616.67		1,616.67		1,616.67	1,616.67	
Pears	tons	309.67		309.67		309.67	309.67	309.67
Alfalfa (flood irrigated)	tons		100.83					
Alfalfa (center pivot irrigated)	tons	100.83		100.83	100.83	100.83	100.83	100.83
Apple	tons	412.67	412.67	412.67		412.67	412.67	412.67
Silage	tons	31.67			31.67	31.67		
Hops	lbs	1.85			1.85	1.85		
Concord Grapes	tons	178.00			178.00	178.00		
Wine Grapes	tons	907.67				907.67	907.67	
Sweet Corn	cwt				3.66			
Potato	cwt				5.23			
Timothy Hay	tons		123.33					
Wheat	bu	3.69			3.69	3.69		
Mint	lbs	11.40			11.40	11.40		

Source: *Washington State Annual Agricultural Bulletin* (2002-2004).

Table 2-15. Average Yields by County (2002-2004)

Crop	Unit	Benton	Kittitas	Yakima	Yakima Valley Fruit Growing Area
Asparagus	cwt	39.47		39.45	
Cherries	tons				4.11
Pears	tons				14.87
Alfalfa (flood irrigated)	tons		4.10		
Alfalfa (center pivot irrigated)	tons	6.90		6.07	
Apple	tons				16.42
Corn Grain	bu			184.57	
Silage	tons			26.40	
Carrots	cwt	635.00			
Hops	lbs	2,106.67		2,106.67	
Concord Grapes	tons	8.04		8.04	
Wine Grapes	tons	4.12		4.12	
Sweet Corn	cwt	196.00	192.00	220.00	
Potato	cwt	640.67	370.00	385.00	
Timothy Hay	tons	4.40	4.93	3.30	
Wheat	bu	91.35		86.65	
Mint	lbs			106.50	

Source: *Washington State Annual Agricultural Bulletin* (2002-2004).

Washington State University compiled the costs of production from various crops grown in this region. These costs represent average production practices in the area. The variable costs of production used in the model are summarized in Table 2-16 below.

Table 2-16. Variable Costs by Crop and District

Crop	Roza	Kittitas	Tieton	Wapato	Sunny-side	Union Gap	Yakima Valley Canal
	($ per Acre)						
Asparagus	1,213.11				1,213.01		
Cherries	4,006.66		4,006.66		4,006.66	4,006.66	
Pears	3,617.06		3,617.06		3,617.06	3,617.06	3,617.06
Alfalfa (flood irrigated)		277.63					
Alfalfa (center-pivot irrigated)	370.40		351.11	351.11	360.75	351.11	351.11
Apple	3,314.56	3,314.56	3,314.56		3,314.56	3,314.56	3,314.56
Silage	335.28			558.80	447.04		
Hops	2,102.63			2,102.63	2,102.63		
Concord Grapes	647.44			647.44	647.44		
Wine Grapes	1,418.36				1,418.36	1,418.36	
Sweet Corn				419.18			
Potato				1,202.30			
Timothy Hay		211.46					
Wheat	272.92			267.13	270.02		
Mint	855.34			1,425.57	1,140.46		

Source: Washington State University Extension Budgets (various years).

2.3.1.1.3 Water Supply

The cropping acreages estimated by the YAI model are based on water data supplied by the Yakima River Basin RiverWare (Yak-RW) model. Irrigation benefits accrue in those years where the proration level is 70 percent or below. The Yak-RW model shows that the water supply fell under the 70-percent threshold in 6 years out of the 25-year period of record. Table 2-17 shows the proration levels for the 6 dry years. It should be noted that conservation action which are included in the No-Action Alternative raised the 1992 proration level to 70 percent; therefore, there are only 5 years where the No-Action Alternative fell below 70 percent.

Table 2-17. Irrigation proration levels by alternative

Water Year	Irrigation proration level (percent)		
	No Action Alternative	Black Rock Alternative	Wymer and Wymer Plus Alternatives
1987	69	82	73
1992	70	80	76
1993	57	73	68
1994	27	70	29
2001	44	70	59
2005	45	70	49

The YAI model assumes that districts with a combination of nonproratable and proratable entitlements receive 100 percent of their nonproratable entitlements and some percentage of their proratable entitlements based on the proration levels shown in Table 2-18.

Table 2-18. Water Entitlements by District

Entity	Proratable Water Entitlement (acre-feet)	Non-Proratable Water Entitlement (acre-feet)
Only Proratable Water Entitlements		
Kittitas Reclamation District	336,000	0
Roza Irrigation District	375,000	0
Subtotal	711,000	0
Combination of Nonproratable and Proratable Water Entitlements		
Sunnyside Division	142,684	315,836
Wapato Irrigation Project	350,000	305,613
Union Gap Irrigation District	4,642	20,697
Yakima Valley Canal Company	4,305	23,720
Yakima-Tieton	38,181	75,868
Subtotal	539,812	741,734
Other Proratable Water Entitlements	29,062	
Total all proratable water entitlements	1,279,874	

Source: *Yakima Basin Interim Operating Plan* (Reclamation., 2002)

2.3.1.1.4 Agricultural Benefit Unit Values

After the YAI model calculates acreages by crop for each alternative, benefit unit values are applied to estimate NED agricultural benefits for the alternatives. The benefit unit values follow the criteria for measuring NED agricultural benefits defined in the P&Gs. The P&Gs are the Federal guidelines by which Reclamation determines NED benefits of Federal actions or project implementation. A P&G

analysis of NED agricultural benefits is a "with and without" project comparison that identifies the change in net farm income related to a change in crop acreage while maintaining the same cropping pattern. Net farm income is estimated using a farm budget methodology.

Table 2-19 summarizes the benefit unit values. These values were derived by a previous study conducted by the Bureau of Reclamation. While some of the unit values are negative, this does not indicate a negative benefit value for these crops, nor does it suggest that growing these crops is unprofitable. Benefit values are derived by taking the absolute difference between the with- and without-cropping patterns times the unit value. See the example below.

Table 2-19. Crop Benefit Unit Values for the Reclamation's Yakima Irrigation Project

Crop	Unit Value ($ per acre)	Crop	Unit Value ($ per acre)	Crop	Unit Value ($ per acre)
Alfalfa (center-pivot irrigation)	-23.42	Alfalfa (flood irrigation)	-109.39	Apples	1,015.70
Asparagus	1,516.28	Carrots	-955.56	Cherries	366.73
Corn Silage	-174.50	Corn Grain	-307.54	Hops	871.19
Mint	-647.58	Onions	2,326.95	Pears	-520.50
Potatoes	143.83	Sweet Corn	-110.25	Timothy Hay	288.39
Wheat	-372.97	Wine	1,097.93		

Example of Computing Benefits for Crops with Negative Unit Values

The hypothetical District Z is able to grow 20 acres of alfalfa with center-pivot irrigation in year X with the action (with-project) alternative, as shown in row 1 of Table 2-20 below. Under the No-Action (without-project) Alternative, District Z is able to grow 10 acres during water year X, also shown in row 1 below. The benefit unit value of alfalfa with center-pivot irrigation is $-23.42. As shown in row 3, the action (with-project) acres times the unit value is $-468.40. The No-Action (without-project) acres times the unit value is $-234.40. The absolute difference between the action (with-project) and the No Action (without-project) Alternative is $234.20, as shown in row 4. This calculation is shown below.

$$|-\$468.40| - |-\$234.20| = \$\ 234.20.$$

Because dry years do not occur annually, a probability of a dry-year occurrence (discussed below) is applied to row 4. In this example, the probability of a dry year occurring is .04 (shown in row 5). The annual benefit for alfalfa grown with center-pivot irrigation in this example is $93.68, as shown in row 6.

Table 2-20. Computing benefits for crops with negative unit values

Row		Year	No Action (without-project) Alternative	Action (with-project) Alternative
1	Alfalfa acres (center-pivot irrigation)	X	20	10
2	Benefit Unit Values (per acre)		$ -23.42	$ -23.42
3	Acres times Unit Value		$ -234.20	$ -468.40
4	Absolute difference between Action and No Action projects		$ 234.20	
5	Probability of a dry year (1/25)		0.04	
6	Annual Benefits by Crop		$ 93.68	

2.3.1.1.5 Probability of Dry Years

Because benefits only accrue in dry years below the 70-percent threshold, the probability of a dry year below the 70-percent level is applied to the total benefit value for the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives. The probability used in this analysis assumes that dry years occur 5 years out of the 25-year period of record. Therefore, the probability of benefits accruing equals .04 in a single year. The .04 is derived by dividing 1 by 25.

2.3.1.2 Findings

The present value of the 100-year stream of agricultural benefits equals $84.6 million (the annual equivalent is equal to $4.16 million for the Black Rock Alternative, $26.5 (the annual equivalent equals $1.3) for the Wymer Dam and Reservoir and Wymer Dam Plus Yakima River Pump Exchange Alternatives (see Table 2-21). It should be noted that the Tieton and Sunnyside Districts are included in the benefits calculation to be consistent with the hydrology data.

Table 2-21. Agricultural benefits by alternative

District	Black Rock		Wymer/Wymer Plus	
	Annual	Present Value	Annual	Present Value
Roza	$3,096,113	$62,965,640	$972,787	$19,783,560
Kittitas	$295,058	$6,000,595	$88,949	$1,808,947
Tieton	$90,411	$1,838,691	$27,551	$560,305
Wapato	$445,934	$9,068,950	$140,821	$2,863,880
Sunnyside	$218,516	$4,443,951	$69,005	$1,403,353
Union Gap	$14,066	$286,070	$4,452	$90,544
Total	$4,160,097	$84,603,896	$1,303,565	$26,510,589

2.3.2 Municipal Benefits

Providing a portion of future municipal water demand is a component of the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives. The goal of each alternative is to supply approximately 82,000 acre-feet of future municipal water demand to the communities in the Yakima River basin by the year 2050. The future municipal demand is treated as a prorated water right, which reduces the amount of water the municipalities receive during a prorated irrigation season. Due to the effect of having to prorate municipal water supply in dry years, the Black Rock Alternative is expected to supply on average 81,100 acre-feet in year 2050, the Wymer Dam and Reservoir Alternative, 79,800 acre-feet, and Wymer Dam Plus Yakima River Pump Exchange Alternative, 80,500 acre-feet. The three action alternatives were designed, in part, to try to meet year 2050 projections of unmet municipal demand. Further description of the municipal demand is presented in the Draft PR/EIS.

2.3.2.1 Methodology

A $235.66 per acre-foot wholesale price of municipal water ($221.06 in 2005 dollars indexed to April 2007 dollars to be consistent with cost estimates using the *Western Region Consumer Price Index*), as obtained from a recent Reclamation report *2006 M&I Water Rate Survey Data* (Contract Services Office, 2006), was used to value the annual supply of municipal water associated with each alternative. The $235.66 value reflects the average of Pacific Northwest Region municipal water prices for the Yakima Project.

The basic assumption of this alternative cost method to valuation is that municipal water demand must be addressed. If municipal water needs are assumed to be met regardless of the selected alternative, then the benefits associated with the provision of municipal water in essence become irrelevant, since they are the same for all alternatives and the analysis can focus on the cost differentials between the various water supply provision options inherent within each alternative. In this case, we are assuming that approximately 82,000 acre-feet of municipal water will be provided by each of the action alternatives (i.e., Black Rock, Wymer Dam and Reservoir, or Wymer Dam Plus Yakima River Pump Exchange), with the No Action Alternative source of municipal water being a water market purchase. The costs of providing approximately 82,000 acre-feet of municipal water are reflected in the construction and annual operating costs for the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives, whereas the avoided cost benefits (i.e., avoided market purchases associated with the No Action Alternative) are presented as a "benefit" in this section.

As with the other benefit measures, by including the municipal water supply cost of the No Action Alternative as an "avoided cost benefit" for the action alternatives, the municipal benefit analysis becomes an incremental analysis as compared to the No Action Alternative. If the costs of providing municipal water associated with an action alternative fall below (exceed) the costs of a water market purchase associated with the No Action Alternative, then the net effect of the action alternative would be positive (negative) from a municipal water supply perspective.

Since the municipal water supply target for each action alternative was identified for year 2050, it was necessary to project a growth in municipal water supply for each alternative from the start of the benefit period to year 2050. Each alternative was assumed to involve a 10-year construction period, plus some additional time to complete the planning process; therefore, the assumption was made that the benefit period would not start until the year 2020. Therefore, a projection was developed from year 2020 to year 2050 for each alternative.

The approximately 82,000 acre-feet of unmet municipal water demand in year 2050 was obtained from a report entitled, *Watershed Management Plan, Yakima River Basin*" (Yakima River Basin Watershed Planning Unit and Tri-County Water Resources Agency, 2003). This report also provided a graphic (Exhibit 2-2) which depicted estimates of future total municipal water demand in years 2010, 2020, 2030, 2040 and 2050. Deducting current ground- and surface-water supply sources of 104,000 acre-feet allowed for the estimation of unmet demand in each of these years. Since only a portion of the municipal demand in the Richland and West Richland areas of the Lower Yakima Subarea actually occurs within the Yakima Basin, the Richland and West Richland out-of-basin demand was subtracted from the total. While the 2020 out-of-basin demand for Richland and West Richard was estimated at about 30 percent of the Lower Yakima Subarea total demand, this out-of-basin component was converted to a percentage of total Yakima Basin demand (about 13.25 percent), since the Lower Yakima Subarea detail was not provided in the projections. The difference in unmet demand between each 10-year period (e.g., 2030 minus 2020) was spread equally across each year of the 10-year periods (e.g., 2021, 2022, …, 2030) to develop the projection for each alternative. Depending on the alternative, the last year or two prior to reaching year 2050 were constrained, so unmet demand would not exceed the 2050 estimate. It was then assumed that the year 2050 municipal supply for each alternative would be provided from year 2050 to the end of the 100-year benefit period (i.e., year 2119). Finally, the $235.66 value per acre-foot estimate was applied to each annual municipal water supply estimate associated with each alternative. The resulting annual municipal values by alternative were discounted to the start of the benefit period (i.e., year 2020) and summed into a present value estimate by alternative (note that an annual equivalent value was also estimated).

Since the year 2050 municipal benefit estimate actually represents the value for years 2050-2119, the discount factor had to discount the 70-year stream of equal annual benefits back to year 2050 before further discounting the result to year 2020.

2.3.2.2 Assumptions

- Current ground-and surface-water supply sources are sustainable in the long run at 104,000 acre-feet.
- Assuming a 10-year construction period for each action alternative, municipal water supply from each alternative would start at year 2020.
- Municipal water supplied by each alternative would reach its maximum in year 2050 and continue at that level to the end of the period of analysis (year 2119).
- Unmet municipal water demands must be provided for regardless of the selected alternative.
- The best option for obtaining the needed municipal water under the No Action Alternative would be a market purchase.
- The assumption was made that municipalities in search of municipal water under the No Action Alternative could obtain the water at wholesale rates.

2.3.2.3 Results

The results of the municipal water unmet demand projection and benefit estimation by alternative is presented in Table 2-22.

2.3.2.3.1 Black Rock Alternative

The value of the growth in annual municipal water supply to 81,100 acre-feet in year 2050 and beyond was estimated to average $14.1 million annually or $286.7 million in present value over the 100-year study period for the Black Rock Alternative.

2.3.2.3.2 Wymer Dam and Reservoir Alternative

The value of the growth in annual municipal water supply to 79,800 acre-feet in year 2050 and beyond was estimated to average $14.0 million annually or $285.2 million in present value over the 100-year study period for the Wymer Dam and Reservoir Alternative.

Table 2-22. Yakima Storage Study M&I water and value projection

2005 Value per Acre Foot	221.06
2005 Average CPI:	198.9
April 2007 CPI:	212.036
April 2007 to Average 2005 CPI Ratio:	1.066043
April 2007 Value per Acre Foot:	235.66
Discount Rate:	0.04875

1) Black Rock Alternative:

Area	Year 2000%	2000	Year 2010%	2010	Year 2020%	Year #: 1 / 2020	2 / 2021	3 / 2022	4 / 2023	5 / 2024	6 / 2025	7 / 2026	8 / 2027	9 / 2028	10 / 2029	11 / 2030	12 / 2031	13 / 2032	14 / 2033	15 / 2034	16 / 2035	17 / 2036	18 / 2037	19 / 2038	20 / 2039	21 / 2040	22 / 2041	23 / 2042	24 / 2043	25 / 2044	26 / 2045	27 / 2046	28 / 2047	29 / 2048	30 / 2049 ****	(70 Years, Years 31-100) 31 / 2050-2119 ***
Upper Yakima Subarea:		15585		19,130		22451	Change										Change									Change									
Middle Yakima Subarea:		48430		57,274		63539	from 2030										from 2040									from 2040									
Naches Subarea:		4565		5,623		6481	to 2020:	16,685									to 2030:	20,000								to 2030:	15,000								
Lower Yakima Subarea		46992		56,172		70844																												
Subtotal:		115,572		138,199		163,315	165000	166700	168400	170100	171800	173500	175200	176900	178600	180000	182000	184000	186000	188000	190000	192000	194000	196000	198000	200000	201500	203000	204500	206000	207500	209000	210500	212000	212000	215000
Minus: Richland and West Richland: (*)	-0.10476	-12107	-0.09897	-13,677	-0.13248	-21636	-21900	-22100	-22300	-22500	-22800	-23000	-23200	-23400	-23700	-23800	-24100	-24400	-24600	-24900	-25200	-25400	-25700	-26000	-26200	-26500	-26700	-26900	-27100	-27300	-27500	-27700	-27900	-28100	-28100	-29900
Total Yakima Basin Demand:		103,465		124,522		141,679	143,100	144,600	146,100	147,600	149,000	150,500	152,000	153,500	154,900	156200	157900	159600	161400	163100	164800	166600	168300	170000	171800	173500	174800	176100	177400	178700	180000	181300	182600	183900	183900	185100
Current Water Supply:		104,000		104,000		104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000
Unmet Demand:		-535		20,522		37,679	39,100	40,600	42,100	43,600	45,000	46,500	48,000	49,500	50,900	52,200	53,900	55,600	57,400	59,100	60,800	62,600	64,300	66,000	67,800	69,500	70,800	72,100	73,400	74,700	76,000	77,300	78,600	79,900	79,900	81,100
Annual Benefits:						8,879,415	9,214,287	9,567,776	9,921,266	10,274,755	10,604,678	10,958,168	11,311,657	11,665,146	11,995,069	12,301,427	12,702,048	13,102,669	13,526,856	13,927,478	14,328,099	14,752,286	15,152,907	15,553,528	15,977,715	16,378,337	16,684,694	16,991,051	17,297,409	17,603,766	17,910,123	18,216,481	18,522,838	18,829,196	18,829,196	19,111,987	
Discounted Factor:						0.95352	0.90919	0.86693	0.82663	0.78821	0.75157	0.71663	0.68332	0.65156	0.62127	0.59239	0.56485	0.53860	0.51356	0.48969	0.46693	0.44522	0.42453	0.40479	0.38598	0.36803	0.35093	0.33461	0.31906	0.30423	0.29009	0.27660	0.26375	0.25149	0.23980	4.52268	Total Present Value:	Annual Equivalent:
Annual Discounted Benefits:						8,466,665	8,377,565	8,294,593	8,201,234	8,098,631	7,970,135	7,852,973	7,729,483	7,600,504	7,452,175	7,287,252	7,174,804	7,057,065	6,946,871	6,820,133	6,690,167	6,568,040	6,432,806	6,295,952	6,167,018	6,027,793	5,855,107	5,685,450	5,518,915	5,355,577	5,195,499	5,038,731	4,885,312	4,735,268	4,515,154	86,437,326	286,734,196	14,099,072

Footnotes:
* Assumed Richland and West Richland demand at year 2020% of the subtotal (13.248%) for projections. Subtracted off "out-of-basin" demand in these areas.
** Subtotal estimates for 2030 and 2040 from Exhibit 2-2 in Watershed Management Plan Yakima River Basin (Yakima River Basin Watershed Planning Unit and Tri-County Water Resources Agency (January 2003).
*** Adjusted Richland and West Richland estimates to agree with total unmet demand for the alternative
**** Adjusted year 2049 so as not to exceed unmet demand of year 2050.

2) Wymer Dam and Reservoir Alternative:

Area	Year 2000%	2000	Year 2010%	2010	Year 2020%	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048 ****	2049 ****	2050-2119
Upper Yakima Subarea:		15585		19,130		22451	Change										Change									Change									
Middle Yakima Subarea:		48430		57,274		63539	from 2030										from 2040									from 2040									
Naches Subarea:		4565		5,623		6481	to 2020:	16,685									to 2030:	20,000								to 2030:	15,000								
Lower Yakima Subarea		46992		56,172		70844																												
Subtotal:		115,572		138,199		163,315	165000	166700	168400	170100	171800	173500	175200	176900	178600	180000	182000	184000	186000	188000	190000	192000	194000	196000	198000	200000	201500	203000	204500	206000	207500	209000	210500	210500	210500	215000
Minus: Richland and West Richland: (*)	-0.10476	-12107	-0.09897	-13,677	-0.13248	-21636	-21900	-22100	-22300	-22500	-22800	-23000	-23200	-23400	-23700	-23800	-24100	-24400	-24600	-24900	-25200	-25400	-25700	-26000	-26200	-26500	-26700	-26900	-27100	-27300	-27500	-27700	-27900	-27900	-27900	-31200
Total Yakima Basin Demand:		103,465		124,522		141,679	143,100	144,600	146,100	147,600	149,000	150,500	152,000	153,500	154,900	156200	157900	159600	161400	163100	164800	166600	168300	170000	171800	173500	174800	176100	177400	178700	180000	181300	182600	182600	182600	183800
Current Water Supply:		104,000		104,000		104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000
Unmet Demand:		-535		20,522		37,679	39,100	40,600	42,100	43,600	45,000	46,500	48,000	49,500	50,900	52,200	53,900	55,600	57,400	59,100	60,800	62,600	64,300	66,000	67,800	69,500	70,800	72,100	73,400	74,700	76,000	77,300	78,600	78,600	78,600	79,800
Annual Benefits:						8,879,415	9,214,287	9,567,776	9,921,266	10,274,755	10,604,678	10,958,168	11,311,657	11,665,146	11,995,069	12,301,427	12,702,048	13,102,669	13,526,856	13,927,478	14,328,099	14,752,286	15,152,907	15,553,528	15,977,715	16,378,337	16,684,694	16,991,051	17,297,409	17,603,766	17,910,123	18,216,481	18,522,838	18,522,838	18,522,838	18,522,838	18,805,630	
Discounted Factor:						0.95352	0.90919	0.86693	0.82663	0.78821	0.75157	0.71663	0.68332	0.65156	0.62127	0.59239	0.56485	0.53860	0.51356	0.48969	0.46693	0.44522	0.42453	0.40479	0.38598	0.36803	0.35093	0.33461	0.31906	0.30423	0.29009	0.27660	0.26375	0.25149	0.23980	4.52268	Total Present Value:	Annual Equivalent:
Annual Discounted Benefits:						8,466,665	8,377,565	8,294,593	8,201,234	8,098,631	7,970,135	7,852,973	7,729,483	7,600,504	7,452,175	7,287,252	7,174,804	7,057,065	6,946,871	6,820,133	6,690,167	6,568,040	6,432,806	6,295,952	6,167,018	6,027,793	5,855,107	5,685,450	5,518,915	5,355,577	5,195,499	5,038,731	4,885,312	4,658,223	4,441,691	85,051,771	285,198,133	14,023,541

Footnotes:
**** Adjusted years 2048 and 2049 so as not to exceed unmet demand of year 2050.

3) Wymer Dam Plus Yakima River Pump Exchange Alternative:

Area	Year 2000%	2000	Year 2010%	2010	Year 2020%	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049 ****	2050-2119
Upper Yakima Subarea:		15585		19,130		22451	Change										Change									Change									
Middle Yakima Subarea:		48430		57,274		63539	from 2030										from 2040									from 2040									
Naches Subarea:		4565		5,623		6481	to 2020:	16,685									to 2030:	20,000								to 2030:	15,000								
Lower Yakima Subarea		46992		56,172		70844																												
Subtotal:		115,572		138,199		163,315	165000	166700	168400	170100	171800	173500	175200	176900	178600	180000	182000	184000	186000	188000	190000	192000	194000	196000	198000	200000	201500	203000	204500	206000	207500	209000	210500	212000	212000	215000
Minus: Richland and West Richland: (*)	-0.10476	-12107	-0.09897	-13,677	-0.13248	-21636	-21900	-22100	-22300	-22500	-22800	-23000	-23200	-23400	-23700	-23800	-24100	-24400	-24600	-24900	-25200	-25400	-25700	-26000	-26200	-26500	-26700	-26900	-27100	-27300	-27500	-27700	-27900	-28100	-28100	-30500
Total Yakima Basin Demand:		103,465		124,522		141,679	143,100	144,600	146,100	147,600	149,000	150,500	152,000	153,500	154,900	156200	157900	159600	161400	163100	164800	166600	168300	170000	171800	173500	174800	176100	177400	178700	180000	181300	182600	183900	183900	184500
Current Water Supply:		104,000		104,000		104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104,000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000	104000
Unmet Demand:		-535		20,522		37,679	39,100	40,600	42,100	43,600	45,000	46,500	48,000	49,500	50,900	52,200	53,900	55,600	57,400	59,100	60,800	62,600	64,300	66,000	67,800	69,500	70,800	72,100	73,400	74,700	76,000	77,300	78,600	79,900	79,900	80,500
Annual Benefits:						8,879,415	9,214,287	9,567,776	9,921,266	10,274,755	10,604,678	10,958,168	11,311,657	11,665,146	11,995,069	12,301,427	12,702,048	13,102,669	13,526,856	13,927,478	14,328,099	14,752,286	15,152,907	15,553,528	15,977,715	16,378,337	16,684,694	16,991,051	17,297,409	17,603,766	17,910,123	18,216,481	18,522,838	18,829,196	18,829,196	18,970,591	
Discounted Factor:						0.95352	0.90919	0.86693	0.82663	0.78821	0.75157	0.71663	0.68332	0.65156	0.62127	0.59239	0.56485	0.53860	0.51356	0.48969	0.46693	0.44522	0.42453	0.40479	0.38598	0.36803	0.35093	0.33461	0.31906	0.30423	0.29009	0.27660	0.26375	0.25149	0.23980	4.52268	Total Present Value:	Annual Equivalent:
Annual Discounted Benefits:						8,466,665	8,377,565	8,294,593	8,201,234	8,098,631	7,970,135	7,852,973	7,729,483	7,600,504	7,452,175	7,287,252	7,174,804	7,057,065	6,946,871	6,820,133	6,690,167	6,568,040	6,432,806	6,295,952	6,167,018	6,027,793	5,855,107	5,685,450	5,518,915	5,355,577	5,195,499	5,038,731	4,885,312	4,735,268	4,515,154	85,797,839	286,094,709	14,067,627

Footnotes:
**** Adjusted years 2048 and 2049 so as not to exceed unmet demand of year 2050.

2.3.2.3.3 Wymer Dam Plus Yakima River Pump Exchange Alternative

The value of the growth in annual municipal water supply to 80,500 acre-feet in year 2050 and beyond was estimated to average $14.1 million annually or $286.1 million in present value over the 100-year study period for the Wymer Dam Plus Yakima River Pump Exchange Alternative.

2.3.3 Recreation Benefits

The recreation benefit analysis evaluated recreation effects at both proposed recreation sites (i.e., the proposed Black Rock and Wymer reservoirs) and existing recreation sites (i.e., existing reservoirs and rivers reaches). The recreation effects at the proposed reservoirs would obviously stem from the existence of those reservoirs and their associated recreational facilities. The recreation effects at the existing reservoirs and river reaches would result from reservoir water level and river instream flow changes as a result of the construction and operation of the proposed reservoirs.

Positive or negative recreational effects could also be experienced outside the Yakima River Basin due to site substitution. With the alternatives under consideration, the effects upon recreation within the Yakima River Basin are generally assumed to be positive. Therefore, in this case, site substitution generally refers to reductions in recreation use of sites outside the Yakima River Basin as a result of the construction of new sites or quality improvements at existing sites within the basin. Given the difficulty and speculative nature of attempts to quantitatively measure the degree of possible site substitution, site substitution effects have not been included in the recreation analysis. As a result, the estimated recreation benefits, both at the proposed and existing sites, may be overstated.

2.3.3.1 Recreation Effects at Proposed Reservoirs

This section analyzes the potential recreation economic benefits at the proposed Black Rock and Wymer reservoirs. The initial estimates of recreation effects, as measured by changes in visitation by recreation activity, are described in the recreation section of the Draft PR/EIS. This section describes the methods and results in terms of the economic valuation of those estimates of visitation changes.

Note that both the Wymer Dam and Reservoir and Wymer Dam Plus Yakima River Pump Exchange Alternatives would produce the same recreational effects at the proposed Wymer Reservoir, but different recreational effects at the existing

reservoirs and rivers within the region (see section 2.3.2.3.3 below for an analysis of the effects at existing reservoir and rivers).

2.3.3.1.1 Methodology

The proposed reservoir recreation economic methodology used estimates of changes in recreation visitation by activity as compared to the No Action Alternative as described and presented in the recreation section of the PR/EIS. Since the No Action Alternative does not include the proposed reservoirs, the entire estimate of visitation at each proposed reservoir would reflect a change from the No Action Alternative.

Initial estimates of annual visitation by activity were projected over the 100-year study period based on annual growth rate assumptions also noted in the recreation section (i.e., Black Rock: 5 percent for the first 10 years and 3 percent thereafter, Wymer: 3 percent for entire study period). Recreation specialists also provided carrying capacity estimates of 700,000 for Black Rock and 200,000 for Wymer based on reservoir surface acreage at high pool, boating acreage requirements, non-boating visitation estimates, associated parking lot size and turnover, and the length of the high and low use recreation seasons (see Table 2-23 below). The carrying capacity estimates were assumed to reflect an upper bound on annual visitation and were therefore used to constrain the visitation growth projection.

Reclamation recreation development at new reservoirs would remain at the minimum level to maintain safety and protect resources for the first five years. As a result, the recreation specialists provided both a preliminary (year 1) visitation estimate as well as a subsequent (year 6) visitation estimate. Incorporating both the year 1 and year 6 visitation estimates resulted in a break in the projection in year 6. Years 7-100 then followed the growth rates mentioned above.

Proposals have been made by a local group (Yakima Basin Storage Alliance [YBSA]) to include a resort type development near the Black Rock Reservoir. This development would be funded privately and would be located outside the lands acquired for the Black Rock Reservoir. This proposed development does not represent a nationally oriented recreation benefit and therefore is not included in the NED benefit analysis.

To estimate annual recreation economic benefits by alternative, per visit economic benefits were applied to the estimated annual visitation levels at each reservoir. Since economic benefits or values per visit vary by recreation activity, it was important that the visitation estimates were broken down by recreation activity. Values per visit for the activities identified in the recreation visitation analysis were obtained from a nationwide recreation valuation study (Kaval and

Table 2-23. Proposed reservoir carrying capacity

Considerations	Wymer	Black Rock
1) Boats at one time capacity based upon Level 1 WROS analysis	High pool=16 boats	High pool = 161 boats
2) Percent of visitation that is boating	20%	50%
3) Projected parking facility limits (#1 ÷ #2)	80 (60 single vehicles + 20 vehicles with trailers)	322 (161 single vehicles + 161 vehicles with trailers)
4) Parking turn-over rate per day	3.0 (assumes local visitation and short visits)	2.0 (assumes regional visitation and longer length of stay)
5) Overnight accommodations	None	50 developed campsites
6) Average number of visitors per vehicle	3.5	3.5
7) Length of recreation season	180 days	240 days
8) Estimate of maximum visitation during recreation season [(#3 * #4 * #6 * #7) + (#5 * #6 * #7)]	151,200	582,960
9) Estimate of maximum visitation during non-recreation season (assumes 15% of recreation season)	22,680	87,555
10) Estimated maximum visitation that could be accommodated per year (after which visitation would be expected to decline due to inadequate facilities, crowding, conflicts, public safety, and visitor displacement).	173,880 visitors	670,134 visitors
11) Carrying Capacity Estimate (#10 rounded up)	200,000 visits	700,000 visits

Loomis, 2003). The Kaval and Loomis study gathered information from hundreds of recreation economic studies throughout the United States. Average values per visit by recreation activity from the Pacific Coast region were used in the analysis. Since the values were presented by Kaval and Loomis in 1996 dollars, they were updated to April 2007 dollars using consumer price indexes in order to be consistent with the cost estimates. The annual values were then discounted to a present value before incorporating them into the BCA.

As noted above, the recreation analysis did not attempt to estimate the effects of potential site substitution. In the proposed reservoir case, site substitution refers to the extent to which recreators may visit the new Black Rock or Wymer Reservoirs as opposed to visiting other reservoirs in the area. If substitution occurs, it would draw visitation from the other sites implying that the change in total visitation regionwide would actually be less than the gain experienced at Black Rock or Wymer. While the reservoirs within the Yakima Basin may not be significantly affected by the construction of Black Rock or Wymer Reservoirs from a strictly site substitution perspective since they probably cater to a different type of recreator (mountain reservoir versus dryland reservoir), there are several

dryland reservoirs in the region whose visitation might be adversely affected by the proposed reservoirs. To provide a more realistic picture of the overall impact upon regional recreation of Black Rock or Wymer Reservoir, the analysis would need to try and account for the potential lost visitation and value at other reservoir sites in the region. Unfortunately, attempting to estimate the substitution effect within a region is typically quite difficult and ultimately fairly speculative. As a result, quantification of possible site substitution effects has not been included.

2.3.3.1.2 Proposed Reservoir Results

Black Rock Alternative

Table 2-24 presents the results of the visitation projection by recreation activity for the proposed Black Rock reservoir. Note that the visitation projection is constrained by the estimated carrying capacity of the reservoir (700,000 visits) in year 23, so years 23 through 100 are assumed to be at the 700,000-visit carrying capacity. The economic valuation results are presented at the end of Table 2-24. The economic values per visit by recreation activity, ranging from $20.32 for horseback riding to $81.26 for wildlife viewing, are presented as well as the present value of the 100-year stream of recreation benefits for each activity. The economic values per visit by activity were multiplied by the estimated annual visits by activity to estimate the annual economic benefit by activity (result not shown). The annual recreation benefit by activity was then discounted to the beginning of the 100-year benefit period. Summing the present value estimates across the various recreation activities provides the $578.1 million total discounted recreation benefit estimate for the proposed Black Rock reservoir.

Table 2-24. Black Rock reservoir visitation projection (growth rates: 5% first 10 years, 3% thereafter)

Year (Percent of Total =>)	Recreation Activities									Total Visits
	Boat Fishing	Shore Fishing	Swim	Picnic	Water Ski, Jet Ski	Walking, Hiking	Wildlife Viewing	Horse Riding	Off-Road Vehicle Riding	
	0.25	0.1	0.15	0.15	0.25	0.03	0.03	0.02	0.02	
1	62,500	25,000	37,500	37,500	62,500	7,500	7,500	5,000	5,000	250,000
2	65,630	26,250	39,380	39,380	65,630	7,880	7,880	5,250	5,250	262,530
3	68,910	27,560	41,350	41,350	68,910	8,270	8,270	5,510	5,510	275,640
4	72,360	28,940	43,420	43,420	72,360	8,680	8,680	5,790	5,790	289,440
5	75,980	30,390	45,590	45,590	75,980	9,110	9,110	6,080	6,080	303,910
6	100,000	40,000	60,000	60,000	100,000	12,000	12,000	8,000	8,000	400,000
7	105,000	42,000	63,000	63,000	105,000	12,600	12,600	8,400	8,400	420,000
8	110,250	44,100	66,150	66,150	110,250	13,230	13,230	8,820	8,820	441,000
9	115,760	46,310	69,460	69,460	115,760	13,890	13,890	9,260	9,260	463,050
10	121,550	48,630	72,930	72,930	121,550	14,580	14,580	9,720	9,720	486,190
11	125,200	50,090	75,120	75,120	125,200	15,020	15,020	10,010	10,010	500,790
12	128,960	51,590	77,370	77,370	128,960	15,470	15,470	10,310	10,310	515,810
13	132,830	53,140	79,690	79,690	132,830	15,930	15,930	10,620	10,620	531,280
14	136,810	54,730	82,080	82,080	136,810	16,410	16,410	10,940	10,940	547,210
15	140,910	56,370	84,540	84,540	140,910	16,900	16,900	11,270	11,270	563,610
16	145,140	58,060	87,080	87,080	145,140	17,410	17,410	11,610	11,610	580,540
17	149,490	59,800	89,690	89,690	149,490	17,930	17,930	11,960	11,960	597,940
18	153,970	61,590	92,380	92,380	153,970	18,470	18,470	12,320	12,320	615,870
19	158,590	63,440	95,150	95,150	158,590	19,020	19,020	12,690	12,690	634,340
20	163,350	65,340	98,000	98,000	163,350	19,590	19,590	13,070	13,070	653,360
21	168,250	67,300	100,940	100,940	168,250	20,180	20,180	13,460	13,460	672,960
22	173,300	69,320	103,970	103,970	173,300	20,790	20,790	13,860	13,860	693,160
23-100	175,000	70,000	105,000	105,000	175,000	21,000	21,000	14,000	14,000	700,000
Economic value per visit by activity (4/2007 $):	49.74	49.74	30.59	72.01	63.87	26.06	81.26	20.32	45.26	
Present value of 100-year stream of benefits (million $):	134.9	54.0	49.8	117.2	173.2	8.5	26.4	4.4	9.8	578.1

Wymer Dam and Reservoir Alternative

Table 2-25 presents the results of the visitation projection by recreation activity for the proposed Wymer Reservoir included within both the Wymer Dam and Reservoir and Wymer Dam Plus Yakima River Pump Exchange Alternatives. The visitation projection is constrained by the estimated carrying capacity of the reservoir (200,000 visits) in year 42, so years 42 through 100 are assumed to be at the 200,000-visit carrying capacity. The economic valuation results are presented at the end of Table 2-25. The economic values per visit by recreation activity, ranging from $26.06 for walking/hiking to $81.26 for wildlife viewing, are presented as well as the present value of the 100-year stream of recreation benefits for each activity. Summing the present value estimates across the various recreation activities provides the $97.7 million total discounted recreation benefit estimate for Wymer Reservoir.

Wymer Dam Plus Yakima River Pump Exchange Alternative

Table 2-25 presents the results of the visitation projection by recreation activity for the proposed Wymer reservoir included within both the Wymer Dam and Reservoir and Wymer Dam Plus Yakima River Pump Exchange Alternatives. The visitation projection is constrained by the estimated carrying capacity of the reservoir (200,000 visits) in year 42, so years 42 through 100 are assumed to be at the 200,000-visit carrying capacity. The economic valuation results are presented at the end of Table 2-25. The economic values per visit by recreation activity, ranging from $26.06 for walking/hiking to $81.26 for wildlife viewing, are presented as well as the present value of the 100-year stream of recreation benefits for each activity. Summing the present value estimates across the various recreation activities provides the $97.7 million total discounted recreation benefit estimate for Wymer Reservoir.

Table 2-25. Wymer reservoir visitation projections (growth rate: 3% annually over entire benefit period)

Year (Percent of Total =>)	Recreation Activities							Total Visits/ Value
	Canoe, Kayak, Small Sailboats	Boat Fishing	Shoreline Fishing	Swimming	Picnicking	Walking, Hiking	Wildlife Viewing	
	0.2	0.1	0.25	0.15	0.15	0.1	0.05	
1	8,000	4,000	10,000	6,000	6,000	4,000	2,000	40,000
2	8,240	4,120	10,300	6,180	6,180	4,120	2,060	41,200
3	8,490	4,240	10,610	6,370	6,370	4,240	2,120	42,440
4	8,740	4,370	10,930	6,560	6,560	4,370	2,180	43,710
5	9,000	4,500	11,260	6,760	6,760	4,500	2,250	45,030
6	14,000	7,000	17,500	10,500	10,500	7,000	3,500	70,000
7	14,420	7,210	18,030	10,820	10,820	7,210	3,610	72,120
8	14,850	7,430	18,570	11,140	11,140	7,430	3,720	74,280
9	15,300	7,650	19,130	11,470	11,470	7,650	3,830	76,500
10	15,760	7,880	19,700	11,810	11,810	7,880	3,940	78,780
11	16,230	8,120	20,290	12,160	12,160	8,120	4,060	81,140
12	16,720	8,360	20,900	12,520	12,520	8,360	4,180	83,560
13	17,220	8,610	21,530	12,900	12,900	8,610	4,310	86,080
14	17,740	8,870	22,180	13,290	13,290	8,870	4,440	88,680
15	18,270	9,140	22,850	13,690	13,690	9,140	4,570	91,350
16	18,820	9,410	23,540	14,100	14,100	9,410	4,710	94,090
17	19,380	9,690	24,250	14,520	14,520	9,690	4,850	96,900
18	19,960	9,980	24,980	14,960	14,960	9,980	5,000	99,820
19	20,560	10,280	25,730	15,410	15,410	10,280	5,150	102,820
20	21,180	10,590	26,500	15,870	15,870	10,590	5,300	105,900
21	21,820	10,910	27,300	16,350	16,350	10,910	5,460	109,100
22	22,470	11,240	28,120	16,840	16,840	11,240	5,620	112,370
23	23,140	11,580	28,960	17,350	17,350	11,580	5,790	115,750
24	23,830	11,930	29,830	17,870	17,870	11,930	5,960	119,220
25	24,540	12,290	30,720	18,410	18,410	12,290	6,140	122,800
26	25,280	12,660	31,640	18,960	18,960	12,660	6,320	126,480
27	26,040	13,040	32,590	19,530	19,530	13,040	6,510	130,280
28	26,820	13,430	33,570	20,120	20,120	13,430	6,710	134,200
29	27,620	13,830	34,580	20,720	20,720	13,830	6,910	138,210
30	28,450	14,240	35,620	21,340	21,340	14,240	7,120	142,350
31	29,300	14,670	36,690	21,980	21,980	14,670	7,330	146,620
32	30,180	15,110	37,790	22,640	22,640	15,110	7,550	151,020
33	31,090	15,560	38,920	23,320	23,320	15,560	7,780	155,550
34	32,020	16,030	40,090	24,020	24,020	16,030	8,010	160,220
35	32,980	16,510	41,290	24,740	24,740	16,510	8,250	165,020
36	33,970	17,010	42,530	25,480	25,480	17,010	8,500	169,980
37	34,990	17,520	43,810	26,240	26,240	17,520	8,760	175,080
38	36,040	18,050	45,120	27,030	27,030	18,050	9,020	180,340
39	37,120	18,590	46,470	27,840	27,840	18,590	9,290	185,740
40	38,230	19,150	47,860	28,680	28,680	19,150	9,570	191,320

Year (Percent of Total =>)	Recreation Activities							Total Visits/ Value
	Canoe, Kayak, Small Sailboats	Boat Fishing	Shoreline Fishing	Swimming	Picnicking	Walking, Hiking	Wildlife Viewing	
	0.2	0.1	0.25	0.15	0.15	0.1	0.05	
41	39,380	19,720	49,300	29,540	29,540	19,720	9,860	197,060
42-100	40,000	20,000	50,000	30,000	30,000	20,000	10,000	200,000
Economic value per visit by activity (4/2007 $):	31.21	49.74	49.74	30.59	72.01	26.06	81.26	
Present Value of 100 -year stream of benefits (million $):	13.3	10.6	26.6	9.8	23.1	5.6	8.7	97.7

2.3.3.2 Recreation Benefits at Existing Reservoirs and Rivers

This section analyzes the potential recreational effects of each alternative at existing reservoirs and river reaches within the Yakima River Basin. The following lakes and rivers were included in the analysis: Kachess Lake, Cle Elum Lake, Clear Lake, Bumping Lake, Rimrock Lake, Keechelus Lake, Lake Easton, Yakima River, Tieton River, Cle Elum River, Naches River, and Bumping River. Of these sites, only four showed differences in hydrologic measures (e.g., reservoir water levels and river flows) resulting in visitation impacts as compared to the No Action Alternative: Kachess Lake, Cle Elum Lake, Yakima River, and Tieton River. This section presents the results of the recreation visitation and economic valuation analysis for these four sites.

2.3.3.2.1 Methodology

As with the proposed reservoir recreation analysis, the existing site recreation economic methodology used estimates of recreation visitation as described and presented in the recreation section of the Draft PR/EIS. For the affected existing sites, changes in recreation visitation as compared to the No Action Alternative were estimated based on differences in the number of months in which reservoir water levels or river instream flows fell within acceptable ranges. The acceptable reservoir water levels and river instream flows were obtained from a recreation survey. The change in visitation estimates varied with the water year type – average, dry, and wet. To calculate an average annual change in visitation estimate, the changes in visitation by water year type were multiplied by the probability of occurrence of each water year type (i.e., 50 percent for average year and 25 percent each for dry and wet years). Since the changes in visitation were not estimated by recreation activity, the general assumption was made that the

changes in visitation would follow the current distribution of recreation by activity seen at each impacted site.

Instead of estimating the change in visitation for each site by recreation activity as was done for the proposed reservoir analysis, a weighted average economic value for each site was developed by multiplying the percent of visitation by primary recreation activity at each site (as obtained from the recreation survey) by the April 2007 indexed economic values per visit by recreation activity (as obtained from the Kaval and Loomis, 2003 study). As shown in Table 2-26, the weighted average values per visit at each site were estimated as follows: Kachess Lake, $90.28; Cle Elum Lake, $69.00; Yakima River, $53.93; and Tieton River, $31.21. The annual change in recreation economic value by site and alternative was assumed to occur each year over the 100-year study period. This 100-year stream of annual recreation economic values were then discounted to a present value estimate. These annual values were not projected to increase over the 100-year study period since no carrying capacity estimate was available to constrain the growth in visitation. As a result, the discounted present value may be an underestimate. Accounting for the potential growth in the change in visitation as compared to the No Action Alternative over time is an issue which may need to be addressed in subsequent analyses.

2.3.3.2.2 Existing Reservoir and River Results

Black Rock Alternative

As shown in Table 2-27, positive recreation effects are expected at Kachess Lake, Cle Elum Lake, and the Yakima River with the Black Rock Alternative. Negative effects were estimated for the Tieton River with this alternative. The combined annual change in value across all four existing sites approached $1.2 million, which converts to a discounted present value of $24.3 million. Note that these estimates may be understated, since the visitation estimates could not be projected over time due to lack of carrying-capacity information.

Wymer Dam and Reservoir Alternative

As shown in Table 2-28, positive recreation effects are expected at Cle Elum Lake and the Yakima River with the Wymer Dam and Reservoir Alternative. No impacts were estimated at Kachess Lake and the Tieton River with this alternative. The combined change in value across all four existing sites was estimated at $246,200 annually, which converts to a discounted present value of $5.0 million. Note that these estimates may be understated, since the visitation estimates could not be projected over time due to lack of carrying-capacity information.

Table 2-26. Percentage of survey respondents by primary recreation activity

Source of Values: Kaval, P. and J. Loomis. 10/2003. "Updated Outdoor Recreation Use Values with Emphasis on National Park Recreation." Dept. fo Ag. & Resource Economics, CSU, Ft Collins, report to NPS under Cooperative Agreement # CA 1200-99-009, project # IMDE-02-0070. Used Pacific Coast values except for horseback riding (multiple area studies) and waterskiing (intermountain).

CPI Value (1996): 157.6
CPI Value (April 2007): 212.036
CPI Indexing Value: 1.345406091

					Kachess Lake			Cle Elum Lake			Tieton River			Yakima River		
Primary recreation activity	Kaval & Loomis Activity	Kaval & Loomis Region	Original Value per Day (1996)	Indexed Value per Day (4/2007)	Original % (Sum > 100%)	Reweighted %s (Sum = 100%)	Weighted Average Value per Day (4/2007 $)	Original % (Sum > 100%)	Reweighted %s (Sum = 100%)	Weighted Average Value per Day (4/2007 $)	Original % (Sum > 100%)	Reweighted %s (Sum = 100%)	Weighted Average Value per Day (4/2007 $)	Original % (Sum > 100%)	Reweighted %s (Sum = 100%)	Weighted Average Value per Day (4/2007 $)
Motorboating	Motorboating	Pacific	22.45	30.20	0.060	0.055	1.65	0.110	0.082	2.48	0.000	0.000	0.00	0.010	0.008	**0.25**
Boat fishing (guided)	Fishing	Pacific	36.97	49.74	0.000	0.000	0.00	0.020	0.015	0.74	0.010	0.008	0.41	0.010	0.008	**0.41**
Boat fishing (private)	Fishing	Pacific	36.97	49.74	0.040	0.036	1.81	0.090	0.067	3.34	0.010	0.008	0.41	0.110	0.092	**4.56**
Bank/Shoreline fishing	Fishing	Pacific	36.97	49.74	0.010	0.009	0.45	0.020	0.015	0.74	0.030	0.025	1.22	0.060	0.050	**2.49**
Kayaking/Canoeing	Floatboating/Rafting /Canoeing	Pacific	23.2	31.21	0.100	0.091	2.84	0.010	0.007	0.23	0.180	0.148	4.61	0.070	0.058	**1.82**
Hunting	Hunting	Pacific	37.91	51.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.010	0.008	**0.43**
Sailing	Motorboating	Pacific	22.45	30.20	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	**0.00**
Water-skiing	Waterskiing	Intermountain	47.47	63.87	0.040	0.036	2.32	0.070	0.052	3.34	0.000	0.000	0.00	0.000	0.000	**0.00**
PWC (Jet skiing)	Motorboating	Pacific	22.45	30.20	0.000	0.000	0.00	0.090	0.067	2.03	0.000	0.000	0.00	0.050	0.042	**1.26**
Swimming	Swimming	Pacific	22.74	30.59	0.060	0.055	1.67	0.200	0.149	4.57	0.010	0.008	0.25	0.030	0.025	**0.76**
Camping	Camping	Pacific	86.96	117.00	0.730	0.664	77.64	0.520	0.388	45.40	0.320	0.262	30.69	0.210	0.175	**20.47**
Sightseeing	Sightseeing	Pacific	16.89	22.72	0.040	0.036	0.83	0.130	0.097	2.20	0.070	0.057	1.30	0.020	0.017	**0.38**
Wildlife viewing	Wildlife viewing	Pacific	60.4	81.26	0.010	0.009	0.74	0.030	0.022	1.82	0.000	0.000	0.00	0.010	0.008	**0.68**
Nature study	Wildlife viewing	Pacific	60.4	81.26	0.000	0.000	0.00	0.010	0.007	0.61	0.010	0.008	0.67	0.010	0.008	**0.68**
Picnicking	Picnicking	Pacific	53.52	72.01	0.000	0.000	0.00	0.020	0.015	1.07	0.040	0.033	2.36	0.090	0.075	**5.40**
Rafting (guided)	Floatboating/Rafting /Canoeing	Pacific	23.2	31.21	0.000	0.000	0.00	0.000	0.000	0.00	0.120	0.098	3.07	0.000	0.000	**0.00**
Rafting (private)	Floatboating/Rafting /Canoeing	Pacific	23.2	31.21	0.000	0.000	0.00	0.000	0.000	0.00	0.300	0.246	7.68	0.330	0.275	**8.58**
Wade fishing	Fishing	Pacific	36.97	49.74	0.000	0.000	0.00	0.000	0.000	0.00	0.050	0.041	2.04	0.070	0.058	**2.90**
Trail use	Hiking	Pacific	19.37	26.06	0.000	0.000	0.00	0.010	0.007	0.19	0.020	0.016	0.43	0.010	0.008	**0.22**
Tubing	Floatboating/Rafting /Canoeing	Pacific	23.2	31.21	0.000	0.000	0.00	0.000	0.000	0.00	0.010	0.008	0.26	0.070	0.058	**1.82**
Wading	Swimming	Pacific	22.74	30.59	0.000	0.000	0.00	0.010	0.007	0.23	0.020	0.016	0.50	0.020	0.017	**0.51**
Other	General Recreation	Pacific	26.96	36.27	0.010	0.009	0.33	0.000	0.000	0.00	0.020	0.016	0.59	0.010	0.008	**0.30**
Total:					1.100	1.000	90.28	1.340	1.000	69.00	1.220	1.000	56.48	1.200	1.000	53.93

Table 2-27. Changes in in recreation visitation and value at existing sites for Black Rock Alternative

Site	Water year type	Change in recreation days compared to No Action Alternative *							Probability	Change in days (expected value)	Apr-07 weighted average value per day**	Average annual change in value***	Present value of 100-year benefit stream (million $)
		May	Jun	Jul	Aug	Sep	Oct	Total					
Kachess Lake	Wet							0	0.25	0			
	Dry		8,610	8,610				17,220	0.25	4,305			
	Average				8,610			8,610	0.5	4,305			
									Total:	8,640	90.28	777,269	15.8
Cle Elum Lake	Wet		2,736		2,736			5,472	0.25	1,368			
	Dry							0	0.25	0			
	Average							0	0.5	0			
									Total:	1,368	69.00	94,390	1.9
Yakima River	Wet			3,630	1,815		1,815	7,260	0.25	1,815			
	Dry	-667		3,630	1,815			4,778	0.25	1,195			
	Average			3,630	1,815		1,815	7,260	0.5	3,630			
									Total:	6,640	53.93	358,063	7.3
Tieton River	Wet						-2,250	-2,250	0.25	-563			
	Dry							0	0.25	0			
	Average					-1,125		-1,125	0.5	-563			
									Total:	-1,126	31.21	-35,146	-.7
Combined Total:												1,194,576	24.3

Notes:

* From recreation analysis presented in Chapter 4.

** Weighted value per visit based on current visitation by recreation activity percentages (as obtained from the recreation survey) combined with values per visit by activity (from Kaval and Loomis (2003)).

*** Does not take into account projected population growth over the 100-year study period.

Table 2-28. Changes in recreation visitation and value at existing sites for Wymer Dam and Reservoir Alternative

Site	Water year type	Change in recreation days compared to No Action Alternative *							Probability	Change in days (expected value)	Apr-07 weighted average value per day**	Average annual change in value***	Present value of 100-year benefit stream (million $)
		May	Jun	Jul	Aug	Sep	Oct	Total					
Kachess Lake		None											
Cle Elum Lake	Wet				2,736			2,736	0.25	684			
	Dry		-1,231					-1,231	0.25	-308			
	Average							0	0.5	0			
									Total:	376	69.00	25,943	.5
Yakima River	Wet			1,815	908		908	3,631	0.25	908			
	Dry			3,630	1,815			5,445	0.25	1,361			
	Average			1,815	908		908	3,631	0.5	1,816			
									Total:	4,085	53.93	220,284	4.5
Tieton River		None	0									0	0
Combined Total:												246,227	5.0

Wymer Dam Plus Yakima River Pump Exchange Alternative

As shown in Table 2-29, positive recreation effects are expected at Kachess Lake, Cle Elum Lake, and the Yakima River with the Wymer Dam Plus Yakima River Pump Exchange Alternative. No impacts were identified for the Tieton River with this alternative. The combined change in value across all four existing sites exceeds $655,000 annually, which converts to a discounted present value of $13.3 million. Again, note that these estimates may be understated, since the visitation estimates could not be projected over time due to lack of carrying-capacity information.

2.3.3.3 Combined Recreation Results

This section combines the present value of the 100-year recreational benefit estimate stream at both the proposed reservoirs and the existing reservoir and river sites for each alternative.

On the one hand, this analysis fails to take into consideration population growth within the existing reservoir and river analysis (understates benefits), but on the other hand, the analysis does not take into account possible substitution from other recreation sites outside the region (overstates benefits). It is not possible to suggest whether the combined results are likely to be under-or overstated.

2.3.3.3.1 Black Rock Alternative

The combined recreational benefit stream for both the proposed reservoirs and the existing reservoir and river sites results in a total present value of $602.4 million ($29.6 million average annual equivalent) for the Black Rock Alternative.

2.3.3.3.2 Wymer Dam and Reservoir Alternative

The combined recreational benefit stream for both the proposed reservoirs and the existing reservoir and river sites results in a total present value of $102.7 million ($5.1 million average annual equivalent) for the Wymer Dam and Reservoir Alternative.

2.3.3.3.3 Wymer Dam Plus Yakima River Pump Exchange Alternative

The combined recreational benefit stream for both the proposed reservoirs and the existing reservoir and river sites results in a total present value of $111.1 million ($5.5 million average annual equivalent) for the Wymer Dam Plus Yakima River Pump Exchange Alternative.

Table 2-29. Changes in recreation visitation and value at existing sites for Wymer Dam Plus Yakima River Pump Exchange Alternative

Site	Water year type	Change in recreation days compared to No Action Alternative *							Probability	Change in days (expected value)	Apr-07 weighted average value per day**	Average annual change in value***	Present value of 100-year benefit stream (million $)
		May	Jun	Jul	Aug	Sep	Oct	Total					
Kachess Lake	Wet							0	0.25	0			
	Dry		8,610	8,610				17,220	0.25	4,305			
	Average							0	0.5	0			
									Total:	4,305	90.28	388,635	7.9
Cle Elum Lake	Wet				2,736			2,736	0.25	684			
	Dry							0	0.25	0			
	Average							0	0.5	0			
									Total:	684	69.00	47,195	1.0
Yakima River	Wet			1,815	908		908	3,631	0.25	908			
	Dry			3,630	1,815			5,445	0.25	1,361			
	Average			1,815	908		908	3,631	0.5	1,816			
									Total:	4,085	53.93	220,284	4.5
Tieton River		None						0				0	0
Combined Total:												656,114	13.3

2.3.4 Hydropower Benefits

The Black Rock Alternative includes the construction of two new hydropower facilities—a Black Rock powerplant and a Sunnyside powerplant. Since both the Wymer Dam and Reservoir Alternative and the Wymer Dam Plus Yakima River Pump Exchange Alternative have no hydropower generation component, the Black Rock Alternative is the only alternative which provides hydropower benefits. In addition, by pumping water up to the proposed Black Rock reservoir from the Columbia River at Priest Rapid Dam, a certain amount of hydropower generation is forgone at Priest Rapids Dam and other hydropower facilities both upstream and downstream. Some of the diverted water at Priest Rapids Dam is replaced by increased flows downstream at the mouth of the Yakima River as a result of decreased irrigation diversions. This water replacement does not occur instantaneously, but is accomplished on an annual basis.

2.3.4.1 Methodology

Average annual power generation at the Black Rock and Sunnyside powerplants was estimated at 71,671.1 and 125,080.0 megawatt hours (MWh) respectively. These annual generation estimates were distributed by month based on monthly water delivery percentages and the resultant monthly generation is multiplied by average monthly energy values to estimate total annual hydropower value. The average monthly energy values, as used by Bonneville Power Administration (BPA), were obtained from the *Black Rock Appraisal Assessment*. The average annual hydropower values were discounted to a present value as of the start of the benefits period based on the assumption that they would occur each year over the 100-year study period.

In addition, annual lost (foregone) hydropower benefits result from pumping water out of the Columbia River at Priest Rapids Dam to the new Black Rock reservoir. The water that is pumped to Black Rock reservoir is no longer available to generate hydropower at Priest Rapids Dam and at downstream Columbia River hydropower facilities. Losses in hydropower generation were also estimated at facilities upstream of Priest Rapids Dam due to adjustments in the operation of the overall Columbia River power system. While there are both positive and negative generation effects, the *Black Rock Appraisal Assessment* estimated the net result as a loss in annual hydropower benefits of $4 million. To calculate a present value, the annual costs were assumed to occur each year of the 100-year study period. This loss in hydropower benefits was deducted from the additional hydropower benefits generated at the Black Rock and Sunnyside powerplants to estimate a net hydropower benefit.

2.3.4.2 Results

2.3.4.2.1 Black Rock Alternative

As presented in table Table 2-30, the hydropower generation at both the Black Rock and Sunnyside powerplants was expected to average approximately 196,751.1 MWh annually, with a combined monthly generation ranging from a low of about 14,508.0 MWh in October to a high of 35,637.6 MWh in July and August. Total generation was valued at about $7.1 million annually. The present value of the 100-year stream of annual hydropower benefits was estimated at $143.9 million. The lost hydropower generation at Priest Rapids and other upstream and downstream dams was estimated at $4 million annually, or $81.3 million in present value over the 100-year study period. Combining the gains and losses in hydropower value results in a net positive hydropower benefit of approximately $3.1 million annually, or $62.5 million in present value. Note that this combined hydropower benefit accrues only to the Black Rock Alternative.

2.3.4.2.2 Wymer Dam and Reservoir Alternative

The Wymer Dam and Reservoir Alternative has no hydropower generation effects.

2.3.4.2.3 Wymer Dam Plus Yakima River Pump Exchange Alternative

The Wymer Dam Plus Yakima River Pump Exchange Alternative has no hydropower generation effects.

Table 2-30. Hydropower benefits for the Black Rock Alternative

Powerplant	Month	Monthly Generation (MWh)	Average Energy Value per Month ($/MWh)	Total Annual Value (thousand $)	Present Value of 100 Year Benefit Stream (thousand $)
Black Rock	April	7,820.0	$37.60	294.0	
	May	10,742.5	$31.92	342.9	
	June	12,144.0	$22.68	275.4	
	July	13,689.6	$32.24	441.4	
	August	13,689.6	$40.69	557.0	
	September	8,832.0	$43.64	385.4	
	October	4,753.3	$55.56	264.1	
	Totals:	71,671.1		2,560.2	52,063.0
Sunnyside	April	11,800.0	$37.60	443.7	
	May	19,509.3	$31.92	622.7	
	June	21,240.0	$22.68	481.7	
	July	21,240.0	$32.24	707.6	
	August	21,240.0	$40.69	893.1	
	September	18,880.0	$43.64	823.9	
	October	9,754.7	$55.56	542.0	
	Totals:	125,080.0		4,514.7	91,822.0
Black Rock and Sunnyside total	April	19,620.0		737.7	
	May	30,251.9		965.6	
	June	33,384.0		757.1	
	July	35,637.6		1,149.0	
	August	35,637.6		1,450.1	
	September	27,712.0		1,209.4	
	October	14,508.0		806.1	
		196,751.1	Total:	7,075.0	143,885.0
Value of lost generation at Priest Rapids and other Columbia River Dams:				-4,000.0	-81,348.4
Net hydropower benefit:				3,075.0	62,536.6

2.3.5 Fish Benefits:

This section presents the results of the anadromous fisheries benefits analysis for salmon (i.e., spring Chinook, fall Chinook, Coho) and steelhead.

The anadromous fisheries analysis focuses primarily on use values. Use values refer to values individuals obtain by using the fishery resource. In the case of anadromous fisheries, use values accrue to individuals that use/consume the fish (e.g., commercial, sport, or tribal fishermen) and are typically based on the quantity of fish actually used (e.g., harvested/caught).

It should be noted that consideration was also given to the estimation of nonuse values. Nonuse values reflect values individuals hold for a resource even if they will never actually use it (e.g., threatened and endangered species). Since Yakima River steelhead are a federally listed (threatened) species, and they were expected to be impacted by the alternatives under consideration, it was speculated the

nonuse values may be applicable to this study. As will be discussed in section 2.3.5.2 below, for various reasons mostly related to measurement, nonuse values were not included within the benefit-cost analysis.

2.3.5.1 Fishery Use Values:

The fisheries benefits discussed below refer to the harvest use values generated by the proposed Yakima Storage Study alternatives. The use value analysis represents the traditional commercial and recreational fisheries analysis found in many Reclamation BCAs, with the added dimension of attempting to value tribal subsistence harvest.

2.3.5.1.1 Methodology:

For this analysis, fish harvests were valued for the following harvest categories: Pacific Ocean commercial, Pacific Ocean sport, Lower Columbia River zones 1-5 non-Indian commercial, Lower Columbia River zones 1-5 sport, Columbia River zone 6 Tribal commercial, Columbia River zone 6 Tribal ceremonial and subsistence, Yakima River sport, and Yakima River Tribal ceremonial and subsistence. These harvest categories reflect the migratory path and therefore the harvest range of Yakima River salmon. Note that the harvest category "tribal ceremonial and subsistence," found in the Columbia River zone 6 area and the Yakima River includes ceremonial harvest which is typically not included in BCAs, since attempting to economically value ceremonial harvest would be akin to valuing tribal spiritual beliefs. Since study team biologists had no information for separating subsistence harvest from ceremonial harvest, the decision was made to value the total ceremonial and subsistence harvest using the subsistence harvest value under the assumption that the ceremonial harvest is likely to be a fairly minor portion of the total. As a result, assuming the values per fish are reasonably accurate, total fishery use value benefits representing commercial, sport, and subsistence harvests may be overstated to some extent by the inclusion of ceremonial harvest.

Economic values per fish by species (e.g., Coho salmon, spring Chinook salmon, fall Chinook salmon[1]) and harvest category (listed above), as summarized below in Table 2-31, were obtained from a detailed analysis of existing economic fishery use values as described in Appendix A. These values are measured in April 2007 dollars to be consistent with the cost estimates. The following briefly summarizes the basis for the values:

[1] Note that study team biologists also evaluated impacts to Yakima River steelhead populations, but given their federally listed (threatened) status, the assumption was made that harvest of those species would be precluded.

- commercial values are based on estimates of profitability per fish as obtained from the most recent 5 years of catch and price data,
- sport values were obtained from an extensive literature search, and
- subsistence values were based on the market price per fish under the assumption that subsistence harvest could have been sold in the marketplace.

Table 2-31. Economics values per fish by species and harvest category

Harvest Category	Coho Salmon	Spring Chinook Salmon	Fall Chinook Salmon
Ocean Commercial	8.07	25.57	25.57
Ocean Sport	118.54	101.49	101.49
Lower Columbia River (zones 1-5) Commercial	5.82	45.53	14.56
Lower Columbia River (zones 1-5) Sport	304.02	304.02	304.02
Columbia River (zone 6) Tribal Commercial	3.11	22.56	8.78
Columbia River (zone 6) Tribal Ceremonial & Subsistence	3.89	28.2	10.97
Yakima River Sport	368.00	461.52	368.00
Yakima River Ceremonial & Subsistence	3.89	28.20	10.97

While the subsistence value is considered a lower bound, the decision was made to value the harvest using a defendable lower bound rather than ignore valuing subsistence harvest altogether. As with other Columbia River Basin studies (e.g., U.S. Army Corps of Engineers, 2002), the per-fish salmon sport fishing values proved significantly higher than the other per fish values. This is due to the fact that these sport fishing values are related to the per-trip values. The very low catch rates per trip (less than one) imply a single fish equates to the sport fishing value of several trips combined, hence the large value per sport-caught fish.

Harvest estimates by fish species, type of harvest, and alternative were obtained from study team biologists. Estimates of total harvest were developed by applying harvest rates by species to annual estimates of returning adults by species (i.e., catch to escapement ratios). Total harvest was then allocated across the various harvest categories (see

Table 2-32). The harvest rates, as provided by Yakama Nation biologists, reflect current fishery management compacts and Environmental Species Act (ESA) restrictions for salmon and steelhead returning to the Yakima basin.

Table 2-32. Percentages used to allocate total harvest by species across the various harvest categories (data from AHA model)

	Ocean		Lower Columbia River (Zones 1-5)		Columbia River (Zone 6)		Yakima River	
Species	**Commercial**	**Sport**	**Commercial**	**Sport**	**Commercial**	**Ceremonial & Subsistence**	**Sport**	**Ceremonial & Subsistence**
spring Chinook	0.0408	0.0000	0.0507	0.1164	0.0673	0.2692	0.0867	0.3698
fall Chinook	0.0265	0.0265	0.0805	0.0805	0.5330	0.0281	0.2250	0.0000
coho	0.2411	0.3617	0.1025	0.1537	0.1051	0.0055	0.0305	0.0000

The All H Analyzer (AHA) model was used to calculate the annual number of returning adults for the 100-year study period for spring Chinook, fall Chinook, coho and steelhead, which accounts for fish produced both by the natural environment and those and released from Yakima basin hatcheries. The AHA model was developed by Washington State fishery managers as a tool to facilitate analysis of anadromous salmonid recovery strategies in the Pacific Northwest. The "H" stands for Habitat, Hatcheries, Harvest, and the Hydroelectric system (of the Columbia River). The model allows the user to better understand the relationship between the 4-Hs towards developing viable salmon recovery and enhancement strategies. A more comprehensive discussion of the AHA model can be found on the U.S. Fish & Wildlife Service website (http://www.fws.gov/pacific/fisheries/Hatcheryreview/documents/AllHAnalyzerDraftUsersGuideAug05.pdf.)

Changes in harvest by species were calculated for each of the action alternatives (i.e., Black Rock, Wymer, and Wymer Plus) by subtracting No Action Alternative harvest levels from action alternative harvest levels. Population and harvest estimates were developed on an annual basis for each year of the 100-year study period. Table 2-33 presents summary information on the range (i.e., average, high, and low) of annual incremental total harvest by species and alternative across the 100-year study period. For example, for the Black Rock Alternative, the average annual increase in total spring Chinook harvest over the No Action Alternative was estimated at 580 fish, with a range from 294 to 1,926 fish. These annual estimates of total additional harvest by alternative and fish species were then allocated across the eight harvest categories.

Table 2-33. Annual Increment in Fish Harvest as compared to No Action Alternative

Alternative	Spring Chinook	Fall Chinook	Coho
Black Rock			
Average:	580	2,580	623
High:	1,926	9,121	1,875
Low:	294	1,251	304
Wymer Dam and Reservoir			
Average:	33	133	41
High:	106	460	123
Low:	17	66	19
Wymer Dam Plus Yakima River Pump Exchange			
Average:	379	1,479	323
High:	1,273	5,519	947
Low:	191	682	150

The economic values per fish by harvest category listed above in Table 2-33 were applied to the annual estimates of harvest change by species, harvest category, and alternative to obtain annual values by species and alternative. The annual values were then discounted to a present value as of the start of the benefit period. Finally, the discounted values by species, type of harvest, and alternative were aggregated to estimate the total fisheries use value by alternative.

2.3.5.1.2 Results

Black Rock Alternative

Table 2-34 and Table 2-37 present the results of the fisheries use value analysis for the Black Rock Alternative. Table 2-34 presents the 100-year projection of fish harvest by species for both the No Action and Black Rock Alternatives as provided by study team biologists. The Black Rock and No Action fish projections are used to calculate the change in annual harvest by fish species. Note that the projection does not show a gradual increase in fish harvest over the study period. This is in part because the fish population and harvest models include an ocean productivity component which occurs cyclically. Table 2-34 also shows the total discounted value for each year of the study period. The values presented in Table 2-37 reflect the present value of the 100-year stream of fishery use values by alternative, fish species, and harvest category. The total present value by species in Table 2-37 agrees with the sum of the annual present values for each species listed towards the bottom of Table 2-34. Table 2-37 shows the detail of present values by harvest category which is not included in Table 2-34. The total present value for the Black Rock Alternative was estimated at $8.7 million. Over 90 percent of that additional fishery use value as compared

to the No Action Alternative stemmed from the ocean, lower Columbia River (zones 1-5), and Yakima River sport fisheries.

Wymer Dam and Reservoir Alternative
As shown in Table 2-35 and Table 2-37, the total present value of the 100-year stream of fishery use values for the Wymer Dam and Reservoir Alternative was estimated at $471.6 thousand.

Wymer Dam Plus Yakima River Pump Exchange Alternative
As shown in Table 2-36 and Table 2-37, the total present value of the 100-year stream of fishery use values for the Wymer Dam Plus Yakima River Pump Exchange Alternative was estimated at $5.1 million. As with the Black Rock Alternative, over 90 percent of that additional fishery use value stemmed from the ocean, lower Columbia River (zones 1-5), and Yakima River sport fisheries.

2.3.5.2 Fish Nonuse Values:

The purpose of this section is to discuss nonuse values within the context of the benefit-cost and cost allocation analyses associated with the Yakima Storage Study.

2.3.5.2.1 Nonuse Values and the Reclamation Planning Process

Nonuse values, otherwise referred to as passive use, intrinsic, existence, or preservation values, reflect an individual's willingness to pay (WTP) for simply knowing a resource exists even if that individual never intends to use the resource. Aggregating across individuals (or in most cases households) provides an estimate of societal nonuse value. For example, the harvest of threatened and endangered (T&E) species may be prohibited and yet households nationwide may still be willing to pay to ensure the continued existence of the species. The economics literature indicates that nonuse values may be greatest when the resource is scarce or unique, when the magnitude of the resource change is relatively large, when the resource is of national significance, and when adverse impacts are likely to be irreversible or of long duration. Therefore, a permanent injury to a unique resource of national significance may generate substantial adverse nonuse value impacts (costs), even for those residing far from the site. Conversely, large improvements to a scarce resource of national significance would likely result in significant positive nonuse values (benefits). This is not to imply that less scarce/unique resources, or resources of regional but not national significance, do not generate any nonuse values. Less scarce/unique or regional resources may still provide nonuse values, but likely to a lesser extent than scarce/unique resources of national significance. This is because less scarce/unique resources tend to have lower per household nonuse values and the aggregation is made over a smaller number of households.

Table 2-34. Annual harvest and total economic value by species for the Black Rock Alternative

Fish Species:	Spring Chinook				Fall Chinook				Coho			
Alternative:	No Action	Black Rock			No Action	Black Rock			No Action	Black Rock		
Year	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value
1	2,677	3,299	622	58,322	6,312	10,005	3,693	411,298	3,426	4,089	663	65,526
2	1,273	1,567	294	26,262	2,992	4,767	1,775	188,478	1,657	1,969	313	29,472
3	1,564	1,921	357	30,414	3,409	5,568	2,158	218,540	2,113	2,589	476	42,802
4	1,623	1,998	375	30,505	3,520	5,795	2,275	219,642	2,184	2,665	480	41,193
5	1,415	1,746	330	25,602	3,040	5,024	1,984	182,658	1,904	2,310	406	33,217
6	1,365	1,685	320	23,642	2,847	4,734	1,887	165,637	1,829	2,250	421	32,815
7	1,478	1,826	348	24,513	3,006	5,023	2,017	168,857	1,969	2,446	477	35,483
8	1,331	1,647	316	21,243	2,672	4,476	1,803	143,928	1,763	2,181	418	29,625
9	3,050	3,777	727	46,542	5,949	9,993	4,044	307,784	4,015	5,039	1,025	69,246
10	6,702	8,341	1,639	100,080	14,013	23,134	9,121	661,889	8,646	10,312	1,666	107,314
11	3,451	4,275	824	47,982	7,643	12,132	4,489	310,586	4,143	4,950	807	49,563
12	1,564	1,932	368	20,449	3,255	5,236	1,981	130,723	1,909	2,272	363	21,253
13	1,725	2,132	406	21,505	3,256	5,374	2,117	133,200	2,240	2,672	432	24,110
14	1,641	2,030	389	19,661	3,019	5,032	2,013	120,758	2,118	2,552	433	23,088
15	1,777	2,201	424	20,404	3,185	5,338	2,152	123,099	2,310	2,785	475	24,118
16	1,707	2,116	410	18,802	3,020	5,074	2,054	112,024	2,222	2,659	436	21,128
17	1,283	1,593	309	13,531	2,225	3,743	1,518	78,933	1,670	2,004	335	15,456
18	1,443	1,789	346	14,458	2,399	4,030	1,631	80,885	1,863	2,316	453	19,959
19	2,510	3,116	607	24,138	4,122	6,932	2,810	132,862	3,227	4,016	790	33,155
20	5,680	7,070	1,390	52,728	9,816	16,327	6,511	293,548	7,252	8,642	1,390	55,630
21	2,815	3,491	676	24,446	5,383	8,579	3,196	137,374	3,352	4,006	655	24,987
22	1,560	1,932	372	12,820	2,806	4,484	1,678	68,784	1,907	2,268	361	13,141
23	1,379	1,708	329	10,822	2,294	3,700	1,406	54,952	1,757	2,115	359	12,448
24	1,662	2,060	398	12,479	2,676	4,317	1,641	61,152	2,100	2,606	506	16,743
25	2,121	2,633	512	15,315	3,444	5,566	2,122	75,420	2,696	3,300	604	19,065
26	1,714	2,131	417	11,878	2,862	4,633	1,770	59,975	2,192	2,606	414	12,452
27	1,522	1,892	370	10,053	2,505	4,051	1,546	49,942	1,949	2,343	394	11,289
28	1,308	1,626	318	8,237	2,119	3,423	1,304	40,183	1,671	2,042	371	10,147
29	3,001	3,729	728	18,004	4,785	7,715	2,929	86,045	3,806	4,742	936	24,407
30	6,956	8,660	1,704	40,172	12,031	19,407	7,375	206,569	8,656	10,338	1,683	41,846
31	2,845	3,523	677	15,225	5,498	8,598	3,100	82,797	3,316	3,970	654	15,514
32	1,631	2,019	388	8,311	2,920	4,631	1,711	43,567	1,971	2,346	375	8,481
33	1,428	1,769	341	6,973	2,362	3,792	1,430	34,711	1,802	2,163	361	7,792
34	1,460	1,810	351	6,831	2,335	3,763	1,427	33,047	1,828	2,270	443	9,100
35	1,734	2,153	419	7,785	2,760	4,453	1,693	37,380	2,179	2,715	536	10,498
36	1,736	2,158	422	7,483	2,806	4,538	1,732	36,467	2,175	2,679	504	9,420
37	1,582	1,968	386	6,525	2,571	4,160	1,589	31,902	1,993	2,435	442	7,879
38	1,623	2,020	397	6,390	2,619	4,235	1,615	30,918	2,045	2,518	474	8,048
39	3,020	3,759	740	11,358	4,873	7,880	3,007	54,877	3,808	4,682	873	14,152
40	7,560	9,413	1,853	27,137	13,051	21,047	7,997	139,147	9,318	11,125	1,807	27,913
41	3,757	4,648	891	12,447	7,275	11,348	4,073	67,577	4,339	5,199	860	12,674
42	1,911	2,363	452	6,017	3,511	5,528	2,017	31,911	2,255	2,692	437	6,135
43	1,856	2,299	443	5,619	3,126	5,003	1,876	28,305	2,319	2,749	430	5,763
44	2,036	2,525	489	5,918	3,334	5,374	2,040	29,344	2,561	3,058	497	6,348
45	2,006	2,490	484	5,588	3,294	5,325	2,032	27,863	2,530	3,004	474	5,769
46	1,370	1,702	332	3,650	2,250	3,641	1,391	18,190	1,731	2,055	323	3,754
47	1,584	1,967	383	4,020	2,515	4,061	1,546	19,280	1,995	2,467	472	5,227
48	1,860	2,312	453	4,529	2,964	4,792	1,828	21,735	2,342	2,883	541	5,712
49	2,571	3,200	629	6,000	4,171	6,755	2,584	29,293	3,235	3,926	691	6,959
50	6,019	7,491	1,473	13,397	10,167	16,440	6,272	67,808	7,477	8,912	1,434	13,767
51	3,564	4,415	851	7,385	6,702	10,555	3,853	39,721	4,155	4,976	821	7,517
52	1,954	2,418	464	3,838	3,537	5,597	2,060	20,249	2,313	2,761	448	3,911
53	2,163	2,681	517	4,079	3,629	5,818	2,189	20,517	2,695	3,197	502	4,181
54	1,296	1,608	312	2,343	2,150	3,466	1,317	11,768	1,615	1,919	304	2,409
55	1,342	1,665	323	2,314	2,122	3,420	1,298	11,064	1,682	2,089	408	3,084
56	1,376	1,709	333	2,277	2,156	3,476	1,320	10,728	1,718	2,129	411	2,964
57	1,719	2,137	418	2,726	2,700	4,355	1,655	12,825	2,129	2,697	568	3,907
58	1,698	2,115	417	2,590	2,728	4,412	1,685	12,446	2,107	2,627	520	3,409
59	3,383	4,216	832	4,934	5,464	8,844	3,380	23,804	4,202	5,217	1,015	6,347
60	7,845	9,771	1,926	10,886	13,698	22,043	8,345	56,047	9,553	11,427	1,875	11,179
61	2,728	3,374	646	3,484	5,290	8,235	2,945	18,862	3,132	3,756	624	3,548
62	2,347	2,905	558	2,868	4,152	6,584	2,432	14,851	2,820	3,359	539	2,922
63	2,037	2,524	487	2,386	3,454	5,537	2,083	12,130	2,498	2,970	473	2,443
64	1,939	2,405	466	2,176	3,202	5,162	1,960	10,884	2,421	2,875	454	2,236
65	1,820	2,259	439	1,956	2,970	4,802	1,832	9,697	2,295	2,723	428	2,014
66	1,447	1,798	350	1,488	2,342	3,790	1,448	7,308	1,833	2,185	351	1,575
67	1,291	1,604	313	1,267	2,044	3,304	1,259	6,061	1,621	2,000	378	1,617
68	1,866	2,319	453	1,750	2,919	4,706	1,787	8,202	2,337	2,902	565	2,302
69	3,060	3,810	750	2,763	4,934	7,989	3,054	13,366	3,829	4,687	858	3,335
70	5,299	6,597	1,298	4,559	9,122	14,711	5,589	23,322	6,492	7,756	1,264	4,683
71	3,131	3,880	750	2,511	5,818	9,188	3,371	13,410	3,660	4,383	723	2,553
72	1,826	2,261	435	1,390	3,243	5,155	1,912	7,255	2,179	2,599	420	1,416
73	1,721	2,134	413	1,256	2,847	4,575	1,728	6,249	2,160	2,561	401	1,289
74	1,531	1,900	369	1,071	2,468	3,985	1,516	5,230	1,912	2,315	403	1,235
75	1,388	1,724	336	930	2,204	3,561	1,357	4,462	1,740	2,137	397	1,159
76	1,842	2,289	447	1,180	2,895	4,672	1,778	5,575	2,295	2,877	582	1,620
77	1,830	2,278	448	1,127	2,946	4,771	1,825	5,456	2,292	2,800	507	1,346
78	1,660	2,067	407	976	2,691	4,359	1,668	4,756	2,078	2,528	450	1,139
79	3,090	3,847	757	1,733	4,969	8,043	3,074	8,358	3,884	4,740	856	2,066
80	5,869	7,305	1,436	3,133	10,080	16,259	6,179	16,019	7,173	8,569	1,397	3,215
81	3,467	4,294	827	1,721	6,503	10,238	3,735	9,232	4,028	4,826	798	1,752
82	1,942	2,403	461	915	3,493	5,533	2,040	4,808	2,298	2,743	446	933
83	1,585	1,964	379	717	2,645	4,244	1,599	3,592	1,972	2,340	369	735
84	1,747	2,167	420	758	2,802	4,518	1,716	3,678	2,173	2,658	485	923
85	1,607	1,996	389	669	2,574	4,163	1,589	3,247	2,018	2,443	425	771
86	1,795	2,231	436	715	2,859	4,625	1,765	3,439	2,239	2,756	517	894
87	1,586	1,974	387	605	2,552	4,133	1,581	2,937	1,997	2,418	421	694
88	1,934	2,406	472	704	3,088	4,995	1,908	3,379	2,416	2,979	563	885
89	2,894	3,604	709	1,008	4,699	7,614	2,916	4,925	3,666	4,389	723	1,084
90	6,927	8,620	1,693	2,295	11,826	19,092	7,266	11,702	8,492	10,131	1,639	2,344
91	3,306	4,091	785	1,015	6,296	9,862	3,566	5,476	3,812	4,571	759	1,035
92	1,873	2,317	444	548	3,362	5,322	1,960	2,870	2,219	2,649	430	559
93	1,522	1,886	364	428	2,529	4,057	1,528	2,134	1,901	2,255	354	439
94	1,280	1,588	308	345	2,043	3,294	1,251	1,665	1,589	1,957	368	435
95	1,753	2,177	423	452	2,737	4,410	1,673	2,123	2,186	2,710	524	591
96	1,500	1,865	366	372	2,394	3,873	1,479	1,790	1,862	2,302	440	473
97	1,843	2,293	450	437	2,925	4,729	1,804	2,082	2,282	2,864	582	596
98	1,553	1,935	381	353	2,509	4,065	1,556	1,712	1,945	2,373	429	419
99	2,329	2,901	571	505	3,723	6,022	2,300	2,413	2,895	3,602	707	659
100	4,802	5,983	1,182	995	7,966	12,905	4,938	4,941	6,015	7,179	1,164	1,034
				1,075,145				6,390,614				1,261,454
Average:	2,402	2,982	580		4,200	6,780	2,580		2,986	3,608	623	
Maximum:	7,845	9,771	1,926		14,013	23,134	9,121		9,553	11,427	1,875	
Minimum:	1,273	1,567	294		2,043	3,294	1,251		1,589	1,919	304	

Table 2-35. Annual harvest and total economic value by species for the Wymer Dam and Reservoir Alternative

Fish Species:	Spring Chinook				Fall Chinook				Coho			
Alternative:	No Action	Wymer Dam and Reservoir			No Action	Wymer Dam and Reservoir			No Action	Wymer Dam and Reservoir		
Year	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value
1	2,677	2,727	50	4,709	6,312	6,500	188	20,960	3,426	3,472	46	4,543
2	1,273	1,293	20	1,758	2,992	3,082	90	9,543	1,657	1,678	21	1,978
3	1,564	1,586	22	1,877	3,409	3,520	111	11,196	2,113	2,143	29	2,637
4	1,623	1,645	22	1,812	3,520	3,637	117	11,269	2,184	2,216	31	2,692
5	1,415	1,434	19	1,485	3,040	3,141	101	9,326	1,904	1,933	30	2,414
6	1,365	1,384	18	1,350	2,847	2,944	97	8,477	1,829	1,857	27	2,130
7	1,478	1,498	20	1,385	3,006	3,109	104	8,668	1,969	1,999	30	2,218
8	1,331	1,348	18	1,191	2,672	2,764	92	7,335	1,763	1,790	27	1,921
9	3,050	3,091	41	2,601	5,949	6,155	207	15,718	4,015	4,075	61	4,120
10	6,702	6,792	89	5,461	14,013	14,473	460	33,377	8,646	8,756	110	7,078
11	3,451	3,496	46	2,656	7,643	7,865	222	15,352	4,143	4,198	54	3,340
12	1,564	1,585	21	1,152	3,255	3,353	98	6,463	1,909	1,933	24	1,390
13	1,725	1,748	23	1,215	3,256	3,363	106	6,692	2,240	2,271	31	1,747
14	1,641	1,663	22	1,107	3,019	3,120	101	6,064	2,118	2,148	30	1,606
15	1,777	1,801	24	1,143	3,185	3,293	108	6,177	2,310	2,345	35	1,790
16	1,707	1,729	23	1,047	3,020	3,123	103	5,615	2,222	2,257	35	1,672
17	1,283	1,301	17	752	2,225	2,301	76	3,949	1,670	1,696	26	1,217
18	1,443	1,462	19	808	2,399	2,481	82	4,085	1,863	1,890	27	1,210
19	2,510	2,543	34	1,338	4,122	4,265	143	6,741	3,227	3,276	50	2,081
20	5,680	5,757	76	2,892	9,816	10,138	323	14,550	7,252	7,342	90	3,622
21	2,815	2,852	37	1,354	5,383	5,543	160	6,864	3,352	3,395	44	1,668
22	1,560	1,581	21	721	2,806	2,891	85	3,498	1,907	1,930	23	848
23	1,379	1,398	19	612	2,294	2,367	73	2,854	1,757	1,781	25	856
24	1,662	1,684	22	702	2,676	2,763	87	3,233	2,100	2,129	29	951
25	2,121	2,149	29	855	3,444	3,556	112	3,974	2,696	2,737	41	1,295
26	1,714	1,737	23	659	2,862	2,955	93	3,138	2,192	2,219	27	804
27	1,522	1,543	21	559	2,505	2,586	81	2,621	1,949	1,980	31	878
28	1,308	1,326	18	459	2,119	2,188	69	2,131	1,671	1,694	24	646
29	3,001	3,042	41	1,005	4,785	4,942	156	4,596	3,806	3,863	57	1,480
30	6,956	7,049	94	2,208	12,031	12,417	385	10,797	8,656	8,766	110	2,732
31	2,845	2,883	38	852	5,498	5,656	158	4,218	3,316	3,360	44	1,038
32	1,631	1,653	22	471	2,920	3,008	88	2,235	1,971	1,995	24	545
33	1,428	1,448	19	395	2,362	2,437	75	1,817	1,802	1,827	25	549
34	1,460	1,479	20	385	2,335	2,411	76	1,756	1,828	1,853	25	520
35	1,734	1,758	24	437	2,760	2,850	90	1,996	2,179	2,211	32	633
36	1,736	1,759	24	418	2,806	2,897	92	1,929	2,175	2,209	34	632
37	1,582	1,603	21	363	2,571	2,655	84	1,679	1,993	2,025	32	565
38	1,623	1,645	22	355	2,619	2,704	85	1,631	2,045	2,077	32	545
39	3,020	3,061	41	630	4,873	5,031	159	2,895	3,808	3,869	61	980
40	7,560	7,662	102	1,497	13,051	13,467	416	7,239	9,318	9,436	118	1,825
41	3,757	3,807	50	700	7,275	7,482	207	3,432	4,339	4,396	58	848
42	1,911	1,937	26	342	3,511	3,614	103	1,625	2,255	2,283	28	398
43	1,856	1,881	25	319	3,126	3,223	97	1,466	2,319	2,346	27	363
44	2,036	2,063	28	335	3,334	3,440	106	1,529	2,561	2,599	37	478
45	2,006	2,033	27	314	3,294	3,400	106	1,455	2,530	2,560	30	371
46	1,370	1,389	19	205	2,250	2,323	73	952	1,731	1,752	21	239
47	1,584	1,605	22	226	2,515	2,597	82	1,021	1,995	2,023	27	304
48	1,860	1,885	25	253	2,964	3,061	97	1,157	2,342	2,375	33	351
49	2,571	2,606	35	333	4,171	4,307	136	1,540	3,235	3,286	51	513
50	6,019	6,100	82	742	10,167	10,494	326	3,528	7,477	7,571	93	894
51	3,564	3,612	48	414	6,702	6,898	197	2,028	4,155	4,209	55	499
52	1,954	1,980	26	218	3,537	3,643	105	1,035	2,313	2,342	29	253
53	2,163	2,193	29	232	3,629	3,742	114	1,064	2,695	2,727	32	264
54	1,296	1,314	18	132	2,150	2,218	68	612	1,615	1,634	19	153
55	1,342	1,360	18	131	2,122	2,190	69	584	1,682	1,705	23	173
56	1,376	1,395	19	128	2,156	2,226	70	570	1,718	1,742	24	171
57	1,719	1,742	23	153	2,700	2,788	88	685	2,129	2,160	31	215
58	1,698	1,721	23	144	2,728	2,817	89	659	2,107	2,140	33	214
59	3,383	3,429	46	273	5,464	5,643	178	1,256	4,202	4,269	67	419
60	7,845	7,951	106	600	13,698	14,131	433	2,910	9,553	9,675	123	731
61	2,728	2,764	36	196	5,290	5,439	149	956	3,132	3,174	42	237
62	2,347	2,378	32	163	4,152	4,276	125	761	2,820	2,855	34	187
63	2,037	2,064	28	135	3,454	3,562	108	626	2,498	2,528	30	155
64	1,939	1,965	26	123	3,202	3,304	102	565	2,421	2,450	29	142
65	1,820	1,845	25	110	2,970	3,066	96	506	2,295	2,322	27	128
66	1,447	1,467	20	84	2,342	2,418	76	383	1,833	1,860	27	120
67	1,291	1,308	18	71	2,044	2,111	67	321	1,621	1,644	23	97
68	1,866	1,891	25	98	2,919	3,015	96	438	2,337	2,371	34	138
69	3,060	3,102	42	154	4,934	5,095	161	703	3,829	3,890	61	236
70	5,299	5,370	72	252	9,122	9,412	290	1,211	6,492	6,574	82	306
71	3,131	3,173	42	141	5,818	5,990	172	686	3,660	3,708	48	168
72	1,826	1,851	25	79	3,243	3,341	98	372	2,179	2,206	27	91
73	1,721	1,744	23	71	2,847	2,937	90	325	2,160	2,185	25	81
74	1,531	1,552	21	61	2,468	2,548	79	274	1,912	1,940	28	85
75	1,388	1,407	19	52	2,204	2,276	72	236	1,740	1,765	25	72
76	1,842	1,867	25	66	2,895	2,990	95	297	2,295	2,329	34	94
77	1,830	1,855	25	63	2,946	3,042	96	287	2,292	2,329	36	96
78	1,660	1,683	23	54	2,691	2,778	87	249	2,078	2,112	34	85
79	3,090	3,132	42	96	4,969	5,130	162	439	3,884	3,946	62	149
80	5,869	5,948	80	174	10,080	10,401	321	832	7,173	7,264	91	210
81	3,467	3,514	46	97	6,503	6,694	191	471	4,028	4,081	53	116
82	1,942	1,968	26	52	3,493	3,598	104	246	2,298	2,326	29	60
83	1,585	1,606	22	41	2,645	2,728	83	186	1,972	1,995	23	46
84	1,747	1,771	24	43	2,802	2,892	91	194	2,173	2,204	31	59
85	1,607	1,629	22	38	2,574	2,658	83	171	2,018	2,047	29	53
86	1,795	1,819	24	40	2,859	2,952	93	181	2,239	2,273	34	59
87	1,586	1,608	22	34	2,552	2,635	83	154	1,997	2,029	31	51
88	1,934	1,960	26	39	3,088	3,188	101	178	2,416	2,454	38	59
89	2,894	2,934	39	56	4,699	4,852	153	258	3,666	3,726	60	90
90	6,927	7,021	94	127	11,826	12,203	377	607	8,492	8,599	107	153
91	3,306	3,350	44	57	6,296	6,478	181	278	3,812	3,863	50	69
92	1,873	1,898	25	31	3,362	3,462	100	147	2,219	2,247	28	36
93	1,522	1,543	21	24	2,529	2,608	79	111	1,901	1,923	22	28
94	1,280	1,298	17	20	2,043	2,109	66	88	1,589	1,612	22	26
95	1,753	1,777	24	26	2,737	2,826	89	113	2,186	2,215	30	34
96	1,500	1,520	20	21	2,394	2,472	78	95	1,862	1,891	29	31
97	1,843	1,868	25	24	2,925	3,021	96	111	2,282	2,316	34	35
98	1,553	1,574	21	20	2,509	2,591	82	90	1,945	1,977	32	31
99	2,329	2,361	32	28	3,723	3,844	122	128	2,895	2,940	45	42
100	4,802	4,867	65	55	7,966	8,224	258	258	6,015	6,090	75	67
				61,988				326,291				83,273
Average:	2,402	2,435	33		4,200	4,334	133		2,986	3,027	41	
Maximum:	7,845	7,951	106		14,013	14,473	460		9,553	9,675	123	
Minimum:	1,273	1,293	17		2,043	2,109	66		1,589	1,612	19	

Table 2-36. Annual harvest and total economic value by species for the Wymer Dam Plus Yakima River Pump Exchange Alternative

Fish Species:	Spring Chinook				Fall Chinook				Coho			
Alternative:	No Action	Wymer Dam + Yakima River Pump Exchange			No Action	Wymer Dam + Yakima River Pump Exchange			No Action	Wymer Dam + Yakima River Pump Exchange		
Year	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value	Total Harvest	Total Harvest	Change in Total Harvest from No Action Alt.	Total Discounted Value
1	2,677	3,086	410	38,387	6,312	8,568	2,256	251,261	3,426	3,762	336	33,225
2	1,273	1,465	191	17,104	2,992	4,093	1,101	116,911	1,657	1,813	156	14,749
3	1,564	1,792	228	19,396	3,409	4,684	1,275	129,070	2,113	2,368	255	22,951
4	1,623	1,863	240	19,538	3,520	4,858	1,338	129,180	2,184	2,450	266	22,763
5	1,415	1,628	213	16,467	3,040	4,209	1,169	107,602	1,904	2,129	226	18,457
6	1,365	1,571	205	15,172	2,847	3,947	1,099	96,497	1,829	2,074	244	19,051
7	1,478	1,701	223	15,723	3,006	4,170	1,164	97,440	1,969	2,224	255	18,971
8	1,331	1,534	204	13,688	2,672	3,712	1,040	82,999	1,763	2,009	246	17,449
9	3,050	3,518	467	29,932	5,949	8,256	2,308	175,614	4,015	4,553	538	36,363
10	6,702	7,785	1,083	66,133	14,013	19,532	5,519	400,517	8,646	9,482	836	53,876
11	3,451	3,997	546	31,817	7,643	10,546	2,902	200,809	4,143	4,553	409	25,157
12	1,564	1,805	241	13,392	3,255	4,509	1,254	82,765	1,909	2,091	182	10,638
13	1,725	1,987	262	13,859	3,256	4,520	1,264	79,513	2,240	2,463	223	12,477
14	1,641	1,892	251	12,692	3,019	4,199	1,180	70,774	2,118	2,352	233	12,436
15	1,777	2,051	274	13,176	3,185	4,430	1,245	71,188	2,310	2,567	257	13,047
16	1,707	1,972	266	12,190	3,020	4,205	1,185	64,635	2,222	2,450	227	11,001
17	1,283	1,484	201	8,778	2,225	3,094	869	45,208	1,670	1,847	177	8,187
18	1,443	1,666	223	9,300	2,399	3,307	909	45,048	1,863	2,090	227	10,003
19	2,510	2,901	391	15,575	4,122	5,674	1,552	73,372	3,227	3,632	405	17,007
20	5,680	6,593	913	34,641	9,816	13,505	3,690	166,339	7,252	7,944	692	27,687
21	2,815	3,262	447	16,178	5,383	7,313	1,930	82,967	3,352	3,683	331	12,638
22	1,560	1,803	243	8,387	2,806	3,800	994	40,729	1,907	2,086	180	6,538
23	1,379	1,592	212	6,988	2,294	3,080	786	30,734	1,757	1,950	193	6,690
24	1,662	1,918	256	8,020	2,676	3,567	891	33,195	2,100	2,349	249	8,244
25	2,121	2,452	331	9,907	3,444	4,594	1,150	40,862	2,696	3,035	339	10,695
26	1,714	1,986	272	7,755	2,862	3,842	980	33,195	2,192	2,398	206	6,202
27	1,522	1,763	240	6,539	2,505	3,354	850	27,449	1,949	2,158	208	5,978
28	1,308	1,514	206	5,338	2,119	2,826	707	21,786	1,671	1,879	208	5,687
29	3,001	3,470	469	11,603	4,785	6,347	1,561	45,862	3,806	4,276	470	12,247
30	6,956	8,078	1,123	26,466	12,031	16,204	4,172	116,863	8,656	9,496	840	20,888
31	2,845	3,293	448	10,060	5,498	7,423	1,925	51,408	3,316	3,648	332	7,870
32	1,631	1,885	253	5,430	2,920	3,947	1,027	26,159	1,971	2,158	187	4,219
33	1,428	1,649	221	4,506	2,362	3,173	811	19,683	1,802	1,992	191	4,110
34	1,460	1,685	226	4,396	2,335	3,116	780	18,067	1,828	2,048	220	4,523
35	1,734	2,004	270	5,019	2,760	3,671	911	20,113	2,179	2,455	275	5,400
36	1,736	2,010	274	4,859	2,806	3,744	938	19,741	2,175	2,463	288	5,384
37	1,582	1,833	251	4,247	2,571	3,435	864	17,345	1,993	2,242	249	4,432
38	1,623	1,881	258	4,151	2,619	3,493	874	16,724	2,045	2,319	274	4,665
39	3,020	3,500	481	7,384	4,873	6,498	1,625	29,658	3,808	4,311	503	8,149
40	7,560	8,782	1,222	17,891	13,051	17,608	4,557	79,303	9,318	10,227	909	14,038
41	3,757	4,345	589	8,218	7,275	9,821	2,546	42,243	4,339	4,775	437	6,436
42	1,911	2,207	296	3,939	3,511	4,748	1,237	19,570	2,255	2,474	219	3,073
43	1,856	2,143	287	3,643	3,126	4,212	1,086	16,381	2,319	2,530	211	2,830
44	2,036	2,353	317	3,835	3,334	4,481	1,147	16,502	2,561	2,815	254	3,238
45	2,006	2,321	315	3,635	3,294	4,431	1,137	15,591	2,530	2,763	234	2,844
46	1,370	1,586	216	2,377	2,250	3,027	777	10,156	1,731	1,891	159	1,847
47	1,584	1,831	247	2,593	2,515	3,353	838	10,447	1,995	2,238	243	2,686
48	1,860	2,153	293	2,933	2,964	3,949	985	11,717	2,342	2,629	287	3,034
49	2,571	2,981	410	3,910	4,171	5,580	1,409	15,970	3,235	3,610	376	3,781
50	6,019	6,986	967	8,802	10,167	13,706	3,539	38,259	7,477	8,193	715	6,868
51	3,564	4,126	562	4,876	6,702	9,065	2,364	24,365	4,155	4,570	416	3,803
52	1,954	2,258	304	2,515	3,537	4,789	1,251	12,298	2,313	2,537	224	1,957
53	2,163	2,499	336	2,648	3,629	4,893	1,264	11,848	2,695	2,942	247	2,055
54	1,296	1,499	203	1,524	2,150	2,899	749	6,695	1,615	1,765	150	1,187
55	1,342	1,549	207	1,488	2,122	2,827	705	6,008	1,682	1,884	202	1,526
56	1,376	1,590	214	1,464	2,156	2,860	704	5,722	1,718	1,920	202	1,455
57	1,719	1,988	270	1,757	2,700	3,578	878	6,798	2,129	2,407	279	1,916
58	1,698	1,969	271	1,685	2,728	3,633	905	6,685	2,107	2,399	292	1,916
59	3,383	3,926	543	3,216	5,464	7,292	1,828	12,876	4,202	4,799	596	3,730
60	7,845	9,118	1,273	7,196	13,698	18,504	4,807	32,284	9,553	10,500	947	5,646
61	2,728	3,154	427	2,300	5,290	7,141	1,851	11,852	3,132	3,449	317	1,803
62	2,347	2,711	364	1,872	4,152	5,613	1,461	8,920	2,820	3,088	268	1,451
63	2,037	2,354	317	1,553	3,454	4,668	1,213	7,065	2,498	2,731	233	1,207
64	1,939	2,242	303	1,414	3,202	4,316	1,114	6,187	2,421	2,644	223	1,100
65	1,820	2,106	285	1,271	2,970	3,996	1,026	5,432	2,295	2,505	210	989
66	1,447	1,675	228	967	2,342	3,144	802	4,047	1,833	2,010	177	793
67	1,291	1,493	202	819	2,044	2,726	682	3,282	1,621	1,821	199	852
68	1,866	2,158	292	1,126	2,919	3,868	949	4,357	2,337	2,616	279	1,137
69	3,060	3,549	489	1,800	4,934	6,586	1,652	7,229	3,829	4,305	476	1,849
70	5,299	6,155	856	3,007	9,122	12,314	3,192	13,318	6,492	7,126	634	2,349
71	3,131	3,626	495	1,657	5,818	7,875	2,058	8,187	3,660	4,025	365	1,289
72	1,826	2,111	285	910	3,243	4,391	1,149	4,357	2,179	2,389	210	706
73	1,721	1,989	268	815	2,847	3,835	987	3,572	2,160	2,356	197	632
74	1,531	1,770	239	694	2,468	3,311	843	2,907	1,912	2,131	219	670
75	1,388	1,606	217	601	2,204	2,942	738	2,427	1,740	1,956	216	632
76	1,842	2,130	288	761	2,895	3,846	951	2,983	2,295	2,590	295	820
77	1,830	2,122	292	734	2,946	3,936	989	2,959	2,292	2,571	279	740
78	1,660	1,926	266	637	2,691	3,602	912	2,599	2,078	2,325	247	626
79	3,090	3,583	493	1,128	4,969	6,642	1,673	4,548	3,884	4,362	478	1,154
80	5,869	6,815	947	2,065	10,080	13,617	3,537	9,169	7,173	7,873	701	1,613
81	3,467	4,013	546	1,135	6,503	8,801	2,297	5,679	4,028	4,432	404	886
82	1,942	2,244	302	599	3,493	4,731	1,237	2,916	2,298	2,521	223	466
83	1,585	1,831	246	465	2,645	3,567	922	2,072	1,972	2,153	181	361
84	1,747	2,019	272	490	2,802	3,754	952	2,040	2,173	2,447	274	521
85	1,607	1,859	252	434	2,574	3,446	872	1,782	2,018	2,248	230	417
86	1,795	2,077	283	463	2,859	3,818	959	1,868	2,239	2,537	297	514
87	1,586	1,838	252	394	2,552	3,414	862	1,602	1,997	2,225	227	375
88	1,934	2,241	307	457	3,088	4,120	1,033	1,830	2,416	2,742	326	512
89	2,894	3,358	463	658	4,699	6,297	1,598	2,699	3,666	4,037	371	556
90	6,927	8,042	1,115	1,511	11,826	15,977	4,151	6,685	8,492	9,309	817	1,168
91	3,306	3,824	518	670	6,296	8,513	2,217	3,404	3,812	4,197	385	525
92	1,873	2,163	291	358	3,362	4,551	1,189	1,741	2,219	2,434	215	279
93	1,522	1,758	236	277	2,529	3,408	879	1,227	1,901	2,074	174	215
94	1,280	1,479	199	223	2,043	2,734	691	920	1,589	1,787	198	234
95	1,753	2,025	272	290	2,737	3,632	895	1,136	2,186	2,443	257	290
96	1,500	1,737	237	242	2,394	3,192	798	966	1,862	2,114	252	271
97	1,843	2,135	292	283	2,925	3,893	968	1,117	2,282	2,590	309	316
98	1,553	1,802	249	230	2,509	3,355	846	931	1,945	2,181	236	230
99	2,329	2,701	372	328	3,723	4,964	1,242	1,303	2,895	3,311	416	387
100	4,802	5,578	776	653	7,966	10,714	2,748	2,750	6,015	6,599	584	519
				700,631				3,741,061				657,375
Average:	2,402	2,781	379		4,200	5,680	1,479		2,986	3,309	323	
Maximum:	7,845	9,118	1,273		14,013	19,532	5,519		9,553	10,500	947	
Minimum:	1,273	1,465	191		2,043	2,726	682		1,589	1,765	150	

Table 2-37. Discounted 100-year stream of fisheries use values by alternative

Alternative	Ocean		Columbia River Zones 1-5		Columbia River Zone 6		Yakima River		Total
	Commercial	Sport	Commercial	Sport	Commercial	Ceremonial & Subsistence	Sport	Ceremonial & Subsistence	
Black Rock Alternative									
Spring Chinook:	11,411	0	25,268	386,930	16,609	83,045	437,833	114,051	1,075,145
Fall Chinook:	37,075	147,153	64,129	1,339,055	256,024	16,836	4,530,341	0	6,390,614
Coho:	23,666	521,448	7,254	568,378	3,974	262	136,472	0	1,261,454
Total:	72,152	668,601	96,651	2,294,364	276,607	100,142	5,104,645	114,051	8,727,213
Wymer Dam and Reservoir Alternative									
Spring Chinook:	658	0	1,457	22,309	958	4,788	25,243	6,576	61,988
Fall Chinook:	1,893	7,513	3,274	68,369	13,072	860	231,309	0	326,291
Coho:	1,562	34,423	479	37,521	262	17	9,009	0	83,273
Total:	4,113	41,936	5,210	128,198	14,292	5,665	265,562	6,576	471,552
Wymer Dam Plus Yakima River Pump Exchange Alternative									
Spring Chinook:	7,436	0	16,466	252,147	10,823	54,117	285,318	74,322	700,631
Fall Chinook:	21,703	86,143	37,541	783,882	149,877	9,856	2,652,058	0	3,741,061
Coho:	12,333	271,740	3,780	296,196	2,071	136	71,119	0	657,375
Total:	41,472	357,883	57,787	1,332,226	162,771	64,109	3,008,496	74,322	5,099,067

As a resource recovers from a depleted or damaged state, overall nonuse values may diminish and be "replaced" by harvest-based use values–reflecting a transition from nonuse to use values. Note that a resource may provide both nonuse and use values simultaneously, a concept referred to as total values. Total values typically refer to a combination of both nonuse values and recreation use values. While it is possible that other use values (e.g., for fisheries resources-potential commercial or tribal fishing use values) may be included to some extent in total values, the application of general population surveys tend to reduce the likelihood of including a significant number of respondents with such values within the sample. When conducting surveys of the general population, it is often difficult to separate nonuse values from recreation use values, and as a result, many "nonuse" value studies actually measure total values. In cases where the resource being valued does not provide significant recreational use values (e.g., studies of T&E species), the resulting willingness-to-pay value from the survey may reflect a more pure nonuse value. It should be noted that even for T&E species, where harvest is not permitted, non-consumptive use (e.g., for fisheries resources—fish viewing or catch and release fishing) of the resource may still occur although its value may be fairly insignificant compared to the nonuse value component. When total value estimates are used in a study, the analyst should be careful not to double count recreation benefits associated with the resource (e.g., in the case of fisheries, one should avoid including separately estimated ocean and inland sport fishing benefits in addition to the total value estimates).

Most, but not all economists would probably agree that a fairly strong theoretical case has been made for the concept of nonuse values. Most of those economists who have problems with nonuse values tend to focus on measurement issues. Problematic measurement issues can include determination of the nonuse value generating resource as well as the actual nonuse value measurement technique. With regard to the nonuse value resource, there is disagreement within the economics profession over whether only unique, nationally significant resources should be considered for nonuse valuation. For example, some economists would claim that non-T&E regionally significant resources would not be unique enough to generate nonuse values. With regard to measurement techniques, models based from stated preference contingent valuation (CV) or contingent ranking/conjoint analysis (CR) surveys are the only techniques currently available for measuring nonuse values. Both approaches evaluate survey respondent willingness to pay for described changes in resource conditions (e.g., T&E fish populations). The CV approach directly asks valuation questions, whereas the CR approach has respondents rank alternatives. Both approaches provide respondents with information on before and after resource conditions, costs, etc., for each of the proposed alternatives. These approaches, especially the early CV approaches, have been criticized from a number of perspectives. As a result, the whole topic

area of nonuse value measurement has become quite controversial. On the positive side, the CV measurement technique has been extensively reviewed and gradually improved over time. The CV approach was included in the Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&Gs) as an acceptable method for recreation valuation. While not directed specifically at nonuse/total values, the P&G endorsement of the CV approach is relevant. In a more direct endorsement, dichotomous choice CV approach was cautiously approved for use in measuring nonuse values in U.S. Department of the Interior damage assessments by a panel of Nobel laureate economists (Arrow et al., 1993).

Many Reclamation studies deal with T&E species or other unique environmental resources which may generate significant nonuse values. Historically, Reclamation has not included nonuse values in benefit-cost analyses (BCA) or cost allocation/repayment (CA/R) analyses. There have been a few Reclamation studies which have attempted to measure nonuse values (e.g., Glen Canyon EIS, Elwha Dam Removal EIS), but to date, no Reclamation studies have actually included nonuse values in a BCA or CA/R analysis. The P&Gs, which shape Reclamation's economic BCAs, are silent on the topic of nonuse values. This is most likely due to the fact that nonuse valuation was still a relatively new concept at the time the P&Gs were published in 1983. Nevertheless, the P&Gs appear to be flexible enough to allow for the inclusion of new benefit measures within Reclamation BCAs. The P&Gs allow the analyst to incorporate benefit categories not expressly described in the guidelines within a BCA, assuming the analyst can make a convincing case for their inclusion. As nonuse value measurement techniques have evolved and impacts to nonuse value generating resources (e.g., T&E species) have increased, questions have begun to surface as to whether or not nonuse values should be measured within Reclamation studies in lieu of qualitative environmental economic discussions.

Before conducting some sort of nonuse/total value analysis, the need for such an analysis should be demonstrated. Generally speaking, if one is dealing with a unique resource (e.g., T&E species, rare habitat, or landscapes of national significance), the case for nonuse/total values may be reasonable. However, as noted above, less scarce/unique or regionally significant resources may also deserve nonuse value consideration. In addition, the type of project may prove important in determining whether or not to consider nonuse values. If environmental issues are a primary objective or driving force behind a particular project, nonuse values may prove to be a critical component of the BCA. Given the considerable controversy associated with nonuse valuation, a fairly strict interpretation of the need for nonuse value estimation seems warranted. The stance was taken that a study only be considered for nonuse valuation if T&E species are involved and significantly affected (the significance determination

should be made by study team biologists). Given we are dealing with salmon and steelhead species, some, but not all, of which are listed T&E species, we may be able to make a case for estimating nonuse values for the Yakima Storage Study. The question then becomes, "should we pursue nonuse valuation for all the salmon and steelhead species or only the listed ones?" Since a significant impact on a T&E species is our criteria for considering nonuse values, it would also seem reasonable to focus the attention of any nonuse valuation exclusively on those same T&E species.

2.3.5.2.2 Nonuse Value Measurement for the Yakima Storage Study-Benefits

From early on in the Yakima Storage Study planning process, nonuse values were identified as a potentially significant benefit category. As a result, the concept of nonuse values could be considered fairly well known to the "publics" following these studies. While the best technical solution for measuring nonuse values would have been to conduct a site- and study-specific survey early on, for various legitimate reasons (e.g., cost, time required, lack of necessary fish population estimates at the time to construct the willingness-to-pay questions), the decision was made not to go in that direction for the appraisal-level/Draft EIS analyses.

Instead of pursuing a site-specific nonuse value survey, initial efforts conducted as part of the appraisal level/Draft EIS analyses were directed at attempting to make use of existing CV/CR nonuse value studies through a process referred to as benefits transfer (BT) in order to evaluate the range and possible significance of nonuse values for the Yakima Storage Study. Basically, BT involves reapplication of the results of existing studies to the current study under consideration. Three options exist for BT: meta analysis, model transfer, and value transfer. The meta analysis and model transfer approaches both require the estimation and application of statistically based models and are therefore considered superior to the simple value-based transfer.

Before diving into the discussion of the BT-based nonuse value analyses attempted for the Yakima Storage Study's appraisal-level BCA, it should be emphasized that while BT has been used for years within the context of recreation use value estimation, the application of BT approaches to nonuse valuation has been infrequent at best. The economics literature on BT from the perspective of recreation use valuation is quite cautious, with little to no discussion of the use of BT for nonuse valuation. Most economists, even those comfortable with the nonuse value concept and the approaches used for estimating nonuse values, may actually object or be highly skeptical of the use of BT for measuring nonuse values. As a result, the decision was made to explore the use of BT approaches for measuring nonuse values only for the appraisal/draft EIS level analyses. If the BT-based valuation approaches proved successful and the nonuse value estimates

proved critical to the analysis (i.e., if the nonuse values affected the accept/reject decision), then consideration would be given to conducting a full-scale site- and study-specific nonuse value survey to provide a more defendable nonuse value estimate. Only through use of site- and study-specific surveys can nonuse values be measured with any degree of confidence. Bottom line, the position was taken that BT approaches do not provide the level of nonuse value estimation accuracy needed for feasibility study analysis.

Meta Analysis - A literature search was conducted to pull together a list of Pacific Northwest salmon and steelhead nonuse value studies. Five studies were located – Bell, Huppert, and Johnson (2003), Hanemann, Loomis, and Kanninen (1991), Layton, Brown, and Plummer (1999), Loomis (1996), and Olsen, Richards, and Scott (1991). These studies provided a total of eight nonuse valuation estimates for various species of salmon and steelhead across the Pacific Northwest states of Washington, Oregon, Idaho, and California. Following the lead of Loomis (1999), a meta analysis effort was attempted whereby the values from the various salmon and steelhead nonuse value studies, indexed to current dollars, were used to try to develop a statistical nonuse value model estimated as a function of fish populations.

With a fair amount of additional effort, including direct correspondences with each of the study authors, information was gathered on both the change in fish populations associated with each scenario described in each nonuse value study as well as the starting fish populations at the time of each study (see Table 2-38). It was believed that both the starting fish population and the change in fish population would be relevant in evaluating survey respondent WTP. While the change in fish populations presented in the scenarios described in each study is a rather obvious potential explanatory variable, it was also believed that the starting fish populations at the time of the study could be important. This is because two studies presenting the same numeric change in fish populations may result in different values because of differences in the starting fish population. For example, two studies which attempt to value an additional 100,000 in fish populations could get vastly different WTP values if one study began from a population of 10,000 fish and the other study began from a population of 100,000 fish.[2] A series of statistical models were attempted using different function forms (i.e., linear, log-linear, linear-log, and double log) and the following fish population based explanatory variables: change in fish population; starting fishing population; percentage change in fish population; total fish population;

[2] Another related concept which could affect respondent WTP but which was not evaluated within the meta analysis modeling was historical fish populations. By the same logic that WTP for scenarios with the same changes in fish populations could vary based on their starting populations, it is also possible that WTP for studies with similar changes in fish population and starting populations could vary depending on historical fish populations within the river system.

and total fish population squared (quadratic model). Table 2-39 presents the results of four of the more promising statistical models.

The models in Table 2-39 were promising from both the standpoint of statistical significance and sign expectations. The overall models proved statistically significant based on the F statistics and each explanatory variable proved to be statistically significant based on the t-statistics and P-values. The models also produced explanatory variables with the anticipated sign. With all of the model's dependent variables defined as WTP per household per fish, the expected sign for all of the explanatory variables was negative. The resulting nonuse value curve from the statistical analysis was expected to be a downward sloping function of fish populations. In other words, at high fish populations, the value per fish was expected to be low, and at low fish populations, the value per fish was expected to be high. Starting from low fish populations and relatively high values, as one adds additional fish, the value per fish is expected to decline. The higher the starting fish population, the lower the starting value per fish (negative relationship). The greater the increase in fish populations (both in numeric or percentage terms), the further down the curve one moves and the lower the value per fish (negative relationship). For reductions in fish populations, the greater the reduction the further back up the curve one moves and the higher the value (negative relationship). Unfortunately, every model was estimated based on a dataset of only eight observations obtained from the five studies which could imply all the results may be questionable due to limited data.

While somewhat promising statistically, each of the models suffered from its own set of problems from a valuation perspective. Using three different function forms, models 1-3 all included only the change in fish population variable and therefore cannot account for different starting fish populations. Model #1 resulted in illogical declining total values as fish populations increased. Based on the above discussion, it is anticipated that values on a per-fish basis would decline as fish populations increased due to diminishing returns (the more fish available, the less value per fish), but total values should continue to increase with additional fish populations (total value continues to grow, but at a declining rate due to diminishing returns). Models #2 and #3 do not suffer from this problem. However, Model #3 may result in illogical negative values when the change in fish populations gets extremely large. Models #1 and #2 cannot be used to measure declines in fish populations given that one cannot take the log of a negative number. Finally, while Model #4 is promising in that both the change in fish population (note this model uses the percentage change in fish population) and the starting fish population variable proved significant, this model suffers from the illogical decline in total value as fish populations increase issue as well as the inability to measure negative changes in fish populations.

Despite the somewhat promising statistical results, given the problems associated with value estimation, the decision was made to abandon the meta analysis effort. Alternatively, the five salmon and steelhead nonuse value studies were then considered from the perspective of the next best benefits transfer option, being that of a possible model transfer.

Table 2-38. Meta analysis full dataset

Authors	Date of Publication	Date of Data	Fish Species	Location	States	Value Type	Original Annual WTP per Household	(Dec 2005 $) Annual WTP per Household	(Dec 2005 $) Annual WTP per Household per add'l Fish	Starting Fish Population	Increase Fish Population	Percent Increase Fish Population	Total Fish Population
Hanemann, Loomis, Kanninen	1990	May 1989	salmon	San Joaquin Valley, CA	CA	Total	181.00	287.73	0.019310644	100	14900	14,900.0	15000
Olsen, Richards, Scott	1991	Dec 1989	salmon and steelhead	Columbia River	WA, OR, ID, west MT	Nonuse primarily	26.52	41.39	1.65555E-05	2500000	2500000	100.0	5000000
Olsen, Richards, Scott	1991	Dec 1989	salmon and steelhead	Columbia River	WA, OR, ID, west MT	Total	50.35	78.58	3.14318E-05	2500000	2500000	100.0	5000000
Loomis	1996	Dec 1994	salmon	Elwha River, WA	WA	Total	73.00	95.97	0.000295286	50000	325000	650.0	375000
Layton, Brown, Plummer	1999	March 1998	salmon	Eastern WA & Columbia River	WA	Total	119.04	144.43	0.000144433	2000000	1000000	50.0	3000000
Layton, Brown, Plummer	1999	March 1998	salmon	Western WA & Puget Sound	WA	Total	249.96	303.28	0.000121312	5000000	2500000	50.0	7500000
Bell, Huppert, Johnson	2003	March 2000	coho salmon	Willapa Bay, WA	Coastal WA and OR	Total	106.09	121.95	0.00190553	64000	64000	100.0	128000
Bell, Huppert, Johnson	2003	March 2000	coho salmon	Tillamook Bay, OR	Coastal WA and OR	Nonuse primarily	61.77	71.01	0.000463187	69000	153300	222.2	222300
							108.47	143.04	0.002786048				

Avg:

Table 2-39. Most promising meta analysis regressions

Model #1: Double Log Regression: Dependent = Ln WTP/HH/Fish, Independent = Ln Increase in Population

	SUMMARY OUTPUT								
	Regression Statistics								
	Multiple R	0.95869321							
	R Square	0.91909267							
	Adjusted R Square	0.90560811							
	Standard Error	0.69452144							
		8							
	ANOVA								
		Df	*SS*	*MS*	*F*	*Significance F*			
		1	32.87713551	32.87714	68.15891	0.000170786			
		6	2.894160171	0.48236					
	Total	7	35.77129568						
		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
		6.34991612	1.774174192	3.579083	0.011656	2.008665094	10.6911672	2.008665094	10.69116716
Change in Population:	X Variable 1	-1.12323343	0.136053178	-8.25584	0.000171	-1.456143808	-0.7903231	-1.45614381	-0.79032305

Observations

Model #2: Semi Log (Log-Linear) Regression: Dependent = Ln WTP/HH/Fish, Independent = Increase in Population

	SUMMARY OUTPUT								
Regression	*Regression Statistics*								
Residual	Multiple R	0.82063093							
	R Square	0.67343513							
	Adjusted R Square	0.61900765							
Intercept	Standard Error	1.39532843							
		8							
	ANOVA								
		Df	*SS*	*MS*	*F*	*Significance F*			
		1	24.08964707	24.08965	12.37307	0.012555998			
		6	11.68164861	1.946941					
	Total	7	35.77129568						
		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
		-6.36572662	0.708890422	-8.97985	0.000107	-8.100320267	-4.631133	-8.10032027	-4.63113298
Change in Population:	X Variable 1	-1.5817E-06	4.49654E-07	-3.51754	0.012556	-2.68194E-06	-4.814E-07	-2.6819E-06	-4.8141E-07

Observations

Model #3: Semi Log (Linear-Log) Regression: Dependent = WTP/HH/Fish, Independent = Ln Increase in Population

	SUMMARY OUTPUT								
Regression	*Regression Statistics*								
Residual	Multiple R	0.74458966							
	R Square	0.55441376							
	Adjusted R Square	0.48014939							
Intercept	Standard Error	0.00483493							
		8							
	ANOVA								

Model #3: Semi Log (Linear-Log) Regression: Dependent = WTP/HH/Fish, Independent = Ln Increase in Population (con't)									
	SUMMARY OUTPUT								
		Df	*SS*	*MS*	*F*	*Significance F*			
		1	0.000174515	0.000175	7.465407	0.034082345			
		6	0.000140259	2.34E-05					
	Total	7	0.000314774						
		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
		0.03620765	0.01235095	2.931568	0.026234	0.005985939	0.06642935	0.005985939	0.066429354
Change in Population:	X Variable 1	-0.00258785	0.000947137	-2.73229	0.034082	-0.004905415	-0.0002703	-0.00490541	-0.00027029

Model #4: Double Log Regression: Dependent = Ln WTP/HH/Fish, Independent = Ln Starting Population, Ln % Increase in Population

	SUMMARY OUTPUT								
Regression	*Regression Statistics*								
Residual	Multiple R	0.959090182							
	R Square	0.919853977							
	Adjusted R Square	0.887795568							
Intercept	Standard Error	0.757222169							
	Observations	8							
	ANOVA								
		df	*SS*	*MS*	*F*	*Significance F*			
	Regression	2	32.90436861	16.45218	28.69306	0.001818465			
		5	2.866927069	0.573385					
	Total	7	35.77129568						
		Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
	Intercept	10.57283695	5.081136403	2.080802	0.091968	-2.488618648	23.634293	-2.48861865	23.63429255
% Change in Population:	X Variable 1	-1.03364099	0.437042011	-2.36508	0.064344	-2.157091409	0.0898094	-2.15709141	0.089809432
Starting Population:	X Variable 2	-1.08475033	0.230617682	-4.70367	0.00532	-1.677570989	-0.49193	-1.67757099	-0.49192968

Residual

Model Transfer - When the meta analysis effort proved unsuccessful, the various nonuse value studies were individually reviewed to select the most applicable study to the Yakima Storage Study alternatives. The Layton, Brown, and Plummer (1999) study was selected for use since it applied a state-of-the-art valuation approach (contingent ranking/conjoint analysis); provided a good discussion of past, current, and future baseline or "with project" conditions; and was developed for the same species of fish in the same overall geographic area as the Yakima Storage Study. Especially helpful was the fact that the Layton, Brown, and Plummer study estimated a model as a function of fish populations. As a result, varying quantities of fish populations associated with the Yakima Storage Study alternatives can be inserted into the model to estimate nonuse values across a wide range of fishery improvement conditions. Of the available nonuse value studies, the Layton, Brown, and Plummer study was therefore considered to be the most appropriate study for a model-based benefit transfer. The other studies did not allow for reapplication of a model and therefore would require very simplistic value transfers as opposed to the more preferable model transfer. As suggested above, the position was taken that it may be acceptable to employ a model-based transfer within the appraisal level/Draft EIS analyses, but a simple value transfer would not be sufficient for a benefit category as potentially contentious as nonuse values. So to reemphasize the point, while value transfer is a BT method, it was considered inadequate for nonuse valuation even at the appraisal/Draft EIS level.

While the Layton, Brown, and Plummer study had a number of advantages, it also has its disadvantages. As with any study within a benefits transfer context, there are certain aspects of the Layton, Brown, and Plummer study which we deemed to be either inconsistent with the Yakima Storage Study or simply inadequately described. The following list presents some of the more difficult to address issues. We contacted two of the study's authors (i.e., Mark Plummer and David Layton) to try and get some resolution to these issues, but, in some cases, even the authors did not agree.

1) Fish populations—The survey used to gather data for development of the willingness-to-pay model asked respondents to rank fisheries improvement scenarios based on cost and migratory fish (salmon and steelhead) populations in 20 years. While there is always a tradeoff between providing too much versus too little information within a survey, several problems arose from this definition of the growth in fish populations.

    a. Which fish population—In subsequently trying to apply the model derived from the survey, the question has arisen as to which fish

populations to apply. Should we be using spawners, adults, or some other measure of fish populations? Based on discussions with the authors, there is disagreement (one author interprets fish populations as adults whereas the other author interprets them as spawners). The definition of fish populations in the survey also said nothing about reflecting only T&E fish, so presumably fish populations represent both T&E and non-T&E fish.

b. Fish population growth before year 20—The survey was silent on the growth of fish populations from year 0 to year 20. As a result, we cannot distinguish between an alternative which has most of its growth in the first few years of the 20 year period versus an alternative which has most of it growth in the last few years.

c. Fish population growth after year 20—One of the authors suggested that the model estimates long-term average values compressed into a 20 year time period. Given the survey says nothing about the fish population growth after year 20, it appears to be a stretch to make this claim. If we really have no idea what fish populations are expected to do after year 20, we run into the same problem as the growth to year 20. The model would not be able to distinguish between alternatives with different growth patterns after year 20.

d. Year 20 fish populations or fish populations over 20 years—While the authors and WA DOE seem to concur that the fish populations presented in the survey clearly reflect fish populations in year 20, others may not be so sure. In reviewing the survey, there is enough ambiguity in the wording of some of the questions that a respondent might interpret the fish population estimate as the total over 20 years. This uncertainty may result in variation in the value estimates.

2) Values—Without a clear definition of fish populations, it becomes hard to say exactly what types of values are being obtained. As noted above, the one author interprets migratory fish populations as salmon and steelhead spawners. Since spawners survive to produce future generations of fish they obviously are not harvested (although they could be "nonconsumptively used" via catch and release fishing, fish viewing etc.) and, as a result, the values obtained could be considered primary nonuse values. Even if one assumed fish populations to mean spawners, by not defining fish populations as T&E, some economists might argue that nonuse values might not be applicable (i.e., are non-

T&E species unique enough to justify a nonuse value estimate?). Conversely, the other contacted author interprets fish populations as adults which may or may not be harvested, implying the potential for both nonuse and harvest (use) values. This total value concept is typically assumed to refer to both nonuse values and recreational use values (as opposed to Tribal and commercial use values). If the Layton, Brown, and Plummer model results in total values, then one would not want to separately estimate ocean and in-river recreational fishing values for fear of double counting the benefit. If the model estimates primarily nonuse values, little to no double counting would occur and recreational fishing values should be separately estimated.

3) Human population for aggregation of values—The survey only gathered information from households across the state of Washington. So while use and nonuse values would undoubtedly accrue to households outside of Washington (at the very least for households in the Columbia River bordering state of Oregon), from a technical perspective, one could question the use of households outside of Washington in the aggregation process.

It should be noted that there are really no right or wrong answers to the above issues since they are a matter of interpretation. Different people (including the study authors) can interpret the survey results differently. Obviously, the problem is that the interpretation is not clear, implying that survey respondents could have been valuing different scenarios based on their interpretations of the survey questions. Ideally, one should not have to make an educated guess as to what the survey questions and ultimately the survey results mean. However, as noted above, survey researchers always have to make tradeoffs between providing too much information (resulting in longer survey instruments and reduced response rates) versus providing not enough information (resulting in ambiguous questions and valuation interpretation problems).

Despite the apparent inconsistency between the interpretations of the study authors, for the preliminary nonuse valuations developed for the Yakima Storage Study appraisal-level BCA, the approach suggested by the Layton, Brown, and Plummer study's lead author was used (i.e., use spawner estimates in the model and assume the valuation results reflect nonuse values only). This is also the position taken by the State of Washington's Department of Ecology (co-lead agency on the Yakima Storage Study) who funded the Layton, Brown, and Plummer study and has been interpreting the Layton, Brown, and Plummer model in this way since the study was completed in 1999.

The actual BT-based nonuse value results associated with the range of preliminary fish population estimates by alternative evaluated in the Yakima Storage Study appraisal-level BCA are not presented. However, given the best-case scenario, high-end benefit-cost ratios for the appraisal-level benefit-cost analyses were calculated at approximately .3 to 1, inclusion of the nonuse value estimates did not critically affect the benefit-cost result. This implies that even the high-end benefit estimates, inclusive of BT-based nonuse values plus all other benefit categories (i.e., agriculture, fisheries, recreation, municipal, and hydropower), only covered about 30 percent of the estimated project costs in the appraisal-level BCA. It should be noted that the BT-based nonuse value estimates developed for the appraisal-level BCA may also have been somewhat optimistic in that all additional spawner populations (not simply the additional T&E spawner populations) were used in the calculation. Given the controversy over nonuse values in general, and nonuse value estimation approaches in particular, questions about the applicability of nonuse values to the range of fishery resources associated with the Yakima Storage Study, and the apparent insensitivity of the appraisal-level benefit-cost result to the inclusion of nonuse values, the decision was made to forego pursuing a site- and study-specific nonuse value survey and simply exclude quantification of nonuse values from the feasibility-level BCA. Instead, a qualitative discussion of nonuse values will be included in the feasibility study/EIS.

Chapter 3. REGIONAL ECONOMIC DEVELOPMENT ECONOMIC IMPACT ANALYSIS

This section describes the methodology and results of the regional economic development (RED) impact analysis conducted for the Yakima Storage Study. Regional economic impacts stem from changes in construction expenditures, operation and maintenance expenditures, gross farm income, and recreational expenditures for each alternative as compared to the No Action Alternative. The regional economic impact analysis comprises the RED account. The NED account compares the alternatives from a national perspective, whereas the RED account measures how the alternatives impact the region's local economy.

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 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 changes are carried over from the NED analysis. For example, changes in agricultural water supply may result in a change in crop acreages which subsequently result 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.

See Chapter 3, National Economic Development Benefit Cost Analysis, for further explanation on the difference between the NED and RED accounts.

3.1 Methodology and Assumptions

The study area encompasses Kittitas, Yakima, Benton, and Franklin Counties of Washington State. Ellensburg, Yakima, and the Tri-Cities (Richland, Pasco, and Kennewick) are the largest cities located within the study area. The Yakima River basin includes all of these counties except for Franklin County. Franklin

County was included because the Tri-Cities are located in both Franklin and Benton Counties.

The common measures of regional economic impacts are output, employment, and labor income. Output is the dollar value of production (sales revenues and gross receipts) from all industries in the region. Labor income is a measure of employee compensation (wages and benefits) plus income for self-employed individuals. Employment is the number of jobs, both full-time and part-time, in a particular sector.

The regional impacts in the analysis of the Yakima Storage Study alternatives are a result of: 1) Construction expenditures made within the study area; 2) regional operation and maintenance expenditures; 3) changes in gross farm income related to the alternatives; and 4) regional expenditures related to recreation visitation.

The regional economic impact analysis involves running alternative specific estimates of expenditures or gross farm income through a regional impact model generated for the study area. IMPLAN (IMpact, Analysis, for PLANning) was selected for this analysis. IMPLAN is an input-output modeling system that estimates the effects of economic changes in a region.

3.2 Construction Costs

The construction-related expenditures associated with each of the alternatives were placed into categories that represent different sectors of production in the economy. The construction expenditures that are made inside the study region were considered in the regional impact analysis. Construction expenditures made outside the four-county area were considered “leakages” and would have no impact on the local economy.

The RED study assumes that the workforce would move to the region and spend their wages inside the area during the construction period. This analysis also assumed that the vast majority of the construction expenditures will be funded from sources outside the four-county study area. Money from outside the region that is spent on goods and services within the region would contribute to regional economic impacts, while money that originates from within the study region is much less likely to generate regional economic impacts. Spending from sources within the region represents a redistribution of income and output rather than an increase in economic activity.

For the purpose of this study, the total construction costs were used to measure the overall regional impacts. These overall impacts would be spread over the

construction period and would vary year-by-year proportionate to actual expenditures.

Table 3-1, Table 3-2, and Table 3-3 summarize the in-region construction costs used in this analysis. Table 3-3 summarizes the Yakima Pump Exchange costs. These costs were added to the Wymer costs shown in Table 3-2 to estimate the Wymer Plus alternative.

Table 3-1. Black Rock in-region costs and IMPLAN sector (million $)

	Total Cost	In Region costs and sector		
		IMPLAN sector	Non-wages	Wages
Intake - Civil/Structural	$59	Other New Construction	26.12	18.27
Intake – Mechanical	$12	Other New Construction	4.35	2.90
Plant - Civil/Structural	$76	Other New Construction	40.40	25.05
Plant – Mechanical	$108	Other New Construction	23.06	12.55
Plant – Electrical	$6	Other New Construction	1.04	0.70
Switchyard & Transmission Line	$24	Other New Construction	4.12	2.74
Discharge 2	$219	Other New Construction	85.34	52.15
Black Rock Outlet Plant Option 1	$25	Other New Construction	12.24	8.54
Black Rock Outlet Mechanical	$90	Other New Construction	13.79	9.03
Black Rock Outlet Electrical	$5	Other New Construction	0.64	0.43
Outlet Switchyard & Transmission Lines	$1	Other New Construction	0.18	0.12
Highway and Utility Relocations	$72	Highway, Street, Bridge, and Tunnel Construction	37.13	24.75
Black Rock Dam Type 2	$891	Water Sewer and Pipeline Construction	470.66	311.42
Low Level Outlet Works	$103	Water Sewer and Pipeline Construction	35.94	26.50
Black Rock Outflow Conveyance	$360	Water Sewer and Pipeline Construction	125.80	75.13

Table 3-2. Wymer in-region construction costs and IMPLAN sector (million $)

	Total Costs	In Region Costs and Sector		
		IMPLAN Sector	Non-Wages	Wages
Yakima River -- Wymer Pumping Plant Intake	18.35	Other New Construction	5.90	4.39
Pumping Plant	54.25	Other New Construction	16.45	11.70
Switchyard & Transmission Line	6.07	Other New Construction	1.05	0.71
Dam & Dike	365.59	Other New Construction	185.96	124.12
Spillway & Outlet Works	59.78	Other New Construction	26.10	19.00
Diversion & Care	4.41	Other New Construction	1.89	1.25
Road & Creek Improvements	5.90	Highway, Street, Bridge, and Tunnel Construct.	2.10	1.38
Discharge Pipeline	24.31	Water Sewer and Pipeline Construction	9.52	6.59

Table 3-3. Wymer Pump Exchange (Wymer dam not included) in-region construction costs and IMPLAN sector

	Total Cost	In Region Costs and Sector		
		IMPLAN Sector	Non-Wages	Wages
Pumping Plant #1	101.9	Other New Construction	24.54	16.48
Pumping Plant #2	116.2	Other New Construction	41.17	28.14
Pumping Plant #3 -- Plan 2	53.1	Other New Construction	17.41	11.61
Pumping Plant Intake	18.3	Water Sewer and Pipeline Construction	7.60	5.59
Discharge Pipelines	1164.2	Water Sewer and Pipeline Construction	373.13	248.75
Deliveries	0.45	Water Sewer and Pipeline Construction	0.27	0.18

3.2.1 Results

Regional economic impacts related to construction expenditures, incremental to the No Action Alternative, for each Joint Alternative, are presented in Table 3-4. The employment, output, and income generated from each alternative's expenditures are compared to the overall regional economy. The estimated impacts are representative of the entire construction period. These impacts would not occur each year; they vary year by year proportionate to annual expenditures. The majority of the employment, output, and income impacts are due to the expenditures of the wages earned by the workforce involved in the construction project and the construction activities.

Table 3-4. Summary of regional economic impacts stemming from construction expenditures

	Black Rock			Wymer			Wymer Plus		
	Labor Income (million $)	Employment (jobs)	Output (million $)	Labor Income (million $)	Employment (jobs)	Output (million $)	Labor Income (million $)	Employment (jobs)	Output (millions $)
Ag, Forestry, Fish & Hunting	3.5	167.0	13.0	1.1	51.0	4.0	3.0	140.0	11.0
Mining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Utilities	1.0	13.0	6.2	0.3	4.0	1.9	0.9	11.0	5.2
Construction	378.8	8,245.0	887.6	116.1	2,540.0	251.0	313.3	6,829.0	718.8
Manufacturing	7.6	168.0	42.9	2.5	56.0	14.0	6.5	144.0	36.4
Wholesale Trade	21.0	492.0	55.7	6.0	140.0	15.8	17.2	404.0	45.8
Transportation & Warehousing	14.5	360.0	34.4	3.7	92.0	8.4	11.5	285.0	26.9
Retail trade	50.6	2,026.0	124.7	15.4	618.0	38.0	42.5	1,700.0	104.6
Information	6.3	139.0	29.0	1.9	42.0	8.8	5.3	116.0	24.3
Finance & insurance	15.4	341.0	56.1	4.5	100.0	16.4	12.7	282.0	46.5
Real estate & rental	10.2	372.0	52.1	2.9	109.0	14.9	8.3	308.0	42.8
Professional- scientific & tech svcs	47.6	762.0	85.2	14.7	234.0	26.3	40.1	641.0	71.8
Management of companies	2.6	39.0	5.9	0.8	11.0	1.8	2.1	32.0	4.9
Administrative & waste services	10.5	447.0	20.4	3.6	152.0	6.8	9.1	388.0	17.5
Educational svcs	3.9	210.0	8.4	1.2	63.0	2.5	3.3	176.0	7.0
Health & social services	77.4	1,995.0	144.5	23.2	599.0	43.4	64.7	1,667.0	120.8
Arts- entertainment & recreation	4.4	274.0	12.3	1.3	82.0	3.7	3.7	229.0	10.3
Accomodation & food services	21.0	1,358.0	63.6	6.3	407.0	19.1	17.6	1,134.0	53.2
Other services	21.9	1,081.0	55.1	6.5	324.0	16.1	18.3	902.0	45.6
Government & non NAICs	11.2	180.0	166.6	3.4	54.0	50.0	9.4	150.0	139.3
Instutitions	0.0	0.0	236.6	0.0	0.0	70.2	0.0	0.0	199.1
Total	709.6	18,669.0	2,100.4	215.5	5,678.0	613.2	589.4	15,538.0	1,731.7

The total number of jobs for the Black Rock Alternative during the approximate 10-year construction period, 18,668, includes 8,181 jobs in the construction sector. Thus, assuming a 10-year construction period, an average of about 820 of the 1,870 average annual jobs would be directly related to construction and include onsite and offsite labor. The 8,181 direct construction jobs would be about 3 percent of the regional 2004 employment, while the total number of jobs, 18,668, would be less than 8 percent. The average annual direct and average annual total number of jobs, 820 and 1,870, respectively, would be less than 1 percent of the regional 2004 employment.

The total number of jobs for the Wymer Dam and Reservoir Alternative during the approximate 10-year construction period, 5,677, includes 2,521 jobs in the construction sector. Thus, assuming a 10-year construction period, an average of about 250 of the 570 average annual jobs would be directly related to construction and include onsite and off site labor. The 2,521 direct construction jobs would be about 1 percent of the regional 2004 employment, while the total number of jobs, 5,677, would be about 2 percent. The average annual direct and average annual total number of jobs, 250 and 570, respectively, would be less than 3/10 of 1 percent of the regional 2004 employment.

The total number of jobs associated with the Wymer Dam and Reservoir Alternative would be an increase in regional population of less than 2 percent, while the direct construction jobs would be an increase of about ½ of 1 percent. The average annual direct and average annual total number of jobs would be about 1/10 of 1 percent of the regional population.

The total number of jobs for the Wymer Dam Plus Yakima River Pump Exchange Alternative during the 10-year construction period, 15,539, includes 6,776 jobs in the construction sector. Thus, assuming a 10-year construction period, an average of about 680 of the 1,550 average annual jobs, would be directly related to construction and include onsite and off site labor. The 6,776 direct construction jobs would be slightly less than 3 percent of the regional 2004 employment, while the total jobs, 15,539, would be about 6 percent. The average annual direct and average annual total number of jobs, 680 and 1,550, respectively, would be less than 1 percent of the regional 2004 employment.

The total number of jobs associated for the Wymer Dam Plus Yakima River Pump Exchange Alternative would be an increase in regional population of about 3 percent, while the direct construction jobs would be an increase of about 1 percent. The average annual direct and average annual total number of jobs would be less than ½ of 1 percent of the regional population.

3.3 Operation, Maintenance, and Replacement

Expenditures that are made inside the study region related to OM&R will also generate a positive economic output to the regional economy. Estimating regional impacts resulting from OM&R expenditures is difficult because they occur during different periods of time. For example, expenditures related to operations and maintenance occur annual whereas replacement expenditures occur periodically based on the replacement schedule.

This analysis quantifies annual impact resulting from annual costs related to operation and maintenance. The analysis does not quantify the positive impacts resulting from replacement costs given they are spread out over the entire study period. Like the construction related expenditures, O&M expenditures made inside the study area associated with each alternative were placed into categories related to the each sector of the economy and run through IMPLAN to estimate impacts to the regional economy. Table 3-5 summarizes the in-region expenditures used in this analysis.

Table 3-5. In region O&M costs and IMPLAN sector

Black Rock O&M	Total	In-region Labor	IMPLAN sector	In-region Nonlabor	IMPLAN sector
Black Rock O&M	$10,170,000	$2,441,098	Medium Household Income	$626,860	Other New Construction
Wymer	$1,080,000	$566,251	Medium Household Income	$234,015	Other New Construction
Wymer Plus Pump Exchange	$18,198,000	$883,771	Medium Household Income	$6,682,695	Other New Construction

3.3.1 Results

Regional economic impacts related to O&M expenditures incremental to the No Action Alternative for each alternative are shown in Table 3-6. The employment, output, and income generated from each alternative's O&M are compared back to the overall economy. These impacts are assumed to occur on an annual basis. Like the construction impacts, the majority of the O&M impacts are due to the expenditures of the wages earned by the workforce involved O&M related activities.

Table 3-6. Regional economic impacts stemming from annual O&M expenditures

	Black Rock			Wymer			Wymer Plus		
	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)
Ag, Forestry, Fish & Hunting	9,783	0.5	36,431	2,447	0.1	9,098	16,495	0.7	60,372
Mining	6	0	76	2	0	20	19	0	172
Utilities	2,813	0	16,895	703	0	4,219	4,690	0.1	28,001
Construction	298,478	6.5	643,422	110,601	2.4	238,230	3,121,910	68.3	6,715,981
Manufacturing	16,919	0.4	99,250	4,522	0.1	26,121	49,680	1.1	261,657
Wholesale Trade	47,650	1.1	126,762	12,195	0.3	32,442	100,438	2.4	267,193
Transportation & Warehousing	26,604	0.7	61,281	6,952	0.2	15,978	66,537	1.6	150,655
Retail trade	134,228	5.3	329,262	33,795	1.3	82,980	242,328	9.8	600,264
Information	15,516	0.3	71,281	3,966	0.1	18,225	32,363	0.7	148,946
Finance & insurance	39,092	0.9	143,750	9,840	0.2	36,130	70,379	1.6	254,979
Real estate & rental	21,705	0.9	112,354	5,636	0.2	29,134	51,674	1.8	264,445
Professional- scientific & tech svcs	57,648	1.1	108,430	18,054	0.3	33,348	361,959	5.4	636,457
Management of companies	6,006	0.1	13,899	1,541	0	3,566	12,927	0.2	29,915
Administrative & waste services	22,086	0.9	44,544	6,019	0.3	11,949	73,283	3.1	133,896
Educational svcs	11,456	0.6	24,463	2,823	0.2	6,027	16,187	0.9	34,566
Health & social services	221,596	5.70	413,323	54,819	1.4	102,270	329,145	8.5	615,473
Arts- entertainment & recreation	12,484	0.8	35,042	3,093	0.2	8,680	18,879	1.2	52,867
Accomodation & food services	60,965	3.9	184,439	15,043	1	45,504	87,739	5.6	265,012
Other services	55,539	2.9	136,294	14,043	0.7	34,509	104,574	4.9	260,141
Government & non NAICs	30,075	0.5	485,755	7,541	0.1	119,776	52,061	0.8	692,971
Instutitions	0	0	1,012,788	0	0	234,932	0	0	366,668
Total	1,090,649	33	4,099,741	313,635	9	1,093,138	4,813,267	119	11,840,631

3.4 Irrigated Agriculture

Regional economic impacts are realized only in drought years when the proration level is below 70 percent. Table 2-17 in section 2.3.1 this document summarizes the proration levels for the 6 years were the proration levels dropped below 70 percent. During these years positive regional impacts are attributable to the Yakima Storage study alternatives. During these 6 dry years, the alternatives increase the water supply available to irrigated agriculture.

The YAI model discussed earlier was used to estimate the changes in gross on-farm income incremental to the No-Action alternative. The crops modeled in the YAI model, were aggregated into the IMPLAN sectors, summarized in Table 3-7. Table 3-8 summarizes the gross on-farm income which was run through IMPLAN to estimate regional impacts.

It should be noted that this analysis measures the impacts stemming from production agriculture. Industries that rely on irrigated crops as part of their production process, for example, food processing or livestock industries, will also be positively impacted by the alternatives.

Table 3-7. Representative crop table

IMPLAN sector	Crops included
Vegetables	Asparagus, Sweet Corn, Potato
Fruits	Cherries, Pears, Apples
Other	Mint, Hops, Concord Grapes, Wine Grapes, Timothy Hay, Alfalfa, Silage
Grains	Wheat

Table 3-8. Gross on farm income summary

Alternative	Year	Grains ($)	Other ($)r	Fruits ($)	Vegetables ($)
Black Rock	1987	556,579	17,232,110	16,043,770	1,129,626
	1992	428,138	13,255,040	12,347,810	868,943
	1993	685,021	21,206,100	19,804,730	1,393,283
	1994	1,840,993	55,196,340	88,008,910	4,932,981
	2001	1,113,159	34,101,480	43,542,390	2,964,663
	2005	1,070,345	32,796,050	41,392,080	2,821,306
Wymer and Wymer Plus	1987	171,255	5,302,016	4,939,123	347,577
	1992	256,883	7,953,024	7,408,685	521,366
	1993	470,952	14,578,580	13,630,830	958,812
	1994	85,628	2,086,366	6,944,756	32,920
	2001	642,207	19,520,940	29,959,800	2,008,826
	2005	171,255	5,221,744	8,601,246	573,428

3.4.1 Results

Table 3-9 and Table 3-10 show the regional economic impacts for the years where the proration level fell below 70 percent for Black Rock and Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives, respectively. These results are shown on an annual basis because dry years do not occur each year in the period of record.

Table 3-9. Regional economics impacts stemming from changes in gross On-farm production for the Black Rock Alternative.

	1987			1992			1993			1994			2001			2005		
	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output($)	Labor Income ($)	Employment (jobs)	Output($)	Labor Income ($)	Employment (jobs)	Output($)	Labor Income ($)	Employment (jobs)	Output($)
Ag, Forestry, Fish & Hunting	13,866,143	439.4	38,678,232	10,669,217	338.1	29,759,350	17,094,462	541.7	47,670,852	62,528,400	1,978	166,979,776	33,397,480	1,055.90	90,741,160	31,874,860	1,007.80	86,685,752
Mining	86	0	1,309	66	0	1,007	106	0	1,612	338	0	5,156	191	0	2,907	182	0	2,783
Utilities	20,618	0.3	119,290	15,864	0.2	91,784	25,414	0.4	147,035	90,246	1	521,803	48,758	0.7	281,990	46,566	0.6	269,314
Construction	63,363	1.4	146,134	48,752	1.1	112,438	78,098	1.7	180,117	275,497	6	635,416	149,217	3.3	344,153	142,528	3.1	328,727
Manufacturing	250,904	4.9	2,272,304	193,051	3.8	1,748,338	309,268	6.1	2,800,618	1,101,938	22	9,828,431	594,180	11.9	5,329,431	567,433	11.4	5,091,297
Wholesale trade	447,860	10.5	1,191,427	344,600	8.1	916,727	552,094	13	1,468,715	1,998,437	47	5,316,373	1,071,152	25.2	2,849,548	1,022,572	24	2,720,313
Transportation & warehousing	277,962	7.1	666,160	213,870	5.4	512,555	342,622	8.7	821,092	1,220,739	31	2,906,881	658,663	16.8	1,572,443	628,999	16	1,501,834
Retail trade	566,840	22.5	1,389,958	436,149	17.3	1,069,490	698,793	27.7	1,713,523	2,545,441	101	6,241,482	1,361,665	54	3,338,882	1,299,707	51.5	3,186,960
Information	82,608	1.8	374,299	63,561	1.4	288,000	101,836	2.2	461,425	369,892	8	1,677,153	198,083	4.4	897,898	189,082	4.2	857,084
Finance & insurance	229,885	5.1	850,312	176,879	3.9	654,250	283,365	6.3	1,048,121	1,012,330	22	3,740,087	545,524	12.1	2,016,374	520,929	11.5	1,925,513
Real estate & rental	230,399	9.4	1,259,919	177,267	7.3	969,370	283,933	11.6	1,552,635	974,986	40	5,315,061	533,903	21.9	2,914,195	510,271	20.9	2,785,394
Professional- scientific & technical services	266,094	5.5	523,895	204,745	4.3	403,108	328,047	6.8	645,866	1,201,562	25	2,362,849	640,979	13.3	1,261,103	611,753	12.7	1,203,633
Management of companies	41,239	0.6	95,436	31,731	0.5	73,432	50,835	0.8	117,643	182,829	3	423,107	98,238	1.5	227,345	93,796	1.4	217,065
Administrative & waste services	119,513	4.7	255,544	91,956	3.6	196,621	147,315	5.7	314,987	525,706	21	1,121,169	283,455	11.1	605,141	270,681	10.6	577,901
Educational services	49,180	2.6	104,889	37,841	2	80,706	60,629	3.2	129,307	221,009	12	471,349	118,195	6.3	252,078	112,815	6	240,604
Health & social services	1,035,076	27.00	1,937,083	796,430	20.8	1,490,472	1,276,037	33.3	2,388,027	4,652,286	121	8,706,460	2,487,882	64.9	4,655,918	2,374,632	61.9	4,443,976
Arts- entertainment & recreation	59,282	3.7	166,382	45,614	2.8	128,022	73,083	4.5	205,116	266,568	16	748,193	142,520	8.8	400,013	136,031	8.4	381,801
Accommodation & food services	260,814	16.8	788,065	200,681	12.9	606,369	321,529	20.7	971,516	1,170,971	75	3,538,230	626,439	40.3	1,892,846	597,938	38.5	1,806,727
Other services	283,118	13.9	694,735	217,841	10.7	534,554	349,014	17.1	856,427	1,265,081	62	3,099,853	678,037	33.3	1,662,294	647,255	31.8	1,586,880
Government & non NAICs	221,980	3.5	2,355,202	170,796	2.7	1,812,175	273,618	4.3	2,903,344	975,744	15	10,504,348	526,309	8.3	5,634,098	502,595	7.9	5,378,534
Institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	18,372,964	581	53,870,575	14,136,911	447	41,448,768	22,650,098	716	66,397,978	82,580,000	2,608	234,143,177	44,160,870	1,394	126,879,816	42,150,625	1,330	121,192,089

Table 3-10. Regional economic impacts Stemming from changes in gross onfarm production for the Wymer Dam and Wymer Dam Plus Yakima River Pump Exchange Alternatives

	1987			1992			1993			1994			2001			2005		
	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output($)	Labor Income ($)	Employment (jobs)	Output($)	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)
Ag, Forestry, Fish & Hunting	4,267,687	135.2	11,903,739	6,401,530	202.9	17,855,610	11,759,857	372.7	32,791,184	4,039,308	129	10,274,031	21,661,356	683.90	58,005,916	6,090,542	192.20	16,221,795
Mining	26	0	403	40	0	604	73	0	1,109	19	0	284	118	0	1,800	33	0	497
Utilities	6,346	0.1	36,713	9,518	0.1	55,070	17,482	0.2	101,143	5,654	0	32,672	31,308	0.4	181,028	8,770	0.1	50,707
Construction	19,501	0.4	44,975	29,251	0.6	67,463	53,721	1.2	123,898	17,156	0	39,568	95,589	2.1	220,472	26,754	0.6	61,707
Manufacturing	77,221	1.5	699,335	115,831	2.3	1,049,003	212,743	4.2	1,926,449	69,660	2	613,034	381,824	7.7	3,406,260	106,990	2.2	952,544
Wholesale trade	137,840	3.2	366,691	206,760	4.9	550,036	379,794	8.9	1,010,352	128,265	3	341,220	692,092	16.3	1,841,149	194,321	4.6	516,946
Transportation & warehousing	85,548	2.2	205,022	128,322	3.3	307,533	235,687	6	564,814	76,780	2	181,517	423,406	10.8	1,008,632	118,657	3	282,437
Retail trade	174,460	6.9	427,796	261,690	10.4	641,694	480,719	19.1	1,178,778	163,819	7	401,675	881,901	35	2,162,445	247,834	9.8	607,693
Information	25,425	0.6	115,200	38,137	0.8	172,800	70,055	1.5	317,425	23,743	1	107,735	128,165	2.8	581,098	36,004	0.8	163,256
Finance & insurance	70,752	1.6	261,700	106,127	2.4	392,550	194,926	4.3	720,996	63,960	1	236,011	350,957	7.8	1,296,700	98,383	2.2	363,448
Real estate & rental	70,907	2.9	387,748	106,360	4.4	581,622	195,299	8	1,067,951	58,778	2	319,231	338,909	13.9	1,847,890	94,529	3.9	515,209
Professional- scientific & technical services	81,898	1.7	161,243	122,847	2.6	241,865	225,675	4.7	444,312	78,159	2	153,465	415,759	8.7	817,684	116,901	2.4	229,881
Management of companies	12,692	0.2	29,373	19,038	0.3	44,059	34,970	0.5	80,927	11,659	0	26,980	63,335	1	146,571	17,768	0.3	41,120
Administrative & waste services	36,782	1.4	78,648	55,174	2.2	117,973	101,337	4	216,676	33,138	1	70,472	182,304	7.1	388,858	51,099	2	108,961
Educational services	15,136	0.8	32,282	22,705	1.2	48,424	41,708	2.2	88,954	14,233	1	30,355	76,570	4.1	163,302	21,520	1.2	45,896
Health & social services	318,572	8.30	596,189	477,858	12.5	894,283	877,822	22.9	1,642,791	299,651	8	560,776	1,611,810	42	3,016,401	453,007	11.8	847,773
Arts- entertainment & recreation	18,246	1.1	51,209	27,368	1.7	76,813	50,276	3.1	141,105	17,184	1	48,233	92,345	5.7	259,190	25,955	1.6	72,850
Accommodation & food services	80,272	5.2	242,548	120,409	7.7	363,822	221,188	14.2	668,332	75,357	5	227,705	405,689	26.1	1,225,840	114,005	7.3	344,480
Other services	87,137	4.3	213,821	130,705	6.4	320,732	240,093	11.8	589,151	81,009	4	198,240	438,412	21.5	1,074,285	123,128	6.1	301,658
Government & non NAICs	68,318	1.1	724,870	102,478	1.6	1,087,305	188,220	3	1,997,257	61,412	1	671,255	338,433	5.3	3,640,708	94,855	1.5	1,022,263
Institutions	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	5,654,766	179	16,579,505	8,482,148	268	24,869,261	15,581,645	493	45,673,604	5,318,944	169	14,534,459	28,610,282	902	81,286,229	8,041,055	254	22,751,121

3.5 Recreation

Regional economic effects stemming from recreation activity derive from in-region recreational expenditures such items as hotels and motels, restaurants, groceries, gasoline, etc. Changes in regional recreation expenditures can result in gains or losses in regional output, income, and employment.

This section describes the methodology for estimating regional economic impacts for recreation as well as the results of the analysis.

3.5.1 Methodology

Economic impacts associated with changes in recreation activity within the region were estimated for both the proposed reservoirs and existing reservoirs and rivers. As noted in the recreation benefit section, changes in existing reservoir water levels and river instream flows occur as a result of the operation of the proposed Black Rock and Wymer reservoirs. These changes in hydrologic water level and instream flow conditions generate changes in recreation visitation at each site for each action alternative (i.e., Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives) as compared to the No Action Alternative. Estimates of changes in visitation by site were obtained from the recreation analysis. Given that the potential Black Rock and Wymer reservoirs are obviously not a part of the No Action Alternative, the estimates of visitation for these potential reservoirs reflect the full change in visitation as compared to the No Action Alternative.

In regional economic impact analyses of recreation, the assumption is typically made that the majority of impacts are generated by expenditures from recreators residing outside the region. Within-region recreators are generally assumed to spend the majority of their recreation expenditures within the region regardless of the alternatives under consideration, implying they would generate little by way of additional regional economic activity. As a result, the analysis focuses on in-region expenditures by nonlocal recreators.

3.5.1.1 Changes in Visitation by Nonlocal Recreators

Estimates of changes in visitation as compared to the No Action Alternative were obtained for each site and action alternative from the *Yakima River Basin Reservoir and River Recreation Survey Report of Findings* (Reclamation, 2008). Since these changes in visitation obviously include both local and nonlocal recreators, estimates of the nonlocal portion of the visitation change had to be

developed. For the existing reservoir and river sites, the nonlocal visitation percentage was estimated based on the results of the recreation survey. For the proposed reservoirs, the nonlocal visitation percentage was estimated by activity based on professional judgment (see percentages listed below). Applying the nonlocal visitation percentage estimates by site to the estimates of the total change in visitation by alternative and site provides an estimate of the nonlocal change in visitation by site and alternative.

Nonlocal Visitation Percentages by Site:

Existing Sites:

1) Yakima River: 50% (from recreation survey)

2) Tieton River: 78% (from recreation survey)

3) Kachess Lake: 86% (from recreation survey)

4) Cle Elum Lake: 66.3% (from recreation survey)

Proposed New Sites:

5) Black Rock Reservoir: 28% (see Table 3-11 below)

6) Wymer Reservoir: 0% (Recreation analysis assumed that visitation was entirely comprised of local area residents)

Table 3-11. Nonlocal visitation percentage for the Black Rock Alternative

Activity	Total # annual visits (1,000)	% Local	% Nonlocal	# Local visits (1,000)	# Nonlocal visits (1,000)
Boat Fishing	100	0.5	0.5	50	50
Shoreline Fishing [1]	40	0.8	0.2	32	8
Swimming [1]	60	0.8	0.2	48	12
Picnicking [1]	60	0.8	0.2	48	12
Water & Jet Ski	100	0.7	0.3	70	30
Walking	12	1	0	12	0
Wildlife Viewing	12	1	0	12	0
Horseback Riding	8	1	0	8	0
ORV Riding	8	1	0	8	0
Total visits	400	72	28	288	112

[1] Shoreline fishing, swimming, and picnicking activities were assumed to be "predominantly local" by the recreation analysis. With water and jet skiing assumed at 70% local by the recreation analysis, we assumed "predominantly local" reflected an even higher percentage. For this analysis, "predominantly local" was considered as 80% local. *Source: Yakima River Basin Reservoir and River Recreation Survey Report of Findings* .(Reclamation, 2008)

3.5.1.2 Recreation Expenditures per Visit by Site

The estimates of the change in visits as compared to the No Action Alternative by site and alternative for nonlocal recreators were multiplied by estimates of nonlocal-recreator, in-region expenditures per visit associated with each site to calculate the change in total nonlocal recreator in-region expenditures by site and alternative. These estimates of the change in alternative-specific total in-region recreational expenditures by nonlocal residents were then run through the IMPLAN model to estimate the alternative-specific regional economic impacts on output, income, and employment within the four-county region associated with the estimated changes in recreation activity.

This section presents information on the nonlocal-recreator, in-region expenditures per visit as obtained from the recreation survey. Given that nonlocal-recreator, in-region expenditures per visit vary by site, the survey was conducted across all the existing reservoirs and rivers within the region. Survey questions asked recreators to estimate their total expenditures for the current visit, the portion of those expenditures incurred within the local region, and the breakdown of expenditures into various expenditure categories (e.g., lodging, food, gas, etc.). This later piece of information was necessary to help subdivide the expenditures across the 500+ economic sectors included in the IMPLAN model.

Table 3-12 presents the results of the total expenditures per trip question by site for nonlocal recreators. Note that the data is only presented for the four existing sites expected to be impacted by the alternatives under consideration (i.e., Kachess Lake, Cle Elum Lake, Yakima River, and Tieton River). The information on average total expenditures per trip was obtained by recreation activity from the survey. In the final analysis, a weighted average expenditure per trip was estimated for each site by weighing the expenditure per trip estimates by activity by their frequencies of occurrence within the overall survey. The estimates of weighted average expenditures per trip were as follows: Kachess Lake = $128.06, Cle Elum Lake = $195.16, Tieton River = $207.00, and the Yakima River = $176.35. Nonlocal-recreator expenditure per trip information was also needed for the proposed Black Rock reservoir (note that Wymer would not generate much in terms of additional regional economic activity, since 100 percent of visitation was assumed to reflect local recreators). A comparison was made between the breakdown of anticipated recreation activities at Black Rock and the current recreational activities at Kachess Lake and Cle Elum Lake. The breakdown of activities at Cle Elum Lake proved to be a better fit than those at Kachess Lake. As a result, the expenditures per trip at Cle Elum Lake were used for Black Rock reservoir as well.

Table 3-12. Average total expenditures per trip to each reservoir and river by primary activity - nonlocal respondents

Primary Recreation Activity	Kachess Lake			Cle Elum Lake			Tieton River			Yakima River		
	Average $ spent per trip	Frequency	Weighted Average Expenditures Across All Activities	Average $ spent per trip	Frequency	Weighted Average Expenditures Across All Activities	Average $ spent per trip	Frequency	Weighted Average Expenditures Across All Activities	Average $ spent per trip	Frequency	Weighted Average Expenditures Across All Activities
Motorboating	$75.36	14	1,055.04	$247.08	12	2,964.96	**			**		
Boat fishing (guided)	**			**			**			**		
Boat fishing (private)	$63.00	10	630.00	$117.50	4	470.00	**			$187.27	11	2,059.97
Bank fishing/Shoreline fishing	$37.22	9	334.98	$45.00	4	180.00	$100.00	4	400.00	$105.00	4	420.00
Kayaking/Canoeing	$167.22	9	1,504.98	$100.00	3	300.00	$153.61	18	2,764.98	$110.83	6	664.98
Water-skiing	$137.50	4	550.00	$307.50	6	1,845.00	**			**		
PWC/Jet-skiing	**			$286.36	11	3,149.96	**			**		
Swimming	$56.43	7	395.01	$181.43	7	1,270.01	**			**		
Camping	$184.18	59	10,866.62	$177.62	26	4,618.12	$214.75	26	5,583.50	$141.96	23	3,265.08
Sightseeing	$52.00	5	260.00	**			**			$86.67	3	260.01
Wildlife viewing	**			$55.00	3	165.00	**			**		
Picnicking/Day use	$23.33	3	69.99	$169.00	5	845.00	$75.00	3	225.00	$95.00	6	570.00
Rafting (guided)	**			**			$170.00	7	1,190.00	**		
Rafting (private)	**			**			$260.17	30	7,805.10	$369.38	16	5,910.08
Wade fishing	**			**			$110.00	6	660.00	$130.83	6	784.98
Trail use	**			**			**			$93.60	5	468.00
Tubing	**			**			**			$102.50	4	410.00
Other	$28.33	3	84.99	**			$483.33	3	1,449.99	**		
		123	15,751.61		81	15,808.05			20,078.57		84	14,813.10
Weighted Averages:			$128.06			$195.16			$207.00			$176.35

** Denotes that there were not sufficient responses or activity not applicable

Table 3-13, Table 3-14, Table 3-15, and Table 3-16 provide cost category details for Kachess Lake, Cle Elum Lake, Yakima River, and the Tieton River. The weighted nonlocal-recreator average total expenditures per trip by site estimate from Table 3-12 was first multiplied by the percentage of nonlocal-recreator expenditures per trip incurred within the region so as to focus on only in-region expenditures. The in-region percentage was estimated at each site by dividing the weighted in-region expenditures across all activities by the weighted total expenditures across all activities. These percentages were calculated as follows: Kachess Lake = 38.3%, Cle Elum Lake = 68.2%, Yakima River = 50.2%, and the Tieton River = 41.2%. The resulting nonlocal-recreator in-region average total expenditures per trip by site (i.e., Kachess Lake = $49.02, Cle Elum Lake = $133.09, Tieton River = $85.24, and the Yakima River = $88.47) were then multiplied by the site-specific percent of total expenditures for each expenditure category (calculated from the in-region weighted totals). This provides an estimate of nonlocal-recreator, in-region expenditures per trip by expenditure category for each site. These expenditures per trip by expenditure category were then multiplied by the estimate of the change in nonlocal visitation by site and alternative to measure the total change in nonlocal-recreator, in-region expenditures by expenditure category, site, and alternative. The total expenditure information by expenditure category, site, and alternative was then aggregated across sites to provide an estimate of the total expenditures by category and alternative. It was this alternative's specific expenditure information by expenditure category that was fed into the IMPLAN model to estimate the regional impacts of recreation for each alternative.

Table 3-13. Average total and within local area trip expenditures by expenditure category - nonlocal respondents

Kachess Lake											
Expenditure Category:	**Total Expenditures**					**In-Region Expenditures**					**Weighted Average In-Region Expenditures per Trip by Nonlocals Across All Activities**
	Frequency	**Average total $ spent**	**% of total $ spent based on Straight Total**	**Weighted Totals**	**% of total $ spent based on Weighted Total**	**Frequency**	**Average local $ spent**	**% of local $ spent based on Straight Total**	**Weighted Totals**	**% of local $ spent based on Weighted Total**	
										Weighted Average Total Expenditures per Trip:	$128.06
										In-Region Percentage:	0.383
										Weighted Average In-Region Expenditures per Trip:	$49.02
Camping fees	64	$71.66	0.185	4586.24	0.273	29	$71.34	0.182	2,068.86	0.322	$15.80
Day use fees	12	$15.33	0.040	183.96	0.011	4	$19.00	0.049	76.00	0.012	$0.58
Hotels/motels and other lodging		**					**				
Restaurants	10	$51.50	0.133	515.00	0.031	8	$60.63	0.155	485.04	0.076	$3.70
Groceries and liquor	54	$121.95	0.315	6585.30	0.393	29	$74.79	0.191	2,168.91	0.338	$16.56
Gas and oil for auto and boat	48	$73.02	0.189	3504.96	0.209	15	$82.33	0.211	1,234.95	0.192	$9.43
Recreation supplies	26	$53.69	0.139	1395.94	0.083	6	$45.83	0.117	274.98	0.043	$2.10
Recreation equipment rentals		**					**				
Guide services		**					**				
Souvenirs/gifts		**					**				
Other		**				3	$37.00	0.095	111.00	0.017	$0.85
Totals:	214	$387.15		$16,771.40		94	$390.92	101.0	$6,419.74	38.3	$49.02
** Denotes that there were not sufficient responses											

Table 3-14. Average total and within local area trip expenditures by expenditure category - nonlocal respondents

Cle Elum Lake											
Expenditure Category:	**Total Expenditures**					**In-Region Expenditures**					**Weighted Average In-Region Expenditures per Trip by Nonlocals Across All Activities**
	Frequency	**Average total $ spent**	**% of total $ spent based on Straight Total**	**Weighted Totals**	**% of total $ spent based on Weighted Total**	**Frequency**	**Average local $ spent**	**% of local $ spent based on Straight Total**	**Weighted Totals**	**% of local $ spent based on Weighted Total**	
										Weighted Average Total Expenditures per Trip:	$195.16
										In-Region Percentage:	0.682
										Weighted Average In-Region Expenditures per Trip:	$133.09
Camping fees	29	$55.45	0.045	1,608.05	0.078	19	$70.53	0.055	1,340.07	0.095	$12.71
Day use fees	10	$11.90	0.010	119.00	0.006	2	$15.00	0.012	30.00	0.002	$0.28
Hotels/motels and other lodging	5	$360.00	0.292	1,800.00	0.087	4	$375.00	0.291	1,500.00	0.107	$14.22
Restaurants	19	$128.47	0.104	2,440.93	0.119	15	$145.67	0.113	2,185.05	0.156	$20.72
Groceries and liquor	42	$159.52	0.129	6,699.84	0.326	30	$144.73	0.112	4,341.90	0.309	$41.17
Gas and oil for auto and boat	39	$110.90	0.090	4,325.10	0.210	23	$112.61	0.087	2,590.03	0.185	$24.56
Recreation supplies	21	$82.86	0.067	1,740.06	0.085	14	$70.00	0.054	980.00	0.070	$9.29
Recreation equipment rentals	6	$275.00	0.223	1,650.00	0.080	3	$316.67	0.245	950.01	0.068	$9.01
Guide services		**					**				
Souvenirs/gifts	4	$50.00	0.041	200.00	0.010	3	$40.00	0.031	120.00	0.009	$1.14
Other		**					**				
Totals:	175	$1,234.10		$20,582.98		113	$1,290.21	104.5	$14,037.06	68.2	$133.09

** Denotes that there were not sufficient responses

Table 3-15. Average total and within local area trip expenditures by expenditure category - nonlocal respondents

Yakima River											
Expenditure Category:	Total Expenditures					In-Region Expenditures					Weighted Average In-Region Expenditures per Trip by Nonlocals Across All Activities
	Frequency	Average total $ spent	% of total $ spent based on Straight Total	Weighted Totals	% of total $ spent based on Weighted Total	Frequency	Average local $ spent	% of local $ spent based on Straight Total	Weighted Totals	% of local $ spent based on Weighted Total	
										Weighted Average Total Expenditures per Trip:	$176.35
										In-Region Percentage:	0.502
										Weighted Average In-Region Expenditures per Trip:	$88.47
Camping fees	31	$31.45	0.054	974.95	0.073	21	$39.76	0.091	834.96	0.124	$11.01
Day use fees		**					**				
Hotels/motels and other lodging	6	$128.33	0.220	769.98	0.058	4	$121.25	0.277	485.00	0.072	$6.39
Restaurants	17	$90.12	0.154	1,532.04	0.115	13	$94.77	0.217	1,232.01	0.184	$16.24
Groceries and liquor	50	$92.24	0.158	4,612.00	0.345	23	$77.96	0.178	1,793.08	0.267	$23.64
Gas and oil for auto and boat	53	$71.19	0.122	3,773.07	0.282	30	$62.37	0.143	1,871.10	0.279	$24.67
Recreation supplies	23	$60.09	0.103	1,382.07	0.103	12	$41.25	0.094	495.00	0.074	$6.53
Recreation equipment rentals		**					**				
Guide services		**					**				
Souvenirs/gifts		**					**				
Other	3	$111.00	0.190	333.00	0.025		**				
Totals:	183	$584.42		13,377.11		103	$437.36	74.8	6,711.15	50.2	$88.47

** Denotes that there were not sufficient responses

Table 3-16. Average total and within local area trip expenditures by expenditure category - nonlocal respondents

Tieton River											
	Total Expenditures					In-Region Expenditures					
Expenditure Category:	Frequency	Average total $ spent	% of total $ spent based on Straight Total	Weighted Totals	% of total $ spent based on Weighted Total	Frequency	Average local $ spent	% of local $ spent based on Straight Total	Weighted Totals	% of local $ spent based on Weighted Total	Weighted Average In-region expenditures per trip by nonlocals across all activities
										Weighted Average Total Expenditures per Trip:	$207.00
										In-Region Percentage:	0.412
										Weighted Average In-Region Expenditures per Trip:	$85.24
Camping fees	30	$67.28	0.107	2,018.40	0.111	16	$66.56	0.209	1,064.96	0.142	$12.07
Day use fees							**				
Hotels/motels and other lodging	**						**				
Restaurants	32	$51.47	0.082	1,647.04	0.090	25	$51.28	0.161	1,282.00	0.171	$14.54
Groceries and liquor	** 57	$91.96	0.147	5,241.72	0.287	38	$68.07	0.214	2,586.66	0.344	$29.33
Gas and oil for auto and boat	52	$87.98	0.140	4,574.96	0.251	26	$83.65	0.263	2,174.90	0.289	$24.66
Recreation supplies	20	$202.75	0.323	4,055.00	0.222	10	$23.00	0.072	230.00	0.031	$2.61
Recreation equipment rentals							**				
Guide services	4	$82.50	0.132	330.00	0.018		**				
Souvenirs/gifts	9**	$43.33	0.069	389.97	0.021	7	$25.71	0.081	179.97	0.024	$2.04
Other		**					**				
Totals:	204	$627.27		18,257.09		122	$318.27	50.7	7,518.49	41.2	$85.24

** Denotes that there were not sufficient responses

3.5.1.3 Change in Expenditures by Site and Alternative

Applying the nonlocal visitor percentages for each site to the estimates of changes in visitation by site and alternative provided estimates of changes in nonlocal visitation by site and alternative. Multiplying this result by the estimates of nonlocal recreator expenditures by category per trip and site resulted in estimates of changes in nonlocal recreator expenditures by category, site, and alternative. These changes in nonlocal expenditures by category, site, and alternative were then run through the IMPLAN model to estimate the regional economic impacts associated with the changes in recreational activity for each alternative.

For the proposed Black Rock reservoir,[3] average annual nonlocal visitation estimates were derived by multiplying the nonlocal visitation percentage (.28) by the straight average of total visitation estimates over the 100-year study period. As shown in Table 3-17, average recreation visitation by nonlocals was estimated at 182.8 thousand annually, which converts to an increase in recreational expenditures of approximately $24.3 million annually.

For the existing reservoirs and rivers, the nonlocal visitation percentages were applied to the expected value of the changes in annual visitation by site. Note that the expected value of the change in annual visitation by site was estimated by multiplying the change in visitation by site and hydrologic condition (i.e., average, wet, and dry years) by the probability associated with each hydrologic condition (i.e., 50 percent for average years and 25 percent for both wet and dry years). As shown in Table 3-22, the expected value of the annual change in recreation expenditures as estimated at $151.1, $55.5, and $95.2 thousand for the Black Rock, Wymer Dam and Reservoir, and Wymer Dam Plus Yakima River Pump Exchange Alternatives respectively. Table 3-18 through Table 3-21 show the change in the expected value of recreation expenditures by alternative at each site (i.e., Kachess Lake, Cle Elum Lake, Yakima River, and the Tieton River).

[3] Recall that the Wymer Reservoir is not expected to generate regional economic impacts because visitation was estimated to be almost exclusively from local residents.

Table 3-17. Nonlocal Recreator visitation and expenditure analysis for the Black Rock Alternative ($)

	Boat fishing 0.25	Shoreline fishing 0.1	Swimming 0.15	Picnicking 0.15	Water ski, Wakeboard-ing, jet ski 0.25	Walking, hiking 0.03	Wildlife viewing 0.03	Horseback riding 0.02	Off-road vehicle riding 0.02	Total visits
Average Annual Visits	163,247	65,300	97,948	97,948	163,247	19,589	19,589	13,060	13,060	652,986
Nonlocal %	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Nonlocal Average Visits	45,709	18,284	27,425	27,425	45,709	5,485	5,485	3,657	3,657	182,836
Average Annual Change in Expenditures by Category ($)										
Total nonlocal visits	**Camping fees 12.71**	**Day use fees 0.28**	**Lodging 14.22**	**Restaurants 20.72**	**Groceries & liquor 41.17**	**Gas & oil 24.56**	**Recreation Supplies 9.29**	**Recreation equipment rentals 9.01**	**Souvenirs/ gifts 1.14**	**Total 133.10**
182,836	2,323,846	51,194	2,599,928	3,788,362	7,527,358	4,490,452	1,698,546	1,647,352	208,433	24,335,472

* Expenditures by category for nonlocal visitors were based on those estimates developed for Cle Elum Lake. Of the available expenditure data from the recreation survey, Cle Elum appeared to be the most similar to Black Rock based on the types of activities and percentages of visitation by activity.

Table 3-18. Change in expenditures for Kachess Lake from the No Action Alternative

Alternatives	Water year type	In-region expenditures on a per-trip basis				Average annual change in expenditures by category ($)										
		Average # of days per visit (from survey)	Change I in visits (expected value)	Nonlocal percent (from survey)	Average annual nonlocal visits	Camping fees 15.8	Day use fees 0.58	Lodging 0	Restaurants 3.7	Groceries & liquor 16.56	Gas & oil 9.43	Recreation supplies 2.1	Recreation equipment & rentals 0	Souvenirs & gifts 0	Other 0.85	Total 49.02
Black Rock:	Wet	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
	Dry	5.3	3,249	0.86	2,794	44,148	1,621	0	10,338	46,272	26,349	5,868	0	0	2,375	136,971
	Average	5.3	1,625	0.86	1,397	22,074	810	0	5,169	23,136	13,175	2,934	0	0	1,188	68,486
	Average Annual:	5.3	1,625	0.86	1,397	22,074	810	0	5,169	23,136	13,175	2,934	0	0	1,188	68,486
Wymer Only	Wet	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
	Dry	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
	Average	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
	Average Annual:	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
Wymer Plus	Wet	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
	Dry	5.3	3,249	0.86	2,794	44,148	1,621	0	10,338	46,272	26,349	5,868	0	0	2,375	136,971
	Average	5.3	0	0.86	0	0	0	0	0	0	0	0	0	0	0	0
	Average Annual:	5.3	812	0.86	699	11,037	405	0	2,585	11,568	6,587	1,467	0	0	594	34,243

Table 3-19. Change in Expenditures for Cle Elum Lake from the No Action Alternative

Alternatives	Water year type	In-region expenditures on a per-trip basis				Average annual change in expenditures by category ($)										
		Average # of days per visit (from survey)	Change in visits (expected value)	Nonlocal percent (from survey)	Average annual nonlocal visits	Camping fees 12.71	Day use fees 0.28	Lodging 14.22	Restaurants 20.72	Groceries & liquor 41.17	Gas & oil 24.56	Recreation supplies 9.29	Recreation equipment & rentals 9.01	Souvenirs & gifts 1.14	Other 0	Total 133.10
Black Rock:	Wet	5	1,094	0.663	726	9,222	203	10,318	15,034	29,872	17,820	6,741	6,538	827	0	96,576
	Dry	5	0	0.663	0	0	0	0	0	0	0	0	0	0	0	0
	Average	5	0	0.663	0	0	0	0	0	0	0	0	0	0	0	0
	Average Annual:	5	274	0.663	181	2,306	51	2,579	3,759	7,468	4,455	1,685	1,634	207	0	24,144
Wymer Only	Wet	5	547	0.663		4,611	102	5,159	7,517	14,936	8,910	3,370	3,269	414	0	48,288
	Dry	5	-246	0.663	363	-2,075	-46	-2,321	-3,382	-6,720	-4,009	-1,516	-1,471	-186	0	-21,726
	Average	5	0	0.663	-163	0	0	0	0	0	0	0	0	0	0	0
	Average Annual:	5	75	0.663	0	634	14	709	1,033	2,053	1,225	463	449	57	0	6,636
Wymer Plus	Wet	5	547	0.663	50	4,611	102	5,159	7,517	14,936	8,910	3,370	3,269	414	0	48,288
	Dry	5	0	0.663		0	0	0	0	0	0	0	0	0	0	0
	Average	5	0	0.663	363	0	0	0	0	0	0	0	0	0	0	0
	Average Annual:	5	137	0.663	0	1,153	25	1,290	1,879	3,734	2,228	843	817	103	0	12,072

Table 3-20. Change in Expenditures (from No Action Alternative) by Alternative on the Yakima River

Alternatives	Water year type	In-region expenditures on a per-trip basis				Average annual change in expenditures by category ($)										
		Average # of days per visit (from survey)	Change in visits (expected value)	Nonlocal percent (from survey)	Average annual nonlocal visits	Camping fees 11.01	Day use fees 0	Lodging 6.39	Restaurants 16.24	Groceries & liquor 23.64	Gas & oil 24.67	Recreation supplies 6.53	Recreation equipment & rentals 0	Souvenirs & gifts 0	Other 0	Total 88.48
Black Rock:	Wet	3.7	1,962	0.5	981	10,802	0	6,269	15,933	23,193	24,203	6,406	0	0	0	86,806
	Dry	3.7	1,291	0.5	646	7,109	0	4,126	10,486	15,264	15,929	4,216	0	0	0	57,129
	Average	3.7	1,962	0.5	981	10,802	0	6,269	15,933	23,193	24,203	6,406	0	0	0	86,806
	Average Annual:	3.7	1,795	0.5	897	9,879	0	5,734	14,572	21,212	22,136	5,859	0	0	0	79,393
Wymer Only	Wet	3.7	981	0.5	491	5,402	0	3,135	7,969	11,600	12,105	3,204	0	0	0	43,415
	Dry	3.7	1,472	0.5	736	8,101	0	4,702	11,950	17,395	18,152	4,805	0	0	0	65,105
	Average	3.7	981	0.5	491	5,402	0	3,135	7,969	11,600	12,105	3,204	0	0	0	43,415
	Average Annual:	3.7	1,104	0.5	552	6,078	0	3,527	8,965	13,050	13,619	3,605	0	0	0	48,843
Wymer Plus	Wet	3.7	981	0.5	491	5,402	0	3,135	7,969	11,600	12,105	3,204	0	0	0	43,415
	Dry	3.7	1,472	0.5	736	8,101	0	4,702	11,950	17,395	18,152	4,805	0	0	0	65,105
	Average	3.7	981	0.5	491	5,402	0	3,135	7,969	11,600	12,105	3,204	0	0	0	43,415
	Average Annual:	3.7	1,104	0.5	552	6,078	0	3,527	8,965	13,050	13,619	3,605	0	0	0	48,843

Table 3-21. Change in Expenditures (from No Action Alternative) by Alternative on the Tieton River

Alternative	Water year type	In-region expenditures on a per-trip basis				Average annual change in expenditures by category										
		Average # of days per visit (from survey)	Change in visits (expected value)	Nonlocal percent (from survey)	Average annual nonlocal visits	Camping fees 12.07	Day use fees 0	Lodging 0	Restaurants 14.54	Groceries & liquor 29.33	Gas & oil 24.66	Recreation supplies 2.61	Recreation equipment & rentals 0	Souvenirs & gifts 2.04	Other 0	Total 85..25
Black Rock:	Wet	3.58	-628	0.78	-490	-5,917	0	0	-7,128	-14,378	-12,089	-1,279	0	-1,000	0	-41,792
	Dry	3.58	0	0.78	0	0	0	0	0	0	0	0	0	0	0	0
	Average	3.58	-314	0.78	-245	-2,958	0	0	-3,564	-7,189	-6,044	-640	0	-500	0	-20,896
	Average Annual:	3.58	-315	0.78	-245	-2,961	0	0	-3,567	-7,196	-6,050	-640	0	-500	0	-20,914

Table 3-22. Change in Expenditures (from No Action Alternative) by Alternative Summed Across Impacted Existing Sites

Alternatives	Water year type		Average annual change in expenditures by category										
		Average annual nonlocal visits	Camping fees	Day use fees	Lodging	Restaurants	Groceries & liquor	Gas & oil	Recreation supplies	Recreation equipment & rentals	Souvenirs & gifts	Other	Total
Black Rock:	Wet	1,216	14,107	203	16,587	23,839	38,687	29,935	11,868	6,538	-173	0	141,590
	Dry	3,440	51,257	1,621	4,126	20,824	61,536	42,278	10,084	0	0	2,375	194,101
	Average	2,133	29,917	810	6,269	17,538	39,140	31,333	8,701	0	-500	1,188	134,396
	Average Annual:	2,230	31,298	861	8,313	19,933	44,621	33,716	9,838	1,634	-294	1,188	151,108
Wymer Only	Wet	853	10,013	102	8,294	15,486	26,536	21,015	6,574	3,269	414	0	91,703
	Dry	573	6,027	-46	2,381	8,567	10,674	14,144	3,288	-1,471	-186	0	43,379
	Average	491	5,402	0	3,135	7,969	11,600	12,105	3,204	0	0	0	43,415
	Average Annual:	602	6,712	14	4,236	9,998	15,103	14,843	4,068	449	57	0	55,479
Wymer Plus	Wet	853	10,013	102	8,294	15,486	26,536	21,015	6,574	3,269	414	0	91,703
	Dry	3,530	52,249	1,621	4,702	22,288	63,666	44,502	10,673	0	0	2,375	202,076
	Average	491	5,402	0	3,135	7,969	11,600	12,105	3,204	0	0	0	43,415
	Average Annual:	1,341	18,268	431	4,817	13,429	28,352	22,433	5,914	817	103	594	95,158

3.5.2 Results

Recreation expenditures (the expenditures used in IMPLAN were incremental to the No-Action) related to the proposed Black Rock reservoir stimulate $23.6 million of output, $9.2 million in labor income, and 360 jobs annually. Recreation expenditures at existing recreation sites generate a small amount of regional economic impacts ($0.14 million of output, $0.07 million of labor income, and 2 jobs). The majority of the regional impacts stemming from expenditures at the proposed reservoir and existing sites occur in the Accommodation and Food Service and the Retail Trade sectors. Table 3-23 summarizes these results.

It is assumed that recreators at the proposed Wymer reservoir are residents of the regional study area so their recreational expenditures do not create regional economic impacts to the region. The Wymer Dam and Reservoir Alternative generates a small amount of recreation expenditures at existing sites as shown in Table 3-23. Regional economic impacts stemming from recreational expenditures at existing sites stimulates $0.05 million in output, $0.02 million in labor income, and 1 job. Like the Black Rock Alternative, most of the regional impacts occur in the Accommodation and Food Services and Retail Trade sectors of the economy.

Like the Wymer Dam and Reservoir Alternative, regional economic impacts related to the Wymer Dam Plus Yakima River Exchange Alternative are related to recreational expenditures at existing recreational sites. Regional economic impacts related to recreational expenditures are small ($0.09 million output, $0.04 million in labor income, and 1.4 jobs). These results are summarized in Table 3-23.

Table 3-23. Regional economic impacts stemming from recreation visitation expenditures

	Impacts of alternatives to existing reservoirs									Impacts to potential Black Rock reservoir		
	Black Rock Alternative			Wymer Dam and Reservoir Alternative			Wymer Plus Pump Exchange Alternative			Potential Black Rock reservoir		
	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)	Labor Income ($)	Employment (jobs)	Output ($)
Ag, Forestry, Fish & Hunting	281	0	1,214	110	0	496	178	0	777	45,643	2.6	201,766
Mining	0	0	2	0	0	1	0	0	1	21	0	316
Utilities	74	0	436	27	0	159	46	0	269	12,537	0.2	73,738
Construction	266	0	614	104	0	240	165	0	380	51,789	1.1	119,008
Manufacturing	479	0	3,046	189	0	1,233	303	0	1,940	82,186	2	518,631
Wholesale Trade	1,018	0	2,708	371	0	987	635	0	1,689	160,343	3.8	426,554
Transportation & warehousing	854	0	1,875	317	0	695	530	0	1,166	152,167	4.3	329,165
Retail trade	14,145	0.6	35,594	5,182	0.2	13,183	8,938	0.4	22,478	2,317,270	109.2	5,728,451
Information	644	0	2,636	242	0	984	400	0	1,634	124,599	2.8	503,166
Finance & insurance	802	0	2,841	275	0	967	491	0	1,739	135,853	2.9	474,197
Real estate & rental	998	0	5,146	330	0	1,721	577	0	2,992	463,482	10.8	2,274,922
Professional- scientific & tech svcs	870	0	1,836	319	0	675	535	0	1,130	165,451	3.9	354,629
Management of companies	450	0	1,042	170	0	393	280	0	649	78,373	1.2	181,372
Administrative & waste services	707	0	1,510	266	0	579	433	0	923	143,501	6	310,584
Educational svcs	186	0	397	59	0	125	113	0	241	26,077	1.4	55,791
Health & social services	3,822	0.10	7,152	1,195	0	2,237	2,321	0.1	4,343	527,515	13.8	987,208
Arts- entertainment & recreation	232	0	643	75	0	208	142	0	392	34,919	2.3	96,124
Accomodation & food services	10,489	0.6	30,988	5,100	0.3	15,048	6,714	0.4	19,887	2,328,772	137.1	6,803,417
Other services	1,041	0.1	2,584	346	0	855	634	0	1,574	167,017	8	412,835
Government & non NAICs	30,474	0.6	40,923	6,535	0.1	9,640	17,759	0.4	24,057	2,345,606	47.2	3,686,015
Institutions	0	0	413	0	0	207	0	0	278	0	0	78,559
Total	67,832	2	143,600	21,212	1	50,633	41,194	1	88,539	9,363,121	361	23,616,448

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APPENDIX A - ESTIMATING FISHERY ECONOMIC USE VALUES

Appendix A - Contents

SUMMARY AND CONCLUSIONS

This paper presents information on the estimation of economic harvest or use values per fish for salmon based on existing data. A case study involving various proposed Yakima River projects was used to define and develop the economic value estimation methodology. Although the values were oriented toward Yakima River salmon, the approaches presented could be generalized to other river systems and fish species.

Given the Yakima River is a tributary of the Columbia River, migratory anadromous salmon stemming from the Yakima River can be caught not only in the Yakima River, but also in the Columbia River and the Pacific Ocean. To estimate fishery economic harvest benefits associated with fishery improvements within the Yakima River Basin, one needs both estimates of the increase harvest by geographic area (i.e., Yakima River, Columbia River, Pacific Ocean) as well as economic values per fish within each geographic area. In addition, each geographic area allows different types of fish harvest – commercial, sport, and tribal ceremonial and subsistence. This report focuses on the estimation of the economic values per salmon by harvest type in each geographic area.

The foundation of the commercial fishing value estimation is the existing harvest (pounds and number of fish) and market price data gathered and maintained by the PFMC and the ADFG. This data allowed for the estimation of commercial revenue per fish by state (CA, OR, WA, and AK) from which profitability estimates were derived. To develop a weighted average value across all Pacific Coast states for the ocean commercial analysis, coded wire tag data from the PSMFC was used to calculate the percentage of Yakima River fish caught in the ocean areas of each state.

The basis for the sport fishing values was a comprehensive literature search of existing sport fishing economic studies. While the sheer number of existing studies is quite large, only a small portion the studies could actually be used within a benefits transfer context. After selecting and averaging indexed values from the most applicable studies, an additional step was required to convert sport fishing values from a per trip/day basis to a per fish basis.

Finally, tribal subsistence values were estimated using commercial revenues per fish (i.e., market price multiplied by average weight per fish). This food based value assumes the subsistence harvest could have been sold within existing markets and therefore reflects the opportunity cost of the subsistence harvest. Given subsistence harvest also includes a cultural/spiritual value associated with

the harvest activity, the exclusively food based value should be considered a defendable lower bound.

In conclusion, there appears to be sufficient existing data to allow for the estimation of commercial, sport, and subsistence values associated with the harvest of Yakima River salmon. While the approaches described in this report can be extended to other species and river systems, the actual value estimation will be contingent upon the existence of adequate data related to the fish species or river system in question.

Chapter 1.0 INTRODUCTION

Federal water management agencies, such as the Bureau of Reclamation, often impact fish populations through the construction and operation of their projects. As a result, estimating the fishery economic effects of a proposed project or of a change in operations at an already existing project is often required in order to evaluate the proposed action.

This technical memorandum provides analytical information on the application of existing information to estimate fishery economic use value benefits applicable to Reclamation benefit-cost analyses. Fishery use values refer to the economic benefits fishery resource users (e.g., fishermen) experience when "using" the fishery resource. Typically, fishery use value stems from the harvest and consumption of fish. This form of fishery use value is therefore often referred to as "consumptive use" value. Commercial, recreational, and tribal subsistence harvests reflect the most common forms of consumptive fishery use value. A less commonly measured form of fishery use value is referred to as "nonconsumptive use" value and includes non-harvest oriented fishery activities such as recreational catch and release fishing and fish viewing. These consumptive and nonconsumptive use values differ from "nonuse" values which can be held by both resource users and nonusers related to the existence or preservation of a resource even if the individual never intends to make use of the resource.

The methods and values presented in this document focus on commercial, recreational or sport, and Tribal subsistence consumptive use values. The example used throughout the report strives to measure consumptive use values associated with Yakima River salmon populations. The Yakima River basin is found in south-central Washington State. The primary salmon species harvested within the Yakima River are Chinook and coho. Salmon are an anadromous species, meaning they migrate to the ocean before ultimately returning to their river of origin to spawn. As a result, Yakima River salmon stocks are harvested not only in the Yakima River, but also in the Columbia River into which it flows, and the Pacific Ocean. While the information presented in this paper focuses on consumptive fishery use values related to Yakima River salmon populations, the approaches can be generalized to many other fish species.

1.1 National Economic Development Benefit-Cost Analysis

To provide some perspective on the need for fishery use values related to the Yakima River Basin, national economic development (NED) oriented benefit-cost analyses (BCA) are being developed for the various Yakima River planning and environmental studies currently underway. To be consistent with Federal water management agency economic guidelines—*Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies,* also referred to as the "P&Gs" (U. S. Water Resources Council, 1983)—these BCAs will attempt to quantify not only the benefits to fisheries (ocean and in-river commercial, recreational, and Tribal), but also any relevant benefits to agriculture, municipal and industrial (M&I) water supply, recreation (reservoir and river), hydropower, etc. Cost categories covered include construction costs, interest during construction, and annual operating, maintenance, replacement, and energy (OMR&E) costs. The annual stream of benefits projected over the period of analysis for each study will be discounted to a present value before being aggregated and compared to the aggregated present value of the costs in order to calculate net benefits for each study alternative. If an alternative's benefits exceed its costs, a positive net benefit results, and the alternative is considered economically justified. This document focuses only on the estimation of fishery economic use values necessary for the BCA fishery benefit analysis. While fisheries benefits are but one piece of the overall BCA puzzle, they tend to be a very important component in many Reclamation studies. This is because many Reclamation studies, especially within the last 20 to 30 years, have been initiated with the objective of improving habitat conditions to aid in the recovery of diminished fish populations.

Chapter 2.0 FISHERIES USE VALUE ESTIMATION

The fisheries use value benefit estimation process discussed below focuses on harvest oriented consumptive use values measured on a per fish basis. Given the migratory range of Yakima River salmon, these harvest oriented fishery use values include commercial, sport, and tribal fisheries in the ocean, lower Columbia River (zones 1-5), Columbia River (zone 6), and Yakima River. The values per fish developed in this report are to be subsequently applied to annual estimates of fish harvest developed by project alternative, harvest area, and species to calculate annual fishery economic benefits. The annual fishery benefits are then discounted to a present value as of the start of the benefits period and aggregated into an estimate of total fishery consumptive use value benefits. As a result, this report focuses on one component of the fishery use value benefit estimation process – the critical estimate of economic values per fish.

2.1 Ocean Commercial

The basic objective of a Reclamation ocean commercial fishing economic benefit analysis, as described in the P&Gs, is to estimate the change in commercial fishing profitability stemming from changes in ocean commercial harvest associated with each of the proposed "action" alternatives as compared to the baseline No Action Alternative. This section describes how estimates of ocean commercial profitability per fish by species were developed for subsequent application to projections of the species specific incremental harvest for each of the action alternatives being considered in the Yakima River planning studies.

The ocean commercial benefit estimation procedure makes use of the most recent annual data on commercial ex-vessel (harvest level) prices per pound by state (CA, OR, WA, AK) and species (Chinook and coho salmon) in conjunction with average weights per fish by species to calculate values per fish by state and species. Table 1-Ocean Commercial Fishing #1 presents data obtained from the Pacific Fishery Management Council's (PFMC) *Review of Ocean Salmon Fisheries* and the Alaska Department of Fish and Game (ADFG). The *Review of Ocean Salmon Fisheries* is published annually by PFMC and includes a comprehensive discussion of salmon ocean commercial and sport fishing activity off the coasts of CA, OR, and WA over the past year. This report also includes a substantial amount of historical data. ADFG also maintains databases with both

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State

Sources: 1) CA, OR, WA Data: 2006 Review of Ocean Salmon Fisheries (2006 Salmon SAFE Document, published 2/2007), Socioeconomic Chapter, Table IV-2, 3, 4, 5, 6, 7, 8
2) Alaska Data: Dept of Fish & Game, Division of Commercial Fisheries, Commercial Salmon Harvests and Exvessel Values
3) GDP Implicit Price Deflator Annual and Quarterly Values: U. S. Bureau of Economics Analysis website (www.bea.gov/national/nipaweb/TablePrint.asp)

Bureau of Economic Analysis — **Insert Target Quarter:** 1st Qrtr 2007 — **Insert IPD Value:** Annual GDP Implicit Price Deflator (IPD): 118.041

Chinook

Insert Profit %: 0.8

GDP Annual Index Value	State/ Year	Nominal Value (**) (K$)	**1st Qrtr 2007** Real Value (K$)	Dressed Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price/lb. (Dressed)	**1st Qrtr 2007** Real Price/lb. (Dressed)	Pounds per Fish	Nominal Revenue per Fish	Real 1st Qrtr 2007 Revenue per Fish
	I. CALIFORNIA:	Table IV-2	Table IV-2 (Calculated)	Table IV-6	A-3	Table IV-2 (Calculated)	Table IV-2 (Calculated)			
0.808	1997	7,288	9,016	5,248	487	1.39	1.72	10.77		
0.817	1998	3,060	3,744	1,847	227	1.66	2.03	8.14		
0.829	1999	7,429	8,960	3,846	264	1.93	2.33	14.54		
0.847	2000	10,304	12,163	5,131	480	2.01	2.37	10.68		
0.867	2001	4,773	5,502	2,409	193	1.98	2.28	12.48		
0.883	2002	7,776	8,810	5,008	392	1.55	1.76	12.79		
0.901	2003	12,181	13,513	6,392	492	1.91	2.11	12.99		
0.927	2004	17,895	19,304	6,230	502	2.87	3.10	12.41		
0.955	2005	12,913	13,521	4,347	341	2.97	3.11	12.75		
0.983	2006 (*)	5,261	5,352	1,030	69	5.11	5.20	14.97		
	5 Year Sum:	56,026	60,499	23,007	1,795					
	10 Year Sum:	88,880	99,885	41,488	3,448					
	1) REVENUE:									
	5 Year Straight Avg:	11,205	12,100			2.88	3.06	13.18	37.99	40.28
	5 Year Weighted Avg:					2.44	2.63	12.81	31.21	33.70
	10 Year Straight Avg:	8,888	9,988			2.34	2.60		28.64	31.86
	10 Year Weighted Avg:					2.14	2.41	12.03	25.78	28.97
								12.25		
	2) PROFIT:									
	5 Year Straight Avg:								30.39	32.22
	5 Year Weighted Avg:								24.97	26.96
	10 Year Straight Avg:								22.91	25.49
	10 Year Weighted Avg:								20.62	23.18

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

II. OREGON:

	Table IV-3	Table IV-3 (Calculated)	Table IV-7	A-8	Table IV-3 (Calculated)	Table IV-3 (Calculated)	
1997	2,469	3,055	1,542	150	1.60	1.98	10.30
1998	2,297	2,811	1,398	124	1.64	2.01	11.26
1999	1,400	1,689	721	63	1.94	2.34	11.53
2000	2,988	3,527	1,481	136	2.02	2.38	10.90
2001	4,680	5,395	2,897	275	1.62	1.86	10.54
2002	5,383	6,099	3,488	304	1.54	1.75	11.47
2003	7,186	7,972	3,639	330	1.97	2.19	11.04
2004	9,832	10,606	2,850	253	3.45	3.72	11.28
2005	8,466	8,864	2,671	251	3.17	3.32	10.63
2006 (*)	2,663	2,709	486	35	5.48	5.57	13.90
5 Year Sum:	33,530	36,250	13,134	1,173			
10 Year Sum:	47,364	52,726	21,173	1,920			
1) REVENUE:							
5 Year Straight Avg:	6,706	7,250	2,627		3.12	3.31	11.66	36.43	38.61
5 Year Weighted Avg:					2.55	2.76	11.20	28.59	30.91
10 Year Straight Avg:	4,736	5,273	2,117		2.44	2.71	11.28	27.57	30.61
10 Year Weighted Avg:					2.24	2.49	11.03	24.67	27.46
2) PROFIT:									
5 Year Straight Avg:								29.14	30.89
5 Year Weighted Avg:								22.87	24.73
10 Year Straight Avg:								22.06	24.49
10 Year Weighted Avg:								19.73	21.97

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

III. WASHINGTON:

A. Non-Indian:

	Table IV-4	Table IV-4 (Calculated)	Table IV-8	A-13	Table IV-4 (Calculated)	Table IV-4 (Calculated)		
1997	125	155	80	6	1.56	1.93	12.46	
1998	123	151	82	6	1.50	1.84	13.83	
1999	377	455	198	17	1.90	2.30	11.34	
2000	224	264	131	10	1.71	2.02	12.76	
2001	349	402	241	21	1.45	1.67	11.35	
2002	756	857	678	54	1.12	1.26	12.60	
2003	951	1,055	821	56	1.16	1.29	14.61	
2004	1,079	1,164	504	35	2.14	2.31	14.25	
2005	1,273	1,333	471	35	2.70	2.83	13.43	
2006 (*)	1,029	1,047	222	17	4.64	4.71	13.24	
5 Year Sum:	5,088	5,455	2,696	197				
10 Year Sum:	6,286	6,882	3,428	259				
1) REVENUE:								
5 Year Straight Avg:	1,018	1,091	539		2.35	2.48	13.62	32.02	33.80
5 Year Weighted Avg:					1.89	2.02	13.67	25.80	27.66
10 Year Straight Avg:	629	688	343			2.22	12.99	25.81	28.77
10 Year Weighted Avg:					1.83	2.01	13.26	24.31	26.62
2) PROFIT:									
5 Year Straight Avg:								25.62	27.04
5 Year Weighted Avg:								20.64	22.13
10 Year Straight Avg:				1.99				20.65	23.02
10 Year Weighted Avg:								19.45	21.29

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

B. Indian:

1) REVENUE:				
5 Year Straight Avg:	- Due to lack of data, used the non-Indian values per fish times	11.53	27.11	28.61
5 Year Weighted Avg:	Treaty Indian pounds per fish.	11.53	21.76	23.33
10 Year Straight Avg:		10.27	20.41	22.74
10 Year Weighted Avg:		10.27	18.82	20.61
2) PROFIT:				
5 Year Straight Avg:			21.68	22.88
5 Year Weighted Avg:			17.41	18.67
10 Year Straight Avg:			16.32	18.20
10 Year Weighted Avg:			15.06	16.49

Notes: (*) Preliminary data.

(**) Value refers to revenue.

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

IV. ALASKA: Southeast Only

1997	8,420	10,417	5,170	300	1.63	2.01	17.23
1998	4,130	5,053	4,050	240	1.02	1.25	16.88
1999	4,910	5,922	2,950	190	1.66	2.01	15.53
2000	5,750	6,787	3,780	230	1.52	1.80	16.43
2001	7,030	8,104	4,160	244	1.69	1.95	17.05
2002	7,527	8,528	6,661	417	1.13	1.28	15.97
2003	7,939	8,807	6,616	431	1.20	1.33	15.35
2004	15,359	16,568	7,413	497	2.07	2.24	14.92
2005	16,491	17,267	6,518	462	2.53	2.65	14.11
2006 (*)	18,121	18,433	5,377	355	3.37	3.43	15.15
5 Year Sum:	65,437	69,603	32,585	2,162			
10 Year Sum:	95,677	105,887	52,695	3,366			

1) REVENUE:

5 Year Straight Avg:	13,087	13,921	6,517	2.06	2.18	15.10	31.11	32.99
5 Year Weighted Avg:				2.01	2.14	15.07	30.27	32.19
10 Year Straight Avg:	9,568	10,589	5,270	1.78	1.99	15.86	28.27	31.62
10 Year Weighted Avg:				1.82	2.01	15.66	28.42	31.46

2) PROFIT:

5 Year Straight Avg:	24.89	26.39
5 Year Weighted Avg:	24.21	25.76
10 Year Straight Avg:	22.62	25.30
10 Year Weighted Avg:	22.74	25.17

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

State/ Year	Coho Nominal Value (**) (K$)	Coho 1st Qrtr 2007 Real Value (K$)	Coho Dressed Pounds Landed (Thousands)	Coho # Fish Harvested (Thousands)	Coho Nominal Price/lb. (Dressed)	Coho 1st Qrtr 2007 Real Price/lb. (Dressed)	Profit %: 0.8 Pounds per Fish	Nominal Revenue per Fish	Real 1st Qrtr 2007 Revenue per Fish
I. CALIFORNIA:	No ocean commercial Coho fishery in California from 1997-2006.								
II. OREGON:									
	Table IV-3	Table IV-3 (Calculated)	Table IV-7	A-8	Table IV-3 (Calculated)	Table IV-3 (Calculated)			
1997	0	0	0	0					
1998	0	0	0	0					
1999	1	1	1	0	1.00	1.21			
2000	75	89	71	12	1.06	1.25	5.79		
2001	41	47	52	9	0.79	0.91	5.57		
2002	8	9	11	2	0.73	0.82	7.26		
2003	36	40	43	6	0.84	0.93	6.68		
2004	86	93	70	9	1.23	1.33	7.92		
2005	37	39	20	3	1.85	1.94	7.64		
2006 (*)	38	39	13	1	2.92	2.97	9.19		
5 Year Sum:	205	219	157	21					
10 Year Sum:	322	356	281	42					
1) REVENUE:									
5 Year Straight Avg:	41	44	31		1.51	1.60	7.74	11.71	12.36
5 Year Weighted Avg:					1.31	1.40	7.54	9.84	10.52
10 Year Straight Avg:	32	36	28			1.42	7.15	9.31	10.15
10 Year Weighted Avg:					1.15	1.27	6.62	7.59	8.40
2) PROFIT:									
5 Year Straight Avg:								9.37	9.89
5 Year Weighted Avg:								7.87	8.42
10 Year Straight Avg:								7.44	8.12
10 Year Weighted Avg:								6.07	6.72

1.30

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

III. WASHINGTON:

A. Non-Indian:

	Table IV-4	Table IV-4 (Calculated)	Table IV-8	A-13	Table IV-4 (Calculated)	Table IV-4 (Calculated)			
1997		0							
1998		0							
1999	19	23	21	4	0.90	1.09	5.45		
2000	34	40	31	5	1.10	1.29	5.89		
2001	34	39	49	8	0.69	0.80	6.04		
2002	2	2	1	0	1.58	1.76	5.56		
2003	40	44	54	9	0.74	0.82	6.03		
2004	106	114	91	13	1.16	1.26	6.85		
2005	16	17	10	1	1.60	1.68	6.93		
2006 (*)	16	16	10	1	1.60	1.63	7.91		
5 Year Sum:	180	194	166	25					
10 Year Sum:	267	296	267	42					
1) REVENUE:									
5 Year Straight Avg:	36	39	33		1.34	1.43	6.65	8.90	9.50
5 Year Weighted Avg:					1.08	1.17	6.60	7.16	7.72
10 Year Straight Avg:	33	30	33			1.29	6.33	7.42	8.17
10 Year Weighted Avg:					1.00	1.11	6.30	6.30	6.99
2) PROFIT:									
5 Year Straight Avg:								7.12	7.60
5 Year Weighted Avg:								5.73	6.17
10 Year Straight Avg:								5.94	6.54
10 Year Weighted Avg:								5.04	5.59

1.17

B. Indian:

1) REVENUE:				
5 Year Straight Avg:	- Due to lack of data, used the non-Indian values per fish times	6.01	8.04	8.59
5 Year Weighted Avg:	Treaty Indian pounds per fish.	6.01	6.52	7.03
10 Year Straight Avg:		5.47	6.41	7.06
10 Year Weighted Avg:		5.47	5.47	6.06
2) PROFIT:				
5 Year Straight Avg:			6.43	6.87
5 Year Weighted Avg:			5.22	5.62
10 Year Straight Avg:			5.13	5.64
10 Year Weighted Avg:			4.37	4.85

Notes: (*) Preliminary Data
(**) Value refers to revenue.

TABLE 1.—OCEAN COMMERCIAL FISHING #1: Ocean Commercial Values per Fish by Species and State (continued)

V. ALASKA: Southeast Only

1997	14,270	17,654	14,410	1,970	0.99	1.23	7.31		
1998	13,990	17,118	23,310	2,990	0.60	0.73	7.80		
1999	21,080	25,425	21,510	3,580	0.98	1.18	6.01		
2000	9,690	11,438	13,800	1,950	0.70	0.83	7.08		
2001	13,950	16,081	22,140	3,300	0.63	0.73	6.71		
2002	10,255	11,619	24,417	3,242	0.42	0.48	7.53		
2003	11,417	12,666	17,564	2,498	0.65	0.72	7.03		
2004	20,089	21,671	21,743	3,085	0.92	1.00	7.05		
2005	17,451	18,272	18,369	3,003	0.95	0.99	6.12		
2006 (*)	19,765	20,105	14,018	2,054	1.41	1.43	6.82		
5 Year Sum:	78,977	84,332	96,111	13,882					
10 Year Sum:	151,957	172,048	191,281	27,672					
1) REVENUE:									
5 Year Straight Avg:	15,795	16,866	19,222		0.87	0.92	6.91	6.02	6.39
5 Year Weighted Avg:					0.82	0.88	6.92	5.69	6.07
10 Year Straight Avg:	15,196	17,205	19,128		0.83	0.93	6.95	5.73	6.47
10 Year Weighted Avg:					0.79	0.90	6.91	5.49	6.22
2) PROFIT:									
5 Year Straight Avg:								4.81	5.11
5 Year Weighted Avg:								4.55	4.86
10 Year Straight Avg:								4.59	5.18
10 Year Weighted Avg:								4.39	4.97

current and historical data. All of this revenue and landings (harvest) information can be found on the PFMC and ADFG websites.[1]

The most recent 10 years (1997-2006) of annual data on revenue, dressed pounds landed (i.e., partially processed harvest which may include the removal of internal organs, gills, fins, and head), and number of fish harvested, was gathered by species and state. To be consistent with PFMC procedures, original year (nominal) revenue data was converted to "current" (real) dollars using the U.S. Bureau of Economic Analysis Annual Gross Domestic Product Implicit Price Deflator (IPD).[2] The intent was to present fishing values measured in current (1st quarter 2007) dollars to be consistent with the cost estimates used in the Yakima River planning studies.

Total dressed pounds landed was divided into total nominal and real revenues on an annual basis to calculate annual nominal and real prices per pound by state and species. Five- and 10-year straight and weighted averages of both nominal and real prices per pound were calculated. The weighted averages were developed by summing the total revenue over the 5- or 10-year period and dividing it by the total dressed pounds landed over the same time period. Five- and 10-year straight and weighted average estimates of dressed weight per fish by state were also calculated and applied to the estimates of price per pound to estimate 5- and 10-year straight and weighted average nominal and real commercial revenues per fish by state. Note that the assumption was made that the additional harvest generated by the alternatives under consideration in the Yakima River studies is not expected to be large enough to generate a change in salmon prices, as a result, the plan was to make use of relatively recent salmon prices within the commercial fishing analysis.

Five- and 10-year straight and weighted average nominal and real profitability per fish by species and state was then estimated by applying a marginal or incremental profitability percentage of 80% (.8) to the estimated revenue per fish. A literature review of a series of salmon ocean commercial fishing studies (U.S. Department of Commerce, National Marine Fisheries Service, and Alaska Department of Fish & Game, 2003) indicated a range of profitability percentages from .43 to .99. As discussed in Platt (2007), excess harvest capacity within the ocean salmon commercial fishing industry leads to the potential of harvesting

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[1] PFMC Salmon Stock Assessment and Fishery Evaluation (SAFE) Report Website: Historic data and annual Reviews of Ocean Salmon Fisheries can be found at http://www.pcouncil.org/salmon/salsafe.html . ADFG Division of Commercial Fisheries – Salmon Catch, Effort, and Value: Annual data by species and area can be found at http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmcatch.php .

[2] U.S. Bureau of Economic Analysis Annual and Quarterly Gross Domestic Product Implicit Price Deflator data can be found at: www.bea.gov/national/nipaweb/TablePrint.asp .

additional fish with relatively little additional cost. As a result, the additional profitability associated with the incremental harvest revenue is likely to be high, implying the use of a high profitability percentage. Ultimately, the 5-year weighted average of real profitability per fish by state and species was applied in the Yakima River ocean commercial fishing economic benefit analyses, since this estimate is based on the most recent data (years 2002-2006), accounts for landings differences between years (weighting), and converts dollars to a common year (real dollars).

Since the ocean commercial profitability values per Chinook and coho salmon vary by state, to apply them to estimate changes in commercial fishing benefits would require estimates of ocean commercial harvest by state stemming from the increases in Yakima River fish stocks. The biological population and harvest modeling effort provided estimates of total ocean commercial harvest, but not ocean harvest broken down by state. To estimate the portion of Chinook and coho commercial ocean harvest by state stemming from the Yakima River, data was gathered from hatchery fish coded wire tag recoveries as obtained from the Pacific States Marine Fisheries Commission (PSMFC) Regional Mark Processing Center (RMPC).[3] With the assistance of RMPC personnel, the database of wire tag recoveries was searched for Chinook and coho ocean commercial recoveries stemming from the Yakima River. Table 2-Ocean Commercial Fishing #2 presents the results of the coded wire tag database queries. The data from the database was used to calculate the percentage of Yakima River ocean commercial recoveries by species and state. Note that while the information within the database only reflects a small portion of the total ocean commercial harvest by state and species, it does provide an indication of the potential percentage allocation of harvest by species and state.

Since Alaskan ocean commercial fishing economic data is broken down into four subregions, a further query of the PSMFC coded wire tag recovery database was needed to separate the Alaskan harvest stemming from the Yakima River by subregion (see Table 3-Ocean Commercial Fishing #3). This additional database query was only conducted for Chinook, since no coded wire tag recoveries in Alaska stemming from the Yakima River were reported for Coho. Since 95 percent of the Alaskan Chinook ocean commercial tag recoveries stemming from the Yakima River occurred in Alaska's Southeast Region, the Alaskan ocean commercial economic data used in the Yakima River analysis focused exclusively on Southeast Region data. So while the percentage of ocean commercial harvest by species and state (including Alaska) was obtained from Table 2-Ocean Commercial Fishing #2, the data from Table 3-Ocean Commercial Fishing #3 was

[3] PSMFC Regional Mark Processing Center (RMPC) website: http://www.rmpc.org/index.php .

needed to make the decision to use of southeast Alaska economic data as reflective of Alaskan Chinook harvest for the benefit estimation process.

The focus of the BCAs is on national economic development; therefore, harvest and associated benefits occurring in Canada would be irrelevant. The 29.9% and 6.7% of ocean commercial Chinook and coho harvest, respectively, stemming from the Yakima River, which was expected to be caught in Canada, should therefore be excluded from the ocean commercial fishery benefit analysis.

The coded wire tag based percentages of ocean commercial harvest by species and state stemming from Yakima River stocks were applied to the state-by-state ocean commercial profitability estimates to calculate a weighted average ocean commercial profitability estimate per fish by species.[4] Since the coded wire tag data included Canada, the state-by-state percentages by species needed to be recalculated without Canada in order to total 100 percent. For coho, there has not been an ocean commercial fishery in California over the past ten years, as a result, both the California and Canada harvest percentages were eliminated, and the value per fish was based on only Oregon and Washington data (notice that the Alaskan percentage was zero for coho). If the percentages had not been recalculated, the United States-only weighted average profitability per fish would have been understated since the unadjusted state percentages total only to 70.1 percent (100 percent - 29.9 percent Canadian) for Chinook and 93.3 percent (100 percent - 6.7 percent Canadian) for coho. To calculate nationally oriented ocean commercial fishing benefits, either the ocean commercial harvest estimates provided by the biologists will need to focus exclusively on the U.S. harvest or the Canadian harvest percentages will need to be applied to the total (U.S. and Canada) ocean harvest by species so that Canadian harvest could be deducted from total harvest to estimate U.S.-only harvest. Table 4-Ocean Commercial Fishing #4 presents the weighted average U.S. ocean commercial revenue and profitability estimates per fish by species. In the Yakima River BCAs, the 5-year weighted average profitability values per fish by species ($25.57 for Chinook and $8.07 for coho in 1st quarter 2007 dollars) were applied to the annual estimates of U.S. ocean commercial harvest by species for each alternative. The annual profitability estimates were discounted to the present and aggregated to provide an ocean commercial fishing benefit estimate.

[4] Another option would have been to apply the percentages by state from the coded wire tag data to the overall ocean commercial harvest estimates developed by study team biologists and then apply the profitability values per fish from each state to the state specific harvest estimates. This approach would require the analyst to keep track of many more value estimates – one for each species, state, harvest type, and harvest area.

TABLE 2.—OCEAN COMMERCIAL FISHING #2: Percentage of Yakima River Ocean Commercial Harvest by Species and State (Hatchery coded wire tag data)

Source: PSMFC Regional Mark Processing Center' Coded Wire Tag Recovery Database

Species	Harvest Type	Recovery Year	Hatchery Salmon Coded Wire Tag Recovery Data by Species and Area Stemming From Yakima River: Alaska	AK%	Canada	Canada%	Washington	WA%	Oregon	OR%	California	CA%	Total
Chinook	Commercial	1984		0.000	2	1.000		0.000		0.000		0.000	2
		1985	2	0.250	6	0.750		0.000					8
		1986	5	0.250	14	0.700		0.000	1	0.050		0.000	20
		1987	18	0.367	25	0.510	3	0.061	3	0.061		0.000	49
		1988	18	0.514	15	0.429	1	0.029	0.000	0.000	0.000	1 0.029	35
		1989	11	0.297	22	0.595	2	0.054	1	0.027	1	0.027	37
		1990	51	0.560	39	0.429		0.000	1	0.011		0.000	91
		1991	23	0.418	30	0.545	1	0.018	1	0.018		0.000	55
		1992	9	0.474	7	0.368	3	0.158					19
		1993	28	0.571	18	0.367		0.000	3	0.061		0.000	49
		1994	32	0.640	18	0.360		0.000					50
		1995	3	0.231	7	0.538	1	0.077	0.000	2 0.154	0.000	0.000	13
		1996	18	0.947	1	0.053		0.000					19
		1997	41	0.612	24	0.358	1	0.015	0.000	1 0.015	0.000	0.000	67
		1998	68	0.701	25	0.258	1	0.010		3 0.031		0.000	97
		1999	133	0.619	68	0.316	13	0.060	0.000	0.000	0.000	1 0.005	215
		2000	114	0.891	9	0.070	4	0.031		1 0.008		0.000	128
		2001	39	0.780	5	0.100	2	0.040		4 0.080		0.000	50
		2002	87	0.837	12	0.115	3	0.029		2 0.019		0.000	104
		2003	80	0.909	6	0.068	2	0.023					88
		2004	20	0.645	8	0.258	3	0.097					31
		2005	17	0.500	16	0.471	1	0.029					34
		2006	6	0.750	2	0.250		0.000	0.000	0.000	0.000	0.000	8
1984-2006 Totals:			823	0.649	379	0.299	41	0.032	0.000	23 0.018	0.000	3 0.002	1269
									0.000		0.000		

Direction of Migration from the mouth of the Columbia River

% North	% South
0.980	0.020

TABLE 2.—OCEAN COMMERCIAL FISHING #2: Percentage of Yakima River Ocean Commercial Harvest by Species and State (Hatchery coded wire tag data) (continued)

Source: PSMFC Regional Mark Processing Center's Coded Wire Tag Recovery Database

	Harvest	Recovery	Hatchery Salmon Coded Wire Tag Recovery Data by Species and Area Stemming From Yakima River:										
Species	Type	Year	Alaska	AK%	Canada	Canada%	Washington	WA%	Oregon	OR%	California	CA%	Total
Coho	Commercial	1981		0.000		0.000	1	0.071	12	0.857	1	0.071	14
		1982		-		-		-		-		-	0
		1983		-		-		-		-		-	0
		1984		-		-		-		-		-	0
		1985		-		-		-		-		-	0
		1986		-		-		-		-		-	0
		1987		-		-		-		-		-	0
		1988		0.000	1	1.000		0.000		0.000		0.000	1
		1989		0.000	10	0.123	5	0.062	64	0.790	2	0.025	81
		1990		0.000	2	0.040	9	0.180	26	0.520	13	0.260	50
		1991		0.000	2	0.024	3	0.036	63	0.750	16	0.190	84
		1992		0.000	1	0.143	1	0.143	5	0.714		0.000	7
		1993		0.000		0.000	1	1.000		0.000		0.000	1
		1994		-		-		-		-		-	0
		1995		0.000	1	0.500	1	0.500		0.000		0.000	2
		1996		-		-		-		-		-	0
		1997		-		-		-		-		-	0
		1998		-		-		-		-		-	0
		1999		0.000		0.000	2	1.000		0.000		0.000	2
		2000		0.000		0.000	1	0.500	1	0.500		0.000	2
		2001		0.000		0.000	3	0.750	1	0.250		0.000	4
		2002		0.000		0.000	1	1.000		0.000		0.000	1
		2003		0.000		0.000	1	1.000		0.000		0.000	1
		2004		0.000		0.000	3	1.000		0.000		0.000	3
		2005		-		-		-		-		-	0
		2006		-		-		-		-		-	0
1981-2006 Totals:			0	0.000	17	0.067	32	0.126	172	0.680	32	0.126	253

Direction of Migration from the mouth of the Columbia River	
% North	% South
0.194	0.806

TABLE 3.—OCEAN COMMERCIAL FISHING #3: Alaskan Ocean Chinook Coded Wire Tag Recoveries by Area

SPECIES_TYPE	RC_STATE	RC_RMPC_REGION *	FISHERY_TYPE	RECOVERY_DATE_YEAR	SUM(RC_TOTAL)	Percent By Area
Chinook	Alaska	CNAK	Commercial	1986	1	0.122
Chinook	Alaska	SEAK	Commercial	2006	6	
Chinook	Alaska	SEAK	Commercial	2005	15	
Chinook	Alaska	SEAK	Commercial	2004	20	
Chinook	Alaska	SEAK	Commercial	2003	80	
Chinook	Alaska	SEAK	Commercial	2002	87	
Chinook	Alaska	SEAK	Commercial	2001	38	
Chinook	Alaska	SEAK	Commercial	2000	112	
Chinook	Alaska	SEAK	Commercial	1999	129	
Chinook	Alaska	SEAK	Commercial	1998	62	
Chinook	Alaska	SEAK	Commercial	1997	38	
Chinook	Alaska	SEAK	Commercial	1996	17	
Chinook	Alaska	SEAK	Commercial	1995	3	
Chinook	Alaska	SEAK	Commercial	1994	31	
Chinook	Alaska	SEAK	Commercial	1993	26	
Chinook	Alaska	SEAK	Commercial	1992	9	
Chinook	Alaska	SEAK	Commercial	1991	21	
Chinook	Alaska	SEAK	Commercial	1990	43	
Chinook	Alaska	SEAK	Commercial	1989	8	
Chinook	Alaska	SEAK	Commercial	1988	17	
Chinook	Alaska	SEAK	Commercial	1987	15	
Chinook	Alaska	SEAK	Commercial	1986	4	
Chinook	Alaska	SEAK	Commercial	1985	2	
				Total:	783	95.140
Chinook	Alaska	WEAK	Commercial	2005	2	
Chinook	Alaska	WEAK	Commercial	2001	1	
Chinook	Alaska	WEAK	Commercial	2000	2	
Chinook	Alaska	WEAK	Commercial	1999	4	
Chinook	Alaska	WEAK	Commercial	1998	6	
Chinook	Alaska	WEAK	Commercial	1997	3	
Chinook	Alaska	WEAK	Commercial	1996	1	
Chinook	Alaska	WEAK	Commercial	1994	1	
Chinook	Alaska	WEAK	Commercial	1993	2	
Chinook	Alaska	WEAK	Commercial	1991	2	
Chinook	Alaska	WEAK	Commercial	1990	8	
Chinook	Alaska	WEAK	Commercial	1989	3	
Chinook	Alaska	WEAK	Commercial	1988	1	
Chinook	Alaska	WEAK	Commercial	1987	3	
				Total:	39	4.739
				Overall Total:	823	100

Note: * Alaskan ocean commercial data is broken down into 4 subregions: 1) southeast (SEAK), 2) central (CNAK), 3) Artic-Yukon-Kuskokwim (AYK), and 4) westward (WEAK)

TABLE 4.—OCEAN COMMERCIAL FISHING #4: Weighted Average Revenue and Profitability per Fish by Species

	Chinook						Coho					
	CA	OR	WA	AK	CANADA (**)	TOTAL	CA	OR	WA	AK	CANADA (**)	TOTAL
% Harvest by State/Country:	0.0024	0.0181	0.0323	0.6485	**0.2987**	1.0000	0.1265	0.6798	0.1265	0.0000	**0.0672**	1.0000
% Harvest by States Only:	0.0034	0.0258	0.0461	0.9247		1.0000	n/a (***)	0.8431	0.1569	0.0000		1.0000
1) REVENUE:												
5 Year Straight Avg:	0.14	1.00	1.56	30.50		33.19	n/a	10.42	1.49	0.00		11.91
5 Year Weighted Avg:	0.11	0.80	1.27	29.77		31.96	n/a	8.87	1.21	0.00		10.08
10 Year Straight Avg:	0.11	0.79	1.33	29.24		31.47	n/a	8.55	1.28	0.00		9.84
10 Year Weighted Avg:	0.10	0.71	1.23	29.09		31.12	n/a	7.08	1.10	0.00		8.18
2) PROFIT:												
5 Year Straight Avg:	0.11	0.80	1.25	24.40		26.56	n/a	8.34	1.19	0.00		9.53
5 Year Weighted Avg:	0.09	0.64	1.02	23.82		25.57	n/a	7.10	0.97	0.00		8.07
10 Year Straight Avg:	0.09	0.63	1.06	23.39		25.17	n/a	6.84	1.03	0.00		7.87
10 Year Weighted Avg:	0.08	0.57	0.98	23.27		24.90	n/a	5.66	0.88	0.00		6.54

** Will need to reduce ocean harvest by Canada harvest percentage (29.87%) to account for only U.S. harvest.
*** Despite the historical data on coded wire tag recoveries (early 1990s), there was not an ocean commercial Coho fishery in California during the 1997-2006 period.

2.2 Ocean Sport

Unlike commercial fishing, recreational or sport fishing activities typically do not take place within a market setting (with the exception of for-hire sector trips – charterboat, partyboat, guideboat activities). As a result, market price information is generally unavailable and nonmarket valuation techniques are typically employed.

The most common nonmarket valuation techniques used in valuing sport fishing and other outdoor recreation activities are the travel cost method (TCM) and contingent valuation method (CVM). Both of these approaches have been recommended for use in valuing outdoor recreation activities within the P&Gs. The travel cost method makes use of data on observed recreator behavior to develop a sport fishing statistical demand model where visitation is estimated as a function of travel costs to the site, site quality (e.g., fish harvest), and other socioeconomic/demographic factors. The area under the demand curve provides a measure of recreator willingness-to-pay (WTP). Subtracting from WTP the cost of accessing the site (e.g., travel cost) provides a measure of the net WTP or economic value attributable to the associated level of recreation visitation, a standard recreation valuation measure otherwise referred to as consumer surplus. Contingent valuation utilizes surveys to directly ask recreators about their WTP for different recreationally oriented scenarios. As with TCM, CVM also provides a measure of consumer surplus. One of the advantages as well as difficulties with CVM is that it involves the posing of hypothetical questions within the survey. As a result, the CVM technique can be used to estimate values for scenarios prior to their implementation. Due to the hypothetical nature of some of the CVM questions, some economists prefer using TCM since it is based on actual observed behavior. A disadvantage of a standard TCM is that it cannot address issues beyond the range of historical observation.

To estimate values per recreationally caught fish for use in the Yakima River studies sport fishing benefit estimation analyses, a detailed literature search was conducted of salmon and steelhead economic sport fishing studies. This approach of using the valuation results from existing studies, a procedure referred to as benefits transfer, is common practice for recreational economic analyses. Virtually all of the reviewed studies providing original value estimates made use of either the TCM or CVM approach. Over 80 studies were gathered and reviewed for their applicability to the Yakima River sport fisheries economic analyses. An annotated bibliography was developed of the various reviewed studies, with those studies providing value estimates included in an Excel spreadsheet for further data analysis. Since various runs of salmon are

recreationally caught both in rivers and in the ocean, with different values associated with river versus ocean sport fishing, the Excel worksheet was separated into salmon ocean versus salmon in-river sections. Note that there were not enough salmon studies differentiated by species (e.g., fall Chinook, spring Chinook, coho, etc.) to allow for separate value estimates by salmon species; therefore, all salmon sport fishing trips/days were assigned the same value within the same general geographic area (i.e., ocean versus river). However, a separate section was developed for steelhead given the number of available steelhead studies (note that steelhead are recreationally caught only within Pacific Northwest rivers and not in the ocean). Of the 80+ salmon and steelhead studies reviewed, only 59 provided original value estimates (17 for ocean salmon, 18 for river salmon, and 24 for river steelhead), the other studies either did not provide value estimates or made use of estimates from another existing study.

A complication with the use of these studies had to do with the type of value estimate(s) provided in each study. Many of the studies provided value estimates for a specific change in fishery conditions (e.g., a certain percentage change in fish populations/harvest or for the marginal/next fish harvested). The specific changes in fishery conditions therefore varied widely across the "change in conditions" studies, suggesting that the valuation results also reflected a wide range of different scenarios. Unfortunately, such studies would likely have little relevance to the Yakima studies since the change in fishery conditions evaluated in each reviewed study would be significantly different from that being evaluated in the Yakima studies. Given this situation, the decision was made to focus only on those studies that provided value estimates for "current" conditions at the time of the study. While conditions at the time of the study may vary from those seen today, it is often the case that fishery conditions tend to change rather slowly, implying those current condition value estimates would likely be more relevant to the Yakima studies. In addition, the studies were grouped and the values averaged within the spreadsheets across the following time intervals: since 2005; since 2000; since 1995; since 1990; and since 1985, with the intent on focusing on the more recently completed studies. With more recent studies, it is more likely that advanced forms of the TCM and CVM approaches would have been employed and fishery conditions would be less likely to have changed significantly as compared to current conditions. Unfortunately, it appears the majority of salmon and steelhead studies were conducted from the late 1970s to the late 1980s, so many (but not all) of the studies may be getting somewhat dated. Also note that the values from the various studies were indexed up to current (April 2007) dollars based on the consumer price index to be consistent with the Yakima River studies cost estimates. To the extent possible, we also tried to make use of the more recent studies so as to minimize the duration of the indexing period. In addition, despite the fact that the studies reflect a range of

different river and ocean locations, most of these studies were conducted in the Pacific Northwest states of California, Oregon, Washington, and Idaho (with several from Alaska). Furthermore, by grouping the studies by species (salmon versus steelhead) and geographic setting (ocean versus river), we tried to lump similar studies together. By averaging valuation results over similar species, geographic areas, and time periods, the intent was to obtain the most relevant values possible.

Another issue pertains to the units of measure of the sport fishing effort estimates. Sport fishing effort is typically measured in terms of recreation days by federal and state fisheries agencies (see Table 5-Ocean Sport Fishing #1). One needs to be careful in utilizing fishery agency effort data because in some cases, the estimates referred to as "trips" actually reflect "days" from an economics perspective (e.g., PFMC data). From an economist's point of view, a recreation trip reflects a single visit to a recreation site from one's primary residence even if the visit involves multiple days. Conversely, estimates of recreation days reflect the actual number of days spent on-site where a recreation day can involve recreating for any portion of a calendar day. As a result, a recreation trip can be comprised of more than one recreation day. Economists tend to focus on trips as the preferred visitation and valuation measure since many of the travel cost components are incurred on a per-trip basis as opposed to a per-day basis (e.g., costs of traveling to the region). For local residents, recreation trips tend to equal the number of recreation days (i.e. locals typically take single day trips). On the other hand, nonlocals tend to stay overnight in the region, implying multiple day trips. If a site experiences a significant amount of visitation from nonlocals, the number of days could significantly exceed the number of trips. Given that the Federal and state agency fishing effort estimates are generally measured in days, the valuation estimates would also need to be measured in days. Unfortunately, the majority of the reviewed studies measured values on a per-trip basis and did not provide estimates of the average number of days per trip to allow for conversion of per-trip to per-day values. To the extent that per-trip values exceed per-day values, the use of per-trip estimates would overstate sport fishing benefits.

The need to develop a value per-day estimate eliminated the available studies that only provided estimates of values on a per-trip basis. For ocean benefit estimation, only two studies conducted since 1985 were located that provided current condition value estimates on a per-day basis: 1) Olsen, Richards, and Scott (1991) and 2) Jones and Stokes (1987). Olsen et al. (1991) conducted a contingent valuation survey in 1989 to estimate use and nonuse values associated with current ocean and Columbia River conditions as well as a doubling of the size of the salmon and steelhead runs on the Columbia River. This is perhaps the most frequently referenced study of Columbia River salmon values found in the

literature. Jones and Stokes (1987) conducted a survey in 1986-7 of Juneau, Alaska, area anglers (with analysis conducted by Michael Hanemann (UC-Berkeley) and Richard Carson (UC-San Diego) using sophisticated random utility travel cost models. The average across the four values -ay estimates (two from each study), indexed to April 2007 dollars, was $115.28.

A final aspect of the ocean sport fishing analysis has to do with the conversion of value estimates from a per-day basis to a per-fish basis. The biological models used in the Yakima River studies estimated changes in fish populations for each alternative from which harvest estimates were developed. Since the sport fishing economic studies employed report values on a per-day basis, those values have to be converted to a per-fish basis before being applied to the harvest estimates. A standard procedure for conversion is to multiply the values per day by the number of ocean sport fishing days per fish harvested. Federal and state fisheries agencies generally collect data on ocean sport harvest and effort from which harvest per day estimates can be derived. Whereas harvest is estimated by species, number of days fished may not be species-specific, since many anglers do not target specific species. In others words, ocean sport trips may target certain general types of fish (e.g., salmon), but those trips may not be species-specific (e.g., fall Chinook trips). PFMC visitation data is available by species group (e.g., salmon), but not by individual species. As a result, it is often necessary to combine individual species (e.g., fall Chinook, spring Chinook, coho) into similar species groups (e.g., salmon) based on the level of detail available for the effort (trips/days) data. Harvest per day estimates can be calculated for general species types using the Federal/state agency catch and effort data. The inverse of harvest per day is the days per fish harvested factor needed to convert value per day to value per fish.

Similar to the ocean commercial analysis, ocean sport data on days per fish harvested varied by state. To estimate a weighted average days per Chinook and coho salmon harvested across the various states, coded wire tag data (as obtained from the PSMFC Regional Mark Processing Center) was again used, this time to estimate the percentage of ocean sport harvest by state stemming from the Yakima River (see Table 6-Ocean Sport Fishing #2). Note that while the days per fish harvested had to be combined for Chinook and coho due to lack of detail on fishing effort (salmon trips, not Chinook salmon trips), the coded wire tag data was salmon species specific. Multiplying the generic salmon days per harvested fish by state by the species-specific (Chinook and coho) percentages by state stemming from the Yakima River allows for the estimation of weighted average species-specific estimates of days per ocean sport harvested Chinook and coho salmon. While this estimate would be more accurate if species-specific visitation estimates could be developed and therefore species specific days per harvested fish estimates were available, nevertheless this estimate does allow for differentiation between fish species.

A complication with the estimation of the weighted average days per Chinook and coho stemmed from the lack of certain data from the State of Alaska. While Alaska gathers data on ocean sport Chinook and coho harvest, their effort (days fished) data is not species- or species-group-specific. The estimates of ocean sport fishing days in Alaska include all species. Therefore, it would not be reasonable to develop a "days per Chinook or Coho harvested" estimate since the fishing day estimate includes days where salmon are not being targeted. Since salmon days per fish harvested could not be estimated for Alaska, another option would be to see if the available Alaskan ocean sport salmon valuation studies provided estimates of values on a per-fish basis. If so, no conversion would need to be made between values per day and values per fish. Unfortunately, none of the Alaskan studies reported values on a per-fish basis or provided harvest per-day information to allow for such a conversion. As a result, a weighted average days per Chinook and coho harvested were estimated, based only on data from the states of California, Oregon, and Washington. The percentages by state for California, Oregon and Washington were re-weighted to sum to 100 percent (see Table 7-Ocean Sport Fishing #3). For coho, this data shortage was not a problem since no coded wire tags were recovered in Alaska, but for Chinook, this exclusion proved problematic since nearly 38 percent of the coded wire tags were recovered in Alaska. By excluding Alaska, we are assuming that the ocean sport fishing value per fish in Alaska is analogous to the weighted average across California, Oregon, and Washington. The decision was made that this was not an unrealistic assumption.

Table 7-Ocean Sport Fishing #3 presents the results of applying the re-weighted percentages by state to the 5-year weighted average days per fish harvested by state to estimate an overall weighted average days per ocean sport fish harvested for Chinook (.880) and coho (1.028). Multiplying these estimates of overall ocean sport days per harvested fish by the $115.28 value per day provides the necessary estimates of values per fish for Chinook ($101.49) and coho ($118.54). While both species utilized the same estimates of value per day and days per fish harvested by state, the difference in value per fish is driven by the harvest percentages by state obtained from the coded wire tag data. As with the ocean commercial analysis, the percentage of ocean sport Chinook harvest stemming from the Yakima River expected to be taken in Canada (31.5%) would need to be excluded from the analysis (note the percentage of coho harvested in Canada was essentially zero [0.3 percent]). To calculate nationally oriented ocean sport fishing benefits, either the ocean sport harvest estimates provided by the biologists will need to focus exclusively on U.S. harvest, or the Canadian harvest percentages will need to be applied to the total (U.S. and Canada) ocean harvest by species so that Canadian harvest could be deducted from total harvest to estimate U.S. harvest.

TABLE 5.—OCEAN SPORT FISHING #1: Days per Chinook & Salmon Harvested

Source: Pacific Fishery Management Council (PFMC), Salmon SAFE Report website, 2005 SAFE Report Socioeconomic Chapter

Year/Area	Charterboat Ocean Sport Salmon Days (Thousands)	Private Boat Ocean Sport Salmon Days (Thousands)	Total Ocean Sport Salmon Days (Thousands)	Charterboat Chinook Ocean Landings (Thousands of Fish)	Private Boat Chinook Ocean Landings (Thousands of Fish)	Total Chinook Ocean Landings (Thousands of Fish)	Charterboat Coho Ocean Landings (Thousands of Fish)	Private Boat Coho Ocean Landings (Thousands of Fish)	Total Coho Ocean Landings (Thousands of Fish)	Total Chinook & Coho Ocean Landings (Thousands of Fish)	Total Chinook & Coho Harvest Rate per Day	Total Chinook & Coho Days per Fish Harvested
CALIFORNIA:												
1997	102.6	131.7	234.3	122.3	106.6	228.9	0.0	0.5	0.5	229.4	0.979	1.021
1998	67.0	85.0	152.0	59.7	62.3	122.0	0.0	0.1	0.1	122.1	0.803	1.245
1999	62.6	84.4	147.0	40.5	47.4	87.9	0.0	0.6	0.6	88.5	0.602	1.661
2000	94.0	120.4	214.4	91.9	94.0	185.9	0.0	0.4	0.4	186.3	0.869	1.151
2001	69.9	95.2	165.1	43.2	55.6	98.8	0.1	1.2	1.3	100.1	0.606	1.649
2002	86.6	123.4	210.0	85.1	96.9	182.0	0.0	0.8	0.8	182.8	0.870	1.149
2003	59.4	75.3	134.7	48.3	46.4	94.7	0.1	0.6	0.7	95.4	0.708	1.412
2004	97.7	121.0	218.7	124.7	96.5	221.2	0.0	1.4	1.4	222.6	1.018	0.982
2005	69.1	103.9	173.0	61.3	81.9	143.2	0.0	0.7	0.7	143.9	0.832	1.202
2006	43.3	77.0	120.3	34.7	54.8	89.5	0.0	1.4	1.4	90.9	0.756	1.323
5 Year Straight Avg:	71.2	100.1	171.3	70.8	75.3	146.1	0.0	1.0	1.0	147.1	0.837	1.214
5 Year Weighted Avg:											0.859	1.165
10 Year Straight Avg:	75.2	101.7	177.0	71.2	74.2	145.4	0.0	0.8	0.8	146.2	0.804	1.280
10 Year Weighted Avg:											0.826	1.210

TABLE 5.—OCEAN SPORT FISHING #1: Days per Chinook & Salmon Harvested (continued)

OREGON:

1997	3.9	26.4	30.3	1.5	6.2	7.7	2.4	3.6	6.0	13.7	0.452	2.212
1998	1.8	24.2	26.0	0.5	3.6	4.1	0.5	1.8	2.3	6.4	0.246	4.063
1999	5.5	43.9	49.4	0.9	6.9	7.8	3.4	10.3	13.7	21.5	0.435	2.298
2000	9.8	68.7	78.5	3.6	21.8	25.4	7.5	25.7	33.2	58.6	0.746	1.340
2001	18.2	102.3	120.5	6.4	20.8	27.2	19.3	75	94.3	121.5	1.008	0.992
2002	15.7	91.9	107.6	7.9	39.5	47.4	9	27.5	36.5	83.9	0.780	1.282
2003	23.4	121.1	144.5	8.8	31.8	40.6	23.7	90	113.7	154.3	1.068	0.936
2004	21.1	124.6	145.7	14.6	41.8	56.4	13.1	58.8	71.9	128.3	0.881	1.136
2005	9.9	66.1	76.0	4.5	23.4	27.9	3.1	10.6	13.7	41.6	0.547	1.827
2006	8.0	54.3	62.3	1.5	11.6	13.1	3.6	12	15.6	28.7	0.461	2.171
5 Year Straight Avg:	15.6	91.6	107.2	7.5	29.6	37.1	10.5	39.8	50.3	87.4	0.747	1.470
5 Year Weighted Avg:											0.815	1.227
10 Year Straight Avg:	11.7	72.4	84.1	5.0	20.7	25.8	8.6	31.5	40.1	65.9	0.662	1.826
10 Year Weighted Avg:											0.783	1.277

WASHINGTON:

1997	12.5	15.1	27.6	1.7	2.3	4.0	12.5	12.8	25.3	29.3	1.062	0.942
1998	5.5	6.8	12.3	1.1	0.9	2.0	5.6	7.1	12.7	14.7	1.195	0.837
1999	17.5	29.9	47.4	5.7	4.1	9.8	16.3	23.7	40.0	49.8	1.051	0.952
2000	17.1	27.9	45.0	5.1	3.4	8.5	27.9	35.8	63.7	72.2	1.604	0.623
2001	41.2	72.4	113.6	11.9	10.8	22.7	66.2	98.2	164.4	187.1	1.647	0.607
2002	37	57.4	94.4	30.9	27	57.9	30.4	43.7	74.1	132.0	1.398	0.715
2003	44.5	75.5	120.0	16	18.1	34.1	53.4	84.9	138.3	172.4	1.437	0.696
2004	36.5	73.1	109.6	10.3	14.6	24.9	37.6	75.1	112.7	137.6	1.255	0.797
2005	31.7	58.9	90.6	15.9	20.4	36.3	19.2	32.6	51.8	88.1	0.972	1.028
2006	24.5	39.1	63.6	4	6.7	10.7	16.2	19.9	36.1	46.8	0.736	1.359
5 Year Straight Avg:	34.8	60.8	95.6	15.4	17.4	32.8	31.4	51.2	82.6	115.4	1.160	0.919
5 Year Weighted Avg:											1.206	0.829
10 Year Straight Avg:	26.8	45.6	72.4	10.3	10.8	21.1	28.5	43.4	71.9	93.0	1.236	0.856
10 Year Weighted Avg:											1.284	0.779

TABLE 6.—OCEAN SPORT FISHING #2: Percentage of Yakima River Ocean Sport Harvest by Species and State (Hatchery coded wire tag data)

Source: PSMFC Regional Mark Processing Center's Coded Wire Tag Recovery Database

			Hatchery Salmon Coded Wire Tag Recovery Data by Species and Area Stemming From Yakima River:										
Species	Harvest Type	Recovery Year	Alaska	AK%	Canada	Canada%	Washington	WA%	Oregon	OR%	California	CA%	Total
Chinook	Sport	1983		0.000		0.000		0.000	1	1.000		0.000	1
		1984		-		-		-		-		-	0
		1985			1	1.000		0.000		0.000		0.000	1
		1986			2	1.000		0.000		0.000		0.000	2
		1987			2	0.500	2	0.500		0.000		0.000	4
		1988			1	1.000		0.000		0.000		0.000	1
		1989			2	0.250	5	0.625		0.000	1	0.125	8
		1990	0.000	3 0.600	1	0.200	1	0.200		0.000		0.000	5
		1991	0.000			0.000	2	1.000		0.000		0.000	2
		1992	0.000	-		-		-		-		-	0
		1993	0.000			0.000	3	1.000		0.000		0.000	3
		1994	0.000	1 1.000		0.000		0.000		0.000		0.000	1
		1995				0.000		0.000		0.000	1	1.000	1
		1996	0.000	1 1.000		0.000		0.000		0.000		0.000	1
		1997		3 0.500		0.000	3	0.500		0.000		0.000	6
		1998	0.000	1 0.091	3	0.273	7	0.636		0.000		0.000	11
		1999		10 0.303	13	0.394	9	0.273	1	0.030		0.000	33
		2000	0.000	21 0.700	8	0.267	1	0.033		0.000		0.000	30
		2001		0.000	2	0.500	1	0.250	1	0.250		0.000	4
		2002		6 0.400	6	0.400	3	0.200		0.000		0.000	15
		2003		6 1.000		0.000		0.000		0.000		0.000	6
		2004		0.000	3	0.600	1	0.200	1	0.200		0.000	5
		2005		1 0.500	1	0.500		0.000		0.000		0.000	2
		2006		1 1.000		0.000		0.000		0.000		0.000	1
		1983-2006 Totals:		54 0.378	45	0.315	38	0.266	4	0.028	2	0.014	143

Of Columbia River	
% North	% South
0.958	0.042

TABLE 6.—OCEAN SPORT FISHING #2: Percentage of Yakima River Ocean Sport Harvest by Species and State (Hatchery coded wire tag data) (continued)

Coho	Sport	1981			0.000		0.000	2	0.500	1	0.250	1	0.250	4		
		1982			-		-		-		-		-	0		
		1983			-		-		-		-		-	0		
		1984			-		-		-		-		-	0		
		1985			-		-		-		-		-	0		
		1986			-		-		-		-		-	0		
		1987			-		-		-		-		-	0		
		1988			-		-		-		-		-	0		
		1989			0.000	1	0.006	69	0.445	77	0.497	8	0.052	155		
		1990			0.000		0.000	59	0.381	82	0.529	14	0.090	155		
		1991			0.000		0.000	78	0.377	85	0.411	44	0.213	207		
		1992			0.000		0.000	10	0.385	16	0.615		0.000	26		
		1993			0.000		0.000	7	0.350	10	0.500	3	0.150	20		
		1994					0.000	1	1.000		0.000		0.000	1		
		1995			0.000		0.000	17	0.773	5	0.227		0.000	22		
		1996					0.000	5	0.833		0.000	1	0.167	6		
		1997			0.000		0.000	17	0.944	1	0.056		0.000	18		
		1998			0.000		0.000	13	0.867	2	0.133		0.000	15		
		1999	0.000		0.000		0.000	25	0.676	12	0.324		0.000	37		
		2000			0.000		0.000	25	0.500	25	0.500		0.000	50		
		2001	0.000		0.000	1	0.019	36	0.692	15	0.288		0.000	52		
		2002			-		-		-		-		-	0		
		2003			0.000		0.000	6	0.857	1	0.143		0.000	7		
		2004					0.000	6	1.000		0.000		0.000	6		
		2005					0.000	4	1.000		0.000		0.000	4	Of Columbia River	
		2006			-		-		-		-		-	0	% North	% South
		1981-2006 Totals:		0	0.000	2	0.003	380	0.484	332	0.423	71	0.090	785	0.487	0.513
			0.000													
			0.000													

TABLE 7.—OCEAN SPORT FISHING #3: Values per Fish

State	5 & 10 Year Wtd. Average Chinook & Coho Days/Fish Harvested	% Chinook Harvest by State	Re-Weighted % Chinook Harvest By State	% Coho Harvest by State	Re-Weighted % Coho Harvest by State
California:	1.165	0.014	0.045	0.090	0.091
Oregon:	1.227	0.028	0.091	0.423	0.424
Washington:	0.829	0.266	0.864	0.484	0.485
Alaska:	not available	0.378	-	0.000	-
Canada:	not applicable	0.315	-	0.003	-
			1.000		1.000
5 Year CA/OR/WA Wtd Average Days/Fish Harvested:			0.880		1.028
Value per Day (April 2007 $):			$ 115.28		$ 115.28
Value per Fish (April 2007 $):			$ 101.49		$ 118.54
California:	1.210	0.014	0.045	0.090	0.091
Oregon:	1.277	0.028	0.091	0.423	0.424
Washington:	0.779	0.266	0.864	0.484	0.485
Alaska:	not available	0.378	-	0.000	-
Canada:	not applicable	0.315	-	0.003	-
					1.000
10 Year CA/OR/WA Wtd Average Days/Fish Harvested:			0.844		1.029
Value per Day (April 2007 $):			$ 115.28		$ 115.28
Value per Fish (April 2007 $):			$ 97.24		$ 118.62

2.3 Lower Columbia River (Zones 1-5) Non-Indian Commercial

The Lower Columbia River non-Indian commercial fishing analysis applies a similar methodology as the ocean commercial fishing analysis. Zones 1-5 basically extend from the mouth of the Columbia River 140 miles upriver to Bonneville Dam. Zones 1-5 are open to non-Indian commercial fishermen and sport fishermen. Ten years of revenue and round pounds landed (entire fish as opposed to a partially processed dressed fish) data were again obtained from the PFMC nnual *Review of Ocean Salmon Fisheries*. Data from both Oregon and Washington were combined to estimate total Lower Columbia River values. As with the ocean commercial fishing analysis, nominal revenues were obtained from the report and real revenues were estimated using the GDP Implicit Price Deflator. Five- and 10-year straight and weighted averages of nominal and real prices per pound by species were multiplied by average round pounds per fish to estimate revenues per fish by species as presented in Table 8-Lower Columbia River Non-Indian Commercial Fishing #1. Round pounds per fish by species data, shown in Table 9-Lower Columbia River Non-Indian Commercial Fishing #2, was obtained from the Oregon Department of Fish and Wildlife (ODFW) website[5] and from Doug Case, ODFW staff. Again, an estimated profitability percentage of 80 percent was used to calculate profitability per fish by species. Since the biological harvest model estimated non-Indian commercial in-river harvest for this stretch of the Columbia River (zones 1-5), there is no need to use hatchery-coded wire tag recovery data to try and allocate harvest within the Columbia River Basin. The 5-year weighted average profitability value per fish by species ($45.53 for Spring Chinook, $14.56 for Fall Chinook, and $5.82 for Coho in 1st quarter 2007 dollars) presented in Table 8-Lower Columbia River Non-Indian Commercial Fishing #1 was applied directly to the annual estimates of Lower Columbia River commercial harvest. The annual profitability estimates were discounted to the present and aggregated into a total Lower Columbia River commercial fishing benefit estimate.

[5] Oregon Department of Fish and Wildlife (ODFW) website: www.dfw.state.or.us/ .

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: Non-Indian Commercial Values per Fish by Species and State

Sources: OR, WA Data: 2006 Review of Ocean Salmon Fisheries (2006 Salmon SAFE Document, published 2/2007), Socioeconomic Chapter, Table IV-9

Bureau of Economic Analysis — **Insert Target Quarter:** 1st Qrtr 2007 — **Insert IPD Value:** Annual GDP 118.041

Non-Indian — Spring Chinook — **1st Qrtr 2007** — Round — **1st Qrtr 2007**

Insert Profit %: 0.8

Year	Implicit Price Deflator (IPD)	GDP Annual Value	Nominal Value Data Year	Applied GDP Index Value	State/ Year	Nominal Value (2) (K$)	Real Value (3) (K$)	Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price/lb. (Round)	Real Price/lb. (Round)	Round Pounds per Fish	Nominal Revenue per Fish	Real 1st Qtr 2007 Revenue per Fish
					I. OREGON:	Table IV-9	Table IV-9 (Calculated)	Table IV-9	?*	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	95.414	0.808	2000	0.847	1997	69	81	26	?	2.65	3.13			
1998	96.472	0.817	2000	0.847	1998	94	111	35	?	2.69	3.17			
1999	97.868	0.829	2000	0.847	1999	81	96	28	?	2.89	3.41			
2000	100	0.847	2000	0.847	2000	229	270	85	?	2.69	3.18			
2001	102.399	0.867	2001	0.867	2001	586	676	222	?	2.64	3.04			
2002	104.187	0.883	2002	0.883	2002	932	1,056	316	?	2.95	3.34			
2003	106.404	0.901	2003	0.901	2003	378	419	147	?	2.57	2.85			
2004	109.426	0.927	2004	0.927	2004 (1)	1,027	1,108	276	?	3.72	4.01			
2005	112.737	0.955	2005	0.955	2005 (1)	314	329	92	?	3.41	3.57			
2006	116.043	0.983	2006	0.983	2006 (1)	614	625	131	?	4.69	4.77			
					5 Year Sum:	3,265	3,536	962						
					10 Year Sum:	4,324	4,770	1,358						
					1) REVENUE:									
					5 Year Straight Avg:	653	707			3.47	3.71	15.21	52.74	56.41
					5 Year Weighted Avg:					3.39	3.68	15.03	51.02	55.26
					10 Year Straight Avg:	432	477			3.09	3.45	14.86	45.93	51.25
					10 Year Weighted Avg:					3.18	3.51	15.00	47.77	52.70
					2) PROFIT:									
					5 Year Straight Avg:								42.19	45.13
					5 Year Weighted Avg:								40.82	44.21
					10 Year Straight Avg:								36.74	41.00
					10 Year Weighted Avg:								38.22	42.16

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: Non-Indian Commercial Values per Fish by Species and State (continued)

II. WASHINGTON:

1997				?*		
1998				?		
1999				?		
2000	15	18	3	?	5.00	5.90
2001	134	154	35	?	3.83	4.41
2002	295	334	70	?	4.21	4.77
2003	80	89	20	?	4.00	4.44
2004 (1)	272	293	69	?	3.94	4.25
2005 (1)	220	230	62	?	3.55	3.72
2006 (1)	320	326	87	?	3.68	3.74
5 Year Sum:	1,187	1,272	308			
10 Year Sum:	1,336	1,444	346			

1) REVENUE:

5 Year Straight Avg:	237	254	3.88	4.18	15.21	58.95	63.63
5 Year Weighted Avg:			3.85	4.13	15.03	57.93	62.09
10 Year Straight Avg:	191	206	4.03	4.46	14.86	59.89	66.31
10 Year Weighted Avg:			3.86	4.17	15.00	57.93	62.63

2) PROFIT:

5 Year Straight Avg:	47.16	50.90
5 Year Weighted Avg:	46.35	49.68
10 Year Straight Avg:	47.91	53.05
10 Year Weighted Avg:	46.34	50.11

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: Non-Indian Commercial Values per Fish by Species and State (continued)

III. OR & WA COMBINED:

1997	69	81	26	?*	2.65		3.13
1998	94	111	35	?	2.69		3.17
1999	81	96	28	?	2.89		3.41
2000	244	288	88	?	2.77		3.27
2001	720	830	257	?	2.80		3.23
2002	1,227	1,390	386	?	3.18		3.60
2003	458	508	167	?	2.74		3.04
2004 (1)	1,299	1,401	345	?	3.77		4.06
2005 (1)	534	559	154	?	3.47		3.63
2006 (1)	934	950	218	?	4.28		4.36
5 Year Sum:	4,452	4,809	1,270				
10 Year Sum:	5,660	6,215	1,704				
1) REVENUE:							
5 Year Straight Avg:	890	962		3.49	3.74	15.21	53.03	56.85
5 Year Weighted Avg:				3.51	3.79	15.03	52.70	56.92
10 Year Straight Avg:	566	621		3.12	3.49	14.86	46.43	51.88
10 Year Weighted Avg:				3.32	3.65	15.00	49.83	54.72
2) PROFIT:								
5 Year Straight Avg:							42.43	45.48
5 Year Weighted Avg:							42.16	45.53
10 Year Straight Avg:							37.14	41.51
10 Year Weighted Avg:							39.87	43.77

Notes:

1) Preliminary Data
2) Nominal value was obtained from Table IV-9. Since real value and nominal values equate in the current year, nominal values were obtained by referring to the real values for the current year in each annual report. The annual report was not available for years 1997-1999, so those nominal values were expressed in real year 2000 $ (obtained from the year 200 report). As a result, the 10 year nominal value estimates are incorrect, but the 10 year real values are correct.
3) Real values were calculated from the nominal values using the GDP index. The calculated real values in this spreadsheet vary somewhat from those presented in Table IV-9 given we used end of year GDP Implicit Price Deflator values.

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: (Fall Chinook) (continued)

Insert Profit %: 0.8

State/ Year	Non-Indian Fall Chinook - Brights & Tules (4) Nominal Value (2) (K$)	1st Qrtr 2007 Real Value (3) (K$)	Round Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price/lb. (Round)	1st Qrtr 2007 Real Price/lb. (Round)	Round Pounds per Fish	Nominal Revenue per Fish	Real 1st Qtr 2007 Revenue per Fish
I. OREGON:	Table IV-9	Table IV-9 (Calculated)	Table IV-9	?*	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	73	86	143	?	0.51	0.60			
1998	36	42	53	?	0.68	0.80			
1999	92	109	89	?	1.03	1.22			
2000	111	131	116	?	0.96	1.13			
2001	130	150	273	?	0.48	0.55			
2002	217	246	604	?	0.36	0.41			
2003	419	465	748	?	0.56	0.62			
2004 (1)	610	658	633	?	0.96	1.04			
2005 (1)	476	498	405	?	1.18	1.23			
2006 (1)	655	666	363	?	1.80	1.84			
5 Year Sum:	2,377	2,533	2,753						
10 Year Sum:	2,819	3,052	3,427						
1) REVENUE:									
5 Year Straight Avg:	475	507			0.97	1.03	18.44	17.93	18.93
5 Year Weighted Avg:					0.86	0.92	18.38	15.87	16.91
10 Year Straight Avg:	282	305			0.85	0.94	17.70	15.08	16.71
10 Year Weighted Avg:					0.82	0.89	18.06	14.85	16.08
2) PROFIT:									
5 Year Straight Avg:								14.34	15.14
5 Year Weighted Avg:								12.70	13.53
10 Year Straight Avg:								12.07	13.37
10 Year Weighted Avg:								11.88	12.86

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: (Fall Chinook) (continued)

II. WASHINGTON:

1997	9	11	9	?*	1.00	1.18
1998	29	34	27	?	1.07	1.27
1999	86	102	82	?	1.05	1.24
2000	131	155	138	?	0.95	1.12
2001	67	77	122	?	0.55	0.63
2002	99	112	215	?	0.46	0.52
2003	258	286	448	?	0.58	0.64
2004 (1)	431	465	338	?	1.28	1.38
2005 (1)	327	342	235	?	1.39	1.46
2006 (1)	420	427	218	?	1.93	1.96
5 Year Sum:	1,535	1,633	1,454			
10 Year Sum:	1,857	2,011	1,832			

1) REVENUE:

5 Year Straight Avg:	307	327	1.13	1.19	18.44	20.76	21.95
5 Year Weighted Avg:			1.06	1.12	18.38	19.40	20.64
10 Year Straight Avg:	186	201	1.03	1.14	17.70	18.15	20.17
10 Year Weighted Avg:			1.01	1.10	18.06	18.30	19.82

2) PROFIT:

5 Year Straight Avg:	16.61	17.56
5 Year Weighted Avg:	15.52	16.51
10 Year Straight Avg:	14.52	16.14
10 Year Weighted Avg:	14.64	15.86

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: (Fall Chinook) (continued)

III. OR & WA COMBINED:

1997	82	97	152	?*	0.54	0.64	
1998	65	77	80	?	0.81	0.96	
1999	178	210	171	?	1.04	1.23	
2000	242	286	254	?	0.95	1.12	
2001	197	227	395	?	0.50	0.57	
2002	316	358	819	?	0.39	0.44	
2003	677	751	1,196	?	0.57	0.63	
2004 (1)	1,041	1,123	971	?	1.07	1.16	
2005 (1)	803	841	640	?	1.25	1.31	
2006 (1)	1,075	1,094	581	?	1.85	1.88	
5 Year Sum:	3,912	4,166	4,207				
10 Year Sum:	4,676	5,063	5,259				

1) REVENUE:

5 Year Straight Avg:	782	833	1.03	1.08	18.44	18.91	19.98
5 Year Weighted Avg:			0.93	0.99	18.38	17.09	18.20
10 Year Straight Avg:	468	506	0.90	0.99	17.70	15.89	17.60
10 Year Weighted Avg:			0.89	0.96	18.06	16.06	17.38

2) PROFIT:

5 Year Straight Avg:						15.13	15.98
5 Year Weighted Avg:						13.67	14.56
10 Year Straight Avg:						12.71	14.08
10 Year Weighted Avg:						12.84	13.91

Notes:

1) Preliminary Data
2) Nominal value was obtained from Table IV-9. Since real value and nominal values equate in the current year, nominal values were obtained by referring to the real values for the current year in each annual report. The annual report was not available for years 1997-1999, so those nominal values were expressed in real year 2000 $ (obtained from the year 200 report). As a result, the 10 year nominal value estimates are incorrect, but the 10 year real values are correct.
3) Real values were calculated from the nominal values using the GDP index. The calculated real values in this spreadsheet vary somewhat from those presented in Table IV-9 given we used end of year GDP Implicit Price Deflator values.
4) “Tules” (to-lee) are fall Chinook that are ready to spawn and are therefore less commercially valuable than fall “brights.” Fall brights spawn later and further upstream (Hanford Reach or Snake River). These values include both tules and fall brights combined.

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: (Coho) (continued)

Insert Profit %: 0.8

State/ Year	Non-Indian Coho Nominal Value (2) (K$)	1st Qrtr 2007 Real Value (3) (K$)	Round Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price/lb. (Round)	1st Qrtr 2007 Real Price/lb. (Round)	Round Pounds per Fish	Nominal Revenue per Fish	Real 1st Qtr 2007 Revenue per Fish
I. OREGON:	Table IV-9	Table IV-9 (Calculated)	Table IV-9	?*	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	115	136	149	?	0.77	0.91			
1998	131	155	193	?	0.68	0.80			
1999	400	472	469	?	0.85	1.01			
2000	506	597	949	?	0.53	0.63			
2001	374	431	1323	?	0.28	0.33			
2002	373	423	1148	?	0.32	0.37			
2003	776	861	1522	?	0.51	0.57			
2004 (1)	679	732	755	?	0.90	0.97			
2005 (1)	845	885	789	?	1.07	1.12			
2006 (1)	627	638	478	?	1.31	1.33			
5 Year Sum:	3,300	3,538	4,692						
10 Year Sum:	4,826	5,329	7,775						
1) REVENUE:									
5 Year Straight Avg:	660	708			0.82	0.87	9.98	8.21	8.70
5 Year Weighted Avg:					0.70	0.75	9.77	6.87	7.37
10 Year Straight Avg:	483	533			0.72	0.80	9.22	6.67	7.41
10 Year Weighted Avg:					0.62	0.69	9.34	5.80	6.40
2) PROFIT:									
5 Year Straight Avg:								6.57	6.96
5 Year Weighted Avg:								5.50	5.90
10 Year Straight Avg:								5.34	5.92
10 Year Weighted Avg:								4.64	5.12

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: (Coho) (continued)

II. WASHINGTON:

1997	2	2	3	?*	0.67	0.79
1998				?		
1999	183	216	215	?	0.85	1.00
2000	256	302	504	?	0.51	0.60
2001	247	285	934	?	0.26	0.30
2002	176	199	538	?	0.33	0.37
2003	449	498	799	?	0.56	0.62
2004 (1)	314	339	370	?	0.85	0.92
2005 (1)	196	205	191	?	1.03	1.07
2006 (1)	276	281	207	?	1.33	1.36
5 Year Sum:	1,411	1,522	2,105			
10 Year Sum:	2,099	2,327	3,761			

1) REVENUE:

5 Year Straight Avg:	282	304	0.82	0.87	9.98	8.17	8.66
5 Year Weighted Avg:			0.67	0.72	9.77	6.55	7.07
10 Year Straight Avg:	233	259	0.71	0.78	9.22	6.54	7.21
10 Year Weighted Avg:			0.56	0.62	9.34	5.21	5.78

2) PROFIT:

5 Year Straight Avg:	6.54	6.93
5 Year Weighted Avg:	5.24	5.65
10 Year Straight Avg:	5.23	5.77
10 Year Weighted Avg:	4.17	4.62

* ? = no data available

TABLE 8.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #1: (Coho) (continued)

III. OR & WA COMBINED:

1997	117	138	152	?*	0.77	0.91	
1998	131	155	193	?	0.68	0.80	
1999	583	688	684	?	0.85	1.01	
2000	762	899	1,453	?	0.52	0.62	
2001	621	716	2,257	?	0.28	0.32	
2002	549	622	1,686	?	0.33	0.37	
2003	1,225	1,359	2,321	?	0.53	0.59	
2004 (1)	993	1,071	1,125	?	0.88	0.95	
2005 (1)	1,041	1,090	980	?	1.06	1.11	
2006 (1)	903	919	685	?	1.32	1.34	
5 Year Sum:	4,711	5,061	6,797				
10 Year Sum:	6,925	7,657	11,536				

1) REVENUE:

5 Year Straight Avg:	942	1,012		0.82	0.87	9.98	8.21	8.70
5 Year Weighted Avg:				0.69	0.74	9.77	6.77	7.28
10 Year Straight Avg:	693	766		0.72	0.80	9.22	6.65	7.39
10 Year Weighted Avg:				0.60	0.66	9.34	5.60	6.20

2) PROFIT:

5 Year Straight Avg:	6.57	6.96
5 Year Weighted Avg:	5.42	5.82
10 Year Straight Avg:	5.32	5.91
10 Year Weighted Avg:	4.48	4.96

Notes:

1) Preliminary Data
2) Nominal value was obtained from Table IV-9. Since real value and nominal values equate in the current year, nominal values were obtained by referring to the real values for the current year in each annual report. The annual report was not available for years 1997-1999, so those nominal values were expressed in real year 2000 $ (obtained from the year 200 report). As a result, the 10 year nominal value estimates are incorrect, but the 10 year real values are correct.
3) Real values were calculated from the nominal values using the GDP index. The calculated real values in this spreadsheet vary somewhat from those presented in Table IV-9 given we used end of year GDP Implicit Price Deflator values.

* ? = no data available

TABLE 9.—LOWER COLUMBIA RIVER NON-INDIAN COMMERCIAL FISHING #2: Average Weights per Fish by Species for Non-Indian Commercial Harvest

Source: ODFW website (Fish Division, Ocean Salmon & Columbia River Program, Columbia River Fisheries & Management, Commercial Fishing Landings) and personal communications with Doug Case, ODFW staff

			Non-Indian Winter/Spring/Summer Chinook			Non-Indian Fall Chinook			Non-Indian Coho		
Year	Season	Location	# Fish	# Pounds	Lbs/Fish	# Fish	# Pounds	Lbs/Fish	# Fish	# Pounds	Lbs/Fish
1997	Combined	Mainstem & Non-Mainstem	1,913	26,211	13.7	8,609	151,696	17.6	19,477	152,855	7.8
1998	Combined	Mainstem & Non-Mainstem	2,231	35,476	15.9	4,339	78,143	18.0	23,801	194,226	8.2
1999	Combined	Mainstem & Non-Mainstem	1,971	28,310	14.4	8,055	116,994	14.5	80,533	683,934	8.5
2000	Combined	Mainstem & Non-Mainstem	6,988	88,077	12.6	13,196	246,583	18.7	173,888	1,548,562	8.9
2001	Combined	Mainstem & Non-Mainstem	15,955	255,295	16.0	24,636	394,516	16.0	253,495	2,257,359	8.9
2002	Combined	Mainstem & Non-Mainstem	26,083	388,461	14.9	43,523	816,528	18.8	164,152	1,687,089	10.3
2003	Combined	Mainstem & Non-Mainstem	10,962	172,739	15.8		1,222,859	18.1	262,450	2,402,880	9.2
2004	Combined	Mainstem & Non-Mainstem	24,329	351,589	14.5	67,601	987,165	18.4	118,466	1,138,396	9.6
2005	Combined	Mainstem & Non-Mainstem	10,557	166,560	15.8	53,706	646,856	17.9		1,001,927	10.2
2006	Combined	Mainstem & Non-Mainstem	16,453	249,269	15.2	36,232	583,787	19.1	98,175	701,722	10.6
		5 Year Sum:	88,384	1,328,618		30,288	4,257,195		709,268	6,932,014	
		10 Year Sum:	117,442	1,761,987		290,465	5,245,127		66,025 1,260,462	11,768,950	
		5 Year Straight Average:			15.2			18.4			10.0
		5 Year Weighted Average:			15.0			18.4			9.8
		10 Year Straight Average:			14.9			17.7			9.2
		10 Year Weighted Average:			15.0			18.1			9.3

Note: Years 2003-2006 from ODFW website. Years 1997-2002 from Doug Case (ODFW).

2.4 Lower Columbia River (Zones 1-5) Sport

The Lower Columbia River sport fishing benefits analysis follows the same general procedure as outlined under the ocean sport fishery. Zones 1-5 basically extend from the mouth of the Columbia River (including the Buoy 10 sport fishery) 140 miles upriver to Bonneville Dam.

The value per day was pulled from the river oriented salmon literature search described under the ocean sport fishing section. Four value estimates obtained from three river oriented salmon studies conducted with data gathered since 1985 averaged $68.72 per day in April 2007 dollars. In addition to the Olsen et al. (1991) study discussed in the ocean sport fishing section, another Olsen study was included (Olsen and Richards, 1992) as well as a study by Gallo (2003). The Olsen and Richards (1992) study reported current condition and doubling of salmon population results from a contingent valuation survey conducted on the Rogue River in Oregon in 1992. The Gallo (2003) study used a zonal travel cost model to estimate values associated with current and salmon doubling scenarios on the Sacramento River in California based on a 1999 survey.

As also described under the ocean sport fishing section, value per salmon sport fishing day needs to be converted to a value per fish before being applied to the Lower Columbia River sport fish harvest estimates provided by Yakima River study team biologists. Ten years of Lower Columbia River sport salmon and steelhead harvest and effort (days fished) data, as obtained from an ODFW report *The 2005 Lower Columbia River and Buoy 10 Recreational Fisheries* with 2006 data provided by James Watts (ODFW), is presented in Table 10-Lower Columbia River Sport Fishing #1. The data was used to calculate the conversion factor of Lower Columbia River salmon sport fishing days per fish harvested. Using the 5-year weighted average estimate of salmon sport fishing days per salmon harvested for the Lower Columbia River (4.424), the $68.72 per-day value converts to $304.02 per fish. This value would be applicable to all species of salmon.

TABLE 10.—LOWER COLUMBIA RIVER SPORT FISHING #1: Days per Fish Harvested

Source: Watts, J. and H. Takata. December 2006. "The 2005 Lower Columbia River and Buoy 10 Recreational Fisheries." Oregon Department of Fish and Wildlife, Fish Division.

Year	Salmon and Steelhead Effort (Days)	Salmon and Steelhead Harvest	Harvest per Day	Days per Fish Harvested
1997	146,734	50,808	0.346	2.888
1998	132,164	29,265	0.221	4.516
1999	149,838	36,738	0.245	4.079
2000	197,354	51,105	0.259	3.862
2001	433,036	197,547	0.456	2.192
2002	430,196	86,738	0.202	4.960
2003	415,740	28,693	0.310	3.230
2004	360,074	86,101	0.239	4.182
2005	304,977	55,916	0.183	5.454
2006	260,532	42,946	0.165	6.067
5 Year Sum:	1,771,519	400,394		
10 Year Sum:	2,830,645	765,857		
5 Year Straight Average:			0.220	4.779
5 Year Weighted Average:			0.226	4.424
10 Year Straight Average:			0.263	4.143
10 Year Weighted Average:			0.271	3.696

2.5 Columbia River (Zone 6) Indian Commercial

The Columbia River Indian commercial fishing analysis applies basically the same methodology as the ocean and non-Indian Lower Columbia River commercial fishing analyses. Zone 6 of the Columbia River extends from Bonneville Dam, approximately 140 miles upriver to McNary Dam. While zones 1-5 are assigned to non-Indian fisheries, zone 6 is purely a Tribal fishery. Ten years of revenue and round (full fish) pounds landed data were again

obtained from the PFMC annual *Review of Ocean Salmon Fisheries*. Data from both Oregon and Washington were combined to estimate total zone 6 Columbia River values. Nominal revenues were obtained from the report and real revenues were estimated using the GDP Implicit Price Deflator. Five- and 10-year straight and weighted averages of nominal and real prices per pound by species were multiplied by average pounds per fish to estimate revenues per fish by species as presented in Table 11-Columbia River Indian Commercial Fishing #1. Round pounds per fish by species data, shown in Table 12-Columbia River Indian Commercial Fishing #2, was obtained from the Oregon Department of Fish and Wildlife website and from Doug Case, ODFW biologist. Again, an estimated profitability percentage of 80 percent was used to calculate profitability per fish by species. Since the biological harvest model estimated Indian commercial in-river harvest for this stretch of the Columbia River (zone 6), there is no need to use hatchery-coded wire tag recovery data to try and allocate harvest within the Columbia River. The 5-year weighted average profitability per fish by species ($22.56 for spring Chinook, $8.78 for fall Chinook, and $3.11 for coho in 1st quarter 2007 dollars as presented in Table 11-Columbia River Indian Commercial Fishing #1) was applied directly to the annual estimates of zone 6 Columbia River commercial harvest. The annual profitability estimates were discounted to the present and aggregated into a total zone 6 Columbia River commercial fishing benefit estimate.

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: Columbia River Zone 6 Indian Commercial Values per Fish by Species and State

Sources: OR, WA Data: 2006 Review of Ocean Salmon Fisheries (2006 Salmon SAFE Document, published 2/2007), Socioeconomic Chapter, Table IV-9

Bureau of Economic Analysis — **Insert Target Quarter:** 1st Qrtr 2007 — **Insert IPD Value:** Annual GDP 118.041 — Indian — Spring Chinook — **Insert Profit %:** 0.8

Year	Implicit Price Deflator (IPD)	GDP Annual Value	Nominal Value Data Year	Applied GDP Index Value	State/ Year	Nominal Value (2) (K$)	Real Value (3) (K$) **1st Qrtr 2007**	Pounds Landed (Thousands) Round	# Fish Harvested (Thousands)	Nominal Price/lb. (Round)	Real Price/lb. **1st Qrtr 2007**	Round Pounds per Fish	Nominal Revenue per Fish	Real 1st Qtr 2007 Revenue per Fish
					I. OREGON:	Table IV-9	Table IV-9 (Calculated)	Table IV-9	?*	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	95.414	0.808	2000	0.847	1997				?					
1998	96.472	0.817	2000	0.847	1998				?					
1999	97.868	0.829	2000	0.847	1999				?					
2000	100	0.847	2000	0.847	2000	2	2	1	?	2.00	2.36			
2001	102.399	0.867	2001	0.867	2001	33	38	25	?	1.32	1.52			
2002	104.187	0.883	2002	0.883	2002	17	19	14	?	1.21	1.38			
2003	106.404	0.901	2003	0.901	2003	5	6	1	?	5.00	5.55			
2004	109.426	0.927	2004	0.927	2004 (1)	148	160	80	?	1.85	2.00			
2005	112.737	0.955	2005	0.955	2005 (1)				?					
2006	116.043	0.983	2006	0.983	2006 (1)				?					
					5 Year Sum:	170	184	95						
					10 Year Sum:	205	225	121						
					1) REVENUE:									
					5 Year Straight Avg:	57	61			2.69	2.97	16.61	44.64	49.37
					5 Year Weighted Avg:					1.79	1.94	16.38	29.30	31.80
					10 Year Straight Avg:	41	45			2.28	2.56	17.65	40.20	45.20
					10 Year Weighted Avg:					1.69	1.86	15.63	26.49	29.05
					2) PROFIT:									
					5 Year Straight Avg:								35.72	39.50
					5 Year Weighted Avg:								23.44	25.44
					10 Year Straight Avg:								32.16	36.16
					10 Year Weighted Avg:								21.19	23.24

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (continued)

II. WASHINGTON:

1997				?*		
1998				?		
1999				?		
2000	51	60	27	?	1.89	2.23
2001	280	323	221	?	1.27	1.46
2002	218	247	185	?	1.18	1.34
2003	142	158	133	?	1.07	1.18
2004 (1)	165	178	105	?	1.57	1.70
2005 (1)	113	118	67	?	1.69	1.77
2006 (1)	425	432	180	?	2.36	2.40
5 Year Sum:	1,063	1,133	670			
10 Year Sum:	1,394	1,516	918			

1) REVENUE:							
5 Year Straight Avg:	213	227	1.57	1.68	16.61	26.12	27.84
5 Year Weighted Avg:			1.59	1.69	16.38	25.98	27.70
10 Year Straight Avg:	199	217	1.57	1.72	17.65	27.80	30.45
10 Year Weighted Avg:			1.52	1.65	15.63	23.74	25.82

2) PROFIT:		
5 Year Straight Avg:	20.90	22.27
5 Year Weighted Avg:	20.78	22.16
10 Year Straight Avg:	22.24	24.36
10 Year Weighted Avg:	18.99	20.66

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: Columbia River Zone 6 Indian Commercial Values per Fish by Species and State (continued)

III. OR & WA COMBINED:

1997				?*			
1998				?			
1999				?			
2000	53	63	28	?	1.89		2.23
2001	313	361	246	?	1.27		1.47
2002	235	266	199	?	1.18		1.34
2003	147	163	134	?	1.10		1.22
2004 (1)	313	338	185	?	1.69		1.83
2005 (1)	113	118	67	?	1.69		1.77
2006 (1)	425	432	180	?	2.36		2.40
5 Year Sum:	1,233	1,318	765				
10 Year Sum:	1,599	1,741	1,039				
1) REVENUE:							
5 Year Straight Avg:	247	264		1.60	1.71	16.61	26.63	28.39
5 Year Weighted Avg:				1.61	1.72	16.38	26.39	28.20
10 Year Straight Avg:	228	249		1.60	1.75	17.65	28.20	30.89
10 Year Weighted Avg:				1.54	1.68	15.63	24.06	26.20
2) PROFIT:								
5 Year Straight Avg:							21.30	22.71
5 Year Weighted Avg:							21.11	22.56
10 Year Straight Avg:							22.56	24.71
10 Year Weighted Avg:							19.25	20.96

Notes:

4) Preliminary Data
5) Nominal value was obtained from Table IV-9. Since real value and nominal values equate in the current year, nominal values were obtained by referring to the real values for the current year in each annual report. The annual report was not available for years 1997-1999, so those nominal values were expressed in real year 2000 $ (obtained from the year 200 report). As a result, the 10 year nominal value estimates are incorrect, but the 10 year real values are correct.
6) Real values were calculated from the nominal values using the GDP index. The calculated real values in this spreadsheet vary somewhat from those presented in Table IV-9 given we used end of year GDP Implicit Price Deflator values.
7) “Tules” (to-lee) are fall Chinook that are ready to spawn and are therefore less commercially valuable than fall “brights.” Fall brights spawn later and further upstream (Hanford Reach or Snake River). These values include both tules and fall brights combined.

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: (Fall Chinook) (continued)

Insert Profit %: 0.8

State/ Year	Nominal Value (2) (K$)	1st Qrtr 2007 Real Value (3) (K$)	Round Pounds Landed (Thousands)	# Fish Harvested (Thousands)	Nominal Price/lb. (Round)	1st Qrtr 2007 Real Price/lb. (Round)	Round Pounds per Fish	Nominal Revenue per Fish	Real 1st Qtr 2007 Revenue per Fish
	Indian								
	Fall Chinook - Brights & Tules **								
I. OREGON:	Table IV-9	Table IV-9 (Calculated)	Table IV-9	?*	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
1997	57	67	136	?	0.42	0.49			
1998	44	52	73	?	0.60	0.71			
1999	70	83	127	?	0.55	0.65			
2000	102	120	166	?	0.61	0.73			
2001	8	9	8	?	1.00	1.15			
2002	4	5	6	?	0.67	0.76			
2003	13	14	19	?	0.68	0.76			
2004 (1)	568	613	775	?	0.73	0.79			
2005 (1)	219	229	267	?	0.82	0.86			
2006 (1)	319	324	217	?	1.47	1.50			
5 Year Sum:	1,123	1,185	1,284						
10 Year Sum:	1,404	1,517	1,794						
1) REVENUE:									
5 Year Straight Avg:	225	237			0.87	0.93	19.22	16.81	17.91
5 Year Weighted Avg:					0.87	0.92	19.16	16.76	17.69
10 Year Straight Avg:	140	152			0.76	0.84	18.65	14.10	15.65
10 Year Weighted Avg:					0.78	0.85	18.77	14.69	15.87
2) PROFIT:									
5 Year Straight Avg:								13.45	14.33
5 Year Weighted Avg:								13.41	14.15
10 Year Straight Avg:								11.28	12.52
10 Year Weighted Avg:								11.75	12.69

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: (Fall Chinook) (continued)

II. WASHINGTON:

1997	278	328	633	?*	0.44	0.52			
1998	246	290	508	?	0.48	0.57			
1999	336	397	613	?	0.55	0.65			
2000	297	351	509	?	0.58	0.69			
2001	315	363	1306	?	0.24	0.28			
2002	282	319	1587	?	0.18	0.20			
2003	292	324	1607	?	0.18	0.20			
2004 (1)	443	478	806	?	0.55	0.59			
2005 (1)	716	750	1404	?	0.51	0.53			
2006 (1)	1269	1,291	905	?	1.40	1.43			
5 Year Sum:	3,002	3,162	6,309						
10 Year Sum:	4,474	4,891	9,878						
1) REVENUE:									
5 Year Straight Avg:	600	632			0.56	0.59	19.22	10.84	11.36
5 Year Weighted Avg:					0.48	0.50	19.16	9.12	9.60
10 Year Straight Avg:	447	489			0.51	0.57	18.65	9.54	10.56
10 Year Weighted Avg:					0.45	0.50	18.77	8.50	9.29
2) PROFIT:									
5 Year Straight Avg:								8.68	9.09
5 Year Weighted Avg:								7.29	7.68
10 Year Straight Avg:								7.64	8.44
10 Year Weighted Avg:								6.80	7.43

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: (Fall Chinook) (continued)

III. OR & WA COMBINED:

1997	335	395	769	?*	0.44	0.51
1998	290	342	581	?	0.50	0.59
1999	406	479	740	?	0.55	0.65
2000	399	471	675	?	0.59	0.70
2001	323	372	1,314	?	0.25	0.28
2002	286	324	1,593	?	0.18	0.20
2003	305	338	1,626	?	0.19	0.21
2004 (1)	1,011	1,091	1,581	?	0.64	0.69
2005 (1)	935	979	1,671	?	0.56	0.59
2006 (1)	1,588	1,615	1,122	?	1.42	1.44
5 Year Sum:	4,125	4,347	7,593			
10 Year Sum:	5,878	6,408	11,672			

1) REVENUE:								
5 Year Straight Avg:	825	869	0.60	0.63	19.22	11.46	12.02	
5 Year Weighted Avg:			0.54	0.57	19.16	10.41	10.97	
10 Year Straight Avg:	588	641	0.53	0.59	18.65	9.89	10.93	
10 Year Weighted Avg:			0.50	0.55	18.77	9.45	10.30	
2) PROFIT:								
5 Year Straight Avg:						9.17	9.62	
5 Year Weighted Avg:						8.33	8.78	
10 Year Straight Avg:						7.91	8.74	
10 Year Weighted Avg:						7.56	8.24	

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: (Coho) (continued)

		Indian						Insert		
		Coho						Profit %:	0.8	
			1st Qrtr 2007	Round			**1st Qrtr 2007**			Real
State/		Nominal Value (2)	Real Value (3)	Pounds Landed	# Fish Harvested	Nominal Price/lb.	Real Price/lb.	Round Pounds	Nominal Revenue	1st Qtr 2007 Revenue
Year		(K$)	(K$)	(Thousands)	(Thousands)	(Round)	(Round)	per Fish	per Fish	per Fish
I. OREGON:		Table IV-9	Table IV-9 (Calculated)	Table IV-9	?*	Table IV-9 (Calculated)	Table IV-9 (Calculated)			
	1997				?					
	1998				?					
	1999	3	4	4	?	0.75	0.89			
	2000	5	6	8	?	0.63	0.74			
	2001				?					
	2002				?					
	2003				?					
	2004 (1)	17	18	29	?	0.59	0.63			
	2005 (1)				?					
	2006 (1)	14	14	12	?	1.17	1.19			
	5 Year Sum:	31	33	41						
	10 Year Sum:	39	42	53						
1) REVENUE:										
	5 Year Straight Avg:	16	16			0.88	0.91	9.84	8.62	8.95
	5 Year Weighted Avg:					0.76	0.79	10.18	7.70	8.09
	10 Year Straight Avg:	10	11			0.78	0.86	8.80	6.88	7.57
	10 Year Weighted Avg:					0.74	0.79	9.38	6.90	7.44
2) PROFIT:										
	5 Year Straight Avg:								6.90	7.16
	5 Year Weighted Avg:								6.16	6.47
	10 Year Straight Avg:								5.50	6.06
	10 Year Weighted Avg:								5.52	5.95

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: (Coho) (continued)

II. WASHINGTON:

1997	1	1	2	?*	0.50	0.59
1998	1	1	1	?	1.00	1.18
1999	8	9	11	?	0.73	0.86
2000	13	15	30	?	0.43	0.51
2001	7	8	68	?	0.10	0.12
2002	3	3	22	?	0.14	0.15
2003	2	2	23	?	0.09	0.10
2004 (1)	5	5	43	?	0.12	0.13
2005 (1)	10	10	34	?	0.29	0.31
2006 (1)	25	25	45	?	0.56	0.57
5 Year Sum:	45	47	167			
10 Year Sum:	75	82	279			

1) REVENUE:

5 Year Straight Avg:	9	9		0.24	0.25	9.84	2.34	2.46
5 Year Weighted Avg:				0.27	0.28	10.18	2.74	2.86
10 Year Straight Avg:	8	8			0.45	8.80	3.48	3.97
10 Year Weighted Avg:				0.27	0.29	9.38	2.52	2.76

2) PROFIT:

5 Year Straight Avg:							1.87	1.97
5 Year Weighted Avg:							2.19	2.29
10 Year Straight Avg:			0.40				2.78	3.17
10 Year Weighted Avg:							2.02	2.21

* ? = data not available

TABLE 11.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #1: (Coho) (continued)

III. OR & WA COMBINED:

1997	1	1	2	?*	0.50	0.59			
1998	1	1	1	?	1.00	1.18			
1999	11	13	15	?	0.73	0.87			
2000	18	21	38	?	0.47	0.56			
2001	7	8	68	?	0.10	0.12			
2002	3	3	22	?	0.14	0.15			
2003	2	2	23	?	0.09	0.10			
2004 (1)	22	24	72	?	0.31	0.33			
2005 (1)	10	10	34	?	0.29	0.31			
2006 (1)	39	40	57	?	0.68	0.70			
5 Year Sum:	76	79	208						
10 Year Sum:	114	124	332						
1) REVENUE:									
5 Year Straight Avg:	15	16			0.30	0.32	9.84	2.97	3.12
5 Year Weighted Avg:					0.37	0.38	10.18	3.72	3.89
10 Year Straight Avg:	11	12			0.43	0.49	8.80	3.80	4.31
10 Year Weighted Avg:					0.34	0.37	9.38	3.22	3.51
2) PROFIT:									
5 Year Straight Avg:								2.37	2.49
5 Year Weighted Avg:								2.98	3.11
10 Year Straight Avg:								3.04	3.45
10 Year Weighted Avg:								2.58	2.81

* ? = data not available

TABLE 12.—COLUMBIA RIVER INDIAN COMMERCIAL FISHING #2: Average Weights per Fish by Species for Indian Commercial Harvest

Source: Data based on personal communication with Doug Case (ODFW)

Year	Indian Winter/Spring/Summer Chinook # Fish	# Pounds	Lbs/Fish		Indian Fall Chinook # Fish	# Pounds	Lbs/Fish		Indian Coho # Fish	# Pounds	Lbs/Fish	
1997	14	267	19.1		39,371	733,602	18.6		223	1,635	7.3	
1998	1	18	18.0		31,349	550,084	17.5		230	1,586	6.9	
1999	1	31	31.0		43,780	739,633	16.9		1,650	14,294	8.7	
2000	1,313	15,496	11.8		37,514	737,821	19.7		4,415	36,474	8.3	
2001	16,134	219,958	13.6		73,231	1,292,967	17.7		3,757	28,679	7.6	
2002	13,733	194,107	14.1		81,399	1,549,161	19.0		454	4,223	9.3	
2003	7,936	149,197	18.8	*	94,822	1,926,555	20.3	*	3,052	25,398	8.3	*
2004	11,043	153,435	13.9	*	111,833	2,020,889	18.1	*	6,042	59,342	9.8	*
2005	3,853	66,315	17.2	*	92,437	1,772,975	19.2	*	2,169	21,810	10.1	*
2006	13,609	258,571	19.0	*	59,050	1,151,475	19.5	*	5,577	65,251	11.7	*
5 Year Sum:	50,174	821,625			439,541	8,421,055			17,294	176,024		
10 Year Sum:	67,637	1,057,395			664,786	12,475,162			27,569	258,692		
5 Year Straight Average:	16.6				19.2				9.8			
5 Year Weighted Average:	16.4				19.2				10.2			
10 Year Straight Average:	17.7				18.6				8.8			
10 Year Weighted Average:	15.6				18.8				9.4			

Notes: * reflects preliminary data

2.6 Columbia River (Zone 6) Indian Ceremonial and Subsistence

Economic analyses do not attempt to place a value on Tribal ceremonial or spiritually oriented harvest since that would be akin to placing a value on Tribal culture. However, subsistence harvest in some cases has been valued purely from a food-based perspective. Tribal subsistence harvest provides more than simply a food-based value since such harvests are also inextricably linked to Tribal culture. As a result, any attempt to use a food-based value to measure Tribal subsistence values would significantly understate the true Tribal value of the subsistence fishery resource. Nevertheless, to avoid the situation of not placing any value on the ceremonial and subsistence harvest, the Yakima River study economic analyses looked to use a food-based value as a defendable lower bound. Crutchfield et al. (1982) suggests two possible approaches for estimating food-based subsistence values – opportunity cost and cost of substitute foods. Assuming the opportunity to sell the fish exists, the opportunity cost approach involves using commercial ex-vessel price as the forgone market value when one harvests a fish for subsistence purposes. The cost of substitute foods approach uses the retail price of the closest substitute food item as an indicator of the value of the subsistence harvest. Given the difficultly in selecting a substitute food item, the analysis uses the opportunity cost concept based on the Columbia River (zone 6) Indian 5-year weighted average revenue per fish from the commercial fishing analysis as a lower bound subsistence and ceremonial value ($28.20 for spring Chinook, $10.97 for fall Chinook, and $3.89 for coho in 1st quarter 2007 dollars; see Table 11-Columbia River Indian Commercial Fishing #1). Since the Columbia River zone 6 Indian fishery includes a commercial fishery there is some logic to applying this approach.

2.7 Yakima River Sport

The Yakima River sport fishing benefits analysis follows the same general procedure as outlined under the ocean and Columbia River sport fishery.

It was assumed that the value per day for Yakima River sport fishing would be the same as that used in the Lower Columbia River sport fishing analysis and was pulled from the river oriented salmon literature search described under the ocean sport fishing section. Four salmon value estimates obtained from three river oriented studies conducted with data gathered since 1985 averaged $68.72 per day

in April 2007 dollars (see the Lower Columbia River zones 1-5 Sport Fishing section for details).

As also described under the ocean and Lower Columbia River sport fishing sections, value per salmon sport fishing day needs to be converted to a value per fish before being applied to the Yakima River sport fish harvest estimates provided by study team biologists. Several years of Yakima River sport salmon harvest and effort (days fished) data, as obtained from Jim Cummings and Paul Hoffarth of the Washington Department of Fish and Wildlife (WDFW), is presented in Table 13-Yakima River Sport Fishing #1. Note that while the fall Chinook sport fishery has been ongoing, the spring Chinook sport fishery has been sporadic (Yakima River coho sport harvest is negligible). The WDFW data was used to calculate the conversion factors of Yakima River salmon sport fishing days per fish harvested by salmon species. While the river sport fishing value per day is assumed applicable to all salmon species, the different days per fish harvested for spring versus fall Chinook results in a different value per fish. Using the weighted average estimates of salmon sport fishing days per salmon harvested for the Yakima River (6.716 for spring Chinook and 5.355 for fall Chinook and coho), the $68.72 per day salmon value converts to $461.52 per fish for spring Chinook and $368.00 per fish for fall Chinook and coho as measured in April 2007 dollars.

TABLE 13.—YAKIMA RIVER SPORT FISHING #1: Salmon Sport Fishing Days per Fish Harvested

Species		2000	2001	2002	2003	2004	2005	2006	3 Year Straight Average	3 Year Total	3 Year Weighted Average
Spring Chinook	Source: Personal communication, Jim Cummings (WDFW), May 2007										
	Effort (hours):		55068.0	22596.8		25883.8				103548.6	
	Hours/trip: (*)			3.5							
	Effort (Day Trips):		15733.7	6456.2		7395.4				29585.3	
	Catch:		1908	843		1654				4405	
			0.121	0.131		0.224			0.158		0.149
	Trips/Fish:	3.5	8.246	7.659	3.5	4.471			6.792		6.716
Fall Chinook & Coho (Coho minor)	Source:	Years 2000-2005: Table 76, District 4 Fish Management Annual Report 2005 (P. Hoffarth, 3/2006) Year 2006: Personal Communication, P. Hoffarth, 5/9/2007									
Catch/Trip:									5 Year Straight (2002-2006) Average	5 Year (2002-2006) Total	5 Year Weighted (2002-2006) Average
	Effort (hours):	12556.0	13193.0	22796.0	32225.0	23878.0	15195.0	16139.0		110233.0	
	Hours/trip: (*)	3.5	3.5	3.5	3.5	3.5	3.5	3.5			
	Effort (Day Trips):	3587.4	3769.4	6513.1	9207.1	6822.3	4341.4	4611.1		31495.1	
		346	1054	2390	1463	830	733	465		5881.0	
		0.096	0.280	0.367	0.159	0.122	0.169	0.101	0.183		0.187
	Trips/Fish:	10.368	3.576	2.725	6.293	8.220	5.923	9.916	6.615		5.355

Notes:

* Based on Personal communication, Jim Cummings (WDFW), May 2007.

Catch:
Catch/Trip:

2.8 Yakima River Indian Ceremonial and Subsistence

The Yakima River Indian Ceremonial and Subsistence benefit estimation methodology applies the same approaches and values as used in the Columbia River (zone 6) ceremonial and subsistence analysis. Lower bound food-based values per fish of $28.20 were used for spring Chinook, $10.97 for fall Chinook, and $3.89 for coho (as measured in 1st quarter 2007 dollar) were based on Columbia River zone 6 Tribal commercial fishing revenues per fish (see Columbia River (Zone 6) Indian Ceremonial and Subsistence section and Table 11-River Indian Commercial Fishing #1). While it is possible the weights per fish and, therefore, values per fish may be somewhat more or less for subsistence harvest in the Yakima River as compared to the Columbia River, the difference was assumed to be negligible given the general proximity of the upriver sections of zone 6 to the mouth of the Yakima River.

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